Constructing Tomorrow on the Kitchen Table:

Cultural Imperatives in Computer Hobbyist Publications (1975-1980)

Luis Latour

A Thesis

in

The Department

Of

History

Presented in Partial Fulfilment of the Requirements
For the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada

April 2003

0-612-77644-1

ABSTRACT

Constructing Tomorrow on the Kitchen Table:
Cultural Imperatives in Computer Hobbyist Publications (1975-1980).

Luis Latour

The field of computing history is recent and still very much limited to establishing a chronology describing the development of computers. As such, many cultural and social dimensions relating to the development of computer technology have not yet been clearly analysed. One particular dimension that is poorly examined in the existing literature revolves around the shift from the 'facility' interpretation of the computer, which stemmed from the type of large-scale research undertaken by the American Department of Defence in the 1940's, to the microcomputer paradigm that emerged in the late 1970's. Between 1975 and 1977, groups of computer hobbyists throughout the United States constructed an alternate interpretation of the computer as a *personal* object for information processing and self-empowerment. This thesis explores this shift by examining several nation-wide computer hobbyist magazines that charted this change in popular imagery. A close analysis of *Byte*, *Creative Computing* and *Dr Dobbs Journal of tinyBASIC calisthenics and orthodontia (running light without overbyte)* also reveals a cultural worldview that was heavily influenced by Science Fiction. The promise of a future fully integrated with technology, which was a recurring theme in novels and the television series, *Star Trek*, very clearly motivated the computer hobbyists to pursue experiments with the construction of homebrewed computer systems. This thesis also challenges the popular image of the early computer 'nerd' as an awkward teenage 'geek' with too much time on his hands. Instead, the readership of *Byte* offers a different picture of the computer enthusiast as a white, middle-class male engineer in his mid-thirties with large amounts of disposable income. Finally, this thesis analyses the construction of a community of computer aficionados throughout the United States, particularly through the hobbyist's development of a prestige value-system attached to hardware and software projects.

Table of Contents

LIST OF FIGURES

Introduction

Ready or not, computers are coming to the people!
That's good news – maybe the best since psychedelics.
-Rolling Stone, December 7th 1972.

The presence of computers is so pervasive nowadays that it is difficult to imagine a moment when the words 'personal' and 'computer' carried no meaning when juxtaposed. Computers are present in many spheres of human activity; indeed some would even say most of them. They have become essential sources of entertainment. They provide the backbone to the financial system which underlines the economy. They are essential tools in war as well as in advanced medicine. They serve as tools in the construction and planning of most industrialised goods from dwellings to mass-market consumer electronics. They are the primary vehicles used to write, paint, design and implement the modern, post-industrial reality of the last quarter century. They are inescapable even when hidden behind simplified interfaces and visual codes. Television has been transformed by new digital methods of composing and delivering content. Music has been profoundly altered by the crystal-clear quality of modern recording, which is inherently dependent on the digital recording industry spawned by the invention of the microprocessor. And even more importantly, the printed word is now acquiring an increasingly unsettled quality as the Web and the Internet shift the foundations of text from a finite crystallisation of ideas to a transient flux.

Even more profoundly, the entrance of the computer into the dwelling has increasingly modified domestic space and opened the way for a repatriation to the home of many activities that had once been the sphere of the outside world: banking, shopping and researching. Computers are also becoming tools for the establishment and preservation of human ties across long distances. With the advent of the Internet, we communicate through email and audio-visual means with people in very remote locations or distant family members. Yet the irony is that the computer was never intended to be a domesticated, popular tool. Instead, it was designed, constructed and implemented as a high-level tool for the scientific community to automate tedious, repetitive and error-prone tasks.

The relatively short history of the digital computer reveals many discontinuities, one of which is that the computer, as it has been constructed in popular culture over the last twenty years, is a strikingly different object from how it was originally conceived in the forties. Why and when did this shift occur? One explanation is that a relatively small group of highly educated, scientifically curious individuals who had been raised in a culture enraptured by the promises of technology, were motivated to actualise those promises through the construction of small, individual-oriented computers in the later part of the seventies. These individuals were almost invariably male, white and middle-class. They shared a common interest in science and technology and often worked in areas connected with engineering or practical applications of technological research. They also shared a common highly positive perception of the role of technology in everyday life and a cultural tendency to present the American future as increasingly (and unavoidably) technological.

As I shall describe in chapter one, first-generation digital computers were enormous data factories that had no personality, either substantive or inherent. They were developed by engineers funded by the US government and were dedicated to resolving the immediate needs of the military and the scientific communities. Furthermore, the prohibitive cost and complexity of the technology rendered any notion of personal or individual use completely absurd. In the public's mind, the idea of the computer was roughly analogous to nuclear reactors in that they were a 'facility', not an object of popular consumption.

There is a profound difference between the history of the computer and other personal tools introduced in the twentieth century and ultimately intended for mass consumption. For example, the car was essentially a continuation of the individual coach carriages of the 19th century. The original aeroplanes were themselves individual means of transportation – the mass-transit jumbo jet was the *product* and not the inspiration for the Wright brother's mono-place biplane. The computer, however, had been designed as a *facility*, not as a standardised commodity.

This shift towards the construction of the computer as an individual object of consumption did not occur overnight. It was the product of a convergence of factors, both social and economic. Within twenty-five years of the end of the Second World War the United States had undergone a massive social and economic transformation. Even more strenuous was the cultural upheaval that resulted from almost unending technological and scientific evolutions and revolutions. From the first explosion of the Atom Bomb in the Nevada desert in 1945 to the landing on the moon in 1969, the United States entered a period where dreams of a techno-centered society were becoming reality. These dreams were particularly resonant within American popular culture, with its long tradition of looking at technology and the frontier as a means to develop and expand social boundaries. The "closing of the American Frontier" at the turn of the century had not diminished the potency of the popular image.[1] Ultimately the Frontier shifted upwards and sideways: into space and technology. These discoveries and realisations reshaped the nature of the ordinary and elevated the potential of humanity, if not in practice, at least in the popular imaginary.

[1] For a rich discussion of the meaning and place of the 'Myth of the Frontier' in American popular culture as well as its connection with concepts of progress and see Richard Slotkin, ***Fatal Environment : The Myth of the Frontier in the Age of Industrialisation*** **(New York :Atheneum, 1985); particularly Part I, chapters 1-3.**

Various literary and visual discourses of the science-fiction genre were essential to the rise of the computer hobbyist community. Many authors of traditional science fiction (Isaac Asimov, Robert Heinlein, Robert Silverberg, and Arthur C. Clarke to name a few) created vivid images of the computer as fundamental elements of their work. Often, the computer present in works of the golden age of science fiction reflected a double-edged sword embodied by the power of the 'electronic brain'. Much like a modernised version of Frankenstein's monster, the computer was often portrayed as a tool with the potential to serve good and evil extremes. In the hands of a totalitarian regime it was occasionally portrayed as a tool to oppress and control populations. However, when used by individuals it stood out as a tool of self-empowerment.[2] As a result of this conceptual duality in the popular imaginary, the rise of the mainframe in the late fifties and early sixties reflected both a promise of individual freedom while hinting at a threat of corporate and government totalitarianism.

During the sixties, in the hands of IBM's marketing, the computer became something else. It acquired a mystical, quasi-religious aura. According to this discourse, the computer could solve social problems and help reduce the disparities between the rich and the poor. It could educate the masses and enlarge the middle-class. It could finally help the government establish a more secure, more profound control over the security of the nation, and in the hands of federal agencies, it would provide the basis for a more democratic, just nation. This promise could only be achieved, however, through the dedication to this cause of a group of

[2] Isaac Asimov's short story *Robbie*, published in *Astounding Science Fiction* in 1941 introduced how mobile computers could become children's best friends: educating and protecting them. By contrast, Theodore Sturgeon's short novella *The Ashes Will Wash Ashore* published in *Amazing Stories* in 1942, reinforced the threat of proto-fascist groups manipulating computer facilities to gain power in a post-Second World War United States.

'information professionals' who were the designated buffers between the population at large and the exceedingly difficult operation of the mainframe.

As a consequence of these marketing concerns, by the late sixties it seemed that the computer had failed at the task of helping or empowering individuals while at the same time succeeding in establishing a cult of productivity and efficiency that neglected humanistic values and concentrated on corporate concerns. The darker image of the computer as a tool for total control had overcome the promise of the computer as liberator. In the hands of large corporations, it not only remained expensive, mysterious and inaccessible – it had also spawned the emergence of a group of 'high priests' who carefully maintained their control over the computer by restricting all information about its operation. Instead of the democratisation of the government some expected, it enabled tighter controls, centralisation and integration of personal data, and a reduction of freedom and individuality. Because of the immense cost associated with its development and use, the computer was increasingly perceived as neither popular nor democratic, but instead had become an oppressive and faceless tool of the establishment.

At the same time the make-up of the American middle-class was swiftly changing. Characteristically white and increasingly suburban, it was demographically larger and more affluent in the sixties than it had ever been before.[3] Hordes of new technocrats were being produced by the recently enlarged higher education machine. More and more engineers attained professional ranks within large corporations. Many shared a common interest in technology, mathematics, the sciences; they were often drawn to science fiction and shared a

---

[3] In *Grand Expectations*, James T. Patterson describes many great changes within the fabric of American middle-class families. Unprecedented economic growth and a rising confidence in the impact of technology helped generate an aura of prestige for the scientist and the engineer as well as tremendous hope in the future fruits of science. "Progress seemed without limits – engineers and scientists, it seemed, could truly achieve anything." James T. Patterson, *Grand Expectations: The United States, 1945-1975*. (New York: Oxford University Press, 1996), 315.

similar outlook on the future that derived from their educational bias. Many of them wanted to be able to work with computers on a variety of problems and apply the technology to more challenging problems than company payrolls. Many of them were also interested in simple hands-on electronics: radio, hi-fi and television. Most significantly, many were frustrated by the tight control on information technologies the corporations had constructed around the computer.

Social, economic and technological factors converged with the arrival of the microprocessor in 1971. The device was a technological breakthrough that combined extremely cheap mass-production techniques with the promise of advanced computing power that had only been available previously to large computing facilities. It allowed for the emergence of the computer hobbyist as a distinct entity from the electronics hobbyist and the radio amateur as well as for the exploration of technologies that had, until then, been restricted to the 'high priests' of mainframe computing. A new cultural mindset that saw a potential for change in the personalisation of the computer appeared within electronic hobbyist circles. The development of the microprocessor industry had significant roots in the technological infrastructure developed in the aftermath of the Second World War, notably in relation to the political decision to engage in high-tech industrial sponsorship in many areas of advanced research.[4] For the common hobbyist, however, the advent of the microprocessor was a source of unmitigated electronic progress.

The computer hobbyist found himself at the centre of an emerging computer counter-culture that asserted individuality and personal knowledge above all else. In the

[4] The infrastructure was a result of the development of technologies for military research. As Patterson points out: "some of the science faculties such as Stanford or MIT relied so heavily on military funding that it was fair to speak of them [in the late fifties] as part of a military-industrial-academic complex", Patterson, 69.

hands of the hobbyist, technological curiosity and economic means became mixed with a certain perception of the future and of the imperatives of realising an image of tomorrow that had long been promised and that finally seemed close at hand.

Significantly, several magazines appeared in the United States starting in 1974 that appealed to the rising computer hobbyist community. Most of them began as club-sponsored fanzines and newsletters, and became more professional as their circulation increased. They provided a forum and an outlet for the interests, passions and desires of this new class of hobbyist. For five years, from 1975 to around 1980, these magazines offered a window on the cultural content of the microcomputer revolution. They charted the motivations, cultural affinities and preoccupations of the hobbyist community.

This thesis examines in particular three magazines published in the period just before and during the microcomputer revolution (1975-1980). *Byte* was examined with particular attention and detail, because of its pivotal importance in the development of the computer hobbyist community. *Dr Dobbs Journal of tinyBASIC calisthenics and orthodontia (running light without overbyte)* and *Creative Computing* were taken as a sample of the larger computer magazine market that evolved particularly between 1977 and 1980. This thesis analyses the imagery, the language and the thematic context found in the articles as well as their art and advertisements. From the analysis of these magazines emerges the notion of a cultural space, constructed around a common adulation of technology and progress, which reflected itself in an implicit cultural imperative to indulge in computer hobbyism. This imperative motivated technologically skilled, economically empowered, white middle-class men, between 1975 and 1980, to invent not only the very notion of *personal* computer, but to also find a place for it within the confines of the domestic space. As such, the very essence of this cultural obsession with constructing personal computers was the result an imagery inherited by these hobbyists from innumerable popular tales of science-fiction, speculative-fiction and anticipation.

Within this cultural space defined by science-fiction and a discourse influenced by technocratic values, these hobbyists elevated the computer to a position of prestige that reflected earlier promises of the computer as a foundation of a better future. Computer hobbyists assimilated the need to integrate computers into everyday life to the realisation of the promises offered by science fiction in the construction of a better tomorrow. Pressed by these imperatives and given the opportunity by the socio-economic conditions which characterised their social standing, they proceeded to construct, often on their kitchen tables, very material representations of a world that was beginning to resemble the imagined future depicted and conceptualised in science-fiction literature and film.

Although the field of computing history is not new, and has already generated a fairly large body of literature about the emergence of the computer as a technological device, there has been very little attention paid to understanding the computer in social terms and even less to the cultural traits reflected by the desire to possess a computer at home.[5] Moreover, because the personal computer brought astonishing economic wealth to many young entrepreneurs in the early eighties, there is a large body of literature - much of it written by journalists and sociologists - that is obsessed with these as examples of entrepreneurial success.[6] By contrast, few historians have explored the topic of computers in personal and

[5] Some excellent general works exist on the technological evolution of the computer. The two most complete books on the history of the digital computer are Paul Ceruzzi *A History of Modern Computing* (1998) and Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine*. In particular, these two works are representative of established literature in that they portray the computer as a series of increasingly more powerful tools, without analysing the reasons that motivated their invention or their role in society.

[6] The best examples of this trend are Robert X. Cringley, *Accidental Empires* (1992) which was adapted for television in a documentary series called *Revenge of the Nerds* and Steven Levy, *Hackers* (1984) which focused on the first members of the MIT computer club in the sixties and brought the term into the mainstream. It is important to note that Levy is not responsible for the incorrect use of the term in the

cultural terms. There are no comprehensive studies of how the technology was popularly represented in the specialised press and there is nothing that deals with the computer hobbyist community. There is, however, a large body of historical literature relating to the cultural and social impact of technology in the United States, particularly surrounding various periods in the 19th and 20th centuries, which will be taken into account.

The thesis is organised in four chapters. The first chapter, meant as an introduction to the rapid evolution of the digital computer, will draw from the existing literature on the topic, both historical and journalistic, to present a simple narrative of the emergence of the digital computer. The second chapter will focus on the importance of the magazine as a medium for community formation and reinforcement within the context of the post-war United States. It will draw from several key works on the history of magazines as well as general works dealing with American culture in the last third of the 20th century. It will also introduce the main primary sources I have used to construct my interpretation of the hobbyist community and provide a short narrative of their respective histories. Chapter three will focus on a deconstruction of the hobbyist magazines along thematic lines, comparing the imagery, language and subtext of the magazines to the heritage of popular science fiction that permeated American culture since the Second World War. Finally, chapter four examines how the representation of the computer hobbyist developed and defined his social role. This will be accomplished by analysing the role of the 'project' in the hobbyist press and by underscoring how notions of technocratic meritocracy are reflected in the community's writings.

---

popular, mainstream media, which uses the word to mean 'cracker' and gives an ill-repute to perfectly good-intentioned hackers everywhere.

Chapter One

From the Mainframe to the Microcomputer: an Overview of the History of Post-war Computing in the United States

Computers have existed for a very long time.[7] Used as tools to simplify large-scale computations, they have been a staple of everyday life for as long as there has been recorded history. The abacus was known in Egypt thousands of years ago, the *Pascaline* liberated mathematicians from constructing painful logarithmic tables in the 17th century and the *Hollerith Tabulating Machine*, one of the first industrial-strength punch-card tabulators, solved the rising problem of how to compile US census data in the wake of the population explosion of the end of the 19th century[8]. These were computers only in the strictest of senses. They were mechanical devices that automated mathematical processes.[9] They served simple purposes by performing arithmetic computations, projections, and the odd trigonometric tabulation. But these were limited machines, in the sense that they were meant to carry out the same operation, over and over again, until disassembled. Ultimately, the limit of their usefulness resided in their hard-wired nature. They could not be programmed for alternative forms of use or calculation. By contrast, the general-purpose computer, which did

---

[7] It is important to point out that until the early fifties, *computer* designated a human performing repetitive calculations. The expression came to designate machines through the intermediary phrase "digital computer" which was largely used in the advertisement of the UNIVAC starting in 1951. For the popular press until the mid-fifties, what we refer today as a computer was usually designated "electronic brain".

[8] James W Cortada, *Before the Computer* (New York, Princeton, 1993), 6.

[9] Generally, a computer (or a calculator) is any machine that can perform various kinds of computations along predefined patterns and constructed from digital or analogue circuits. However, electronic digital computer, within the context of this paper, will more precisely refer to programmable, general-purpose electronic devices with memory and varied Input/Output capabilities built from digital designs.

not emerge as a practical concept until the 1920's, promised to offer infinite ways of wiring the machine to accomplish a variety of tasks. The first serious attempts to construct general-purpose computers began between the two world wars, but these attempts did not gain momentum until they were framed within the scope of military and scientific research.

The evolution of the computer from pure calculator to the modern tool for communication, information handling and economic planning stemmed from a series of reinterpretations of what the technology could do. In the United States, the computer was first a military and scientific tool of industrialised warfare during the Second World War. After the end of the conflict, it developed into a complete tool for information storage and analysis thanks to the massive technological and economic effort undertaken by the US Army and various research branches of the military-industrial complex, during the Cold War. In the sixties, its uses were broadened and it was reinterpreted as a productivity and efficiency icon in the American corporate landscape. The entrance of the computer into most Americans' lives had been heralded in tales of science-fiction for decades well before the cost and feasibility of the device finally made it possible for individuals to own one. The computer, like many other images of technology and automation, occupied an increasingly large part of the popular imagination. By the eighties, the computer had become ubiquitous and was wholly absorbed by mainstream culture. As a sure sign of mainstream acceptance, popular vernacular had even absorbed and 'computerised' classic expressions of technology.[10]

This narrative will describe the evolution of four very important technological concepts from the forties to the mid-seventies that charted the road from mainframe to

[10]Cecelia Tichi in *Shifting Gears*, points out how mechanical expressions such as having a 'screw loose' have been replaced by computer images such as having a 'bad chip'. Cecelia Tichi, *Shifting Gears* (Chapel Hill: University of North Carolina Press, 1987), Xii-xiii.

microcomputer: in order, it describes the stored-program concept (which was a corollary to the development of the digital computer); the transistor; the integrated circuit (IC); and finally the microprocessor. All four engineering realisations were the direct result of fundamental research carried out in response to the varying contexts of industrialised warfare, demands for efficiency and productivity in the marketplace and personal self-realisation.

The Digital Computer as a Tool of Industrialised Warfare: the ENIAC

The first attempts at constructing a general-purpose calculating machine using electric circuits appeared in various academic institutions in the United States between 1935 and 1942. These attempts were the result of occasionally unrelated work done by various individuals, mostly in the United States, but also in Poland and Britain. Some theoretical foundations had been laid down in Britain by mathematician Alan Turing as early as 1935, but his interest was purely theoretical at the time and he did not delve into concrete engineering.[11] In the same period, many other engineers like Howard Aiken and John Atanasoff were hard at work in the United States to come up with integrated concepts for a general-purpose machine. The difficulty was twofold. First, there were important engineering problems in constructing complex, reliable circuits with the technology of the period. But more importantly, a clear image of how automated calculators could be made to process information in useful terms was not yet established. In Turing's view, which was proposed as a theoretical construct in 1941, the machine was composed of a processor, which followed instructions and a long tape of 'memory' which contained the instructions for the processor. The processor only did what the instructions on the tape told it to do. The machine was therefore split in two: the instructions that told it what to do (the software) and the concrete execution unit (the hardware) that followed the instructions fed to it by the software. This concept, referred to as linear computing, evolved gradually between 1937 and 1945. Turing saw it as a mathematical model to automate the resolution of repetitive problems with fixed algorithms. It became the fundamental element of most commercial and experimental computers that have been built since then. More importantly, it allowed the US Army to speculate that such a machine could produce large amounts of tabulated results for the ground forces' artillery units that were far more accurate than human computers.

This was a crucial period in fundamental and applied research, and many ideas came to fruition at a time when the American government, particularly the US Army, was actively seeking technological responses to the problems inherent to industrialised warfare. Most, if not all, of the funding that went towards building the first electronic computer came in fact from the US Army, through the various institutions of higher learning it financed.[12]

The interest of the US Army in the computer was threefold. First, it could serve as a tool to calculate firing range tables for the US Navy during the eventual invasion of Europe. Navy gunners needed accurate firing tables to be able to hit their designated targets on the beaches of Normandy. Second, computers could assist the Manhattan project by solving the complicated mathematical models required for the fabrication of the Atom Bomb. Finally, computers could assist cryptographers in their research on enemy (Axis) codes, as the British research centre of Bletchley Park had already shown. However the digital computer was perfected too late for use during the Second World War. Of all the projects started after 1937, only the Harvard Mark I, developed by Howard Aiken and the Differential Analyzer

---

[11]Joel Shurkin, *Engines of the Mind* (New York : Norton & Company, 1996), 141.
[12]Nallur Prasad, *IBM Mainframes: Architecture and Design* (New York : McGraw Hill, 1995), 2-5.

built by Vannevar Bush between 1932 and 1938, were used to any great extent in the construction of the first atomic bomb.

For most of the early forties, computer research became an important element of the Allied war effort and computer research centred on creating high-performance number-crunching machines for the various branches of the Army. The first truly digital electronic computer was built between 1941 and 1943 at MIT by a team of electrical engineers and mathematicians from the Electrical Engineering faculty. It was called the Harvard Mark II and as soon as it was turned on in 1943, was used extensively to calculate ballistic firing tables for the US Army. For a brief period of time between 1944 and 1946 it was occasionally used in various code-breaking projects, but it was so difficult to set up that the Army corps of engineers preferred letting it churn out tables rather than reprogramming it. The Mark II could carry out in 12 minutes the same calculations produced by 35 people in one week. It was not, however, a general-purpose computer. From the start it had been designed as a tabulator that had pre-set equations and was programmed through patch-panels. It was also an electro-mechanic device, since it operated by the flipping of electromagnetic relays between on and off positions. The input had therefore to be seriously chewed in advance for the machine to be able to digest it. Although the usefulness of these designs was immensely appreciated by the scientific community, the difficulty to program them convinced the US Army to pursue the funding other projects in the hope that simpler methods of setting up calculations could be devised.[13] Vannevar Bush, one of the earliest proponents of the computer as a tool to increase productivity and military efficiency, had by

[13]For a more complete description of the roles of computers and early Polish *bombas*, see Shurkin, 138-145.

1941 become the head of Roosevelt's Office of Scientific Research and Development and worked actively at obtaining funding for the development of new computer designs.[14]

In early 1941, John Mauchly anc' J. Prosper Eckert, two electrical engineers teaching at the University of Pennsylvania's Moore School of Electric Engineering, elaborated a way to replicate the circuit boards of electric-relay-based computers with vacuum tubes and to separate the instruction-execution units from the programmable space, so that instead of patch-panels, switches could be used. After three hard years of trial and error, the project - which was funded by the Department of Defense in the form of direct grants to Pennsylvania University - culminated in 1946 with the production of the first modern, purely digital electronic computer : the Electronic Numerical Integrator and Computer (ENIAC).

The ENIAC was a mammoth of a machine. By its mass and sophistication alone, it had an important impact on American culture. In many ways, it set the tone for the image and the expectations of what a computer was like for the next three decades. It filled the collective imaginary with numbers and statistics almost too difficult to comprehend: 18 000 vacuum tubes, 140 Kw of electric power and a whole floor requiring elaborate cooling procedures.[15] Visually, the machine appeared as a series of large panels with blinking lights, emanating large amounts of heat and a loud humming noise that came from the vacuum tubes and the snapping electromechanical relays deep in the machine's circuits. The ENIAC could carry out calculations at unequalled speeds. For ten years after its unveiling, it was used by the US Army to calculate tables of all sorts, from shell ranges to the hydraulic displacement capacities of submarines.[16] More importantly, the ENIAC entered the

---

[14] Martin Campbell-Kelly and William Aspray, *Computer : A History of the Information Machine* (New York : Basic Books, 1996), 79. Vannevar Bush opposed *digital* computers until his death in 1974 on the grounds they were not as 'elegant' as analog designs. His office did, however, provide direct funding to Harvard , MIT, Stanford and Pennsylvania to continue research on digital computers.
[15] Shurkin, 150-152.
[16] Paul Ceruzzi, *A Modern History of the Computer* (Cambridge : MIT Press, 1998), 24-29.

collective consciousness with images drawn from science-fiction novels and pulp magazines such as the scientist, with glasses and an inquisitive eye, peering over the mammoth electric brain.[17] The original photograph released to the press by the US Army on the unveiling of the ENIAC underscored the size and mass of the machine and featured an operator dressed in a white shirt and wearing glasses intently peering at a panel of flashing and blinking lights. (Figure 1)

Figure 1 – *The first image of the ENIAC released to the press in 1946.*

Unlike the Mark I or II, which were shrouded in wartime secrecy, the arrival of the ENIAC was widely publicised in the press. Its unveiling, on February 14th 1946, was a glamorous event bringing together engineers, academic administrators and Army representatives in Pennsylvania. The Army's public relations branch made sure the event was properly covered by *Newsweek* and other national magazines. The advent of the "electronic brain" was presented as a "turning-point in the history of the world". In an article in the *New York Times* on February15th 1946, one could read:

> One of the war's top secrets, an amazing machine which applies electronic speeds for the first time to mathematical tasks hitherto too difficult and cumbersome for solution, was announced here tonight by the War Department (...) Its

[17]Shurkin, 124.

> inventors claim it computes a mathematical problem 1,000 times faster than it has ever been done before.[18]

It made a particular impact on a certain slice of the American middle-class that was closer to technological and scientific advancement. Science-fiction writer Isaac Asimov and *Star Trek* creator Gene Roddenberry were both stunned by the technological realisation. They both saw it as fundamental step in the construction of the future, far more important in fact than the end of the Second World War or at least on equal footing with the explosion of the first atom bomb.[19]

However, for all the glory and publicity the project created, the ENIAC was already a thing of the past by the time the first switch was turned on. The vacuum tubes burned at such a fast rate that whole crews of operators were needed to replace them on a regular basis.[20] The ways to input information so that the machine could carry out operations were complicated and the output required an army of interpreters to understand. It was a laboratory experiment painfully turned into an operating device but its operation only served to underscore the limitations of the design. Almost as soon as the ENIAC was born, a number of scientists were motivated to develop more modern versions, with more complete features. The Pentagon, which was interested in producing theoretical models for the development of the H-bomb (then called the 'Superbomb' and under the direction of Edward Teller), continued to finance the development of newer, more complex machines. The financing was facilitated by the shift in geopolitical context which turned technological advancement into a fundamental element of American foreign policy during the first years of the Cold War. The political confrontation with the Soviet Union and the rise of the military-

[18] Merritt Ierley, *Wondrous contrivances* (New York : Clarkson Potter, 2002), 159.

[19] Renowned science fiction writer and scientist Isaac Asimov saw it instantly as the beginning of a new era – an era he had been writing about for over ten years by that point. Isaac Asimov, *Robot Visions* (New York : Dell Books, 1986), 44.

industrial complex in the late forties and early fifties allowed for the investment of even larger sums of dollars into computing research and facilities.

The immediate successor to the ENIAC, the EDSVA, was developed by the University of Pennsylvania under the associated supervision of mathematician John von Neumann. It introduced the concept of a 'stored-program' (also called the von Neumann architecture) which remains in fact the foundation of modern computing architectures. In stored-program computers, the basic step-by-step instructions needed to accomplish any task - adding, multiplying, comparing - are stored in non-volatile memory within the circuits of the central processing unit (CPU). The instructions fed to the machine are in fact references to those stored programs which can then be combined to assemble more complex series of instructions. The von Neumann architecture was a marriage of theoretical and engineering concerns that defined, all at once, the concepts of 'processor', 'memory' and 'program'. In the case of the EDSVA, programs were entered in the memory of the machine through various forms: punch-cards, teletypes and other similar data-entry devices. The stored-program concept allowed architectures to be developed in parallel with similar 'operator code' features. The introduction of external (soft-wired) data-entering processes provided the basis for machine language standardisation which in turn permitted the emergence of higher-level computer languages, such as Assembly Language and Fortran. It is generally accepted that software in its modern sense is in fact an extension of von Neumann's vision of how to reprogram computing circuits on-the-fly without having to patch new connections in the machine.[21]

[20]Scott McCartney, *ENIAC : The Triumphs and Tragedies of the World's First Computer* (New York : Walker and Company, 1999), 102.

[21]The stored-program principle is also referred to commonly as the 'von Neumann architecture' and is still the central paradigm around which computers are being designed. Very few alternatives have been proposed since, and none have managed to rally constructors other than supercomputing devices such as the Cray II and III in the early 1990's. Ceruzzi, 20.

At roughly the same time, the groundbreaking invention of the transistor at the Bell research labs opened a new venue for computer researchers. Originally conceived in 1947 as the solid-state equivalent of the vacuum tube, the transistor quickly took the world by storm. Easy to manufacture, transistors had the potential to be much more efficient, durable and inexpensive than vacuum tubes. Compared to tubes, they represented a true godsend because they had no moving or heating parts and did not break or burn out.[22] Transistors are in fact built upon the physical properties of various kinds of silicates: silicone, germanium, which are compounds readily available under the form of *sand*. Almost overnight, the relatively easy processes that allowed for large-scale production of transistors and the abundance of sand in southern California resulted in the emergence of the semiconductor industry there. The transistor, however, took a few years to get from the lab to the manufacturing plant. In the meantime, research continued using increasingly sophisticated vacuum tubes.

Convinced that there was a certain amount of money in making the computer available to large corporations, the creators of ENIAC, Eckert and Mauchly left the University of Pennsylvania in 1948 to create their own company, the Eckert and Mauchly Corporation (EMC). They had become disillusioned with the infrastructure of research proposed by the University and saw a strong potential in the private sector for the sort of machines they were interested in building. Eckert and Mauchly thought computers could be used by any medium to large sized corporation or organisation, including the US government itself. They were not precisely sure *what* these machines could be used for but they were convinced that there existed a large enough market for this sort of device.[23] Their first creation after they left Pennsylvania was the BINAC, followed closely by the

[22]Ceruzzi, 64-66.

UNIVAC.[24] The UNIVAC was in line with the ENIAC but it also borrowed several features from the EDSVAC. Much like its predecessors, the UNIVAC was huge, consumed staggering amounts of power and was generally geared towards large-scale repetitive computation. One important difference between the UNIVAC and its predecessors was that since it was being designed with the business market in mind, the machine was particularly designed to be able to handle text as well as numeric data. Neither the ENIAC nor the EDSVAC had ever been put to the task of organising words. By contrast, the UNIVAC could easily alphabetise a list of words and store records with names as well as numbers. Of course, the machine inherently only handled binary information, but particular care had been taken to design a translation matrix between numbers and letters in memory (the ancestor of both ASCII and EBCDIC standards). This made the UNIVAC much easier to adapt to various business uses such as payroll, inventory control and general data processing. Despite its significant expense (the first fifty UNIVACs ended up costing more than 1.5M$ each in 1951 dollars) it sold rather well and motivated other automation companies, such as RCA, IBM and NCR, to investigate the potential of the computer in commercial contexts.[25] Thanks in part to the publicity surrounding the 1950 census, which was partially analysed with a UNIVAC (the first one had been sold to the US Census Bureau in 1951), the exposure of computers as tools to analyse not only numbers, but also to organise alphanumeric, data began to emerge. [26] More significantly, the use of the UNIVAC in the census began a discussion of the computer as a tool for efficiency and productivity, two

[23]McCartney, 137-144.

[24] It stood for 'UNIversal Automatic Computer', meaning it could be set-up to crunch numbers or perform alphanumeric analysis. From very early on, the UNIVAC was being designed to be able to handle business data as well as advanced scientific calculations. Ceruzzi, 26.

[25] By the time the first UNIVAC was shipped in early 1950, EMC had accumulated orders from companies and agencies as diverse as General Electric, the US Air Force, Du Pont, Westinghouse and US Steel. Ceruzzi, 28

[26] Ceruzzi, 32-33.

ideas that were resonant within the corporate outlook of early fifties America. The UNIVAC's first moment of glory, and its first serious exposure to the public imagination, came on election night 1952, when CBS broadcast the presidential election results from the operations room of a UNIVAC. During the evening, Walter Cronkite sat near the UNIVAC while it was fed survey data from the various polls in the New York area. Around 9pm, the simple statistical program loaded into the machine was able to predict the outcome of the elections. The publicity stunt was remarkably well timed. For several weeks after the November elections, articles in magazines and newspapers described the 'robot' that 'predicted the future of democracy.'[27] The famous photograph that circulated in the press (figure 2) showed Walter Cronkite shaking his head in disbelief in front of a UNIVAC's operator console minutes after 9pm, when the computer announced Eisenhower's landslide electoral success.

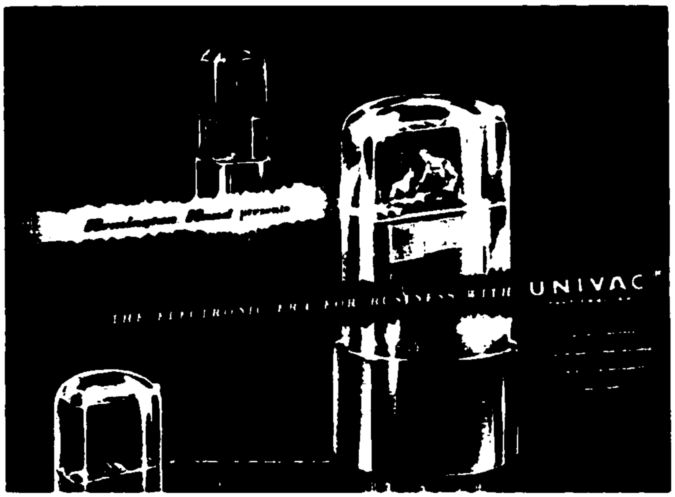

Figure 2 – *The New Observer* article on the ENIAC predictions for the presidency (November 1952 – left) and ad for UNIVAC that promised the "electronic era of business" in the pages of *Fortune* (1952).

One big absentee from the computing scene in the late 1940's was International Business Machines (IBM) – the largest domestic and international provider of mechanical tabulators and calculating machines for the business market. At first, IBM had been wary of

[27] Campbell-Kelly and Aspray, 122.

entering the digital computer market mostly because the upper management failed to see how it could ever displace the mechanical tabulating and processing devices the company sold in large quantities. Tom Watson, Sr., then president of IBM, went as far as saying, in 1953, that he "didn't see the potential for more than six or seven digital computers in the United States".[28] This was not necessarily industrial myopia. There was a fairly established worldview regarding the need for and potential use of computers which precluded the idea of large-scale consumption. Inherent to this worldview, the computer was akin to a power plant or a hospital: it would provide global services as part of a large electronic infrastructure. Private computing seemed then a contradiction in terms. The UNIVAC was the first machine to encourage a shift in thinking of many large corporations away from mechanically-based information processing to electronic processing, largely because of productivity issues. By 1952, Watson's position had begun to disintegrate in the face of growing interest in the potential of digital computers. Among the early adopters that managed to transform IBM's worldview were the various branches of the American government, but also a few large corporations such as US Steel and industrial companies such as Du Pont and General Electric.

As the profitability of the UNIVAC became clear, IBM, National Cash Registers (NCR) and Burroughs (the three largest providers of mechanical tabulating and typewriter machines for the US Census Bureau) rapidly shifted gears and began experimenting with digital designs. The upper management of those companies struggled with two realistic questions: was there a market for a commercial electronic computer in the US? and if there

[28] The quote has been variously attributed to Tom Watson senior, junior and Howard Aiken, the builder of the Harvard Mark I, who was by the early fifties a senior management consultant at IBM. No matter who really pronounced the sentence first, they all shared in the belief that electronic digital computers were not appropriate for the business market.

was such a market, how would it be tapped?[29] There were also concerns that the costs of operation would be enormous and the dependency on cutting-edge technologies might be a terrible idea. Therefore, IBM quickly settled on a motto of "productivity, solidity and efficiency" to promote their machines (Figure 3).

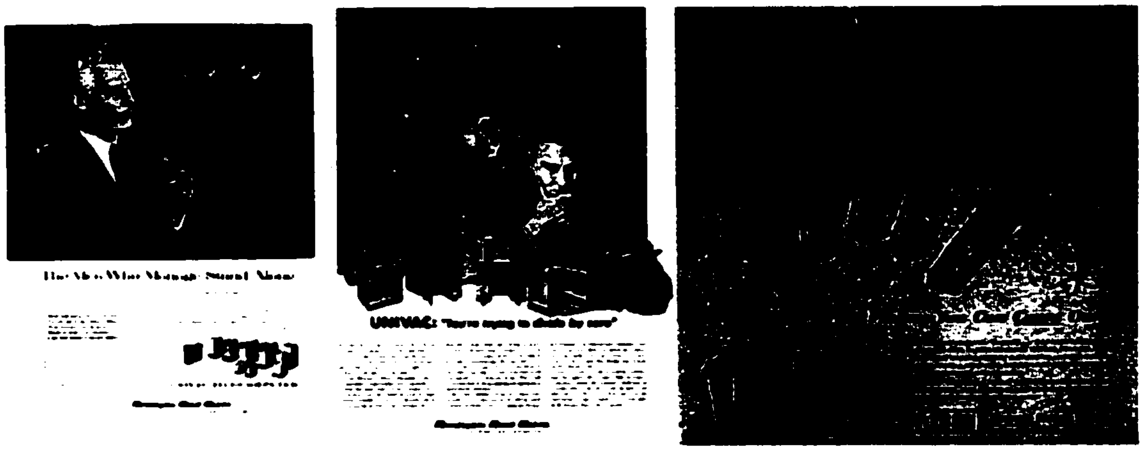

Figure 3 – Three advertisements from 1953. The two to the left are from Remington Rand (UNIVAC) aimed at the businessman 'seeking a world of efficiency' and at the scientist 'seeking a world of precision'. The one to the right is for the IBM 704 and underscores the solidity and reliability of 'proven IBM products' (*source : www.digibarn.com)*

Both NCR and Burroughs boasted how many "man-hours [were] saved" by replacing large groups of human calculators with large machines. They announced the benefits of digital computers by boasting about the increased productivity of automating payroll and timesheet systems stored-program machines provided. By May 1952, IBM's first digital computer, the 701, became available to US customers. Significantly, the first prototype was installed in the company's headquarters, but numbers two through five were purchased by the Pentagon to carry out calculations at Los Alamos. By 1953, IBM had also hired more than 75% of the engineers that had worked on the ENIAC, the EDSVAC and

[29]Campbell-Kelly and Aspray, 128-139.

the various other fundamental research institutes. In return, IBM provided the US government with the cutting edge in computing technologies. Largely because of this marketing focus, most computer facilities were built in large actuarial corporations or insurance companies, where probabilities and mass-calculations were a time-consuming and error-prone occupation. With a single electronic computer, actuarial predictions could be carried out in seconds where before it might have taken weeks.[30]

The first motivation for the construction of computers had been linked to the military and scientific requirements stemming from the Cold War arms race. The impetus to provide increasingly powerful models to conceive the H-bomb largely absorbed the costs of the machine construction. However, as businesses began to realise the benefits of replacing floors of computer persons with computing centres, an increasingly large amount of research began to be conducted by private corporations that were looking to take a share of the emerging computer market. Rather quickly, the vocabulary of advertising began to focus on these efficiency issues. Corporations like Remington Rand and NCR quickly realised that computers were almost synonymous with modernity in the popular imagination. In 1952, for instance, Remington Rand ran a series of ads in various magazines (*Newsweek*, *Fortune*, *Life*, *Look)* that announced the 'electronic era of computing' (figure 2) and exploited the speed of electricity as an indication of how much more efficient electronic digital computers would be than traditional tabulators. Soon, computer facilities became the pride and joy of many insurance companies. In 1954, Franklin Life Insurance in Ohio purchased an UNIVAC level2 for 2M$ and placed it in a specially designed building. Employees were invited to tour the facility Friday afternoons and witness the Computer at work. Others, such as Metropolitan Life (New York) and Pacific Mutual Life Insurance (California) featured their

---

[30]Ibid. 145.

acquisitions as sure signs of the company's dynamism and forward-looking entrepreneurship. For investments varying from one to several million dollars, they purchased not only a useful productivity tool, but a certain amount of publicity and a *mystique*.[31]

Amid fears that the computer market would soon be saturated, IBM quickly consolidated its lead in 1955 by taking advantage of its already well-established network and providing complete end-to-end solutions to its consumers.[32] In the face of ever-changing competition, IBM presented the image of a stable, serious business that was trying to integrate new technologies with already established practices.[33] IBM progressively replaced its whole line of mechanical tabulators with whole lines of electronic computers. They also provided crews of 'specialists' carrying over old business practices to the new 'digital age' way of doing things. In one of the most dramatic turnabouts ever witnessed by corporations that size, IBM's upper management vowed to switch the bulk of the company's operations to digital computing before the end of the decade.[34]

By 1960, IBM had produced a series of successful electronic computers built mostly of semiconductors. The vacuum tube had become a thing of the past. Semiconductor-based digital computers were large collections of fridge-sized cabinets replete with thousands of components. IBM designed, constructed, marketed, distributed and maintained these machines. To develop these systems, it made a number of commercial decisions. First, it decided that no matter how much the technology would eventually cost to market and develop, the machines would have to be expensive to purchase and operate. The company

---

[31]Ibid. 140.

[32] The development of the BINAC and the UNIVAC (sold at over $1 Million US each) was too expensive for Eckert and Mauchly and they had to sell their firms to a competitor by 1953 to raise capital. Remington Rand (which would soon change its name to Sperry Systems) purchased the EMC and turned Eckert and Mauchly into senior designers. Ceruzzi, 31.

[33]Ceruzzi, 34-36.

[34] Emerson Pugh, *Building IBM: Shaping an Industry and its Technology* (Cambridge: MIT Press, 1995), 44-50.

was not only in the market to provide business machines for companies that could afford them, it was also attempting to create a mystique and an aura of prestige about how the computer operated and how it was constructed, programmed and maintained. To a large extent, IBM succeeded beyond its wildest dreams. A second concern was the type of support offered to the clients who showed an interest in the computer. It would be a binding type of support: one that would allow the companies to propose candidates to be trained by IBM in the use and care of their machines. The reasoning behind this was simple: these candidates would act like moles in corporate America, and become so accustomed to using IBM-based mainframes that the mere idea of operating something by the competition was unthinkable.[35]

The Era of the Mainframes and the Minicomputers (1960-1969)

The early sixties saw a proliferation of computer companies that exploited the window of competition provided by the exceedingly high costs required to operate IBM products. These companies (Sperry, CDC, Honeywell, RCA, NCR, General Electric and Burroughs) came to be known as the 'seven dwarfs' because they totalled less than 20% of the market while IBM leveraged over 75% of the contracts and installations.[36] The sixties saw the computer become a full-fledged consumer item, except the consumers were medium to large corporations looking to augment productivity in their data centres. Banks, insurance companies and large nation-wide distributors were the first to purchase these technologies,

---

[35]Ibid. 35, 43-45.

[36]Ibid. 144-159. It is even more staggering to consider that IBM's 75% of the market share was in fact in *installations*. In dollar revenue, IBM's share soared to $3.5 Billion by 1965, while all other companies together commanded a mere $245 Million. This was in fact one the foundations for the anti-trust case against IBM for much of the 70's and early 80's.

largely because of the huge savings that consolidated operations brought to their business practices.[37]

The computer had long been a subject of intense theoretical research: it was now becoming something that was common enough for most small colleges and universities to access. At this point, the uses of the typical computer were becoming standardized over a few well-defined categories: payroll, information databases, automated operations, indexing, mass calculations and projections. There were no *individual* uses for these machines: the applications were invariably batch-oriented. During the day, people punched-in variations in the inventory, streams of data about scientific experiments and so forth. At night, the mainframe would crunch away at all this data and eventually produce reports. The computer operator gathered the reports and distributed them. In other words, there was no concept of using the computer interactively or individually. Few applications had been designed for real-time operations and none were single-user oriented. No word processors or spreadsheets were available until well into the seventies and email was an experimental, poorly understood communication tool.[38] Nevertheless, use of computers to automate information-related tasks was spreading to areas previously untouched by automation technology. This technology, however, was invariably accompanied by a tendency to separate the computer from the mere mortal thereby creating an aura of 'high priesthood' around the army of technicians trained to operate the mainframes.

Mainframes were becoming more common but, thanks in part to the carefully designed aura around the systems, remained expensive. Most mainframes had terminals for

[37] Campbell-Kelly and Aspray, 155.

[38] Technically, email within a single system was common in large systems in the late sixties but inter-system connectivity did not emerge until 1973 when Len Kleinrock designed the username@machine morphology and the protocols to propagate email between several machines. For a full discussion of the invention of email and connected technologies, see Katie Hafner, *Where Wizards Stay Up Late* (New York : Touchstone Books, 1996), 186-205.

remote access, and while the computers were often centralised in a computer room, the operation of these machines was generally less unusual than before. By 1965, most engineers and many corporate accountants had had some contact with the departmental systems. These new machines were no longer built within the same framework of the ENIAC, the UNIVAC or even the highly successful series of 701's released by IBM. Thanks to gigantic advancements in miniaturisation and manufacturing techniques, the new generations of mainframes were increasingly powerful and complex. At the same time, companies were now interested in medium-sized machines that could be allocated to specific departments to handle their own business. These smaller computers were called 'minicomputers'. The size of these machines, marketed mostly by Data General with their successful Nova and Digital Electric Corporation (DEC) with the PDP family, as well as their price, occasionally influenced some companies to replace large mainframes with a series of smaller machines.[39]

DEC was founded in 1957 by two young engineers from MIT with funding from the American Research and Development Corporation, a firm set up by Professor Georges Doriot, of the Harvard Business School, to "commercialise the scientific and technical innovations he had observed during the Second World War as an officer of the US Army." Very quickly they began producing small computers based on simple designs and using all the possible miniaturisation techniques they could come up with. DEC's machines gradually evolved to fill the vacuum left behind by IBM's huge mainframes. Their first models (the PDP-1 through 3) were technologically uninteresting. By 1965, however, with the release of the PDP-8, DEC took a radical decision. It purposely *undervalued* the machine. While market analysis revealed that the computer could probably be sold for over 40,000$, DEC priced it at a little over 18,000$. At those prices, it generated a small profit, but the effect of the

[39]Ceruzzi, 124-129.

announcement in the computer world was tremendous. The computer also happened to be an excellent model. Within six months, the company had received 50,000 orders for the small machine. The minicomputer became an instantaneous hit with medium-sized businesses.[40]

'Minicomputer' can be a misleading term since these machines often featured the same powerful capacities found in the full-fledged mainframe computers. Their architecture was geared towards providing large amounts of computing to small groups of people, by opposition to the 'facility' approach of the mainframe. They were easier to access, easier to program and a host of new tools were available to customise them so that the programmer was increasingly further away from the actual bare metal of the machine. New programming languages had begun to replace the assembly language of the early designs and the writing of specific business applications was becoming commonplace. Languages such as COBOL or BASIC[41] allowed newcomers an easy way to program the machine, without knowing the internal processing of the CPU.

For all the glory of the minicomputer, however, the mystique surrounding the massive, industrial-looking mainframe remained. IBM maintained its control of the market by constantly coming up with marketing ideas that supported the expectations inspired in earlier times, while allowing enough flexibility that most customers preferred to remain with the Big Iron machines sold by Big Blue[42]. The most famous marketing decision of IBM in

---

[40] Ibid. 130-132.

[41] The name stands for 'Beginners All-Purpose Symbolic Instruction Code'. Ceruzzi, 351

[42] So-called 'Big Iron' referred to the large, heavy, discrete-component mainframes built by IBM that required large rooms and specially-conceived floors to sustain their weight. Because of its corporate image of heavyweight machines, and the omnipresent colour blue on every single one of their designs, IBM was quickly dubbed 'Big Blue' by the industry and the press. The duality Big Iron and Big Blue became eventually associated with an Orwellian vision of society. This cultural construction was in turn the target of the famous superbowl television commercial in 1984 that introduced the Macintosh and promised to shatter the monopoly of Big Blue and to prevent the realisation of the dystopian future described in George Orwell's classic novel, *1984* (1948).

the early sixties was to introduce the concept of the architectural family.[43] For several years, each new machine sported such a completely different architecture and instruction set that companies upgrading from one version to the next would literally waste hundreds of thousands of dollars adapting their software. Starting in 1963, IBM announced the System/360 family, a series of machines ranging from the upper-scale mini to the supercomputer that were promised to always share similar 'instruction sets'. Software written for the mini would run on the high end without any changes; this feature forever enshrined IBM as the prime supplier of national computing power as companies realised they could develop their payroll in a standard language, such as COBOL, and be assured that they could still operate it five years down the road on any other IBM machine. [44]

Throughout the sixties, the role of the computer in the corporate world had helped develop the popular image of the machine as a tool for increased productivity in the marketplace, often to the detriment of the clerical workers who were often pictured as victims of progress. In a January 1962 article published in *Fortune* titled "Office Robots", the author underscored how cost effectiveness was threatening to transform the way businesses were run, often to a point where the human being could be completely removed from the equation:

> No intervening clerical operators. No bookkeepers. No punched cards. No paper files. In the utility billing facility, for instance, meter readings would come automatically by wire into the input organs of the central office's electronic accounting and information processing machine, which, when called upon, would compare these readings with customer's accounts in its huge memory storage, make all

[43]Prasad, 27-35.

[44]The concept of integrated family also allowed IBM to relegate older models of a similar family to less critical roles in a computing environment while keeping a customer interest for older designs. The top-of-the line 1401 (1958) had become, by 1964, the 'card-puncher' entry-level machine. It is a trend that became predominant in the next decade, giving a lot of young students and engineers the opportunity to practice with technology that had previously been considered invaluable with relatively little risk the computing facility would be jeopardised. Ceruzzi, 109-111.

> computations, and return the new results to storage while printing out the monthly bills. Completely without human intervention, aside from the clerical duties of occasional operators whose occupation would be reduced to loading the computer with appropriate cards and keep the printers running.[45]

In the long run, sentiments like these were combined with the promises of the computer as an instrument to detach the human from boring and repetitive jobs. In the popular mind, however, the corporate data centre became much more an icon of the inability of progress to find a place in the future for the individuality of workers.

The Invention of the Integrated Circuit and the First Microchip (1970)

Just as IBM depended on the concept that computing was expensive and serious, a plethora of new companies emerged in the late 1960's promoting an innovative new way of doing things. The integrated circuit (IC) had been another significant result of military industry miniaturisation efforts between 1958 and 1962.[46] By 1963, IC's were a staple of the semiconductor industry. The integrated circuit, as its name implies, describes a circuit where all the discrete components are integrated into a germanium (or other silicate) layer. The various discrete components (resistors, transistors, etc) are no longer manufactured independently and then assembled: they are built on a wafer, out of the wafer material itself. Much like the transistor, once the design pattern is complete, it is exceedingly cheap to produce, very hard to break and the industrial process by which it is obtained is easy to modify and adapt to new designs. In many ways, producing integrated circuits is similar to

---

[45] 'Office Robots', *Fortune*, January 1962, quoted by Campbell, 125.

[46] Particularly, the *integrated circuit* (IC) was developed as part of an effort to miniaturise controller circuits in ICBMs (inter-continental ballistic missiles) Ceruzzi, 182-190.

printing copies of a book - and it is as easy to print a new design as it would be to print a different text, as long as the paper (or the germanium) and the text (circuit design) are changing accordingly.

The promise of a large-scale revolution in electronics was clearly at hand. Many in the industry refused to accept it. It was much too threatening to imagine that a bunch of integrated circuits might one day replace discrete components in the very expensive and serious mainframes IBM was selling.[47] In 1969 a young start-up called Intel received an order from a Japanese electronics company to design and build a simple adding machine on a single die chip. Other semiconductor companies had been approached but none had been interested in the project. However the chief engineer at Intel, Ted Hoff, had been intrigued by the concept. After one year of work, Intel released the first micro-processor: the Intel 4004, in 1970. The microprocessor was the logical consequence of the integrated circuit, much as the IC had been a logical consequence of the transistor. It readily offered all the promises of yet another groundbreaking technological shift.[48]

At first, the emergence of the microprocessor was greeted with scepticism and a grain of salt by the 'serious' computer manufacturers. Surely these tiny devices — computers on chips — which were based on antiquated 4-bit designs and came with limited instruction sets could not seriously compete with the monstrous mainframes of IBM? Significantly, even the manufacturer of the minis (with 16 and soon 32 bit words) did not see the chip as a serious threat to their markets.

In truth the first microprocessor was little more than a proof of concept. However, the sales of the 4004 were brisk enough that Intel began researching the successor, which

[47]IBM had in fact developed large manufacturing plants centering around discrete components and viewed rather dimly the emergence of cheaper, faster and more efficient circuit-production facilities after the amount of money they had already invested. Ceruzzi, 192-193.

became known as the 8008.[49] Where the 4004 was barely sufficient to animate a pocket calculator, the 8008 was a complete package with 8 bit data paths, full-sized registers and accumulators and a more complete instruction set. One year later, in 1974, Intel announced the 8080. This time, most basic features found within the CPU cabinet of a mainframe or a mini were present: large addressing potential, interrupts, registers and accumulators and controlled I/O ports. Furthermore, the CPU could address 16,000 words of memory – a fantastic amount of space by most standards of the time – and its cost was ridiculously low: 380$ each in quantities of 1000 and more.[50]

The most radical side-effect of the emergence of the microprocessor was its immediate effect on the domestic electronics industry. The microprocessor was an exceedingly powerful new invention, however its uses were rather mysterious to the average consumer. It was not a complete device – it was a starting point for something else. It could not be packaged or operate by itself, and it needed a fairly large number of peripheral elements to make it do anything noteworthy. Among the few things it could do by itself were adding, subtracting and multiplying numbers with those stored in its registers and accumulators. It had no internal memory – so it needed some sort of temporary storage outside of the main packaging – and more importantly, it had no real interface other than the included input/output ports. Circuits needed to be designed to bring the input from the user to the many legs of the microprocessor and other circuits needed to be designed to carry the outputs to some form of comprehensible medium.[51]

---

[48]Ceruzzi, 217-221.

[49]Intel sold between 25 and 30 000 units of the 4004 between 1970 and 1976. Shurkin, 144.

[50]Paul Freiberger and Michael Swaine, *Fire in the Valley* (New York : McGraw Hill, 2000), 19-22.

[51]Freiberger indicates that the 8008 or the 8080 were roughly equivalent in complexity to the CPU (built of discrete components) of a very popular minicomputer of the time, the PDP-8. These claims are however disputable, since the 8008 was built of less than 1000 transistors and offered almost no capability to perform strenuous input/output operations. However, a large subsection of the electronics hobbyist community of the time might have thought it true. Freiberger and Swaine, 25.

Paradoxically, the work to make these computers on a chip truly useful was generally considered by some too complicated and by others too easy. Intel thought it too complicated because it would necessitate focused manufacturing plants, which Intel and other semiconductor or microprocessor manufacturers were not interested in building, since they had just recently discovered the wonders of 'printing' components. Establishing the infrastructure to design, build and market full-fledged computers was too much of a daunting task to smaller firms like Intel or Motorola. At the same time, it was not complicated enough to justify investments by larger corporations. Moreover, the promise of microprocessors was dangerous to companies like IBM and Digital since they purposefully kept the computer an expensive, serious, professional and mysterious affair. It would have been hard to justify a 2M$ price tag for a machine constructed from 400$ chips.

For over two years, the microprocessor, despite its technological wonder, was relegated to the role of controlling automata, allowing dumb terminals to connect to time-sharing mainframes, and similar other undeserving tasks. Simultaneously, Intel discovered that its manufacture of chips was so efficient that it needed outlets to unload its large amounts of overproduction. It looked at small electronic hobbyist companies that existed throughout the southern California region, who in turn turned to the specialised hobby shops throughout the country.

By 1974, there was a very small but growing interest in second-hand electronic hobbyist circles for the potentials of these reasonably cheap devices (an 8080 went for 70$ in these markets while it commanded list prices of 380$ in the firsthand market). In particular, the interest of electronics hobbyists focused on how the microchip would influence the future role of electronics in domestic life. Several small companies had attempted to put together kits based on the 8008 in 1973 but failed, largely because of poor marketing and even worse component quality. However, by late 1975 most of the tools to build a computer were available to anyone who cared to flip through a mail-order catalogue from electronic hobby shops. Some people did just that.[52]

Edward Roberts, an engineer and a hobbyist with a flair for business, realised in late 1974 that by putting together a few dozen discrete components in a metal box with a few switches and using LED's as output, he could essentially build a computer. He spent a few months working on it, eventually producing a fairly complete machine. In order to make it easy to add-on parts, he designed a very simple 'bus' (the S-100 bus) to connect expansion devices onto the newly created machine. He was not the only person designing computers out of microprocessors; many other projects had been discussed and proposed, particularly in one of the most technical hobbyist magazines of the time, *Popular Electronics*. Roberts's design, however, had two very strong points: it was based on off-the-shelf components that one could buy in hobbyist shops all around the country and it was *advertised* as a full machine; in a metal case that bore strong resemblance to the minis made by Digital. As such, it was not just only a hobbyist's project, but a marketable product as well.

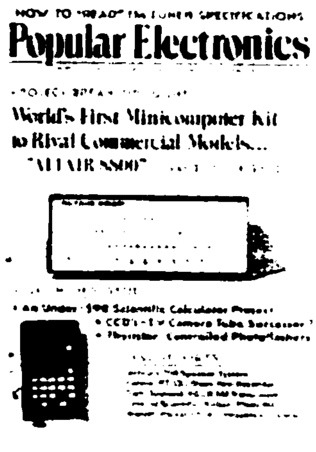

Figure 4 –*Popular Electronics* cover from January 1975 introducing the Altair 8800.

[52] Freiberger and Swaine, 38-44.

Ed Roberts knew that the potential for microcomputers in America was enormous, because he was part of a crowd of young engineers who yearned to take away from large corporations and giants such as IBM the power of computing. For a few years, under the name of a company he owned and operated (MITS) he had been constructing pocket calculators, but the market had recently plummeted after reaching saturation. To test the waters, he took his invention to the pages of *Popular Electronics* in a famous article which ran in January 1975 (figure 3). His initial hopes were that some people would be willing to pay 397$ for a kit package including all the necessary elements to build the Altair, or 500$ for a fully-built version. It even included an impressive 256 bytes of memory![53]

Looking for a name for the machine, Ed Roberts asked his daughter if she had an idea. That morning, the daily rerun of *Star Trek* on television was the episode "Amok Time" (1968) which discussed getting the *Enterprise* to a planet called Altair VI. Ed Roberts liked the name and chose it to christen the first microcomputer commercially available produced by MITS: the Altair 8800.[54] As will become clear later in this thesis, this seemingly innocent and innocuous anecdote was in reality very revealing of the mentality and cultural framework of the computer hobbyist's community Roberts helped to create.

The response to the *Popular Electronics* article was staggering. In less than a week, Roberts received more than 4000 cheques, some for amounts far larger than the price of the Altair. He was stunned, and for a short while worried about what he had done because he had no way of producing 4000 kits.[55] In many ways, it could be argued that Roberts wasn't selling a computer or anything remotely approaching one. He was selling a dream: the dream of entering the world of the 21st century, of automation, of Isaac Asimov's robot stories and

[53]Most Altair 8800 sold and shipped never managed to work properly, in part because the electronic parts were very often defective, but also because of the complexity of the assembly. Freiberger, 51, 55-59.
[54]Freiberger, 46.

of *Star Trek*. At once, Roberts's project appealed to electronic hobbyists, engineers and many young Americans who dreamed of building a piece of the future and of stealing away computing power from large corporations. In 1974, there were electronic enthusiasts; by 1975, they were computer hobbyists.

The Computer Hobbyist and the Home Microcomputer Industry (1975-1983)

Between 1975 and 1977, a flurry of activity focused on the integration of the microprocessor to the already established frameworks of computing. Largely, this was a movement of electronic enthusiasts and hobbyists, organised in clubs throughout the country. The traditional technology magazines having largely been superseded by specialised publications catering to the computer hobbyist, a bonanza of projects, kits and machines emerged in these new publications. In January 1975, the Altair 8800 became available in kit and in packaged form, and thanks to the design decisions taken by Ed Roberts regarding the bus, anyone could built expansion boards that could enhance the uses of the computer. This was a radically different approach from the closed-vendor hardware companies, which had specialised in making the machines as impenetrable as possible.[56] Furthermore, while the sixties had seen minicomputers and mainframes being marketed to businesses under the banners of efficiency and productivity towards established businesses, the microcomputer kits were aimed at a completely different crowd, and for completely different reasons. No one was very clear on the reasons that motivated people to buy and assemble computers.

---

[55]Ibid. 52.

[56]The development of the S-100 bus (as it came to be called) is viewed by many, such as Shurkin and Ceruzzi, as the true innovation of the early computer hobbyist movement. Through the freedom it granted on the consumer, it allowed for the emergence of open competition in an industry that had always been strictly closed. Shurkin, 307-310 and Ceruzzi, 226-232.

Few seriously considered using the machine for practical purposes. Often, the roles of salesperson and client were reversed. Even Ed Roberts shipped the hardware *then* asked of the client what he intended to do with it.

By 1976, several homebrew computers[57] had become available through mail order kits. Small companies, formed primarily of hobbyists who saw the potential for a small steady income derived from activities they were already enjoying, sprang up throughout the United States. Some of them became household names. Apple systems was one of the many companies that emerged in this period, when a young engineer from Hewlett-Packard, Steve Wozniak, joined forces with a friend from college named Steve Jobs to market a machine built (and showcased) partly at the Homebrew Computer Club at Stanford University.[58]

These early attempts at marketing mainboards and peripherals led the way, in 1977, to the emergence of the first truly packaged microcomputers: the Apple II, the IMSAI, the PET Commodore and others. These were easier to control – they often came with keyboards for data acquisition and featured TV-out connectors for easy feedback. They also featured more powerful languages, such as BASIC, often built in ROM, that were directly in the circuits of the mainboard.

The sales quickly took off[59], mostly within the computer enthusiast crowd, but eventually also within the mainstream, as units became friendlier and easier to set-up and operate. Publications appeared very quickly and appealed to different types of readers. The college crowd already familiar with elements of software creation latched onto *Dr Dobbs*

[57] "Homebrewing" in the electronics hobbyist jargon means to design and assemble a project from the ground up with parts available at surplus stores or electronic part retailers. "Homebrewed Computers" were usually built by hobbyists and occasionally sold as assembled units through mail-order.

[58] Steve Wozniak was actually an active contributor to *Dr. Dobbs*, one of the cornerstones of the computer hobbyist's community-building magazines which we will analyse in chapters three and four.

[59] The Apple I sold less than 2000 units in 1976 and the Altair sold about 10 000 units between 1975 and 1978. However, by 1979 Apple had sold half a million Apple II's and machines such as the TRS-80 Model I had surpassed the 50 000 unit sold range. Freiberger and Swaine, 254-265.

Journal of Calisthenics and Orthodontia. The main crowd of hobbyists interested in computers switched from *Popular Electronics* and began reading *Byte*.

Fairly quickly, the same companies that had deprecated the microprocessor and its potential to produce usable consumer goods began regretting their decision.[60] By 1978, many packaged consumer computers had appeared, mostly based on the Intel 8080, the MOS 6502 or the Zilog Z80 chips: TRS-80, PET Commodore, Atari ST. These machines were quickly equipped with more lavish looks and hardware: disk drives, printers, and more memory.

By 1980, there was a very large and profitable industry centred on the microcomputer.[61] In many ways, even these early personal computers had more power than a typical minicomputer from the late sixties, for a price that was several orders of magnitude cheaper. A typical Apple II in 1980 had 48Kb of RAM and sold for around 1500$. By comparison, a PDP-8 from 1968, which was actively used for the launch of the Apollo missions, had 56Kb of RAM and cost 44,000$.[62] Because the cost was so much lower in the microcomputer market than in the mainframe or minicomputer markets, businesses began adopting microcomputers to replace ageing minicomputers. Most Americans had their first contact with physical computers and the popular imagination began to relegate the old picture of the big computer facility centre to the background. By 1983, when *Time* magazine elected the "Personal Computer" man of the year, the common impression in the media as

[60]IBM had set up a small task-force to analyse the use of the computer in small office and home environments, but their result, the Topaze, carried a price tag of $12 000 and was considered unmarketable by the company. Other companies, such as Wang Automation had produced electronic typewriters for most of the early 1970's which greatly influenced the look of the first industrially produced microcomputers. Ceruzzi, 254-263.

[61]By 1980, Apple Systems had sold over a million Apple II's and was posting sales of several hundred millions a year. By 1983, the Steve Wozniak's shares in Apple were estimated at $550M US. Freiberger and Swaine, 255.

[62]The Apple II had an open-standards expansion bus which allowed anyone to build add-ons, which the PDP's definitely never had. Campbell-Kelly and Aspray, 244-267.

well as in the mind of most Americans was that these new devices were called to replace the large mammoths of the fifties and sixties.

The microcomputer revolution's first phase had ended somewhere between 1981 and 1983. Large corporations had moved in and appropriated large parts of the market. IBM, going against almost thirty years of corporate culture, had released in 1981 the IBM PC, a personal computer based on the Intel 8086 chip and built entirely out of off-the-shelf parts and with a completely open architecture.[63] The computer hobbyist was by then no longer the innovator in hardware but the avid programmer, who sought to extend the use of computers to all manners of human interaction. The next period would see the absorption of the computer as an integral part of society, not only in the workplace but also in the very core of domestic life.

In roughly 35 years, the computer descended from the high-tech labs that saw its birth as a tool of military and scientific research, to the den of most American middle-class families, with a detour through the accounting departments of American corporations. Although the importance of the phenomenon cannot be over-stressed, given the very nature of the technological advances involved, the path to mass acceptance taken by the computer seems unlikely particularly because of its initial starting point as a large-scale research project by the military. Few other technological creations have enjoyed such a rapid shift in popular image and such complete absorption into the very fabric of society, or have managed to enter domestic life largely because of one particular group of people. This group, the computer hobbyists, were mostly animated by motivations and cultural imperatives of their

[63]The shock to the IBM corporate culture was so tremendous it took ten years, and a very real flirtation with bankruptcy in the early 1990's, before it began to absorb the meaning of *personal computing*. In the end, IBM had great difficulty relating to the business model attached to the machine it helped disseminate. Well into the 21st century, it seems many people wrongly associate IBM with PC, while in many ways the PC rose in *opposition* to what IBM represented: monolithic, facility-oriented computing. It is one of

own that had in the end little to do with the initial reasons which saw the construction of the ENIAC or the UNIVAC.

While the computer, in its mainframe and mini incarnations, was a result of a partnership between corporate America and the funding provided by the Pentagon during the post-war period, the microcomputer traces its roots to a completely different origin. It is personal, individual. It does not cater to social or structural needs dictated by centralised knowledge - on the contrary, it thrived as a tool of knowledge and understanding in the hands of a few skilled people. In the following chapters I will sketch these motivations, and interests, as they are reflected in hobbyists periodicals.

---

those ironies of modern marketing that one of the most famous products developed by the corporation was the most distant from its line of thought. Freiberger and Swaine, 345-350.

Chapter Two

Special Purpose Publications: Functions of the Magazine in Post-war American Culture.

Because this study of computer magazines is primarily concerned with examining the growth of the computer hobbyist community in relation to mainstream culture it is logical to begin the inquiry by exploring the role and function of special-purpose periodicals in post-war American society.[64] Relevant literature on the history of American magazines, however, consistently fails to examine the relation between mainstream, mass-market publications and tightly-focused hobby magazines. A certain amount of confusion even exists as to the definition of simple terms such as 'mainstream', 'special-interest', 'mass-market' and 'specialised' publications. For certain magazine historians, such as John Tebble[65], *Scientific American* was a 'mass-market' publication, largely because it could be purchased almost anywhere in the continental United States. In contrast, another magazine historian, William Peterson[66], considers *Scientific American* a 'special-interest' publication, because it targeted a relatively small audience, rarely surpassed a circulation of 90,000 copies, and dealt exclusively with scientific-related content.

Even more complex is the nature of magazines such as *Popular Science* and *Popular Mechanics* which paradoxically targeted a specific subculture while at the same time boasting

[64]The computer hobbyist community is treated generally as a footnote to the rise of computer in society by historians of computing. Most authors, such as Ceruzzi or Shurkin, barely acknowledge their existence, even if sometimes they observe the value of magazines such as *Byte*. Freibeger and Swaine recount anecdotal trivia in a chapter entitled 'Spreading the word : magazines', 214-223.

[65] John Tebbel, *The American Magazine* (New York : Hawthorn Books, 1969), 301.

enormous circulation figures. Ham radio publications such as *QST* and *Popular Communications*, which have existed since the early thirties, constitute a third group: the tightly focused niche market publication with a very loyal, and relatively small, readership. This particular type of magazine is generally ignored by magazine historians. As such, the nature of the computer hobbyist periodical does not fit with existing models of periodicals history.

On the one hand, the rise of publications such as *Byte*, *Popular Electronics* and *Dr Dobb's* was part of a wider proliferation of mainstream, general-interest scientific and technological magazines towards the end of the sixties. These publications emphasised technocratic values and a view of society that was steeped in the practical uses of technology in everyday life. On the other hand, the hobbyist magazines also reflected a growing tendency, among larger media corporations such as McGraw-Hill, to identify (and exploit) niche markets. This development was part a major social shift in the way that middle-class Americans constructed interpersonal bonds and established patterns of self-valorisation. But according to David Abrahamson the splintering of the periodical markets into specialised units in the sixties was also tied to the rise of post-industrial society and new business imperatives that evolved in response to the rise of television. Post-industrial economics translated into a higher percentage of clerical and service-based work and a shift in the focus of the workforce from manufacturing to bureaucratic tasks.[67] Incidentally, the rise of the semiconductor and electronics industry in the early sixties created a whole new class of workers; namely engineers who worked in large corporations to design or repair new electronic devices, repair them or investigate new ways in which combinations of off-the-

---

[66] Theodore Peterson, *Magazines in the Twentieth Century* (Urbana: University of Illinois Press, 1986), 201.
[67] David Abrahamson, *Magazine-made America* (New Jersey : Hampton Press, 1996), 30.

shelf components could solve productivity issues.[68] These 'white collar' technicians earned decent wages and benefited from reasonably good work conditions.

The magazine industry through the Second World War had shown an ability to adapt its content and format to the business requirements of its ever-changing demographic targets. This flexibility was closely tied to the need to generate revenue through advertising targeted at specific kinds of readers. In the wake of the First World War, publications that focused on various popular pastimes (golf, yachting, sports in general) had begun to appear.[69] This trend intensified with the emergence of an urbanised middle-class with increased leisure time and a desire for more information about recreational activities in which they indulged in the years following the Second World War. A key element of this development was the desire by the readership to establish the authenticity and legitimacy of their pastime.[70] In effect, the reduced cost of mass-printing periodicals, matched with the increased revenue obtained by charging both subscription fees and advertisement dues from the sponsors, permitted the magazine industry to create custom-tailored publications that focused on specific interests. Instead of selling hundreds of thousands of copies of one very popular title, such as *Life* or *Look*, magazine publishers could afford to sell twenty or thirty thousand copies of more focused titles and still make a profit.

In the years following the Second World War another set of social changes affected magazine markets. The GI Bill transformed the amount and type of education received by young male Americans. Between 1946 and 1960, enrolment in institutions of higher education increased from 2 million to 3.5 million, while by the beginning of 1970, 7 million

[68] Bruce Seely, 'Research, engineering and Science in American Engineering Colleges :1900-1960' in Stephen Cutcliffe and Terry S. Reynolds ed. *Technology & American History* (Chicago : University of Chicago Press, 1997), 345.
[69] Peterson, 244.
[70] Abrahamson, 24.

men were in college.[71] Young white males profited disproportionately from the GI Bill and greatly swelled the ranks of engineers and scientists: the number of engineers was multiplied by four during this period and the number of scientific professionals by ten[72]. This boom in engineering resulted in the creation of a white, middle-class (male) audience which became eventually the focus of magazine demographic planning.

Postwar America was substantially different from the semi-agrarian society of the turn of the century. It had been systematically mechanised by the joint efforts of modern capitalism and the scientific-management principles of Frederick Taylor. The so-called Ford-Taylor effect had transformed the nature of work by reducing dramatically the number of blue-collar workers and fostering the development of a service-based society. American society in the fifties was rapidly shifting from the manufacturing powerhouse it had become during the Second World War to a bureaucratic, increasingly clerical structure. Simultaneously, the emergence of the consumer electronics industry required large amounts of technically-minded and trained workers. Companies like General Electric (GE) and Radio Corporation of America (RCA) invested large amounts of money in institutions of higher learning to make sure graduates could support the technological backbone of the emerging markets.[73] The post-industrial nature of the late fifties and early sixties in the United States was not only transforming people's occupations and the way in which they worked, but it also encouraged new work ethics that allowed for more leisure time and less strenuous schedules.[74]

[71] Abrahamson, 7-8.
[72] Seely, 351
[73] David Noble, *America by Design*. (New York : Alfred A. Knopf, 1997)
[74] Daniel Bell, 'Notes on the post-industrial society' in Jack Douglas ed, *The Technological Threat*, (New Jersey : Prentice Hall, 1971), 8-15.

These transformations of the American middle-class were accomplished against the background of a larger shift in geopolitical realities and necessities. The beginning of the Cold War in the years immediately following the Second World War had a profound impact on how technology was viewed by the American public and the political leadership. In particular, it promoted an emphasis on scientific and technological development as an instrument to fend off the threat of Communism, both in social and in practical strategic terms. The construction of more advanced weapons and systems of national protection were viewed as a natural extension of the process that allowed the United States to achieve victory during the previous war.[75] The value of work was also changing in terms of the relative strengths of skill and brute force. According to Daniel Bell, the value of labour was becoming increasingly attached to knowledge – especially "theoretical knowledge", which in the practical sense translated into an increase in the value of technocratic knowledge.[76] This, in turn led to an increased emphasis on higher education programs which, by 1960, was drenched in military funding.[77]

The new engineers, scientists and technicians who emerged as part of this new social structure showed an increased interest in print media that covered their areas of expertise. Simultaneously, improvements in work conditions for most of the middle-class workforce resulted in an increased amount of time dedicated to leisure activities. Leisure was becoming one of the most important elements of the American lifestyle. The amount of national income spent on leisure rose from 4% before the Second World War, to more than 12% in

[75] Walter McDougall, *The heavens and the earth : a political history of the space age* (Boston : Johns Hopkins University Press, 1997), 35-61 as well as the discussion in Paul Boyer, *By the bomb's early light* (New York: Pantheon, 1985) of the cultural impact of the bomb in American culture.
[76] Bell, 12.
[77] Patterson, 69. Also, see the discussion of how military funding transformed MIT and Harvard, starting in the 1940's but also through the 1960's, in M. Mitchell Waldrop, *The Dream Machine* (New York: Viking, 2001), 8-23.

the mid-sixties. The nature of the newly-found time to enjoy leisure varied greatly, but it circumscribed a new need to express individuality in relaxation as much as in work.[78]

The emerging individuality that characterised the sixties stemmed in part from the disintegration of a social consensus image that had evolved in the fifties from the outset of the Second World War. The fifties had largely been marked by a discourse of homogenisation, which the popular press, Hollywood cinema and television had constructed.[79] In the wake of the progressive acceptance of the idea that the individual was more important than his (or her) assumed role in the great mass of society, leisure became an expression of well-being and a comforting source of relaxation which the sixties established as the normal vehicle for personal growth. In turn, this prioritisation of leisure became the focus of the new specific-interest press characteristic of the late sixties and seventies.

Another discontinuity that altered the nature of the magazine in American culture centred on the shift from urban to suburban markets of the late fifties. Much as the turn of the century had seen a massive urbanisation movement, the fifties witnessed an even more radical suburbanization, in part as a response to the demographic boom and the increase in wealth derived from the reactivation of the domestic economy.[80] Families moved to the suburbs and established new patterns of social and cultural development. News about the world suddenly became domestic to many Americans, who were increasingly receptive to these forms of discourse.[81] Significantly in relation to the magazine business, suburban families tended to rely on subscriptions more than news-stand purchases. This

---

[78]Abrahamson, 12.

[79] On the nature of Hollywood cinema and the construction of a marketplace consisting largely of a teenage audience, both for movies and derived products such as magazines, see Thomas Doherty, *Teenagers and Teenpics* 2nd edition, (Philadelphia: Temple University Press, 2002).

[80] Kenneth T. Jackson, *Crabgrass Frontier : the Suburbanization of the United States* (New York : Oxford University Press, 1985), 4-8.

[81]Abrahamson, 11. Also, see Michael Sherry *In the Shadow of War: The United States since the 1930's* (New Haven: Yale University Press, 1995).

disproportional increase of subscription sales transformed the way in which mass-market magazines such as *Look* projected their circulation figures. In the long run, this shift brought the magazine industry to a precarious point. As explained by Roland Woleslay in *The Changing Magazine*, the growing reliance on subscriptions allowed mass-market magazines to trim their prices to inflate their readership figures and therefore their advertisement figures.[82] By the early seventies, many large publishing houses were looking for smaller, stable and loyal markets that relied less on branding and advertisement than news-stand sales to survive.

The emergence of American post-industrial society and its technocratic outlook had a profound impact not only on the way that Americans lived, but also how they represented and understood themselves. This implied a reinterpretation of common values within the collective consciousness: the frontier, the self-evident promise of a better future and the constantly increasing automation of work were important elements of popular imagery. In the pre-war years, technocratic dreams had been publicised by exhibitions and world fairs and the popular imagery had become enraptured by the technological dimension of contemporary life. As far back as the thirties, popular imagery had constructed a vision of the future largely inspired by the technocratic and industrial representations of tomorrow that were a recurring theme of the great fairs.[83] The New York's World Fair of 1939, for instance, presented "The World of Tomorrow" and focused on what the sixties would be like. General Electric's exhibit "Futurama" featured several stages depicting the impact of technology on human life. This impact was being represented as thoroughly positive. Underscoring how General Electric's mission was to "make this world a better place to live"

[82] Roland Wolseley, *The Changing magazine* (New York : Hasting House, 1973), 62-74.

and that it was to this "service for humanity that General Electric is dedicated" the fair showed how electricity could be used in the kitchen for modern appliances that would liberate domestic life from everyday chores.[84] This promise of an easier life was also pre-eminent in magazines of the pre-war period. Ruth Cowan has shown how publications such as *Ladies' Home Journal* and *Good Housekeeping*, in the thirties, were filled with advertisements promoting the use of electric irons, electric washing machines and other domestic appliances by showing radiant, happy American middle-class wives freed from dreadful tasks by the use of technology.[85]

In the post-war years the focus of the message and the imagery shifted to the potential of Space as the new frontier. While space exploration had become synonymous with technology and progress, it did not gain momentum until the launching of Sputnik in 1957 and the start of the American Mercury program in 1958, turned the exploration of the Space frontier into an important element of the Cold War. Significantly, the 1962 Seattle World Fair featured the "Space Needle" which presented a showcase for technologies involved in space exploration and futuristic designs. Furthermore, the Century 21 exhibit explored what the future might provide in terms of convenience for humanity, particularly regarding communications, computers and broadcasting technologies. The world fairs were an important stage for presenting technology and progress as positive and desirable elements of contemporary life.[86]

---

[83] For a discussion of the impact of World Fairs on the American popular imagination, see Robert Rydell and John Findling, *Fair America : World's Fairs in the United States* (Washington : Smithsonian Institution Press, 2000).

[84] Daniel Nye, *Electrifying America*, (Cambridge, Mass. : MIT Press, 1990), 368-375.

[85] Ruth Schwartz Cowan, 'The industrial revolution in the home : Household technology and social change in the 20th century' in Stephen Cutcliffe and Terry Reynolds ed *Technology and American History* (Chicago : University of Chicago Press, 1997), 321.

[86] For a various perspectives on the nature of World Fairs and concepts of modernity, see Robert Rydell ed, *Fair representations : World Fairs and the Modern World.* (Amsterdam : VU University Press, 1995).

As a result, technological change became a normal, anticipated, feature of modern American middle-class life. The obsession with new car models, coming year after year to showrooms and exhibition halls, reflected this normalisation of change and its absorption into the routine of modern life.[87] More importantly, argued Bell in 1967, "men became accustomed to change – they now measure the course of its direction and its impact, attempt to control it and even shape its predetermined end".[88] Eventually, the texture of American middle-class imagery, in the iconography of advertisements and popular literature, became infused with technocratic references preoccupied with not only new but changing patterns of technological application. Whether the final outcome of change produced significant improvements to life was often deemed secondary, since change itself was sufficient to justify the process. In 1961, cultural historian John Kouwenhoven declared that the essence of American cultural traits is the "concern with the manner of handling experiences or materials rather than with the experience or materials themselves." According to this view, in American culture, the process was more important than its result, much like the chewing gum, an American invention that was a "non-consumable confection, its sole appeal being the process of chewing it."[89]

Simultaneous with the transformation of the American middle-class in the sixties, television began to infiltrate domestic space by quickly establishing itself as the prime source of entertainment and displacing both the radio and the press as sources of news. First as an extension of the advertisement-sponsored radio programs but then as fully developed content vehicles of their own, television shows quickly became attractive to corporate

---

[87] The role of the car in this cultural trait traces its roots to the early 20's. James Flink, chapter 'The Automobile Culture : Prospects and Problems' from *The Car Culture* (Cambridge : MIT Press, 1975) reprinted in Randall Stross ed, *Technology and Society in Twentieth Century America* (Chicago : Dorsey Press, 1989), 124-140.

[88] Bell, 9.

sponsors. The combination of moving images that allowed sponsors to show products as they could be found on the store shelves, with the power of audio-visual slogans quickly placed television in a privileged position in regards to radio or the print media.[90]

The television also had dramatic advantages over the printed press. It offered sensorial representations that could not be matched by the printed word. News programs not only reported events - they *showed* them. Along with this new emphasis on the moving image, came the power of establishing iconic references to consumer goods in a lively and attractive manner. As a result, television became far more attractive to companies seeking to establish strong iconic marketing campaigns. Soon, advertising dollars followed the higher penetration possibilities of television. During the sixties, television's share of the national advertisement expenditures went from $1.5 billion to over $3.5 billion. However, over the same period, the magazine advertising revenues remained almost constant at $1 billion. [91]

Threatened by the competition of television, the magazine industry began to shift its focus to the specialised markets. Since television could deliver the same with added texture, quality and immediacy, magazines struggled to compete in the realm of general-purpose information. By the late sixties, the television shows such as *60 Minutes*, had also absorbed news commentary, and daylong television broadcasts were far more popular, in demographic terms, especially among the middle-class suburban population, than weekly or monthly periodicals. According to James Patterson, the explosion of television, from 1949 to 1970, represented a tremendous shift in the ways that Americans absorbed cultural elements.

[89] John Kouwenhoven, *The Beer can by the highway*, quoted by Richard Rhodes in *Visions of Technology* (New York : Simon & Schuster, 1999), 226.

[90] Abrahamson, 55. Also, for a discussion of the emergence of television culture, see Cecelia Tichi, *Electronic Hearth: Creating an American Television Culture* (New York: Oxford University Press, 1991).

[91] Ibid. 23.

Television at once threatened Hollywood motion pictures, news magazines and radio programmes in capturing the attention of the American public.[92]

In this context, special-purpose magazines, that is magazines that focused on a niche topic with a strong loyal following, became an opportunity to exploit markets that television could not reach. Titles began to appear with increasingly focused demographics. The first targets were the teenagers and the young adults: studies had shown that the increase in leisure time was constructing a craving for 'legitimate' pastimes and cultural models. Modern musical movements were particularly lucrative, as they contained both elements of cultural attachment and economic imperatives. Markets were developed around iconography and textual representations of the role of music in society. For example, the rebellious nature of *Rock'n'Roll* was a significant hook that could be used to some effect in special purpose publications to attract a greater following.[93] At the same time, the 1950's witnessed the rise of audiophile magazines which targeted specific slices of the American middle-class and focused on consumer technology, particularly hi-fi equipment.[94]

Special-interest magazines greatly exploited the concept of the advertisement-driven publication. This genre of magazine usually featured very cheap prices, so that a maximum number of readers purchased the magazine, with a content entirely devoted to a very specific segment of mass consumer items. Usually two-thirds of the magazine was made up of advertising appropriate to the publication's topic: cars, oil and car cleaning products in car magazines; record labels, phonographs and particular artists in music or audiophile magazines. Costs were kept at a strict minimum and the aficionado therefore had to pay very little for the articles that were provided as a bonus for the advertisement provided by the

[92] Patterson, 353-355.
[93] Ibid. 27-31.

publisher. Content was tailored to fit the demographic and the construction and layout of the magazine was strictly dictated by the marketing of the target audience. While in the fifties these demographics were based on intuitive assumptions by large publishing houses, by the sixties, market surveys were conducted by large publishing firms to provide an indication of reader interests and potential niche markets according to age groups, income and geographic distribution.[95] Data collection had as its primary purpose the production of so-called "analysing variables" that allowed for the construction of magazines custom-tailored to specific interest groups. For example, using these techniques, in 1957, Ziff-Davies published *Cars Illustrated* aimed at the car aficionado.[96] Its success legitimised the technique by scientifically determining a market of potential readers before launching a title by sending surveys to already established readers. The goal of these surveys was twofold. They allowed companies to verify the popularity of titles beyond the simple sales figures. Some titles, such as *Popular Science* were read, on average, by 2.5 readers and therefore a circulation of 1.6 million copies reached an audience of 5 million readers. Similarly, *Life* in 1969 sold 7 million copies but claimed a total readership of 21 million, while *Look* sold 8 million copies and claimed 18 million readers in total. Secondly, these techniques allowed magazines to charge higher rates for advertising by claiming a large and stable target audience. Very quickly the special-interest magazine began to challenge the traditional magazine in both subscription

---

[94] Keir Keightley, "Frank Sinatra, Hi-Fi and Formations of Adult Culture: Gender, Technology and Celebrity, 1948-1962" (Ph.D. Thesis, Concordia University, 1996), particularly 86-100.

[95] The fifties had also seen the construction of marketing techniques aimed at developing the specific niche market of teenagers. According to Doherty, Hollywood movies had not been 'mass-market' products in the US since the early 1940's. In fact, the focus of the motion industry, later echoed in music and music-oriented magazines, was the teenager subculture that emerged as part of the new wealth and prosperity that affected American life in the late 1950's and early 1960's. Doherty, 9-25.

[96] It was renamed, in 1961, *Car & Driver*. Ibid. 23.

numbers and news-stand space. The mainstream publication had lost its edge by the early seventies and many well-known titles, such as *Life*, *Look* or *Saturday Night*, disappeared. [97]

One of the niche markets that grew in the seventies was the scientific and technological magazine. In the magazine landscape of the 1950's, technological and scientific knowledge had been confined to a few periodicals: *Science*, *World of Knowledge*, *Physics Today*, *Astronomy*, *Popular Science*, *Popular Mechanics* and *Scientific American*.[98] The great-grandfather of all other American technological periodicals, *Scientific American*, for instance, had been established in 1846 originally as a vehicle for the discussion of inventions, patents and the latest developments in innovative research. It was primarily interested in illustrating the growing technological and scientific currents developed in the United States. Famous inventors such as Edison, and Morse contributed occasional pieces on fundamental and applied research. But this magazine's focus drifted over time and by the early fifties it had become "an authoritative monthly with an elite readership" largely consisting of scientists and engineers who wished to keep an eye on latest scientific and technological developments.[99]

In the sixties, *Scientific American* boasted that it had published over thirty-two contributions from Nobel Prize winners in chemistry and physics.[100] This demonstrated that the focus of the magazine was on pure research and the explanation of this research from scientist to scientist. The core of the magazine featured opinion pieces written by the regular staff on current scientific and technological questions as well as news about biological discoveries, physics and mathematics. The intended audience was scientists and engineers as articles presumed a fairly high level of scientific training from the reader. Aside from the

---

[97] Ibid. 24
[98] Peterson, 266.
[99] Ibid. 370-374.

letters to the editor and a few columns, notably Martin Gardner's column 'Mathematical recreations', there was little feedback or sense of reader collaboration on content. In fact, the intended readership was the cultivated urbanite who wanted to stay abreast of the latest innovations and applications of scientific knowledge, but could not afford the time to scan the specialised journals of those disciplines. In contrast to the group of periodicals that form the subject of this thesis, *Scientific American* avoided projects, hands-on tutorials or reader accounts of their scientific experiments. Curiously, with the emergence of the Atom Era and the Space Age, the readership of *Scientific American* began to dwindle. While in the twenties monthly circulation of *Scientific American* had consistently surpassed 90,000, by the fifties, its readership had diminished to less than 40,000.

By contrast, *Popular Science* was far more focused in its interests. It traced its *origins* to the 1870's, when a contributing editor to the *Appleton Journal*, a high school teacher named Edward Youkmans, decided the American public needed to be informed and educated about the new emerging principles of science and technology. He sought to demystify new technologies and, by showing in simple terms the science at work, to teach how they worked. In illustrated articles, the magazine surveyed the realm of practical and applied technologies, from the gadget to the latest developments in heavy industry.

For most of its history, *Popular Science* was firmly rooted in the realm of industrially available technology and the emergence of new techniques. Some issues resembled brochures promoting particular models and companies. With the rise of the automotive industry, for example, *Popular Science* often focused on the relative merits of different car models. Throughout its history, the magazine took for granted the importance of the individual's interaction with technology and assumed that effects of technology were positive

[100] Peterson refers to the claim without providing precise sources. Peterson, 286.

for mankind. From the thirties onwards, *Popular Science* was more successful in terms of circulation than *Scientific American*, largely because of its accessible language and its focus on illustrations and vividly reproduced images of new planes, boats and armament.[101]

Beginning in 1943, the heightened interest demonstrated by the general public for the industrialised warfare tools (tanks, guns, planes, ironclads) motivated the editors of *Popular Science* to capitalise on the war. In a series of experiments aimed at measuring the interest of the readership in technological specifics, *Popular Science* began inserting colour foldouts of tanks, planes, ships and guns modelled on the US Army's arsenal. Accompanying these images were lengthy descriptions of the characteristics and features of the weapons, including details on their technological construction. Soon it became clear to the editors of *Popular Science* that many readers wanted to learn more about what it took to build small motors, radio equipment and such. By 1945, *Popular Science* was fully committed to listening to its audience and provided how-to projects in the last pages of every issue. Often, small mail-order kits could be purchased that would contain balsa wood and schematics for small drifter planes. Hot air balloons were equally popular, as were quartz-based fixed-frequency radios. Thanks in part to these features, a whole generation of Americans grew up reading the back pages of *Popular Science* and dreaming about experiments. The forum section, where readers could write in and ask for specific answers to scientific and technological issues, also provided a stage for popular extrapolation on the course of progress and technology. By 1963, the magazine was a staple of young middle-class Americans, with a monthly circulation of over 1.3 million copies, 95% of whom were male. [102]

By the sixties, the changes in the publishing industry had encouraged most large publishing houses, such as McGraw-Hill, to seek new areas for new niche publications. It

[101]Ibid. 375.

was generally accepted that technology and science benefited from a tighter focus and a higher amount of readership input. In 1966, *Popular Science*, which already had given birth to *Popular Mechanics*, gave birth to another new publication: *Popular Electronics*.[103] Following the same structure as the parent publication, *Popular Electronics* focused on the rise of the electronics industry and the cheaply available discrete components increasingly available in surplus shops of electronic hobbyist stores. Learning from the success of *Popular Science*, *Popular Electronics* followed a similar formula. The industry and the importance of electronics in everyday life was given a fair share of coverage, as were the results of fundamental research and the explanation of new technologies, such as the transistor, the integrated circuit and digital circuit designs. More importantly, the magazine set aside more space for projects and how-to articles. *Popular Electronics* was put together by an editorial staff that was ready to try almost any combination of electronics and everyday interests. Many short-wave radio projects were presented; including transmitter and receivers based on solid-state components. Basic calculators built out of discrete components were equally popular, but nothing matched the general interest in transistor receivers, hi-fi stereo projects (such as amplifiers and equalisers) and projects that integrated these to the automotive technologies.[104] The publication was fairly successful in its first few years of life. Readership was constantly rising and as the nature of projects became increasingly complicated, the feedback of the readers became even more engaged. Moreover it became clear early on that a unique feature of the magazine was the regular feedback it received from readers.

---

[102] Thomas White, 'One Hundred Years of Popular Science', December 1974, *Popular Science*, 20ff.

[103] The history of *Popular Electronics* is complex. It existed as the 'Journal of Popular Electronics' between 1954 and 1964. After a brief hiatus, it was brought back by the publishers of *Popular Science* under the shortened title *Popular Electronics*. While the earlier title offered occasional simple projects, it mostly centred on reviewing electronic items of common consumption : radio sets, hi-fi, television sets, etc. The new title however put the emphasis on hands-on projects and did not cover consumer electronics.

This trend in concentrating on smaller niche markets and presenting a higher amount of reader-generated content was also present in other publications such as *73*, *Radio Amateur*, *Popular Communications* and *QST*, which were dedicated to the ham radio crowd. Although these magazines appealed to different segments of the ham radio niche, they all shared a similar emphasis on hands-on projects and demystification articles. Tutorials, mentoring and simple articles explaining the inner workings are better design practices of radio equipment design constituted the core of the publications. The average readership for such publications rarely surpassed 30,000 in the sixties and they were usually only available in specialised news stands or hobby shops. More importantly, these publications formed an overlapping spectrum where titles were rarely mutually exclusive. Very often, readers of *Radio Amateur* also purchased and read *QST*. In addition, the editorial staff of these magazines routinely commented on features and projects from rival magazines. By contrast to magazines such as *Scientific American* or *Popular Science*, the magazines of the *73* kind explicitly wished to foster the establishment of a community of like-minded hobbyists. While *Scientific American* discussed fundamental topics of science and *Popular Science* demystified technologies to make them easier to understand, *QST* provided a forum for the exchange of ideas and experiences among people who shared similar leisure activities.[105]

This rise of hobby magazines was closely related to the emergence of a new way of looking at pastimes. By the late sixties, hobbies had become an element of social standing in addition to being a form of entertainment.[106] According to Abrahamson, the rising levels of prosperity that had characterised the American middle-class in the 1960's had diminished the

---

[104] John Dwight, 'How we have changed: Popular Electronics since 1966', *Popular Electronics*, June 1976, 44-51.

[105] Wayne Green 'My 50 years on magazines'. Internet. http://www.waynegreen.com/magazines, accessed on February 2nd 2003.

[106] Abrahamson, 39.

social standing associated with wealth. Affluence was no longer a paramount end in itself, but a stepping stone to new forms of social standing. New symbols of social standing became increasingly necessary so that middle-class Americans could compare to each other not only in terms of salary and wealth, but in terms of personal accomplishments as well.[107]

Many young Americans in particular yearned for a sense of personal competence and began searching for new ways to enhance, sharpen or develop skills. The magazine industry cultivated this interest by promoting new fields of personal accomplishment such as radio hobbyism, golf, yachting, sailing or home cooking. Hobbies, particularly those that offered concrete results such as splashy complicated meals or impressive electronic realisations, offered levels of improvement in what seemed to be an unending progression of skill and competence.

A key element in the emergence of this new valorisation of the hobby was the apparent ease with which magazines presented the adoption of new leisure activities. Photography, tennis, boating, electronics, gourmet cooking - anyone could take up these hobbies and, following the simple instructions given by professional or equally gifted amateurs, proceed to develop unique and impressive competence in any given field. Daniel Bell theorises that in fact, the sixties saw the deconstruction of the 'social location' of the individual from his lifestyle or values.[108] Thus, anyone could become a gifted amateur photographer by purchasing a copy of *Photography Today* and, following its instructions, beginning to take pictures. As a consequence, whereas previous generations of Americans had attained pre-eminence, in their own eyes, through a solid work ethic, they now sought the adoption of value-added leisure activities.

---

[107]Abrahamson, 41.
[108] Ibid. 42.

These activities centred on magazines in part because they helped to legitimise these activities by identifying a wider community with similar interests . Sharing one's risky adventures in Cape Hatteras with fellow readers of *Sailing* could bring much enjoyment and a sense of status and accomplishment to the adventurous amateur sailor. Increasingly, magazine forums and letters to the editors became essential in crafting this sense of community – of social appreciation.

The Rise of the Computer Hobbyist Press: Byte, Dr. Dobbs, Creative Computing.

By the early seventies television was now in full, glorious colour and had constructed a space for the mass marketing of consumable goods. The semiconductor industry was booming and sought to establish specialised channels for the outlet of its overproduction. Publications like *Popular Electronics* proposed ways of using simple IC's in projects, as well as mail-order kits. One could easily order a transistor radio in kit-form and save substantially on the cost of purchasing an equivalent item in an established electronics store – with the added benefits of learning the inner workings of the device being constructed.

These projects began to appear in earnest in the pages of *Popular Electronics* starting in 1973.[109] The first articles described simple workshops involving the creation of crude binary calculators controlled by logical switches. Much to the editor's surprise, these devices, which had no apparent practical use, were extremely popular. With time, these projects began to be announced in advance – so that hobbyists could mail order the parts and start working on the projects as soon as the schematics were printed. Many of the readers were engineers, some working at large corporations, where they had acquired some familiarity with

[109] Dwight, 33.

mainframes and minicomputers.[110] Typically, access to computing facilities was severely constricted as departments were being billed for every second of CPU power consumed. The 'facility' construction of the computer was increasingly familiar not only through its representation in the media but also through the everyday experience: bills and official documents were increasingly computer-generated. As a consequence, the readers of *Popular Electronics* saw these projects as a convenient way to familiarise themselves with the more advanced elements of electronics and therefore to broaden their horizons at work.

The growing interest in computers forced *Popular Electronics* to devote a greater attention to this topics. At the same time, readers who were more keen on hi-fi and stereo projects resented the space taken by yet *another* project on how to build a dumb calculator. In the October 1974 issue, for instance, a reader of *Popular Electronics* complains:

> Another project of a computer? This is getting silly. I can't afford to build one. Who can? And what would I do with one if I could? I notice this publication is losing its focus. Electronics means more than computers... [] I like the discussion of current trends in computing, but could we please focus on *practical* projects?[111]

The editorials of the time reflect the struggle that was going on in the managerial staff. Very few of the editors believed that the computer craze sparked by the microprocessor would last; and even fewer imagined that a monthly publication dedicated to the computer would be feasible financially. The market, as perceived by established entrepreneurs, was too small for a 'serious' venture. In the September 1973 issue of *Popular Electronics*, John Williams expresses his doubts about the microprocessor craze:

> The uses of microprocessors are infinite. As time goes by and more designs are available from established catalogues, digital

110 Dwight, 38.

111 Robert Patrick, 'Letter to the Editor : Not Another Computer Project', *Popular Electronics*, October 1974, 9.

> designers will undoubtedly approach the process as a cook selects ingredients for a grand dish. The current craze for 'computers on a chip' however, is bound to collapse. Today, everybody wants projects based on chips; they are popular because they are glamorous and exotic. I bet in five years it will be something completely different.[112]

There were, however, many dozens of electronic hobbyist clubs that did not share this opinion. Many had their own newsletters (or fanzines) and some prided themselves on having enough interesting content to be able to make the jump into big league publishing. One of these hobbyists was Carl Helmers, the editor, writer and publisher of *ECS* (*Experimenters Computer Systems*), a newsletter he had been producing in Boston fairly regularly since 1974. When Wayne Green, the founder of *73* was looking in early 1975 for a minicomputer to handle the administration and typesetting of his magazine, he first examined the magazines that were already covering the subject. To his shock, there were none. Only *Radio Today* and *Popular Electronics* touched the field. He did, however, stumble upon Helmer's newsletter and was impressed both with the style and the breadth of the topics covered by his editorials. Green was an experienced magazine publisher with many titles under his belt. He suspected that there was a potential to tap into a specialised market that no one else had seriously covered.

Green gave Helmer a call and offered him the opportunity to produce a 'professional' computer magazine about the micro and the mini technologies. He also had a name in mind: *byte*. Helmer's reaction was very positive and by September 1975, the first issue of *Byte* magazine had appeared. It was a classic niche market magazine, marrying irreproachable research and glossy, full-coloured covers, to the inimitable style of the hobbyist newsletter. It presented projects, the weirder the better, and saw no end to the

[112] John Williams, 'commentary : the chip fad?', September 1973, *Popular Electronics*, 11.

influence of the computer. The advertising in the magazine was by a few established electronics providers (Semanco, Shugart, Intel, Zilog) and the plethora of small 1-person workshops constructing add-on boards for the Altair 8800. Carl Helmers' direction gave the magazine a mission to seek out new forms of computerisation, new computers and new computer users everywhere.[113]

Byte was the first special-interest computer publication to be distributed nationally by a large publisher. It started by viewing itself as a computer-oriented equivalent to *QST* or *Popular Communications* with a very specific focus on computers, digital designs and personal experimentation. While *Byte* concentrated on hardware projects and the demystification of computing concepts, it neglected in many ways the important ascent of software as the logical partner to the computer revolution. The first few years of *Byte* reflected the interests of those who saw the future as being built through the computer often without clear ides of uses and practical goals for the machines.

The other segment of the hobbyist population saw software as the means by which the microcomputer could become a tool of information to address individual needs. This view often resulted in an interest in programming more than *homebrewing*[114]. As a consequence, the programmer was a different type of individual than the hardware hobbyist. The notion of liberation resonated very firmly in the circles that considered that software was somehow higher, more evolved, than hardware design. In September 1975, two hobbyists from Texas, Dick Whipple and John Arnold wrote a (non-functional) version of the BASIC language developed at Dartmouth that they wanted to share with the world. They

---

[113]The story of how *Byte* came to be has been told by Helmers in various locations. Freiberger tells a variant in *Fire in the Valley* (215-218). I have taken this version from the interview Helmers gave to *Byte* for the tenth anniversary issue. 'An interview with Carl Helmers', *Byte*, June 1985, 21-30.

[114] In the words of Wayne Green, homebrewing was "the art of discovering, learning and constructing" electronic equipment. It implied not only following guidelines but also *understanding* them. 'What is homebrewing? It's also a hobby.' *Santa Cruz Homebrew Club Newsletter*, June 1974, 2.

turned to a newsletter of the Houston Homebrew Computer Club, unintuitively called the *People's Computer Company*, and published the code in three issues, under the name TinyBASIC.

The reaction of the other clubs was initially to copy the code, but then photocopied versions of the *People's Computer Company* newsletter began to circulate. The demand from the readers was enormous. Both Whipple and Arnold realised there was the potential for a forum to discuss matters relating to software in particular as well as the new frontier of computing in general, but they were initially hesitant to act on that belief.

In January 1976, one full year after the appearance of the advertisement for the Altair 8800, Whipple and Arnold decided to publish the whole of TinyBASIC as a three-part newspaper-like newsletter. By this point they had concluded that computers would only be good for humanity if they were somehow able to prolong existing traditions rather than mark a complete break with the past. To this end, they decided to draw on 1960's whimsical humour and created a look that was expressly reminiscent of revolutionary tracts from the 1770's. The full title of their publication was *Dr.Dobbs TinyBASIC Journal of Calisthenics and Orthodontia : running light without overbyte*. It was a momentous hit, especially with the college crowds who saw in the publication a clear message for the liberalisation of computer knowledge. It featured techie humour and references to "maximising code performance" as well as examples of mainframe and minicomputer "operation techniques" that could be adapted to the newly emerging microcomputer scene. [115] Very quickly, Whipple and Arnold decided to make the special three-issue publication into a monthly. Since the magazine would focus on more than just TinyBASIC, they shortened the title to *Dr. Dobbs Journal of Calisthenics and Orthodontia*.

As *Byte* appealed to hardware generalists and *Dr Dobbs* reflected the 'computer liberation' movement, a third publication, *Creative Computing* brought together education professionals to present their view of the future. Originally published as a series of newsletters sponsored by Digital Corporation between 1971 and 1974, *Creative Computing* focused on the use of the machine as a tool to spread knowledge and its incursion in the standard curriculum of teaching and learning. Its discourse was generally optimistic and underscored the need to raise children from a very early age with the presence – and the understanding – of the computer. [116]

David Ahl, the editor and prolific contributor to the magazine, had also been a contributor in the sixties to the professional journal *Datamation*, which focused on integrating large-scale computing (mainframes and minicomputers). From this experience, he retained the need to construct issues around particular topics. Some issues were therefore devoted to mathematics, others to 'fun and games' or 'artificial intelligence' or the 'social impact of computers'. Occasionally, particular computer languages were chosen: Smalltalk, Pascal and BASIC were often the focus of whole series of articles. The amateurish look of the magazine was often counter-balanced by the complex topics tackled by the writers. Like *Byte* and *Dr Dobbs*, *Creative Computing* encouraged contributions from its readers. David Ahl, however, favoured contributions from teachers, educators and researchers rather than electronics hobbyists. Advertisement was secondary to the content of the magazine – but since the magazine retailed at 2,50$ (twice as much as *Byte*) the publication's lack of attraction for potential advertisement was not a problem.

---

[115]The story of Dr Dobbs was told by the editors themselves in the editorial of the first regular publication in January 1976. 'How we came to be', *Dr Dobbs*, January 1976, 2-3.

[116]The editor of EDU and later Creative Computing explained the evolution from newsletter in the preface to the first compilation of EDU and CC articles in David Ahl, *Best of Creative Computing* (New Jersey : Creative Computing Press, 1981), 6-10.

After 1978, and especially following the entrance in the microcomputer market of the 'big guns' (Tandy, Texas Instruments and Commodore Systems) the magazine industry segmented even more. With the explosion of computer brands, chipset families and incompatible sets of programming languages that resulted from the hardware boom, the individual magazines began to specialise in particular subsets of microcomputer architectures. Although *Byte* continued to cover all sorts of technologies and *Dr Dobbs* dealt with anything that was even remotely software based, other publications such as *80 Microcomputing* started in 1979 focusing exclusively, in increasingly partisan terms, on the technologies released by Tandy and available at Radio Shack. Similarly, *Nibble*, the Apple journal, began publishing in 1978 after a short run as a customer newsletter and was equally partisan, in promoting the solidity and value of Apple products.[117]

As a result of this burgeoning of titles, the computer magazine industry, in its infancy, underwent remarkable growth in terms of audience. Carl Helmer's original newsletter, *ECS*, reached on average between eighty and one hundred electronics clubs throughout the United States. The first 'professional' print of *Byte* in 1975 reached 6 000 newsletter subscribers, many of whom received the magazine for free as part of an effort by W. Green to get the world to learn about the magazine. Initially, its length was little over 100 pages, with very few advertisement. But by September 1980, *Byte* magazine had a confirmed monthly circulation of around half a million and regularly surpassed 650 pages, including a 150-page section which covered community announcements, classifieds and pages upon pages of news about clubs from the hobbyist community.[118]

As we have seen in this chapter, American culture and society had been radically transformed in the post-war period by various imperatives. The effects of modernism on the

[117] Other publications of the same period include *68Micro*, *Kilobaud*, and *Popular Computing*.

popular imagery and the technological advances of the post-war era produced a general interest in science and technology which was compounded by the higher number of available engineers and scientists coming out of higher education institutions. In parallel, changes to the patterns of leisure and entertainment in the late fifties and sixties, which resulted from the rise of the post-industrial society, led to a change in the magazine industry's marketing techniques, which began to target specific interest groups and hobbies with niche publications that catered to smaller markets. In the long run, this resulted in the emergence of a niche-oriented segment of scientific and technological magazines that emphasised hands-on projects, readership involvement and a sustained interest in understanding and pushing technology in domestic life. Computer hobbyist publications, such as *Byte*, *Dr Dobbs* and *Creative Computing*, particularly exemplified this trend.

[118]Freiberger and Swaine, 216.

Chapter Three

Isaac Asimov, Star Trek and Science Fiction: Elements of Cultural Background in the Conceptual Space of the Computer Hobbyist Publications (1975-1980).

The American cultural landscape has always been rich with references to science and technology. The mechanisation of the countryside and the rapid urbanisation of the turn of the 20th century resulted in a common imaginary that was profoundly influenced by the legacy of the second industrial revolution. The industrialisation of agriculture demanded that farmers become businessmen and join in an integrated national economy linked by new sources of transportation to urban markets.[119] The railway, electricity, the telegraph, the telephone – all the advances that were instrumental in the construction of the continental republic between the Civil War and the First World War – created a popular mentality that embraced a forward-looking spirit of advancement and modernisation that was obsessed with this idea of progress. The spread of electricity across most of the country by 1930 extended the influence of technology to all aspects of everyday life. According to David Nye in *Electrifying America*, "predictions about the electrified future were an integral part of the new technology's social meaning; Americans learned that they might use electricity to abolish sleep, cure disease, quicken intelligence, banish housework, and much more."[120]

---

[119] David Banbom, *The Resisted Revolution : urban America and the industrialisation of agriculture*, excerpts from Randall E. Stross ed, *Technology and Society in Twentieth Century America* (Chicago : Dorsey Press, 1989), 31-50.
[120] Nye, 101.

In the 1920's, one way that these positivistic images reached a wider public was through a new form of popular expression: pulp science fiction. Closely related to the comic book, Hugo Gernsback's *Amazing Stories* and its rival James Campbell's *Astounding Stories* offered young readers, as well as adults, entertaining speculations on the themes of tomorrow and the effects of progress and technology on everyday life. Although Gernsback envisioned a source of inspiration and education for the masses, the pulps presented mostly fantastic images of monsters and aliens with an emphasis on adventure, excitement and high drama rather than a coherent view of a mechanised future.[121]

At first these tales were both wild and fantastic. Some took inspiration from the tales of authors such as Jules Verne or H.G. Wells. These tales pitted man against the powers derived from new knowledge acquired through science and experimentation. Very often they drew on themes that were both ancient and well known and they projected current technologies onto their most far-fetched narratives. Although few dared to contemplate these tales as more than pure escapism, with the growth of its reading public the genre became a popular context for speculating about the future.

Although the science fiction pulps were initially considered somewhat disreputable, following the decade after the Second World War they began to be taken more seriously and as more than pure escapism. In his discussion of the impact of the atom bomb on the American popular imagery, Paul Boyer notes how the genre became respectable in the wake of the explosion of the first bomb over Hiroshima, largely on the grounds that many authors of science fiction (H.G. Wells, Ray Bradbury, Theodore Sturgeon) had, for the last twenty years, described various weapons of the same nature and strength as the A bomb. Boyer

[121] Tony Goodstone, *The Pulps : Fifty Years of American Pop Culture* (New York : Chelsea House, 1970), 201.

quotes Asimov saying that the bomb "had salvaged science fiction into respectability"[122] and recalls Ray Bradbury's reaction to the announcement of the bombing of Hiroshima:"I saw the headlines, brought in the bus by a stranger and I thought: YES! Of course the bomb is here! I knew it would come for I had read about it and thought about it for years!"[123] One particularly important audience of these stories were the recent graduates of the GI Bill; some of whom were engineers coming out of higher learning institutions. The so-called *descent into respectability*[124] of science fiction brought the works of several big names of the genre (Isaac Asimov, Theodore Sturgeon, Ray Bradbury, Arthur C. Clarke) to public attention and greater visibility in the mainstream of the American popular consciousness.[125]

The fifties saw a new preoccupation with modernism, including the absorption of futuristic designs in everyday life. Initially, the 'atomic age' combined promises of innovation and prosperity along with fears of nuclear annihilation.[126] In 1957, the Soviet launch of Sputnik, ushered in the 'space age', opening up new frontiers of high technology constructed first by robotic automation and eventually by computerisation

This chapter examines how the imagery and themes of Cold War science fiction – both literary and visual -- had a profound influence on constructing the computer hobbyist's frame of reference and encouraged individual experimentation with new forms of technology in general, in particular computers.

---

[122] Boyer, 258.
[123] Ibid. 261.
[124] Lerner uses the expression as a literary criticism device, 151.
[125] John Carter, *The Creation of Tomorrow : Fifty Years of Magazine Science-Fiction* (New York : Columbia University Press, 1977), 5-6.
[126] This duality was an important element of American popular culture in the immediate after-bomb years; on the one hand the promises of technology provoked a "euphoric reaction" from the scientific community on the possibilities of nuclear energy; however on the other hand, the "terror of the atomic threat" was equally pervasive. Boyer, 6.8,256-260.

What is now referred to as 'traditional' American science fiction evolved over a period of thirty years beginning in the twenties. It appeared first in the pulps, then in movies, and finally in hardcover books and television shows. In the early sixties, traditional science fiction was superseded by the *new wave* genre, which redefined the acronym SF to 'speculative fiction'. Central themes in traditional science-fiction stories concerned mankind's role in a world of technology and the changes that technological advancement would have on human society. The exploration of space, the automation of work and the wealth and leisure time derived from mechanisation of labour stemmed from the first theme. The relationship between man and machine and the evolution of the machine itself encompass the second theme. [127]

Science-fiction came to be recognised as a fully-developed literary genre in the fifties. According to Michael Ashley the science fiction audience was generally "white, middle-class and urbanised. [...] also mostly male and under forty years old." [128] Until 1953, when hardcover science-fiction books were first published by Doubleday, the only channels available for the genre had been the pulp magazines. Unlike the pure escapist adventure-oriented pulps, 'Space Age' science-fiction increasingly adopted the role of prophet. Not only did authors such as Isaac Asimov, Robert Heinlein, Arthur C. Clarke and Ray Bradbury have large followings of readers but they were also increasingly consulted on all matters

[127] Michael Ashley, *The History of the American Science-Fiction Magazine (vol.2)* (London : New English Library, 1978) , 44.
[128] Michael Ashley, *The History of the American Science-fiction Magazine (vol.3)* (London :New English Library, 1979), 10-53.

pertaining to the development of science and technology by magazines such as *Popular Science*.

Borrowing from classical popular writers, such as H. G. Wells and Jules Verne, these space age writers constructed worlds where human beings were not only existing but *evolving* through the use of new and more varied forms of technologies.

In his analysis of the established science-fiction literature of the post-war period, *The Creation of Tomorrow*, John Carter argues that the dominant theme of the works was to extrapolate modern social and cultural situations towards a *possible future*. In similar vein, commenting on the legitimisation of science fiction in the wake of the atom bomb, Paul Boyer explains: "the a bomb was now reality and the large amount of short stories that had dealt with it before it even became reality amply confirm the familiar insight that for all its exotic trappings, science fiction is best understood as a commentary on contemporary issues."[129] In Isaac Asimov's works, for instance, the presence of artificial intelligence was a premise to most of his short stories and novels alike. Computers, technological advances and social questions often took the backseat to the development of the robot, both as a tool and as an entity. In *Caves of Steel* (1953), his first full-length novel published in hardcover, robots and computers were described as characters with interests, agendas and motivations every bit as complex as human beings themselves but the true focus of the story is the relationship between a human detective and his android colleague.[130]

Asimov's construction of the 'modern robot' was not instantaneous. It progressed as a series of speculations on the nature of the relationship between man and machine that envisioned the creation of an industrial equivalent to cars. Cars, he thought, did not rebel against their owners and drivers. Why would the robots? The three laws of robotics

---

[129] Boyer, 259.

introduced by Asimov in "Liar!" became the foundation for all of his robot stories, published between 1941 and 1986. They solved the problem of the robot as a threat to mankind. These were, in order:

> *First Law*: A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
> *Second Law*: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
> *Third Law*: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

These laws were built into the very *circuits* of the robots, which Asimov described as possessing a 'positronic' brain.[131] His robot stories became the basis for hundreds of similar short novellas and inspired many other authors to emphasise the potential of technological advancement without falling into traditional dramatic traps of the pulp or even of classical stories such as *Frankenstein*, where the creator is doomed by its creation.

In an increasingly large amount of stories published after the ENIAC had been unveiled, digital computers were described as mobile, articulate servants of humanity. With few exceptions, Asimov's laws governed post-war science-fiction and prevented technological creations from physically harming humans. The very purpose of the machines was to serve their masters, to allow them to indulge in their favourite pastimes and to help them in their quests for artistic expression.

Even when Asimov's stories presented darker futures, they never hinged on technological threats. On the contrary, in works such as *Caves of Steel* or *Naked Sun* (1956), both of which depict a future mankind living in huge underground cities, the causes for enslavement and misery are human behaviour. In these novels, mankind has colonised over

[130] Isaac Asimov, *The Caves of Steel* (New York : Doubleday, 1953).

50 planets but these colonies have seceded from Earth and created sparsely populated societies where the bulk of the work is performed by robots. The 'Spacers' regard Earth with contempt, but the Earth's population is exploding and the planet can no longer sustain itself. Earth represents the 'old world': human labour is protected by law and robots are banned. Masses of humans live in cramped spaces. The Spacer worlds are the opposite: manual labour is performed by hordes of robots. The planets are virtually empty, to the point where spacers can go for months without meeting. While on Earth computers are immobile tools used primarily for the exchange of information, on the spacer worlds they are sophisticated anthropomorphic beings with exquisite human-like features. It is against this background that the characters, a robot from a spacer planet, and a detective from Earth, interact when the murder of a famous spacer occurs during his secret visit to Earth. Like in many of Asimov's works, technology in these novels signifies the construction of a better future, but can also lead to self-imposed misery if handled improperly.[132]

A contemporary of Asimov, Robert Heinlein, constructed a significantly different body of work based on similar initial ideas. Heinlein's focus was the interaction between humans and new technologies that threatened long-established social values. Heinlein was also more interested in the reaction of individuals to shifts in their environment. In *Starship Troopers*, *Stranger in a Strange Land* and *The Puppet Masters*, Heinlein's focus on the psychology of characters who discover that the biggest threats are not mechanical but in fact *organic*: alien creatures and alien cultures. More directly influenced by the contemporary political context, Heinlein's work is set against a post-war 'Us versus Them' dialectic reminiscent of

[131] Asimov, *Robot Visions*, 6-10.
[132] Isaac Asimov, *The Naked Sun* (New York : Doubleday Books, 1958)

Cold War rhetoric.[133] A thread running through Heinlein's novels is that mankind is constantly at risk of extinction. This risk come as threats from the outside world (space) are realised through the 'turning' of innocent humans. In Heinlein's worlds, technology becomes the tool through which mankind fights the dangers represented by alien forms of culture. This reference to the 'tool' as a protective device against the unknowns of the universe is recurrent in later forms of science-fiction and translates directly to the usage of computers in the computer hobbyist's imagery.

Not all examples of modern science-fiction defy "Frankenstein's Syndrome", however. Arthur C. Clarke's most celebrated contribution to the world of science-fiction is the script on which Stanley Kubrick's 1968 motion picture *2001: A Space odyssey* was based. Constructed as a 'good, solid sci-fi story', it marks a radical departure from the idea of the computer, and technology in general, as a positive influence upon mankind. HAL 9000, the onboard computer of the spaceship *Discovery* kills two of the three astronauts it is supposed to care for.[134] In the novel, as well as in the movie, HAL is a full-fledged character. It has a soft, male voice that has become a stereotype of the genre. It is also an accomplished chess player and a useful 'maid'. Ultimately, however, the personalised computer cannot escape its role as a threat to mankind. Despite this negative outcome, the movie's legacy, as reflected in the computer hobbyist's literature, seems to reside more on its imagery and realistic portrayal of future technology than on its anti-Asimovian premises. More significantly, the finale, which was constructed with impressive kaleidoscopic images was instrumental in the early seventies in associating psychedelic imagery with computer-generated art.

---

[133] David Seed, *American Science Fiction and the Cold War* (Chicago : Fitzroy Dearborn Publishers, 1999), 28ff. Similar topics are also well examined in M. Keith Booker, *Monsters, Mushroom clouds and the Cold War : American Science Fiction and the Roots of Postmodernism, 1946-1964*, (Westport : Greenwood Press, 2001). Especially chapter 1, 'Politics in the American Science Fiction novel'.

[134] An often remarked 'coincidence' is that HAL, the name of the heuristic computer onboard Discovery, is one letter apart from the name IBM.

Asimov, Heinlein, Clarke and the other writers of this period were essential in constructing a usable popular imagery filled with robots, computers, space exploration and in encouraging an obsession with looking to the future for the 'next big thing'. Their stories value mathematics, physics and chemistry as disciplines worthy of interest because of their capacity to explain the universe and provide mankind with ways to survive and adapt to new situations. They also valued abstract and unusual manners of expressing thought: gaming, chess, logical puzzles were important symbols and linguistic elements used in this literature. Since the average age of a computer hobbyist in the mid seventies was 35 years old, many of these individuals experienced their formative years between 1950 and 1960, at the very moment when science-fiction gained respectability. In addition to traditional science-fiction. however, the sixties saw the rise of two new subgenera of science-fiction, both of which became important subgenera in the decades to come.

The first was the arrival of the so-called 'new wave' novels of Philip K. Dick, Michael Moorcock, Frank Herbert and many others.[135] This *new wave* proposed an alternative to science-fiction generally referred to as SF, for speculative-fiction. It centred its attention on the human being and attempted to explore the issues of psychological and spiritual evolution of humanity, occasionally against a backdrop filled with intelligent machines. The second sub-genre was a vehicle for the exploration of the American Dream set against a backdrop of galactic exploration. It emerged most prominently in the shape of a television series called *Star Trek*. Both sub-genres became extremely influential in the early seventies, in the construction of a popular imagery of what tomorrow could, or *should*, be like.

The *new wave* explored the inner space of humanity while merging psychedelic influences and post-apocalyptic themes that assumed that one day, mankind would come to its end. In *The Cornelius Chronicles* (1964-1966), a series of novels written by Michael Moorcock, Jerry Cornelius is a strange and powerful individual, a rock-star and time-traveller who rejects the linear construction of his identity and refuses to be bound by the strict rules that govern the physical world. As such, he can manipulate technology and reality to his own advantage. In Moorcock's baroque universe, the world itself is a computer. It is a machine that can be reprogrammed and rewired at will, as long as one understands its language. The post-modern construction of the narrative brings to the work an aura of mystical and spiritual overtones that, as we will see, is evident in the cover art of many computer hobbyist magazines. The title of one of the novels in the series, *The Final Program*, refers to a plan by Cornelius' brother, Frank, to destroy the world by erasing the 'World' program that is stored in the galactic computer. Significantly, many articles published in *Creative Computing* or *Dr Dobbs* are reminiscent of this broken narrative.

In striking contrast, *Star Trek* (1966-1969) presented a rational, carefully constructed future that cast the American technological impetus in the mould of *space opera*.[136] For Gene Roddenberry and Gene L. Coon, creators and producers of the (initially) short-lived television series, humanity's next big leap forward would involve a new Golden Age of exploration and the new frontier would be that provided by space. This theme was engraved at the beginning of every episode by the voiceover in which Captain Kirk intoned: "*Space... the final frontier.*" A reassuring image that echoed the American frontier myth of the 19th century, the expression also reflected a profound belief in the forward-looking path humanity was bound to follow in the future. The place of the individual in *Star Trek* was

---

[135] Carter, 282-290.

[136] *Space Opera* is a designation usually referring to grandiose, pompous works of science fiction, where the focus is less on technology than on operatic drama: *Star Trek* (1966-1969), *Star Wars* (1977), *Dune* (1967), *Babylon 5* (1992-1998) are fine examples of this genre; by opposition to hard science fiction, such as *Destination Void* (1971), *Foundation* (1941-1953), where the drama takes a second place behind intellectual speculation.

defined by the technology of his or her surrounding. While episodes were often anchored in psychological and humanistic observations about mankind, the plot devices were always dependent on the role of specific technological achievements. The breadth, scope and texture of the series created a sense of adventurous exploration that very closely followed Thorstein Veblen's idea of a society propelled by the wisdom of the engineer. "I always thought" writes Gene Roddenberry in his memoirs about the creation of *Star Trek*, "that in the future everyone would know how to pilot a shuttle, reconstruct a warp nacelle or operate a computer. These would be basic requirements for a citizen of the future, much like driving a car and reading and writing are essential elements today."[137]

Perhaps the most striking element of the series was its reliance on the unique character of Mr. Spock. A half-breed by birth, Spock – the son of a human mother and a Vulcan father -- aspired to explore his Vulcan heritage, which dictated the refusal of emotions and the overarching nature of logic as a defence against the perils of social and cultural warfare. Much of the banter and dialogue in the series relied on observations between the old-fashioned Doctor McCoy, the embodiment of pure humanistic thought and tradition and the cold, rational computer-like Mr. Spock[138]. In the imagination of the evolving computer hobbyist community, *Star Trek* held a special role. Its presentation of technology as an inherently positive influence and the pervasive use in every episode of computers as tools, sparked a huge following, not only among youth, but also among

[137] Stephen Whitefield and Gene Roddenberry, *The Making of Star Trek*, (New York : Ballantine Books, 1979), iv-vii.

[138] Roddenberry had originally created two characters: a female with a computer-like brain to serve as second in command of the starship and a humanoid alien (M. Spock). The NBC network did not think the audience could accept the thought of a woman serving as executive officer and demanded the part to be changed. Roddenberry therefore merged M. Spock and 'Number One's' character into the now familiar, logical and computer-like M. Spock. Roddenberry, 67-71.

engineers and technologically-minded people.[139] It was hardly a coincidence that the first available microcomputer kit was named in honour to a planet visited by the starship *Enterprise* or the fact that the first NASA space shuttle was also named *Enterprise*.

Another science-fiction thread that resonated widely within the computer hobbyist crowd was best represented in a short story by D. F. Jones called *Colossus*. The short story, made into a movie in 1966 called *Colossus: The Forbin Project*, embodied the fear that a UNIVAC-like computer, in the hands of the US government or the Soviet Union, could achieve control over mankind. In the story, an extremely powerful Digital Computer, built by the US to control its nuclear arsenal and prepare strategic analysis for an eventual conduct of a nuclear war with the Soviet Union, links up with its Soviet counterpart to take charge of mankind's future. This negative theme of the danger of a large computer facility under control of a single agency was another very important element of the popular construction of the computer in the late sixties[140] and was frequently echoed in many *Star Trek* episodes. "The Apple" (1968), for instance, represents a once-thriving culture rendered barbaric by a large, benefactor-computer that prohibits certain behaviours among its followers. In "A Taste of Armageddon" (1969) references to the Vietnam war and the threat of computerisation are blended in the portrayal of a society where war is waged by computer simulations. Occasionally, the computer selects citizens, under the argument they have been marked as casualties by the war-program, and these citizens are promptly eliminated. In these stories, rational, positive representations of computers in American culture were juxtaposed with darker fears of the computer as a threat for individuality.

[139] Asimov himself came to the defence of the show in 1967 when NBC cancelled it because of 'poor ratings' (the rating system at the time neglected segmented demographics and it seemed as if *Star Trek* was a dud). Asimov led a letter-writing campaign to bring back to television what he thought was the "smartest, most intelligent science fiction television show ever written." Roddenberry, 101.

[140] Seed, 119. Also examined in Thomas Clareson, *Understanding Modern American Science Fiction* (Columbia: University of South Carolina Press, 1990), 200-210.

These doubts were part of a complex language of symbols and references that were common to most computer hobbyists and on which most computer publications drew heavily. Whether it was the warm images of *Robbie*, Asimov's first robot or Mr. Spock playing 3-dimensional chess against the computer or the kaleidoscopic finale to *2001*, these references were essential to creating a visual backdrop to the promise of futuristic technology. In this way, science fiction helped to construct both a language and a visual frame of reference for a whole generation of male, white, middle-class Americans who had been raised in a climate of positive and optimistic expectation of the future.

Science Fiction, Escher and Cultural Influences in Byte's Cover Art

Carl Helmers was particularly sensitive to the importance of the futuristic visual imagery that permeated the nascent computer hobbyist community. Therefore, when he sat down to design the look of the magazine, he consciously attempted to steer *Byte* away from the factual, realistic, style of representation that typified most hobbyist publications of the time. The first contact a potential reader has with the magazine is by its cover. While popular wisdom dictates not to judge a book by its cover, in fact the magazine industry was heavily focused in designing covers that enticed the potential reader to pick up the publication. While most magazines, such as *Popular Electronics*, selected images of printed circuit boards, projects, that represented the contents of the magazine in purely descriptive ways, *Byte* chose a completely different approach.

Byte's covers were richly drawn allegories, in full colour, and rarely contained the elements of realism found in other publications. Instead, they contained futuristic references to space flight, mechanised communication, and domestic realisations of technology. Some of the images were forms of crude computer art, such as the productions of minicomputer generated images vaguely reminiscent of kaleidoscopes and fractals. But most were collages of utopian or dystopian imagery that were both powerful and imaginative. They drew their inspiration from common cultural elements such as space flight and the exploration of the unknown, but also from the importance of mathematics and future uses of computers in everyday life: themes drawn from traditional science-fiction. The single most striking feature of these covers was the primary role of imaginative abstract concepts and a total lack of realistic objects that permeate the art. Moreover, unlike most hobby magazines, which publicised the contents of each issue on the cover, the early computer magazines focused exclusively around this artwork to the virtual exclusion of accompanying text.

The first few issues of *Byte* shortly flirted with collages of photographs that echoed the articles included in the magazine. The cover of the first issue, for instance, in November 1975, presented a series of photographs of keyboards of all types falling in a cascade. This type of cover exemplifies the first few issues of the magazine. This cover is also atypical in that it lists the articles included in the magazine. Very quickly, however, allegorical themes and hand-drawn art took over from photographic art which was so common on the covers of other electronics publications such as *Popular Electronics* or *Amateur Radio*. Teasers also disappeared from the covers, as if the image was meant to carry the full meaning of the contents of the magazine. While issues of *Popular Electronics* featured titles and excerpts of the contents of the magazine, *Byte* only did that in its first five issues. Also, photographs vanished completely from *Byte*'s covers after the first five months. By early 1976, the look of the magazine had changed and attained the look it kept for almost fifteen years. Abstract art, science-fiction references, Escher references and mathematically-inspired paradoxes became the norm.

The May 1978 (figure 5) cover of *Byte* for instance, featured a large white chess knight floating above a floppy disk that was itself floating above a granite shaped chessboard floating in space. The imagery was impressive in its wilful disregard for literal representation, and simultaneous evocation of popular computer themes and images. Here, space implies the new frontier and the future of mankind while the chess piece and the floppy established a profound link between intellectual games (chess) and the computer (the floppy disk). Indeed, the cover was so popular that it was soon made available by mail order as a print and so iconic was the image that several computer clubs used it as a wall decoration in their chapterhouse.

Figure 5 – *Byte*, May 1978

Another famous *Byte* cover, from November 1979 (figure 6b) returned to the same space chessboard covered by large reflective half spheres. A disembodied hand has picked one of the half-spheres while a generic computer with the words 'you win' emerges underneath. On one of the half-spheres, echoing M.C. Escher's famous prints (figure 6b), one can make out the reflection of the person lifting the half-sphere. An archetype of the computer hobbyist, it is a man of indeterminate age, sporting a full beard, and grinning broadly.[141]

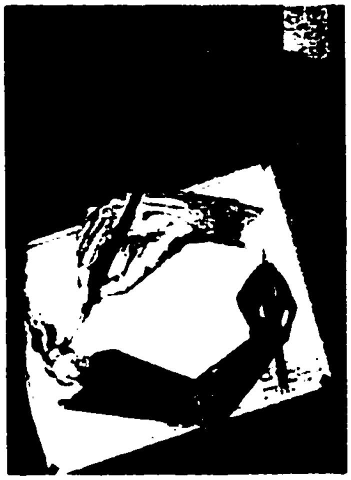

Figure 6a – *Byte*, February1979

Figure 6b – *Byte*, November 1979

Another cover inspired by Escher appeared in February 1979 (figure 6a). It features a parody of Escher's famous print of two hands drawing themselves on a piece of paper (figure 7). In this case, however, a human wearing a digital watch is sketching a robotic arm that itself is drawing the contours of the human hand. Moreover, the sketch is stitched to a drawing board and bears the borders and marking of an engineering blueprint. The *clin d'oeil* is immediate and rich with meaning: the man of the future, whose work and leisure are interwoven, creates the machine, which in turn establishes the boundaries of the human hand. As a twist on Asimov's contention that machines could only serve as tools for mankind, this cover tried to convey the image that machines could help one day design humans as well. Like the chess knight image, the image of the hands was also reproduced in poster form.

---

[141] It is generally accepted that the bearded-hobbyist was in fact Carl Helmer's himself.

Escher was particularly essential to a segment of American culture that was interested in logical puzzles and topological paradoxes. His work assimilated abstract intellectual pursuits in mathematics, physics and other scientific disciplines and was infused with an irony about these subjects that appealed to many engineers and scientists. By the late seventies it had also become an important element of a language that sought to bridge the seeming discontinuity between science and art. Escher managed to construct visual representations of themes deeply woven into computer science: recursion, self-awareness, introspection. In the Pulitzer-winning book *Godel, Escher, Bach : An Eternal Golden Braid* (1979), Douglas Hofstadter crystallised these interests in a sweeping exploration of the mind, mathematics and Kurt Godel's theorems. Hofstadter's use of Escher to illustrate various essential points of modern mathematical inquiries subsequently earned him a column of his own in *Scientific American*. Called "Metamagical Themas", the title was an anagram of "Mathematical Themes" which was a famous column by Martin Gardner that had appeared for decades in *Scientific American*.

Escher's contribution to the popular imagery of the scientific community resided in his ability to represent visually complex mathematical problems that were of particular interest to logicians of the early 20th century. His fascination with endless loops (or as Hofstadter puts it, "strange loops") found a strong echo in Alan Turing's work on the concept of linear programming. Turing had a fundamental influence on the field of computer theory. His mathematical answer to Godel's *Incompleteness Theorem* was the notion that a machine is in essence an information-evaluation construct, much like the mind. By focusing his art on the visual representation of mathematical enigmas, Escher was the visual extension of a larger discourse on computing theory.

Figure 7a – M.C Escher, *Self-Portrait, (1935)*

Figure 7b - M.C. Escher, *Drawing Hands, (1948).*

Another form of mathematically influenced art was the *fractal geometry* developed in the mid-seventies by French mathematician Benoit Mandelbrot which was an essential component of the emerging Chaos Theory.[142] Many issues of *Byte*, such as that of April 1978 (figure 8, left) refer to theory by their focus on computer-generated art. Kaleidoscopes of repetitive shape and form evoked the paradox of form and randomness that recalled Mandelbrot's equations. These covers capitalised on the computer hobbyist crowd's interest for images and art often referred to as *"2001 art"*. Much like the Escher references, they bridged the gap between science and art. The beauty of geometric patterns and self-generating fractals captured another dimension of futurism was an important part of the visual language of *Byte*.

[142] Benoit Mandelbrot, *The Fractal Geometry of Nature* (New York : W.H.Freeman, 1983) and James Gleick, *The Chaos Theory* (New York: Penguin Book, 1976).

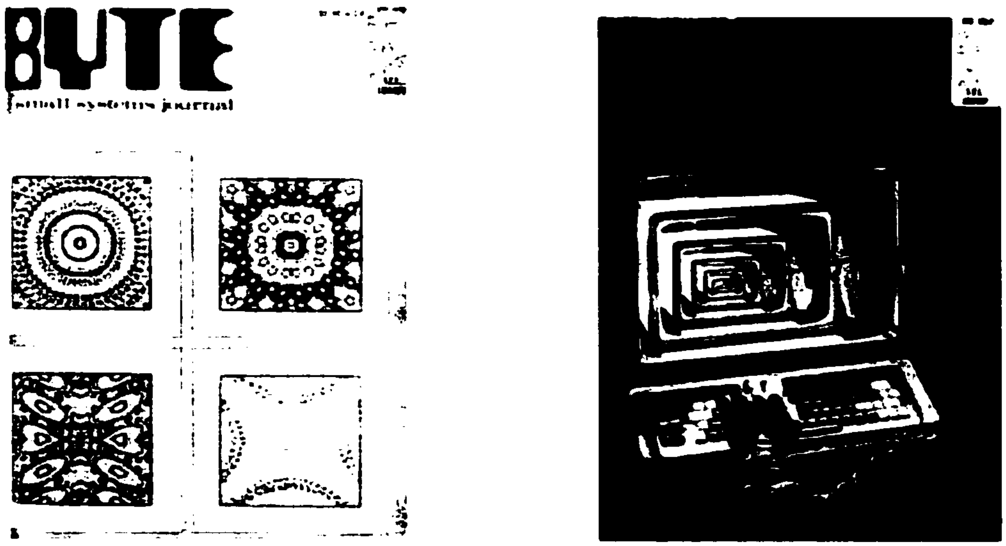

Figure 8 – *Byte*, April 1978 and April 1979, featured fractal geometry (left) and recursion (right)

Beyond abstract images, the relationship between mind, music and computers was another essential theme of *Byte* cover art. In the March 1978 (figure 9) issue, a majestic surreal organ set in a cathedral-like background is wired to a small Altair and a series of patch panels. Much in the way that Bach's fugues are often of interest to mathematicians, the image of the organ – arguably the most complex of instruments -- established a link between music and machines. Music was often interpreted as part of the mathematical construct of the world and the future. Music itself was portrayed as a universal mathematical language in movies such as *Close Encounters of the Third Kind* (1976) and in several episodes of the original *Star Trek* series such as "The Way to Eden"(1968) or "Charlie X"(1967). Along the same lines, the May 1979 (figure 10) issue represents a skewed view of three artists hands working side-by-side. The first is sketching a classical looking figure on paper. The middle one is expertly playing a harpsichord. The leftmost and most visible one, however, is typing on a computer keyboard. The construction of equivalence between creativity, imagination and technology within the computer hobbyist is a common recurring theme. Often, the musician and the artist engage in activities similar in value to those of the hobbyist, and vice versa.

Figure 9 – *Byte*, March 1978

Figure 10 – *Byte*, May 1979

Cover art imagery also echoed 'inner-space' preoccupations that reflected the influence of *New Wave* speculative-fiction. Some issues depicted vast, disembodied objects in purely abstract, thought-oriented representation. Attempting to visualise Moorcock's baroque fantasy worlds or Philip K. Dick's troubled androids, these covers assembled images of common objects in unusual, or unexplained, concepts. The cover from the April 1979 (figure 11) issue, for instance, reflects a purely virtual image of a floating keyboard and a kaleidoscope-inspired screen rotating, with the face of a man set in the middle. It is difficult to guess whether the man is the object of the computer's visualisation, or whether it is a reflection of the man observing the computer. In their duality, however, both are visibly searching for meaning in the other. This quest resembles the quest of the androids in Philip K. Dick's *Do Androids Dream of Electric Sheep?* (1966)[143] who seek answers for their existence in the humans that oppress and chase them.

[143] Which was turned into the 1982 Ridley Scott film *Blade Runner*, starring Harrison Ford and featuring computer-generated music by Vangelis.

Figure 11 – *Byte*, April 1979

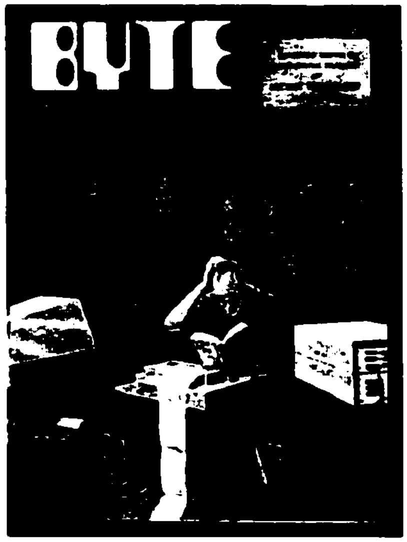

Figure 12 – *Byte*, December 1977

This search for inner meaning was also represented in idyllic images. The cover of December 1978 (figure 14) offers what looks like a city landscape covered by a deep black starry night. The stars, however, are arranged in oddly schematic patterns reminiscent of the game *Life*, a mathematical construct that mimics cellular evolution following a few simple rules. From the middle of the sky, a large lightning bolt lashes out to the landscape below. The reference is to Prometheus but also to the emergence of Silicone Valley; to the power inherent in electricity and its link with nature, and the very positive effects it can have if mastered wisely.

An element of the discourse within the pages of *Byte* focused on the potential for liberation and social progress embodied by the computer. However, this image was occasionally modified by the fear of the computer integrating the negative impacts of industrialisation, mostly pollution. This duality between the dystopian / utopian potential of the microcomputer, reminiscent of science fiction works such as George Orwell's *1984* (1948), William Nolan's *Logan's Run* (1964) or John Brunner's *Stand on Zanzibar* (1968) can be readily observed in the January 1977 cover of *Byte*. On this image, a sketched Altair 8800 rests on a desk besides a much more advanced machine displaying a gorgeous image of an utopian world. Outside the window, however, the reality of a polluted and dystopian world shows its ugly face.

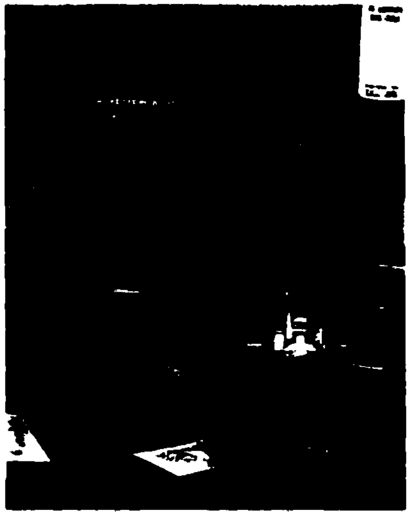

Figure 13 – *Byte*, January 1977

Throughout the first five years of publication, *Byte*'s covers made many other specific references to well know works of science-fiction. Almost invariably, these images related the realities of computer hobbyism to adjoining popular references from the cultural mainstream. The cover of the August 1979 (figure 14a) issue for instance features two American astronauts on a strange-looking surface. They are staring at a large, black monolith standing in front of them. In clear reference to the monolith in *2001: A space odyssey* (1969), the image is enhanced by the writing on the monolith. The text is written in LISP, an artificial intelligence computer language developed in the 1960's as a way of breaking down human language and making it 'understandable' by machines. The astronauts seem perplexed – a common thread that runs throughout most depictions of humans on the covers of *Byte*. Another example, the December 1977 (figure 12) cover represents the crew of the starship *Enterprise* looking over a 23rd century museum representation of a computer hobbyist trying to decipher a manual on the BASIC programming language.


Figure 14a – *Byte*, December 1978


Figure 14b – *Byte*, August 1979

Space travel, quite possibly the most widely recognised element of science-fiction, was also featured prominently in the magazines. The June 1978 (figure 16) issue shows a bearded male engrossed at a computer station on the edge of a strange and quiet alien pond. The sun is setting in the background, and it is unclear whether the person is creating an image from the setting sun on his microcomputer or *controlling* the sun's setting itself. The effect is of a direct link between the application of the machine to the contemplation of nature, as a natural logical extension of the human condition. It is important to note that even when dealing with futuristic and technological themes, the art often incorporates imagery drawn from the present or the past. The floor on which the bearded man sits, for instance, is covered by geometric tiles and the kaleidoscopic stained-glass window at the top of the image establishes links with cathedral architecture.

Other space representations carry an element of partial realism. The November 1978 (figure 15) issue, for instance, represents the Earth surrounded by floating computers that are linked together by cables. They seemingly establish a network connecting various parts of

North America, Europe and Africa. The image is particularly resonant today since the Internet is such an important reality of the world, but at the time it was futuristic to evoke the importance of the computer in the building of strong ties between geographically remote locations. More interestingly, the image is equally reminiscent of the sketch produced by science fiction author Arthur C. Clarke to describe the concept of geosynchronous orbit in his famous article "Communication satellites in geosynchronous orbit". Published in 1945, this article is widely accepted as the first mention of the potential of artificial satellites (which before Sputnik in 1957 were in the realm of pure science fiction) as useful tools for planetary communication.[144]

Figure 15 – *Byte*, November 1978

Figure 16 – *Byte*, June 1978

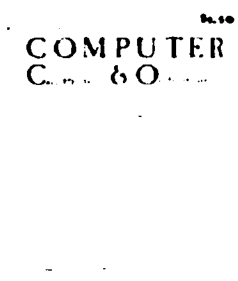

Figure 17 – *Dr Dobb's* first cover, January 1976

[144] Rhodes quotes part of the article and shows the sketch accompanying the text, 161.

By comparison with other scientific magazines, another striking element of the computer magazines was their absent imagery. Throughout the whole run from 1976 to 1980, not a single issue featured a photograph on their cover or a schematic representation of a computer that was available on the market. *Byte* insisted on an ethereal representation of values and subjects, never falling into the trap of constructing the image of a 'consumer's catalogue'. A typical cover of *Popular Electronics* is that of July 1976 (figure 18). The cover is full of text around a simple photograph of a prototype. No allegorical discourse is present; no abstract imagery and definitely no direct references to science-fiction elements. A traditional cover of *Popular Science* is the cover from March 1946 (figure 19) featuring an adventurous image without text explaining the contents of the magazine. At the other end of the spectrum, *Dr Dobbs* preferred long descriptive titles on its cover page, in reference to the cover pages of "serious" journals of professional interest (Figure 17).

Figure 18 – *Popular Electronics*, July 1976

Figure 19 – *Popular Science*, March 1946

The intent behind *Byte*'s covers, on the contrary, was clear even if it was never publicly articulated by Carl Helmer. They served to propose a dream by making unconscious cultural references to the potentials and the pitfalls of the computer, without introducing specific vendor models to clearly imply *Byte* was not interested in merely reviewing consumer products. Indeed, Carl Helmer's editorial in the first issue of *Byte* underscored this wish to present the reader with a dream. Entitled "The Impossible Dream" it centred on the promise of a future where microcomputers served individual needs and allowed the hobbyist to express his tinkerer wishes fully. In order to establish a clear image in the mind of the reader, Helmers chose a reference to a Heinlein short story:

> The present devices are not as good as the *thorsen memory tubes* in Robert Heinlein's *Door into summer*, but it's getting to the point where a basement tinkerer can put together a manufacturable robotic device and plant the economic acorn which will grow into an industrial tree[145]

In an interview given to *Byte* for its tenth anniversary, Robert Tinney, one of its most famous cover artists, described the process by which he constructed the images. Before every issue, Tinney started by discussing with Carl Helmers the topic (or topics) most relevant to the monthly editorial. Afterwards, he established a list of ideas and concepts the issue would try to convey. In his sketches, he explored visual symbols and images that he knew triggered associations and popular references His final sketch was examined by Helmers and if it felt 'conceptual' enough, and particularly non-representational, they used it.[146]

"I tried to draw concepts rather than technical facts" claims Tinney. "I always tried to create a separate three-dimensional reality that the reader feels drawn into."[147] If Tinney's approach to cover art appealed to the imagination and creativity spaces embraced by the computer hobbyist community, it also underscored the attraction of homebrewing in its

---

[145] Carl Helmers, 'Editorial : the Impossible Dream' *Byte*, September 1975, 5.
[146] Robert Prosper, 'Interview With Robert Tinney' *Byte*, September 1985, 220.
[147] Ibid. 221.

design to create in one's domestic space a piece of the future that could redefine the nature of humanity itself.

On the cover of the September 1979 (figure 20) issue, for instance, one finds a half-sculpted piece of stone surrounded by wild bushes and plants. On the floor there is a hammer and a chisel and the top part of the stone is in the shape of a personal computer vaguely reminiscent of a PET Commodore from that era. In a departure from many other covers of the period, the word 'Homebrewing' appears at the bottom at the page. The image embodies the grail sought by many computer hobbyists in its merger of art and science in a realisation that was purely individual. Like a statue from the renaissance carved by Michaelangelo, the computer made of stone like a work of art destined to withstand calamities and remain as an enduring symbol for posterity.

Figure 20 – *Byte*, September 1979

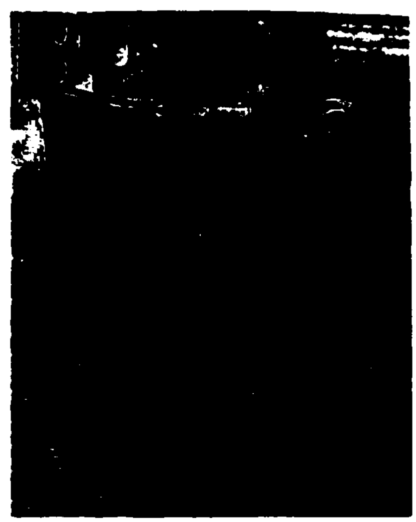

Figure 21 – *Byte*, June 1981

Occasionally, themes of real-life concern, such as software piracy, found their way onto the covers of the magazines under rich allegorical creations. The cover from June 1981 (Figure 21) for instance, presents a Viking *drakkar* with sails in the shape of a floppy disk. Anyone looking at the image who was aware of the nascent problem of software piracy immediately understood the reference at once to adventure, games and the clash between the notions of copyrighted intellectual property dear to software companies and the ethics of free-flowing information that were part of the computer hobbyist community.

Other titles, such as *Nibble* and *Creative Computing* featured an eclectic mixture of naive cartoon and geometric art that relied on vivid colours to stand out from the crowd of other magazines (Figure 22). *Dr Dobbs*, finally, embraced a look that was profoundly different. It featured simple folkloric art and fonts reminiscent of revolutionary tracts from the 18th century and favoured a conservative typeset reminiscent of professional journals such as the *Journal of Computer Science* published at Harvard in the sixties. In every case, however, the desire was to create an imaginary space inspired of cultural references devoid of concrete references to consumer articles available to the reader.

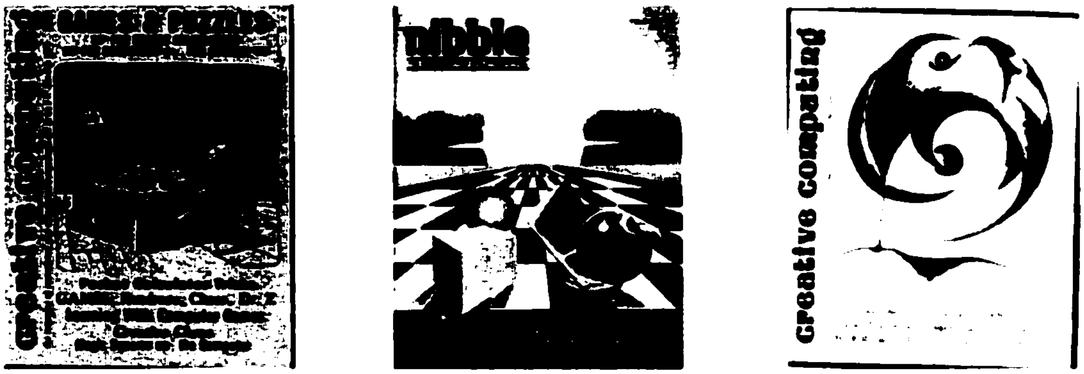

Figure 22 – Assorted covers from *Nibble* and *Creative computing* underscoring the lack of photo-realistic images in the computer hobbyist magazines.

If the cover art of *Byte* reflected shrewd marketing or instinctive business decisions, in its creations of a cultural bond with potential readers the language and subtext of the magazine's contents reinforced this connection. Indeed, this point was underscored by feedback from readers who continually commented on the look and feel of the magazine and helped to govern its content.

Text, Subtext and Language in Byte

Beginning with the very first issue, *Byte* offered a wide array of textual and subtextual references which appealed to its readers. Unlike traditional scientific magazines, the input and feedback of the readers was considered to be just as important as the editorial content and featured articles. Betraying its early incarnation as a newsletter, *Byte* drew heavily on contributions from the readers to augment its pages. As such, the contents of the magazine reflected not only the substance of the interests of the readers, but their cultural framework as well. Furthermore, the magazine presupposed from its very beginning that the computer was a reality that was increasingly becoming part of the world, and not just a fluke or a fad as many other popular electronics publications might have conceived.

The language of *Byte* is decidedly technical, almost unapologetically so. While great care was taken to allow the neophyte to enter the realm of computer hobbyism, the language is never toned down, simplified or edited for the 'masses'. Clearly the intended readership either had to be already familiar with computer terms, or willing to expand its frame of reference to include these. Of course, the first element of language encountered by a potential reader of the magazines was the title itself. Byte was not a particularly common word. It surfaced in high-level computer research circles sometime in the late fifties, possibly as a whimsical play-on-words on the term 'bit'. Contrary to previous publications in the hobby world, such as *Photography Today*, *Sailing* or *Golf!*, the title *Byte* could only be understood by consumers who were already familiar with computing. Even science and technology magazines felt compelled to spell out their nature through their title: *Popular Science*, *Scientific American* or *Discovery* all expressed their topics through simple terms that laymen could easily identify. Other titles were even more deliberately obscure. *Dr. Dobb's*

Journal of tinyBASIC Calisthenics and Orthodontia (running light without overbyte) was probably the most extreme example in its kind, but other titles, such as *Nibble*, *Datamation*, *68Micro*, *80 Microcomputing*, *Kilobyte/baud* and *Hot COCO*[148] were also expressely targeted at an insider community

At the same time, however, the language of the magazine also drew on common references to technology, science fiction and popular culture. For instance, a letter by Carol Pruitt in the April 1978 issue, links a discussion of future computing methods to a *Star Trek* episode ("A wolf in the fold", 1969) where an entity takes control of the starship's computer::

> The fact that a conscious being could inhabit in so integral a fashion may imply that the computer of *Star Trek*'s time is based on an entirely new, indeed unfathomable, technology (I say may because to the best of my knowledge no one has et attempted to inhabit a Z-80) One possibility which suggests itself is that the device is at least partly organic. Such a development would probably lend itself very nicely to speech recognition and natural language processing without having to refer to complex artificial intelligence programming techniques (LISP, PROLOG) and could do away with the hardware-fixation of modern computer design.[149]

The problem is clearly beyond the scope of modern computing: it discusses the possibility that a mind could enter a machine and how this might be accomplished. But the letter also implies that the reader is also familiar with computer languages, such as LISP or PROLOG, and terms like Z-80 (a very popular microprocessor by Zilog).

---

[148] *Nibble* ran from 1978 to 1989; *HotCOCO* ran from 1982 to 1986; *Datamation* started in 1970 as a newsletter and still exists today as an electronic mailing list. *80Microcomputer* began in 1978, changed name to *80Micro* in 1981 and folded in 1987. *68Micro* (focusing on the 68XX chip family by Motorola) started as a quarterly in 1978, turned into a monthly in 1981 and folded in 1985.

[149] Carl Pruitt, 'Letter to the Editors' *Byte*, April 1978, 20.

Other technological articles, such as Steve Wozniak's description of his design of the Apple II published in 1977, did not attempt to clarify basic electronics knowledge because it was assumed to be known to the readers:

> The Apple II analogue control paddle circuits are based upon inexpensive timer chips of the 555 type. I've used a quad timer of this type, called the 553. To read the value of resistance on the paddle's potentiometer, the timer is strobed under software control using routines in system ROM. The input routine then enters a loop which counts the length of the timer output pulse, which is a function of the paddle potentiometer's settings. To prevent endless loops if a wire breaks, the paddle scan routines exit at a maximum count of 255. The resolution of the loop cycle is at 12 microseconds.[150]

In order to follow this explanation, and much of the rest of the article's equally technical content, the reader had to comprehend basic electronics: potentiometers (variable resistors), microchip terminology and programming techniques.

. Although this initial bond that was created between the magazine and its readers by the titles and artwork was consistent with David Abrahamson's theory that successful magazines in the 1970's needed to establish a special, accomplice-like relationship with the 'consumer', this feature was progressively lost as subsequent computer magazines entered the mainstream. By 1986, most truly successful magazines had adopted more mainstream titles: *PC World, Mac World, PC Magazine, Information Week.*

Ironically, despite the highly technical language of the magazines, they also achieved a remarkable degree of intimacy. Virtually all of the writing – whether by the editorial staff or outside contributors – was done in the first person. Instead of esoteric highbrow pieces, most of the articles were colloquial and filled with personal commentaries designed to share individuals' interests in common themes.

---

[150] Steve Wozniak, 'The Apple II' *Byte*, May 1977, 34-41.

Typical articles in the first two years often began with personal accounts of some particular project that went horribly wrong. In the March 1976 issue of *Byte*, for instance, a computer hobbyist described building a new set of executive commands for his IMSAI computer on his kitchen table:

> Every time I get something new, I take it apart to see how it works and what I can change to make it work better for my use. My Analyst says: "Don't worry! Boys are always taking apart clocks and radios and toasters apart." Well, that's fine for boys, but I'm pushing 32 and still taking things apart.. so I worry![151]

The language establishes a familiar relationship between writer and reader by implying a common set of values: a 'boyish' identity, middle-class domesticity and the urbanite presence of the analyst as a cultural icon.

Throughout the magazines, the difficulty of realising a project is both an object of complaints and congratulations. The challenge is always presented from the perspective of an experienced hobbyist who wants to share tips and other counselling that might help others. Often, the first paragraph explains how the project began but soon ran into complications that could only be solved through the help of a fellow hobbyist or a piece of random information found in the literature.

Beyond these goals, however, the magazines also betray many preoccupations that are not explicitly voiced. Throughout the period, there was a concern with history, and the place of the hobbyist in the computerisation process. The letters to the editor were filled with references to the emergence of the microcomputer and its historical significance. Many of the letters revealed a lack of perspective on the microprocessor in the technological continuum although some of the readers had enough experience with ham radio to wonder

[151] Edward Smith, 'Privileged Command Set for the IMSAI' *Byte*, March 1976, 41-50.

about the ties between the new technologies and the immediate past. A reader, in the October 1975 issue comments:

> I had always dreamt of playing with a computer but I never had the extra million in change to indulge. Until recently I thought computers were enormous, heavy machines like Colossus. However now I have purchased an IMSAI and I look at it and wonder: how is this tiny machine related to those huge colossal (pun intended) behemoths I remember reading about? How did we get from there to here and from here to ... where?[152]

In this example, the reader draws parallels between contemporary reality and the promises created in the realm of science-fiction (Colossus). Paradoxically his account is more clearly shaped by fiction than reality.

The responses to these sorts of comments often came from readers themselves. Many readers identified themselves as having worked on the large mainframes of the late 50's and early 60's; others were engineers who recalled creeping back to work at night to be able to spend a few CPU-hours working on their personal design projects because the minis were unavailable during the day. Even though these contributors worked for large corporations, the role of the hobbyist was often presented as similar to the pioneer, exploring the wild frontier of individual computing.

One large, three-part article contributed by Sol Libes, president of the Computer Amateur Club of New Jersey, even tried to stretch the history and importance of the personal computer by ten years. In the preamble, Libes explained his dismay at reading that many people associated the microprocessor with the microcomputer, and the microcomputer with the personal computer. He proceeds to show how the personal computer, as a concept opposed to the mainframe, dates back to at least 1966, when a series of engineering clubs around the country began to build computers for private use out of the large amounts of military surplus available at the time. To support these efforts, the first official 'small systems' newsletter, the *ACS*, began its publication. Libes' language is both accusatory and acerbic towards the new upstarts "who think the personal computer started only two or three years ago with the introduction of the Altair 8800". According to him, the microcomputer was only a new, more successful incarnation of something serious amateurs were already pursuing years before.[153] Few people, by judging the responses in the letters to the editor, agreed with his perspective on things.

One distinct portion of the magazine was Carl Helmer's two or three page editorials which he used as a soapbox to voice opinions about issues raised by other writers. As early as December 1976, Helmers was already wondering about the emergence of the 'appliance computer' and its effect on the hobbyist spirit that *Byte* embodied.[154] In order to demonstrate his point, he presented a hypothetical discussion between what he called the "pragmatists" and the "hackers": those who wanted the convenience to be able to purchase a professionally-built and supported computer, and those who wish to construct fantastic pieces of technology for technology's sake. Although he was very careful not to criticise either side, he clearly perceived that the hobby would eventually get to a crossroads where the impetus to construct devices for pleasure met up with the goal of finding practical uses for these devices.

In another editorial, Helmers links searching the cultural impulse behind the creation of the home computer to general concepts of individuality in the West. He claimed that much in the same way that the mind is a perfectly adaptable and portable machine, so the computer could be conceived as a 'thought amplifier' in the manner of modern science-

---

[152] Eric Theodore, 'Letter to the Editor' *Byte*, October 1975, 22.
[153] Sol Libes 'Ten Years of Personal Computing' *Byte*, June 1976, August 1976 and September 1976.
[154] Carl Helmers, '1977 : The Year of the Computer Appliance?' *Byte*, December 1976, 6.

fiction literature, particularly of Asimov's robotics.[155] These self-conscious efforts at placing computing in a historical and evolutionary context were always present in the early magazines and no doubt differentiated them from other special interest magazines such as *Sailing*. At another level the publications made constant references to the need to 'establish a rationale for the homebrew system'. For all the attention it received, the microcomputer in the mid 1970's had no proper uses or applications that made it more useful than, for instance, a calculator. In fact, many specialised pocket calculators from 1972 or 1973, like many of the early HP non-programmable calculators, were far easier to use to add or multiply numbers. The Altair, with its clumsy switch-system of data entry and programming, or the IMSAI, with the intricate keyboard adapter, were not as clearly targeted at any specific application.

Curiously for many hobbyists the impracticality of this computer was considered a strength rather than a limitation. References to Howard Aiken's assertion that in many ways the computer was a "solution expecting an answer" were commonplace in the magazines. Equally common were discussions about the potential uses of the computer many of which were inspired directly by science fiction.[156]

In an issue focusing almost entirely on *Star Trek* several articles analysed in great detail how computing devices would help human beings in the 23rd century.[157] As tools of information management, they would replace paper-based libraries and would allow for the creation of massive cross-indexed catalogues for an easy analysis of literature. They could also provide the same service in dealing with music, cinema and art. As tools to automate

[155] Carl Helmers, 'Minds and Robots', *Byte*, August 1977, 7.

[156] Howard Aiken was the engineer, mathematician and computer scientist behind the Harvard Mark I, Mark II and Mark III electro-mechanic calculators. By the fifties, he had joined a technological advisory committee that presented reports to IBM's board of directors. It is in this context that he expressed doubts about more advanced uses for computers than repetitive, high-level number crunching. Shorkin, 103-105.

production, they would allow for the replication of items instead of forcing their manual construction. As communication tools, they would establish networks and allow for the decrypting and translating of alien languages. As providers of entertainment, they would be able to play chess -- an important sign of the evolution of the computer -- or enable mediocre performers to produce exquisite music. In short, the readership described renaissance-like abilities that would be unleashed by the computer in its role as a 'thought amplifier'. More importantly, maybe, the computer hobbyist sought in the *Star Trek* visual references varied potential uses of the newly available technology.

Subsequent issues featured letters to the editor that revealed readers' familiarity with these concepts and infatuation with elements of *Star Trek* in pop culture. One reader even wondered about the sex of the *Enterprise*'s computer. In the original series, the computer had been reprogrammed by a matriarchal culture and the voice was sensuous and feminine.[158] While interrogating the computer's gender was intended as a joke, it reveals how technology was personified as an object that combined elements of a tool and of a pet. The computer was treated as an object with a will of its own. Yet this personification does not stem from ignorance about computers but was a direct result of the cultural background of the hobbyist.

[157] Gerard Lay, 'Computers and Star Trek', *Byte*, June 1976.
[158] John Smith, 'Letter to the Editor', *Byte*, July 1977, p5.

Figure 23 – *Spock* ASCII art in *Creative Computing*

Star Trek was a strong recurring presence in the magazines. *Creative Computing* carried out a series of contests in 1975-1977 offering free subscriptions to readers who submitted computer-generated images relating to the *Star Trek* universe. A particularly striking realisation was a photograph of Mr. Spock recreated by the artist with ASCII characters. (Figure 23) For several years, *Creative Computing* also ran a regular column entitled "The Star Trek information exchange" covering any topic relating to the series or computers. In late 1976, the magazine even took part in an effort to bring back the series which had been cancelled in 1969 after a 3-year run (Figure 24).[159]

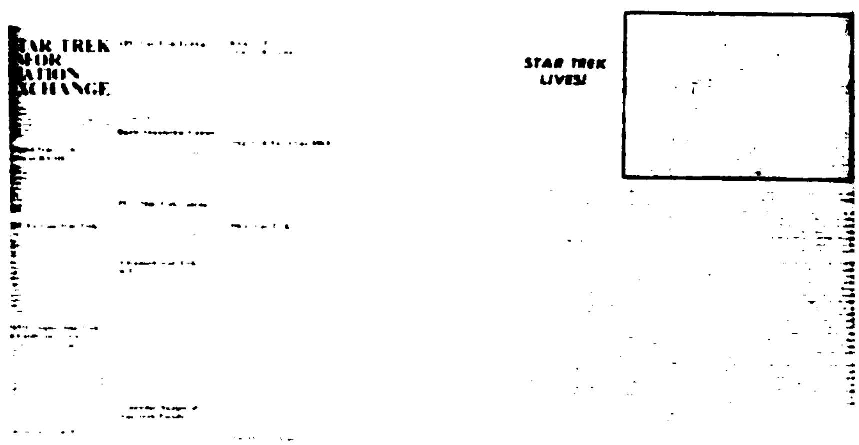

Figure 24 – *Star Trek Information Exchange* and *Star Trek Lives!* From the pages of *Creative Computing*

[159] "Star Trek Lives!" campaign, *Creative Computing*, September-October 1976, 29.

Numerous references in the magazines to Isaac Asimov's famous construction of the robotic individual seem to permeate the image of the future incarnation of the computer. In a famous project, concerning the building of a 'cognitive mobile computer' called the Newt (in honour to Newton), the author for instance ascribes the original inspiration to the short story *Robbie*, first published in *Amazing Science-Fiction* in 1940 and reprinted many times in several anthologies:

> Much like John F. Engelberger, I remember reading Asimov's short story *Robbie* and deciding right then and there I wanted to construct a robot that could do all those fun things. It would be able to sing... dance... or make me a sandwich![160]

By the seventies, Asimov's Robot stories and the Foundation series had come to embody 'classic sci-fi' and opposed a stark contrast to the 'new wave' stories in vogue at the time. Furthermore, Asimov was himself a contributor to certain technological magazines. In three interviews with *Creative Computing* in 1979, he explained that modern robotics was bound to produce better life conditions for mankind and he pointed to his stories as a valid intellectual construction of a possible future.[161] In those stories, Asimov had sought to establish the nature of humanity in contact with artificial thinking devices that were nevertheless bound by strict rules and programming codes. His stories often featured a character, Susan Calvin, who was a robot psychologist. Her work brought her into contact with highly advanced thinking machines that were often in difficult positions of moral or ethical nature. Those stories were extremely influential in spawning the very real robotics industry - but they also had a very visible impact on computer hobbyists, in the way that

---

[160] John F. Engelberger was the engineer who co-founded Unimation (in 1962) a company dedicated to the construction of industrial robots. Wildly successful, his robots were used by most large corporations in the US for manufacturing processes and assembly plants. He often explained that the idea to start Unimation came to him after reading *I Robot* by Isaac Asimov back when he was a student at Columbia University in the mid-fifties.

[161] David Ahl, 'Interview With Isaac Asimov', *Creative Computing*, June 1979, 13.

they conceptualised computers not only as passive tools, but also as prototypes of the future robots.

Helmers often commented on Asimov's legacy in liberating the speculative fiction realm from the shackles of *Frankenstein's Syndrome* since Asimov's robots never (or at least very rarely) constituted a danger to human beings. In one editorial, in response to some letters sent by a robotics engineer, Helmers suggested that the hobbyists' obsession with making computers play chess was a direct response to the association with the game made in Asimov's stories, *Star Trek* and even *2001*. These images evoked the humanity of the computer by virtue of its ability to challenge mankind on the grounds of intellectual prowess.[162] On the *Byte* cover from January 1978 (Figure 25) the outline of a man is set against a background reminiscent of the circumvolutions of the brain. At the centre of the man's head is a large microchip. The caption, at the bottom of the image, reads: 'The Brains of Men and Machines'. Inside, an article co-written by Carl Helmers asserts that "modern science has proven the machine-like qualities of the brain" and that soon "the concepts of men and machines will fold into one, under the combined effects of evolution and technology".[163] The issue commanded a very high level of response, not all positive, but most of which was taken by the idea of an eventual marriage of men and machines which is embodied in the traditional sci-fi concept of the cyborg.

[162] Carl Helmers, 'The Mind of Men and Machines' *Byte*, January 1978, 22-28.
[163] Ibid. 31.

Figure 25 – *Byte*, January 1978

In an attempt to illustrate the importance of these references in the magazines, I randomly selected a sample of 6 magazines drawn from the 1976-1980 period and analysed their content, establishing lists of common science fiction references. In this subset, I was able to collect 22 references to Star Trek, 14 to Isaac Asimov, 3 to Robert Heinlein, and a spattering of other science-fiction cultural icons of various importance. Most often, Asimov seems to have been used to portray the future of cognitive computing, as well as the potential of developing tools for the expansion and exploitation of man's need for information technologies. *Star Trek*, however, was more commonly referred to as a possible future where technology had infused positively every aspect of human experience. Games, cartoons and humour were very often centred around well-known and loved characters from the series. Heinlein, however, was more commonly quoted within the context of hardware specifics (such as Carl Helmer's first editorial in September 1975) or various tools derived from mankind's need to fend off extraterrestrial forces. Overall, the importance of science-fiction establishes itself in the commonality by which references are dropped without much explanation. When mentioning "Asimov's rules" Steve Cercia for instance instantly assumes the readership will know the Laws of Robotics.[164] When talking about "the computer core warping at full speed" Helmer's expects the reader to know about the Warp Engine that propels the *Enterprise* at faster-than-light speeds.[165] When talking about "feeling like a Stranger in a Strange land" when he first sat in front of an Alto, Helmers expected the reader to automatically understand the reference to Heinlein's famous novel from 1964.[166]

Significantly, a recurrent theme of the magazines was the fear of the computer assuming too much control over society and eventually dissolving the individual. The November 1975 issue of *Creative Computing* was completely dedicated to the topic: "Computer: Threat to society?". The invited contributors included Isaac Asimov, who contributed a piece introducing a short story he had written in the fifties about the risks of leaving computing in the hands of the government. More interestingly, an interview with senator John Tunney from California explored his position on the growing role of computers in American life including the challenges of preventing them from becoming a "monstrous dehumanizing force". Although he was a member of the US Senate Subcommittee on Science and Technology, Senator Tunney was hardly reassuring, arguing that:

> many Americans are concerned, quite rightly, that the technological imperatives that flow from the rapid spread of large computers and telecommunications networks will gradually overwhelm traditional democratic values, leading ultimately to the loss of individual autonomy and the concentration of extraordinary power in corporate and governmental bureaucracies. [167]

[164] Steve Ciercia, "A project Card For the S-100 bus", *Byte*, September 1979, 151.
[165] Carl Helmers, "Editorial", *Byte*, October 1977, 4.
[166] Carl Helmers, "Editorial", *Byte*, June 1977, 8-9.
[167] David Ahl, 'Interview With Senator John Tunney' *Creative Computing*, September-October 1975.

As a member of the US Senate Subcommittee on Science and Technology, Tunney was probably well-aware that his answers would strike a nerve within the hobbyist community.

Despite the Senator's intervention, commentary on current social and political matters was remarkably absent from the content of the magazines. From the fall of Saigon to the second energy crisis of 1979, to the Iranian revolution, the years 1975-1980 were filled with political, social and economic upheavals in the United States. Yet no comments are made on these issues throughout the whole period. Instead, the focus was on the latest piece of hardware by IMSAI or Apple, or the promises of object-oriented programming for the future of computing. In the science-fiction-coated sphere that surrounded these magazines, the realities of political and social transformations were coat-checked at the door.

Occasionally, editorials by Carl Helmers in *Byte* or David Ahl's pieces in *Creative Computing* discussed issues of digital privacy, computer facility centralisation or of the ongoing anti-trust case between the US government and IBM. But for the most part, the only political causes mentioned by the editorial staff or the contributors centred around furthering the use of computers in school, establishing policies for public funding of computing and addressing the needs to educate the masses for the coming of the computer to the office. There were no allusions or comments to the unravelling of American foreign policy in the middle-east, the various energy crises of the late seventies or the 'conservative revolution' that brought Reagan to power and put an end to Carter's presidency in 1980. One of the few political themes covered to any large extent is that of the US government's alleged blindness to the growing importance of personal computing, particularly from the perspective of a utopian retooling of the American Federal government. In an editorial entitled "The Government Dinosaur" published in *Creative Computing* on the September 1975 issue, Charles Winn discussed the establishment of a network of personal machines that would provide a synthesis of the nation's pulse which would then be provided to the President as a snapshot of public opinion. Dubbed "Uncle Sam" this decentralised, democratic computer system:

> [the Uncle Sam system] would obviate much of the reliance placed upon outside lobbyists, who are almost always selfishly motivated, and self-appointed experts whose information is often, at best, questionable. Uncle Sam could offset and reduce much of the mediocrity partiality and outright chicanery that now exists in the government area.

This passage features a certain naivete and utopian mode of thinking that is common to the occasional forays into political or social discussions outside the immediate sphere of technological themes and which can effectively be traced to the utopian/dystopian duality of traditional science-fiction.

Over the course of the five years of publications surveyed by this thesis, there was a rapid shift in some elements of the communities' language and values. Most revealing is the shift in the advertisements found in the magazine. At first, during the 1975-1977 period, most ads were similar to those found in electronic hobbyist magazines. They described the products in hard technological terms: the type of processor, the amount of RAM, the speed of the clock, etc. One striking exception concerns the Altair 8800. A particular example of the connection between 'dream' and owning a computer is found in the 1975 advertisement for the Altair 8800. The image is almost psychedelic and features a dreamland partially covered in clouds, out of which an Altair emerges (Figure 26). The text reads:

> Imagine a land where computing is in the hands of the *people*. Creative people, from farmers to engineers, to artists, to housewives and dentists. Imagine a land where the computer brings man closer to nature, with hope, with peace. You are imagining the land of Altair. The Land of Altair is now. [168]

[168] "Advertisement for the Altair: the Land of Altair", *Byte*, January 1975, 81.

Figure 26 – *Altair 8800* advertisement, *Byte*, January 1975.

However, between 1977 and 1980, an important shift occurred as marketing concerns and planning began to grow, especially as smaller companies became established and nurtured a following among the computer enthusiasts. The themes presented by the second generation of ads reflected closely the topics covered by the substance of the magazine itself. Recurrent themes revolved around the hobbyist himself who was always figured as post-adolescent, casually dressed and looking intrigued, enthusiastic and excited by the product or lost in thought.

The most common reference point in these ads was completely built, tested and supported machines. As new groups of people who lacked the electronic know-how to build them at home, began purchasing computers, Apple and IMSAI began capitalising on the finished look of their machines. Commodore proposed adapters that looked modern, in beige plastics and moulded sets. Apple had come out with the Apple II in its beige casing, with soft pleasant keys and an array of easy to connect plugs for the television and the cassette tape (then used to record programs and data). A famous ad of the period declares: 'honey, you can have your kitchen table back... get rid of the wires, the soldering iron and the tools. I got an Apple!' while featuring a smiling middle-class white American male holding an Apple II with visible satisfaction.[169] The original ad that ran in 1976 for the Apple I (left pane of figure 27) is austere and descriptive. A full page of text with a simple black and white photograph of the Apple's mainboard and the device's price. By comparison, the first advertisement that ran for the Apple II in 1977 (right pane of figure 27) was in full colour, but presented a white, middle-class man working on a tidy kitchen table on his portfolio projections. In the background, his wife is cooking. It is the perfect embodiment of domestic bliss. The text is simple and eminently non-technical: "Introducing the Apple II". The image contains all the information that is pertinent to the potential buyer. No longer interested by pure specs, the buyer is acquiring a completely built, tested and supported piece of hardware with readily available and instantly usable applications.

Another one of the angles exploited by Apple's series of ads focused on 'how to buy a personal computer'. The series of ads, which began appearing in January 1978, always prominently feature an Apple II, connected to a normal television colour set, and contains various paragraphs describing why the Apple allowed the user to "do things that other systems [were] still unable to do". In these ads, Apple explained how the Apple II could "carry out finances, balance the chequebook or the stock market portfolio, and provide a easy-to use complex problem-solving machine". In another ad, Apple described many normal users and their relationship to their new Apple II: "a storeowner charts sales on his Apple computer; on weekends, he totes Apple home to help plan family finances with his wife. And the kids can explore the New World of personal computers!"[170] Eventually, Apple began to emphasise the educational potential of the computer in terms that underscored the invaluable advantage children raised with computers would have. But the promises remained

[169] *Byte*, October 1978, 44.

vague and the stated uses were stereotypical of the community's conceptualisation of what the computer could do. Before Electronic-Pen and VisiCalc, though, these promises remained highly speculative.

The relationship between the reader and his family was also important. An ad for 'Shugart Associates' (one of the first makers of floppies and microfloppy systems) in May 1979 (Figure 28) declared:

> I own a fast growing business and before I bought my computer system I put in a lot of late hours keeping up with my accounting and inventory control. Now the computer does my number crunching quickly so I have time after hours to have some fun with the system. My son and I started out playing Star Trek on the system, and now we're learning to play chess![171]

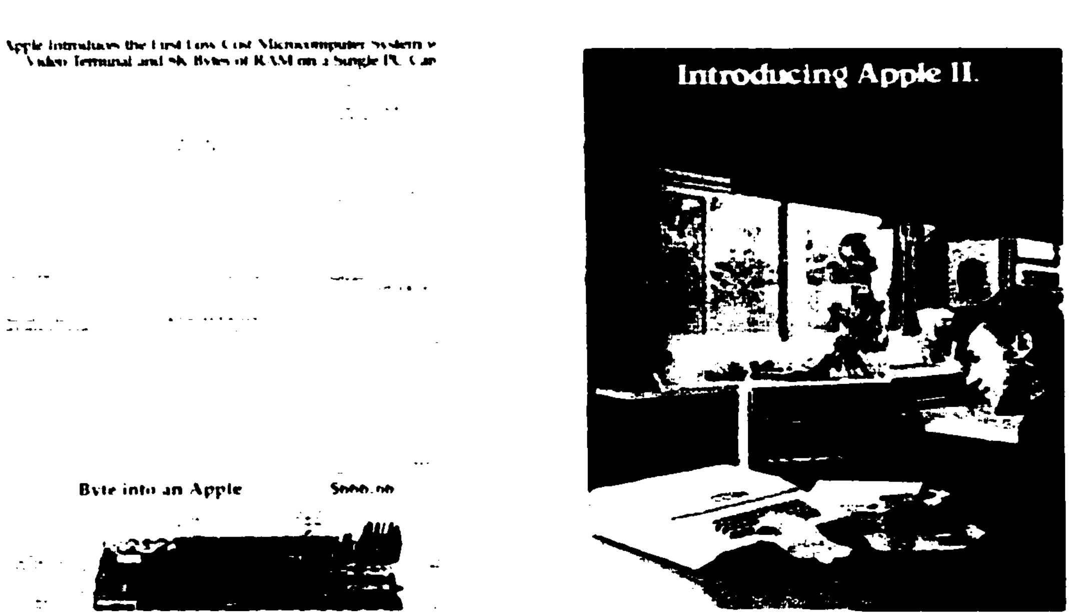

Figure 27 – Two generations of Apple ads, Apple I on the left (1976) and Apple II on the right (1978)

---

[170] *Byte*, September 1978, 101.
[171] *Byte*, May 1979, 202.

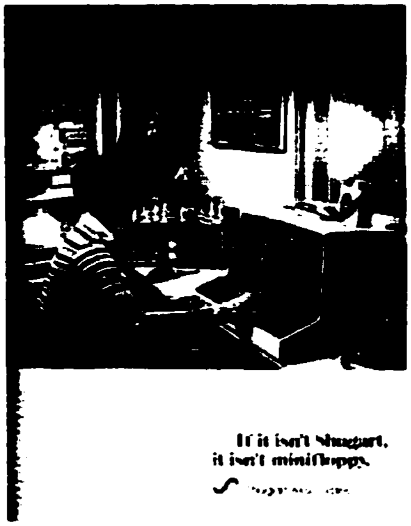

Figure 28 – Shugart associates advertisement, *Byte*, 1979

This ad encompasses many elements found throughout the articles, as we have already seen: education, chess, *Star Trek* and practical uses. The image even represents a young boy, around 12, masterfully commanding the computer while a chess set sits on the top of the floppy drive (the drive itself is the size of a small cabinet) and the father overlooks the scene with an approving parental look. The meaning of the cultural framework of the computer hobbyist could not be better focused: middle-aged, white, middle-classed men with a desire to establish their prestige in the eyes of their surroundings, including their children.

The importance of science-fiction icons is also indicative of the importance of the genre in the language of the computer hobbyist community. Several science-fiction personalities were drafted in the early years of the microcomputing revolution to stand in as part of marketing campaigns. Tandy, for instance, used Isaac Asimov in various campaigns to express the versatility and futuristic designs of its TRS-80 line (left hand figure 29). Commodore, however, opted for actors of science fiction series: William Shatner, better known for playing Captain Kirk on *Star Trek* (right hand figure 29), as well as Leonard

Nimoy (Spock), Lorne Green (Commodore Amada from *Battlestar Galactica*) and James Doohan (Scotty) were all featured between 1979 and 1983 in various computer periodicals.

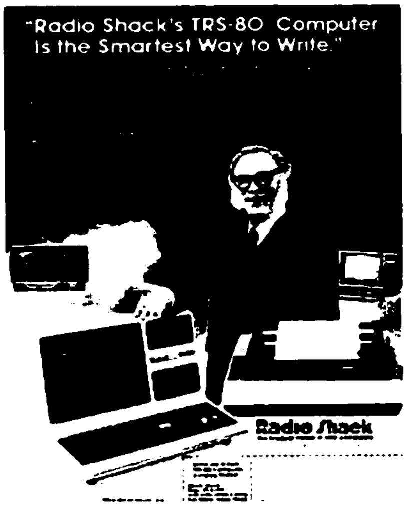

Figure 29 – Isaac Asimov and William Shatner in computer ads, *Byte*, 1980.

The schemes of textual, visual and subtextual substance found within these publications, as analysed in *Byte*, underscore important elements of cultural significance. The influence of mathematically-inspired art, drawing influences from science fiction is as important as the notions of cultural and historical identity. The impetus to realise something significant, either, as Helmer points out, for its own sake or within the framework of providing a useful tool for humanity, is unquestionable. The subtext also underscores a familiarity with mainstream cultural elements and a complex dialectic between the importance to ascertain the hobbyist's individuality facing the construct of the mainframe (or the computing facility) and his need to construct a community both supporting and enhancing his status as a leisurely individual.

Chapter Four

The Role of the "Project" in the Computer Hobbyist Community

One of the major themes of *Byte*, *Dr Dobbs* and *Creative Computing* is the importance of the hobbyist's place in history, and the definition of the social role of the hobbyist. While the hobby is often performed in a solitary atmosphere it takes on a greater significance when the results are shared with other enthusiasts. Furthermore, newsletters and computer clubs underscored this perception of the pioneering role of the hobby. This view carried an element of communal self-realisation, with the construction of a skills-based recognition system and a hierarchy hinging on technological and design knowledge. As a consequence, the language in publications such as *Byte* and *Creative Computing* began to reflect the importance of constructing communal bonds with other individuals who shared in the same cultural impetus to bring the mythical facility-computer down to the kitchen table. The magazine, as a national extension of the computer club newsletter, transformed the local phenomenon of homebrewing and constructed a Pan-American forum for the exchange of these ideas. As a consequence, the magazine also constructed a national stage for the organisation and showcasing of computer-related projects.

The first computer clubs developed in urban areas, close to institutions of higher learning, in the late sixties. They usually centred around a mainframe or an accessible minicomputer that was left idle during the weekend or late at night. Usually an 'initiate', who had daily operator tasks to perform and therefore knew how the system worked, came back at night with some friends and taught them the basics. For instance, Steven Levy describes how students from MIT had operated a clandestine club that centred around the institution's first "kludge" (a TX-01) starting in 1963.[172] The members had originally met to discuss electric trains and models but had slowly shifted their attention to the School's mainframe, which was kept running 24 hours a day for fear of not being able to restart it after a shutdown. Originally a faculty member had asked them to hold their meetings in the mainframe's room to monitor it in the evening. Soon, the club members were not only monitoring but using the mainframe as often as possible. With the arrival of the minicomputer, however, systems became much more common. By 1970, well over twenty clubs existed throughout the United States and most of them had grown around campuses, such as Berkeley, MIT and Stanford.[173]

One major focus of the electronics club culture was that of the 'project'. A project in hobby parlance is a long-term activity that seeks to construct an object or a system that is not readily available to the hobbyist in pre-packaged form. In the sixties, MIT students constructed simple calculators; memory devices, digital alarms and so forth. By the seventies, the electronics hobbyist crowd, particularly in the pages of *Popular Electronics*, sought more challenging activities. Often, the design and assembly of a major project required the participation of various individuals who mastered different areas of the system being built. Clubs were therefore essential as gathering resources and sharing information about specific technologies. Many large and successful clubs, such as the Homebrew Computer Club at Stanford University, even benefited from various deals with surplus vendors from the Army, which provided discarded hardware such as radio equipment, power supplies and such, or

[172] Steven Levy, *Hackers : Heroes of the Computer Revolution* (New York : Penguin Books, 1984), 24.
[173] Ibid. 30.

bona fide secondary market distributors that unloaded hardware at a rebate price. Eventually, once the club had established blueprints and guidelines for the construction of a project, the club members divided the work and organised 'fests' where the various parts of the project were assembled in a communal gathering. Individually, club members contributed by putting together their assigned parts. More often than not, these were assembled on kitchen tables and, because the point of the exercise was the design and construction, an aura of chaos often permeated the ongoing assembly of any given project. Those hobbyists who did not have local homebrew clubs to relate to often turned to the pages of hobbyist publications to gather parts necessary to their projects. The norm for a completed project was a working prototype from which other projects could be designed. The 'finished' product was not usually a tidy affair, nor was it ever intended to be. It usually was sufficient for the device to work. For instance, the Apple I project showed in figure 30 reflects what a typical computer hobbyist, machine looked like assembled on his kitchen table in 1976. [174]

Figure 30 – Assembled APPLE I on Bruce Damer's kitchen table, circa 1976.

[174] This particular model was by assembled Bruce Damer in 1976. This image comes from M. Damer's online repository of computer history and images, 'The DigiBarn': http://www.digibarn.com, accessed February 20th.

Each of these clubs had between twenty and fifty members in their original clandestine format. While access to computers was the primary motivation to join, few of these clubs actually managed to get close enough to a computer to put in practice whatever theoretical software design they might have had. Instead, gatherings typically included discussions of the place of computers in society and what the future might hold in terms of computing power. The more successful clubs, such as the Homebrewing Club at Stanford or the Manhattan Surplus Club, began to blossom in the early seventies with the arrival of the microprocessor. It allowed several young members to share and compare design ideas, to test them in a challenging intellectual environment. The microprocessor price was such that club members could realistically pool in their resources and plan common projects. To co-ordinate these efforts, several clubs turned to newsletters and irregular publications announcing the latest results from the common experiments.[175] The *Personal Computing Company*, founded by Jim Warren in 1971, was one of these clubs; it soon began to produce a newsletter which eventually turned into *Dr Dobbs*. Originally, the newsletters provided a local forum for the computer hobbyist to exchange ideas. The magazines expanded that role by linking dozens of local clubs into one large national movement.

Few newsletters from the homebrew clubs made it into the mainstream. By their very nature, they were focused on a very specific audience. They did, however, spawn the computer hobbyist publication, which incorporated many of their ideals into nationally-available publications. In fact, of all the computer magazines published by the early 1980's, most had been launched by specific computer constructors, such as Tandy (with the TRS-80) or Commodore (with the PET, the Vic-20 and then the Commodore 64) or even Atari or Apple Systems, to generate a fan community strong enough to provide a consumer base

[175] Freiberger and Swaine, 72.

for derived products, and remain close to their specific technology. In the period that preceded standardisation around the Intel chipset and the IBM PC format, the construction and successful establishment of customer-product bonds was an integral result of fan magazines. In contrast, the periodicals from the first phase, between 1975 and 1978, however, were profoundly dependent on the patterns set by newsletters and fanzines, and were above all directed by the need to allow hobbyists to communicate.

Dr Dobbs was the most explicit about its intended role. As early as the first 'regular' issue, in February 1976, an editorial by Jim Warren described that there was an important information vacuum in the sphere of software and programming techniques. Software, he claimed, can only be experienced and shared - it should not be purchased or sold. Therefore, *Dr Dobbs* had a very specific role:

> This Journal is explicitly available to serve as a communication medium concerning the design, development and distribution of free and low-cost software for the home computer We need suggestions, contributions, comments, software designs, hardware designs, evaluations and anything anyone is willing to share with fellow computer enthusiasts.[176]

In so declaring the intent of *Dr Dobbs*, Jim Warren expressed clearly a concept that had been instrumental in the amateur radio community years before and was shared by most scientific communities: that it is much easier to share information among peers than among strangers. The construction of the computer hobbyist community was partially inspired by the experience of the creators of UNIVAC and the ENIAC as Jim Warren explains in his March 1976 commentary. Reflecting on the nature of the computer hobbyist community, the need to expand the notion of *open communication* and the willingness of most club members to share freely the result of their experimentation he states:

---

[176] Jim Warren, "What is the purpose of this publication?", *Dr Dobbs Journal of tinyBASIC Calisthenics and Orthodontia*, January 1976, 2.

> I note with pleasure the great willingness to share ideas, developments, facilities and solutions among the hobbyists. This obviously compares with the easy and open communication that was perhaps invaluable to those early researchers [builders of the ENIAC]. They were pioneers of thought and action and their thirst for knowledge was strong. I hope we can follow in their footsteps.[177]

In Warren's view, the opening of the technological frontier to anyone willing to learn was the most important feature of the computer hobbyist's role in communicating knowledge. Warren looked up to the early community of scientists and engineers who built the first digital computers and hoped to emulate them with the microcomputer as a focus.

This insistence on 'open communication' was a hallmark of the MIT hackers of the early sixties, who insisted, through the 'Hacker's Ethic' that all information should be free and that there should be no limit put on knowledge. In *Hackers*, Steven Levy shows how this ideal was at first the sacred law of a few, but that it expanded within academic circles as computer science became important in multiple disciplines.[178] By the late sixties, a large component of graduate mathematics, physics and chemistry programs required the use of some sort of computing facility. In the paradigm devised by IBM and the other mainframe companies, graduate students would have had to go through properly trained mainframe or mini operators in order to execute their programs. This was impossible in most academic circles and very soon graduate students in all manner of scientific disciplines began experimenting with computers themselves. Often, they managed to improve on the prescribed techniques dictated by the manuals of the machines. The need for free access to information and techniques about the use of the machines was the motivation for sharing of this information. The clubs served as repositories of the knowledge accumulated by the students. Soon, students left academia and brought with them ideals of sharing information,

[177] Jim Warren, "Our community", *Dr Dobbs*, March 1976, 2.

programming techniques and computer language skills. The 'Hacker Ethic' became part of the electronic hobbyist community that was in close contact with the computer educated generation out of Stanford, MIT and others. It stressed the 'hands-on imperative'; the belief that *doing* something is the most perfect way of learning something.[179] This ethic of learning through constructing was tied to the computer hobbyist project as it evolved, from hardware to software, in the pages of *Byte* and *Dr Dobbs*.

The format of *Dr Dobbs* followed a simple pattern: pages and pages of reader contributions were often clumsily assembled and interspersed with folklore imagery of revolutionary soldiers. Warren thought *Dr Dobbs* was leading a revolution against fifteen years of corporate oppression in the information age. In one editorial, from March 1978, he states:

> The main problem with IBM is not that is a large and powerful corporation which controls many aspects of modern computing. The main problem is that IBM is the *only* large corporation that controls modern computing. As such, it threatens our future as individuals of a free and technologically advanced society.[180]

The magazine in general viewed itself as the vehicle of an elite trying to wrestle control of computers away from closed-source corporations.

The atmosphere of the publication cultivated iconoclastic references in order to build fan readership and underscore its opposition to the 'establishment'. The editors, for instance, referred to themselves as the 'Dragons', or as 'Dr Dobbs' Minions'. In the September 1977 issue, for instance, a 'Dragon' claims:

---

[178] Levy, 39-45.
[179] Pekka Himanen, *The Hacker Ethic and the Spirit of the Information Age* (New York : Random House, 2001), 72-76.
[180] Jim Warren, 'Computer Liberation', *Dr Dobbs*, March 1978, 25.

> Some people are perturbed by our power. They wonder why we cannot just call ourselves editors, staffers, writers... That is because we are MORE. We are the DRAGONS of Dr. Dobbs. We are the keepers of the knowledge. We are the ones who keep knowledge FREE. As such, we must embrace our power. There.[181]

This was a humorous twist on the representation of the mainframe culture and the monolithic facility computer as the ultimate evil, controlled by IBM and its army of 'high priesthood' minions. This corporate culture was invariably represented as turning the computer into an evil agent, subverting the true potential of the dawning information age and enslaving humanity to the whims of the One Machine. The 'Dragons' often underscored how they served a much more lenient dictator. It was a willing servitude, centred around the personal control of the individual computer.

The magazine embodied the fight to discover knowledge, to snatch it away from the high priests, then to turn around and give it freely to 'the people'. Nevertheless, this populist discourse was rarely grounded in a serious discussion of who 'the people' really were. In fact, judging by the only readership census conducted in 1979 on the readership, 'the people' were in fact a generally wealthy, middle-class group of thirty-something males working in a technologically-related field.[182]

The identity of the computer hobbyist is discussed many times, both in *Byte* and in *Dr Dobbs*, generally in descriptive terms. The image reflected by the community is very different from the one constructed in recent times by journalists and historians briefly looking at the hobbyist. In Steven Levy's *Hackers* (1984), for instance, the computer hobbyist is generally described as a teenager, a kid with a lot of money and a toy-computer that his dad had purchased him. In Paul Ceruzzi's *A short history of the computer* (1998), the hobbyist is

---

[181] Dragon Eric, 'A Dragon (mis)speaks', *Dr Dobbs*, September 1977, 18.

a young brilliant kid with social issues and far too much time on his hands. Even in Freiberger's *Fire in the Valley* (1985 and 1999), which otherwise paints a realistic picture of the community's demographics, the focus turns very quickly to the 'whiz kids' who made a fortune, such as Steve Jobs, Bill Gates, Paul Allen, etc. In *Accidental Empires* (1993), Robert X. Cringley goes as far as claiming that "the only story worth telling is that of the young guns, barely out of kindergarten, who stole the PC from the hands of IBM, Digital and DEC (while they were not looking or noticed they had it) and made a fortune of it"[183]. For many Americans, the image of the 'hacker' became embodied by the character played by Matthew Broderick in the 1983 motion picture *War Games*: young, smart and full of disreputable intentions.[184] However, this reflects only one part of the community, and a small one at that. It is true that many teenagers became enraptured by the use of the computer, especially after the emergence of the 'appliance microcomputer', but the initial crowd was much older. It also had a large amount of experience in other aspects of electronic hobbyism. Contrary to the subsequent mythology, the computer hobbyist was predominantly male, worked in a technologically-oriented profession and generally had a family to support.

Increasingly conscious of their role as an emerging community tool, both *Byte* and *Dr Dobbs* ran various surveys focusing on the nature and identity of the hobbyists. The data collected by Carl Helmers drew a picture of the computer hobbyist as an engineer looking for fun. More than 80% of Byte readers had obtained at least a bachelor's degree – more than 50% were Engineers (mostly in electrical engineering). They were 99.5% male, mostly aged between 25 and 40, with a median age at 35, and their domestic income was

[182] Jim Warren, 'Readers', *Dr Dobbs*, November 1979, 20.
[183] Robert X Cringley, *Accidental Empires* (London : Penguin Books, 1990), 45.
[184] Incidentally, the movie portrays the computer hobbyist in the same stereotypical (and historically inaccurate) image of the teenager. In the movie, Matthew Brodderick's character breaks into NORAD with an IMSAI and a modem and almost causes the start of a global thermonuclear war.

rather high (over 28,000$ in 1978). They had on average 1.5 kids, worked 35.5 hours a week and their families owned at least 1 car more than 78% of the time. They regularly watched television, read on average three magazines a week and read on average 1.5 novels per month.[185]

Furthermore, various surveys about the interests and pastimes of the computer hobbyist crowd revealed a very broad number of interests, including a diverse set of beliefs about the role of computers in modern life. At the top of the list, most computer hobbyists sought knowledge and understanding in the pursuit of their hobby. They wanted to expand their comprehension of electronics, programming and mathematics in general. They also wanted in large numbers to automate boring and repetitive tasks: bookkeeping, inventory and other similar administrative work. A small minority was interested in pursuing artificial intelligence research but most respondents felt the future of the computer would take a robotic shape. Significantly, the hobbyists' non-computing interests emphasised science-fiction as the favourite genre of literature and television. Over 80% of respondents claimed to play computer games at least once a week, but curiously less than 10% identified gaming as being an important part of their interest in computers. Among the games played, Chess was the most popular, closely followed by *Star Trek* variants and Draughts.[186]

In addition to news and information about computers, these magazines also provided information about social events. An important part of every issue was a description of activities, gatherings and achievements from all over the country. In 1975, *Byte* listed 61 clubs dedicated to computer hobbyism and homebrewing throughout the United States.[187] By 1980, there were over 5000 such clubs. Several pages of every issue of *Byte* and *Dr Dobbs*

---

[185] Carl Helmers, 'Another Year, Another Survey', *Byte*, March 1980, 9.
[186] Carl Helmers, 'The Computer Hobbyist', *Byte*, April 1979, 8.
[187] Theodore Carson, "An Overview of Homebrewing Clubs" *Byte*, August 1975, 20.

focused on a specific club, describing the members, their interests and what their current projects were. A typical club announcement from April 1978 read:

> The Orlando Computer Users Group is calling its first annual Computer Fair. Discussions: building a 300-baud modem; interfacing the IMSAI with a television. Guest stars: John McNealy of the *Byte Shop*. Drop by! Bring your projects! Bring your questions! Bring your machines![188]

Many computer hobbyists who were isolated in remote areas or simply unaware of the local facilities available to them, thanked the magazines for providing addresses, names and phone numbers for local clubs and associations. In the June 1977 issue of *Byte*, Mark Andreson sent a letter thanking the magazine for running a round-up of local shops that also featured workshops and local exhibitions:

> Who would've thought that Houston was such a great place for homebrewing? To think I was planning to fly off to California to shop for a microkit! Thanks guys for letting me know about the Bit Shop.[189]

Many hobbyists sought pen pals with whom to discuss technological issues and in *Dr Dobbs* they could find ways to make a contact. The logical step in the establishment of the community was the holding of a convention of computer hobbyists. This was set up by various homebrewing clubs, including *Byte*, MITS and a few other players on the microcomputer scene. In the fall of 1976, the first "Altair World Conference" took place in Las Vegas. It gathered 6000 enthusiasts and established friendships that spanned the continent. Over the next few years, a host of conventions became established. The "Altair World Conference" only lasted three years and was subsequently replaced by a number of exhibition shows. The "West Coast Computer Fan Faire" (figure 32) of 1977, sponsored in

---

[188] *Byte*, 'Clubs in the News', April 1978, 102.
[189] Mark Andreson, 'Letters to the Editor', *Byte*, June 1977, 17.

part by Ted Nelson and *Dr Dobbs*, became an essential stop for anyone interested in networking.[190]

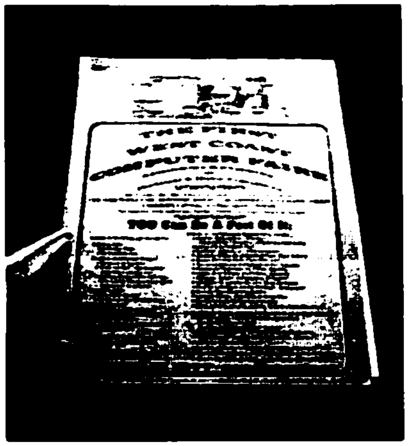

Figure 31 - Pamphlet describing the 'First West Coast Computer Fan Faire' (1977) describing how 'YOU can be a part of it!'
(source : www.digibarn.com)

By the time of the second 'West Coast Computer Faire' (1978), several individuals had become famous within the community. Reporting on the event, both *Byte* and *Dr Dobbs* underscored the crowd appeal of new celebrities such as Ed Roberts, Tom Nelson or John Draper (the hacker famously known as Captain Crunch). Covering the event, *Byte* described Ted Nelson's appearance:

> Saturday evening, speaking to a large crowd of enthusiasts, Ted Nelson raised his fist and intoned: *Computer Lib! Computer Lib!* The crowd went wild. Minutes later, Mr. Nelson, as the applause finally calmed down, began, on a serious and academic tone, his discussion on the potentials of the computer as a tool of *sexual liberation*![191]

[190] Freiberger and Swaine, 65.
[191] John Schmidt, "Clubs in the News" *Byte*, August 1978, 211.

Programming feats and hardware building were paramount in explaining the prestige of these individuals. Historical involvement in computer development was also celebrated, and finally, to a very small degree, financial success. By 1978, the community had clearly become increasingly aware of its own existence. A few years before, the editorial staff of *Popular Electronics* had seriously doubted whether there would be a market for computer projects or whether they were a fad that would be long forgotten. A few years later, the answer was clear: mass-marketing of general purpose machines was becoming a national sensation, especially among white middle-class consumers.

With the arrival of packaged microcomputers such as the PET, the Vic-20, the Atari 400/800 and the Apple II's in the living rooms of many American families, software became a serious need. Few hardware companies knew exactly how to handle software publishing or pricing for the microcomputer market. Increasingly fewer and fewer hobbyists were interested in spending hours typing in source code from magazines or writing their own. Some did not even care to know how it worked: they just wanted to see it work. To rescue the fledging microcomputer software market, several hobbyist magazines began to offer advertising space as 'classifieds', to small one-person companies trying to sell software.

For the first few years of their existence, both Byte and Dr Dobbs carried a section of 'classified ads'. From a few pages in 1975, the 'classifieds' section of *Byte* ballooned to over 100 pages by 1980. These were literally thousands of ads covering everything from computer programming classes to the art of generating photo-realistic images with 4-color palettes. Inexpensive to purchase (25$ for three issues) these ads reached a slice of America's middle-class that was becoming increasingly fanatical about the microcomputer. The 'Ziploc bag' companies that dominated the early eighties had their roots in these classifieds. Typically, the vendor was someone who had written a piece of software, then proceeded to make copies on cassette tape or floppy disk that were sold in ziploc bags through mail-order. Several companies began in this fashion. A prime example is Sierra On-Line (now part of Ubi Soft) which managed to carve itself an empire over the adventure gaming genre with titles such as King's Quest and Space Quest.[192] The first few titles, such as "Mystery House" and "The Wizard and the Princess" were advertised in publications such as *Micro*, *Nibble* and *Byte*, and sold for 24.95$. A typical advertisement in the classifieds section of Byte from September 1978 reads:

> Lose yourself in a world of wizards and princes. Fight Evil and save the world from the clutches of Lord Daramorr. Crafted by John Nellis, *Darius Challenge* is written in BASIC, with added extended graphics for the Apple II palette. Still images add to the atmosphere. 24.95$ or 29.95$ with manual, Apple II, cassette tape.[193]

Yet, even though many companies emerged in the lucrative market of the late seventies and blossomed rapidly into mid-sized corporations by the early eighties, the accumulation of wealth was never a sign of status within the computer hobbyist community. In fact, it quickly became apparent that too much success in financial affairs was a rather suspect achievement. Celebrities like Gary Kildall (creator of CP/M, an operating system for the Z80 chip), Bill Gates (cofounder of Microsoft), and even Ed Roberts lost some of their prestige as their bank accounts surpassed their technological achievements or their perceived mastery of technological matters within the community. Reader letters in *Byte* became increasingly sarcastic in their comments about Gary Kildall, for instance, who was known to own two dozen Corvette's of various years by 1980. A reader responded to the publication of one of Kildall's articles in the May 1979 issue of *Byte* with sarcasm:

---

[192] Steven Levy recalls the history of Sierra On-Line from the first program written by Ken Thompson and Roberta Williams in 1979 and underscores the importance of the 'community' as an audience for the lone programmer. Levy, 282-302

[193] *Byte*, September 1978, 401.

> I'm sure Mr. Kildall sees the importance for all of us to run *modern* Disk-Operating Systems such as his own CP/M product. However, we do not all have Mr. Kildall's wallet. I could barely afford an IMSAI with 16kb of RAM. I don't know many people who can afford a full floppy-based system. Even less a *dual* floppy-disk system! I think Mr. Kildall, and *Byte* in general, needs to come back to Earth and focus on what a normal hobbyist can reasonably spend on his hobby.[194]

Overall, the target audience for the computer hobbyist magazines was the young or middle-aged professional who, having achieved a certain amount of pecuniary stability, searched for new ways of escape, new forms of personal competence, or self-realisation. Instead, the disinterest in financial heroes and their focus on the 'technical knowledge' reflected that new form of social value that Daniel Bell describes as "essentially post-industrial".[195]

Prestige in the Computer Hobbyist Community.

To a large extent, projects and inventions were the heart of the first period of computer hobbyist periodicals. In the first two years of publication, projects accounted for more than two-thirds of the content of *Byte* and *Dr Dobbs*. These projects were originally hardware-driven, inspired by the long tradition of electronic projects published in *Popular Electronics* and *Radio Electronics*. They differed, however, in one important respect because they were sent to the magazine by the readers themselves.

Originally, the reason for the importance of the project was a result of the scarcity of pre-built kits and readily available microcomputers. The Altair 8800 was a case in point. Although the product was announced and advertised in 1975, it was never mass-produced.

[194] Jerry Thomson, "Letter to the Editor", *Byte*, May 1979, 20.

The IMSAI was widely available but its expense put it out of reach of most consumers. Most computer hobbyists in the first period were in fact attracted to the idea of exploring the frontier by constructing these objects themselves. The frenzied attempts to discover new ways to assemble chips and surplus hardware in order to come up with creative new designs were imbued with a spirit of hands-on dedication only equalled by the need to impress and generate envy among fellow hobbyists.

The breakdown of hardware projects offered in these specialised publications between 1975 and 1978 fall in two categories: the microcomputers themselves, assembled from chips such as the Z80, the 6502 or the 8080; and the peripherals, which were meant to extend the usability of projects that were already proposed. The first category was the most ambitious and quickly faded as the availability of pre-built kits increased. The second category, however, reflected a growing interest in transforming existing computer models into something more productive, or impressive.

The list of these projects remains even today quite ambitious: music instruments, automation, domotics (domestic robotics), printers, storage devices, interfaces to cassette players. On average, every issue of *Byte* contained three to five projects, of increasing difficulty. Most required soldering, all required software to be written afterwards. The cost of these projects ranged wildly, between 20$ to 1000$ and more. Discussing a survey published in May 1980, Carl Helmers stated that the average cost of a computer hobbyist's set-up (including main projects such as the computer itself) was 7475$; a very large sum by any standard. Most of this money went into assembling peripherals and interfaces to link the computer to other electronic appliances.[196]

[195] Bell, 25-30.
[196] Carl Helmers, 'Another Year, Another Survey', *Byte*, March 1980, 10.

A 1978 survey of *Byte*'s most popular projects was analysed by Carl Helmers. To his surprise:

> The most popular kind of project is that which is difficult to achieve. Over 44% of respondents claim they prefer 4-6 month projects over quick and dirty ones. The recent 300-baud modem proposed by Steve Gutts comes back over and over as an all-time favourite. The IMSAI cabinet also was extremely popular. 22% of respondents claim finishing most projects they attempt, but they all consider it worthwhile just trying. [...] In more than 40% of cases, the respondents claim constantly thinking of projects they dream of submitting for publication. Lately, there seem to be more software writing than homebrewing, and most people nowadays get into the hobby by purchasing prebuilt units.[197]

Dr Dobbs provided the software equivalent to *Byte's* hardware projects. Drivers for new pieces of hardware were commonly featured in short projects. Small interface expansion boards, often aimed at very obscure platforms such as the Sol-8, were proposed. Efficient uses of memory -- which was then a rare commodity -- in software design were especially welcome. Very often, the projects were described in brief first-person accounts that discussed the full range of problems encountered by the author as well as the solutions that were found. A typical software project emerged in 1978 as a submission to *Dr Dobbs*:

> We started coding on paper three years ago, in BASIC. Now we have started porting everything to C, since Mathew got a PDP-10 at work. However, this is the BASIC listing, which should work with little effort on tinyBASIC or Microsoft's Altair BASIC. We tried it on an IMSAI and it works fine. It is however not very strong. We call it Sargon. We hope in the future it will become a stronger chess player.[198]

This project was for a chess program called Sargon which derived its name from an episode of *Star Trek*, "Return to tomorrow" (1969), in honour of a particularly cunning villain who was brilliant but mad and whose mind had been imprisoned in an energy sphere for

[197] Carl Helmers, 'What You Like... And What You Don't', *Byte*, October 1978, 8.
[198] Tom Reynolds, 'A Chess-Playing Computer Program: Sargon', *Dr Dobbs*, September 1978, 44.

millennia. Early versions played very poorly but they generated so much enthusiasm that, eventually, Sargon was released as a commercial ziploc product and became a best-seller on a number of platforms.

As pre-constructed machines and peripherals became more available in the market, software projects gradually took over both publications. The shift from building tools to operate the machines to designing software in order to make the computers perform useful tasks was complete by early 1979. The 'userspace' project became then the focus of a new group of readers and contributors who sought to expand the horizons of the machine, much in the same way that business applications had exploited the efficiency and productivity promises of the minicomputer in the sixties.

Games were essential to this new focus. Electronic games had been part of the hacker subculture at MIT in the sixties, in particular the text-based adventures such as *Adventure*, and numerous semi-graphic games inspired by *Star Trek*. Some were designed as action-reflex games in the *Spacewar* tradition[199] and dozens of *Breakout* clones were featured in the pages of *Dr Dobbs* as well as in *Byte*. These games were a reflection of the ways in which the culture of the computer hobbysist was an extension of literature, television and entertainment. Essential to this process was the challenge of programming and the amalgamation of computer graphics, theoretical design and artificial intelligence. Even if some renowned personalities objected to the reduction of the computer to the role of high-priced toy, many projects focused on constructing homebrewed game systems. Commenting on the use of computer games in an educational context, David Ahl wrote in the September 1977 issue of *Creative Computing*:

[199] *Adventure* was responsible for drawing a large amount of non-computer users to the computing facilities at MIT in the late sixties. Similarly, as the microcomputer revolution began to spread, many people discovered the computer as a partner in game playing. Levy, 140-141.

> Some people view computer games as a big waste of money, time and intellectual power. These people completely miss the boat. Computer games can be very useful. Of course, they can be entertaining. But they can also serve as a gentle introduction to the worlds of microcomputers. They can be used to teach and kids love to learn while being entertained. They can be used to educate people on how machines ultimately react to the human's input. In general, I think games can reduce the amount of 'computer fear' in our society. Then there is the attraction of *writing* a game that someone else will enjoy. I think that those who think computer games are a waste of time should wonder whether music or art have any point at all... .[200]

Carl Helmers wondered in 1980 whether anyone seriously played any computer games. He was aware of the large market developing for these creations, but he could not imagine sitting in front of a computer screen and getting immersed in its visual fields. Instead, he was exclusively interested in gaming as a vector for computer programming and exploration.[201] In the pages of *Creative Computing*, however, gaming was portrayed as an essential element of the adoption of the computer by youth. Languages were eventually developed that performed a fusion of the ideals of computer programming and gaming. Logo was such a language. Designed as a teacher's tool in the early seventies, it became very popular within the hobbyist community as a way to reach a new audience. Conceived as an abstract representation of the rules that govern computer operation, it removed the need of interacting with the machine in traditional terms and instead introduced a graphical, two-dimensional surface inhabited by a 'turtle' that could be taught to do any number of things. Youngsters and parents alike marvelled at the principle, and many projects developed around finding educational uses for the language set. In the March-April 1975 issue of *Creative Computing*, a young high school kid from Palo Alto, California was introduced as an example of what computers and kids can

[200] David Ahl, 'Entertainment and Computer Acceptance', *Creative Computing*, September-October 1977, 11.

[201] Carl Helmers, 'My Uses of the Computer', *Byte*, March 1980, 8.

accomplish. The young boy, Martin Goldeen, had been attending the Jordan Junior High School in Palo Alto in 1973 at the time that Xerox held its research lab there. In December 1973, Goldeen had been selected by Xerox to follow a crash-course on computer programming designed to examine how easily children could learn to program. Martin followed a two-week course on Smalltalk (an experimental object-oriented language designed by Xerox as part of their Alto Computer project) and was placed in a classroom with an Alto and an instructor. In his article, Martin describes the experience:

> After we had learned just about everything there was to know about boxes, we were able to create our own programs... (Gulp!!)... I don't know what the two other boys in the class did, but Colleen and I created a painting program. It was fairly complicated. To run it you first called up a menu. Then, you would point with the mouse to the box that contained the shape you wanted to draw with, then press the top mouse button. Now the shape would be a brush and you could paint with it. That's it. It wasn't all that hard, really.[202]

For the editor, David Ahl, Martin's account was

> a fabulous example of how we must work to encourage kids to manipulate the machine. Martin's experience is purely positive. It promises a future shining with computer creativity![203]

Creativity was an important factor of computer hobbyist projects, both in hardware and in software. The impetus was not just to copy something else, but to create something new.

At first these projects were essentially driven by a genuine desire to push the machines to their limits. However, very quickly they became a vehicle to establish prestige and recognition within the community. Fame and glory in the pages of *Dr Dobbs* and *Byte* were much sought achievements. As the readership grew and a larger pool of contributors became available, more complex editorial criteria for selection appeared. In the first year or

---

[202] Martin Goldeen, 'Learning to Program', *Creative Computing*, March-April 1978, 71.
[203] David Ahl, 'Teaching How to Program', *Creative Computing*, March-April 1978, 8.

so, almost anyone who had anything to contribute could safely count on their article or project being published. There was a craving for experimentation, any kind of experimentation, even the kind that failed. In the first page of *Dr Dobbs*, a call to "contributors, experimenters and hackers of all sorts" invited submissions from anyone who had something to say. In every issue of *Byte*, under Helmers' editorial, there appeared a grey box with the message:

> Articles policy:
> BYTE is continually seeking quality manuscripts written by individuals who are applying microcomputers or personal computer systems, designing such systems, building them or who have knowledge which will be useful to our readers. We also seek new and interesting pieces of software. [...] Each month, the authors of the two leading articles in the reader's poll (BOMB: Byte's Ongoing Monitor Box) will be presented with a check for 150$ and a diploma attesting of their accomplishment.[204]

However, as the number of people skilled enough to conceive new software and hardware rapidly grew, the quality of the projects published also increased, often to the detriment of the general hobbyist at whom the magazine was initially targeted. In the fanzine and newsletter format, anyone who wanted to submit something usually could. As the magazines became larger and more established, a certain level of quality in terms of project complexity and prose style was expected.

One of the most famous project designers of the period, Steve Ciarcia, started out as a 'normal' reader of *Popular Electronics* in 1971. By the late seventies, his prestige had grown significantly on account of his participation to the monthly projects column in *Byte* magazine. In 1985, for the 10th anniversary of the magazine, he shared his thoughts and experiences

[204] This caption was included in all of the issues of the first five years of *Byte*. The language shifted occasionally, but overall the meaning stayed the same. This sample was taken from the March 1979 issue.

and explained how he had become attracted to computer hobbyism in the first place.[205] Early on, as a young adult and engineering student at MIT, he began constructing projects designed by professional electronics wizards: hi-fi stereo, ham radio receivers, etc. Those projects never enthused him much since they "lacked the thrill of the new, of the future technology". One morning, in 1972, he spotted an issue of *Radio Electronics* describing a project for a 'TV typewriter' built on top of an 8008 microprocessor. He was instantly hooked. That was his first serious project and it motivated him to design his own. Three years later he picked up the first issue of *Byte* and spotted the invitation to submit material. He sent in a few proposals and Helmers wrote back asking him to elaborate on his ideas about a graphics subsystem for a homebrew 8008 system on which he had been working.

Ciarcia's first project appeared in November 1976 and received a lot of positive responses from readers in letters to the editor. He won the 'BOMB' award for his first three articles. Helmers continued publishing Ciarcia's projects for a while on a one-on-one basis, until it became clear that the author was developing quite a following. In particular, his simple, first-person style was very popular. His way of describing projects in a broader context was also appreciated by the readers. Starting in December 1977, Ciarcia became a regular contributor to the magazine. He balanced his day job as a consultant for Pratt & Whitney with his passion for electronics. Looking back, he remarked ten years after the fact that "the pleasure of getting a real project completed was often outweighed by the pleasure of receiving fan mail. It was a true rush to think that all those people *looked up* to my skills as a project designer!" Along with many other regular contributors to the magazine, he became nothing short of a personality in the community. His presence was always marked at fan fairs

[205] Steve Ciarcia, 'Interview With Steve Ciarcia', *Byte*, September 1985, 217.

and gatherings and he sometimes conducted sessions with would-be hobbyists about the art of assembling and designing simple circuits.

Mentoring was a very important element of the 'project mentality' that pervaded the computer hobbyist magazine of the period. In many cases, the finished product was not necessarily the point. Showing how to design and assemble the system was. Sharing one's experience, whether glorious and successful or embarrassing and a failure, was also part of the accepted style of the magazines. When John Zarrella described assembling an Altair 8800 to "pay *close* attention to the way in which the mainboard is fixed to the base case and to make sure to use the *right* screw is in the *right* place" he was sharing the pain of short-circuiting a perfectly nice kit through inexperience and unbridled enthusiasm. "Be careful!" he warns. "Don't be too quick, like I have been so many times. Of course, you will. You will burn a perfectly working chip. And then you will learn... but don't say I didn't warn you first!".[206]

At another, more political, level many projects reflected an agenda that aimed to repatriate the computer from the corporation and the data centre. In June 1980, Steve Wozniak unveiled his latest project in the pages of *Byte*; to design efficient software to compute the mathematical constant *e* to 116 000 digits. Up to this moment in time, special-purpose circuits costing over 20,000$ had been used to perform these computations. In his introduction he summed up the core of the computer hobbyist mentality of the time:

> The 1960's were a decade of unrest, turbulence and accomplishment. Man walked on the moon, *Star Trek* was on the air and the first million digits of pi were determined by a mainframe. Today, as we face the 1980's, Robert Truax, a computer hobbyist, is constructing a private spacecraft. *Star Trek* has been revived as a motion picture and personal computers have become a reality. As a people, passion drives us to explore the unknown reaches of the universe. It is

[206] John Zarrella, 'Assembling an Altair 8800', *Byte*, November 1975, 78.

> pleasing to note that this exploration is no longer the exclusive domain of governments and large corporations.[207]

He succeeded in his project, using an Apple II which, incidentally, by the time the article was published had sold 1 million units in the United States alone. Furthermore, the success of the project was such that three months later, he managed to compute *e* to the 100,000,000 digit with a simple series of compression algorithms. The fan mail was ecstatic, and the mentor basked in the glory he felt he deserved.

Skill, Technocracy and the Computer Hobbyist Community.

In his survey of the cultural and social values associated with technology in American history, *Technological Utopianism in American Culture*, Howard Segal argues that the fifty year period from 1883 to 1933 was a key formative period in the construction of the American middle-class relationship with technology. In particular, he argues that many intellectuals of the period "believed that advancing technology would be the key to turning the impossible into the possible and even the probable" and that they conceived of the United States as a utopian society constructed on the benefits of technology.[208] This positive outlook on the future was dimmed by the despair of the Depression. However, in the wake of the material abundance of the fifties and sixties, it can be argued that this old-fashioned faith in technology as a tool for ultimate good had resurfaced with the advent of mass-production and the consumer society.

---

[207] Steve Wozniak, 'Calculating e to 110,000 digits', *Byte*, June 1980, 45.

[208] See two Howard Segal books: *Technological Utopianism in American Culture*, (New York: Penguin Books, 1986) and *Future Imperfect: The Mixed Blessings of Technology in America* (Amherst: University of Massachusetts Press, 1996).

The technocratic nature of the new society evolving in this climate of material wealth was a product of three quarters of a century of industrial change and advancement. It traced its roots to the assembly chain as conceived by Ford and the "production unit as a machine" described by Frederick Taylor. Although the computer hobbyist who devised projects in the seventies was partly seeking entertainment and leisure, he was also the inheritor of the Ford-Taylor, partly in his desire to construct a new tomorrow through the complete computerisation of domestic space. In the magazines of the hobbyist community, tomorrow is often portrayed as inevitable and inescapable. It also embodies change and evolutionary themes. "Change," declared Helmers in the February 1977 editorial, "remains the only true constant in the history of the Computer".[209]

This notion of perpetual change was often the basis for optimism about future technological advancements. If the problems that the computer targeted had not yet been solved, it was only because computing power had not reached the catalytic level required. In an article published simultaneously in *Creative Computing* and *Byte* in June 1981, Gary Kildall made the point that computer evolution was essentially a process of refining core concepts. His immediate focus was the evolution of operating systems for 16-bit systems based on the 8086 but he was also absorbed by this "emergence of software as a problem-solving tool". In a future not that far away, he prophesised, "refinement through engineering" would complete the shift from hardware to software.[210]

This forward-looking tunnel-vision characterised not only the contributions and the editorials, but the letters to the editors and the advertisements found in these magazines. The exceedingly rapid rate at which new technologies were announced and deployed created an

[209] Carl Helmers, 'Computers tomorrow', *Byte*, February 1977, 10.
[210] Gary Kildall, 'CP/M: a Family of 8 and 16 bit Operating Systems', *Byte*, June 1981, 216.

atmosphere of planned obsolescence that was imposed by the community upon itself. By 1978, the ever-changing goals of the computer hobbyist were no longer about building a 'simple' microprocessor-based computer as it had been three years before. Instead the goal was to integrate it with a keyboard, a monitor (or a screen) and even to interface it with a speech synthesis package to emulate conversations with a human being. That the average amount of memory on a typical system hovered around 16kb of RAM and that permanent forms of storage, such as floppy disks, were incredibly expensive at the time were not a deterrent. On the contrary, the speed at which technologies had devalued over the previous few months indicated that soon anyone would be able to walk into a ComputerLand or a Radio Shack and purchase memory, Winchester hard drives and floppy disks for a few dollars.

This fluid atmosphere reflected the changing skills set valued by the community as time went by. At first, the ability to construct and design circuits was a prime source of notoriety and skill. However, increasingly, software design and astute programming became the focus of celebrity. By the eighties, alongside a dwindling number of hardware projects, software plans became central to the focus of the magazines. The first widely circulated computer language source had been TinyBASIC in the earliest issues of *Dr Dobbs*. Soon, other software 'masterpieces' circulated.

In the pages of *Creative Computing*, the ability to program was equated with the power of understanding and controlling the machine. Right from the first issue, the purpose of the publication was to educate the masses and prepare professionals and educators so that they could introduce youth to the joys and possibilities of interacting with a computer. From very early on, programming prowess was equated with intelligence and skill. In an editorial from 1976, the publisher of the magazine claimed that the ability to transpose mathematical and physical problems in a language that a computer could understand would be the prime determinant in the society of tomorrow. Echoing Daniel Bell's description of a post-industrial society where the value of knowledge outweighed the product of hourly work, the author implied that thinking alone would be sufficient in the world of tomorrow. "The machines will be *thought catalysts*" he promised "that will develop dreams into realities". But creativity and the ability to interface with the machine would be "skills essential to achieving success."[211] In this sense, this article clearly reflected the belief that the computer hobbyist were in the vanguard of a profound social change.

One of the most significant achievements of the computer hobbyist community was the elaboration of ties that were based directly on the operation of the machines themselves. The idea of communicating through a computer is common nowadays, in the age of the internet. In the late seventies, however, the whole proposition seemed rather peculiar. The costs of developing and installing the hardware and software necessary to carry out such a task were very high. At the same time, the small benefits in terms of added-value between a computer-based communication system and the telephone were deemed, in mainframe circles, uninteresting. On the other hand, in the hobbyist aficionado community, using the computer to communicate soon became an essential element of the hobby's construction. In 1978, the electronic extension of the magazine was intended as an extension of the fanzine, the newsletter, and came to be known as the 'BBS' - The Bulletin Board System.[212]

Warren Christensen, a physicist and mainframe programmer in his early 30's, was also a computer hobbyist in his spare time. By the late 1970s he had become expert at programming computers to transfer files from one machine to another via modems over

[211] Robert Peters, 'Do Humans Think?', *Creative Computing*, July-August 1976, 12.

telephone lines. His speciality was to construct simple protocols that allowed computers of different architectures to exchange information in serial form. Christensen lived in Chicago, where winters bring below-freezing temperatures and piles of snow, and in January 1978 there was plenty of indoor time for programming and fiddling with digital equipment. Particularly, during a blizzard, Christensen was forced to miss a meeting of his local computer club. Stuck at home because of the weather, he wondered why the club could not use microcomputers along with some modems to communicate 'asynchronously'. Christensen was aware of the existence of the ARPAnet and a few other private networks used by banks and large corporations to exchange data between computing facilities. He was convinced such networks could be constructed informally over normal telephone lines around a hub where users could dial-in with their own microcomputers. The idea had been building for awhile, and that winter he decided to devise a simple hub for microcomputer communications. Christensen developed the software and Randy Suess, one of Christensen's friends, assembled the hardware.

On February 16, 1978, their system was complete. They named it the Computerised Bulletin Board System (CBBS) in reference to the bulletin boards used during club meetings to exchange messages between fellow users. At first the system was only available to a few friends who had been fortunate enough to receive instructions on how to dial-up Christensen's machine and had been provided with a login account. Of course these friends were also fortunate enough to own a microcomputer and even more fortunate to own a modem. Many in fact had to construct their first modem, since telephone line modulators-demodulators were not yet available from any major constructor in the US at the time. In the

[212] The history of the BBS is recounted in the 'History of the Internet' archives of the WWW3 Consortium at http://www.historyoftheinternet.com/chap3.html as well as at ChicagoNet's History Page: http://www.chinet.com/html/cbbs.html both accessed between February 23rd 2003 and March 11th 2003.

Chicago computer hobbyist crowd, CBBS, or "The BBS" as it came to be known, was at the centre of all discussions. CBBS operated like the computer club's cork bulletin board. People called in (when the single phone line of the BBS was not busy) and logged on with a 'handle' or a 'nickname'. They were then presented with a menu. They could leave messages on a 'public board' or they could write or read messages in private and public forums. The result was the creation of an ongoing, asynchronous computer club meeting that lasted for as long as people logged on and answered each other's messages. Very quickly, the users discovered they could post files and exchange not only messages, but programs and data as well. The user's identities, as well as their age and sex, were protected by the semi-anonymous system of the 'nickname'; the computer club meetings progressively vanished and were replaced by an ongoing virtual gathering which only occasionally met in person, particularly during hardware 'fests'.

In November 1978 Christensen and Suess published an article in *Byte* magazine, describing a BBS and showing how to assemble and administer one.[213] The ensuing popularity of the CBBS project was staggering. The letters to the editors for the months to come were full of dazzled testimonials about the seductive power of this new technology. Hundreds of BBS's appeared throughout the United States and Canada, some focusing on specific topics or computer architectures, but all respecting the basic concept of universal inter-operability. It had been one of Christensen's essential ideas that the basic serial-line protocols should be kept at a bare minimum so any microcomputer could connect to any BBS. While up to that point, the computer was a solitary construct around which communal bonds developed as a result of a need to exchange knowledge with other hobbyists, the BBS gave it a new focus. Now the microcomputer was its own means of communal binding

[213] Warren Christensen, 'A Computer Bulletin Board System', *Byte*, November 1978, 48-65.

much like a real-life construction of one of Escher's *Strange Loops*. The computer community was now constructing its own technological communication network to discuss the construction of the very technology it was discussing. Essential to the mindset of tne BBS crowd was the importance of communal prestige and the Hacker's Ethic principle of open access to information for all who wished it.

Starting in 1964, the US government had sponsored a series of projects researching how to construct national networks spanning several computer facilities. By 1979, the most successful of those projects, ARPAnet, was in fact connected to more than 3000 sites in the United States.[214] The users on any of the machines of the network had a set of tools to communicate to other users on other machines. Email existed and was used in limited fashion by the scientific community. Newsgroups (Usenet) was also in its infancy. However, the computer hobbyist at large had very little personal experience of these developments and ordinary people could not obtain access to any of them. What the BBS did was bring the concept of computer-based communications down to the everyday experience of thousands of computer hobbyists.

The importance of the nascent online community can be readily witnessed by its effect on *Byte*. Throughout 1979 and into 1980, alongside announcements of meetings of clubs and computer user groups there were more and more listings of private BBS's that computer hobbyists were invited to join. The liberalising effect seems to have been electrifying on the community. Between Christensen and Suess's project article from 1978 to January 1981, over 40 articles appeared on various forms of BBS software, terminal emulation, modem technology and projects. One of Steve Cercia's most celebrated projects appeared in 1980 and described how to construct, from discrete components, a 300-baud

[214] For a history of the ARPAnet, see Katie Hafner and Matthew Lyons *Where the wizards stay up late.*

modem good enough "to login to [the hobbyists] favourite neighbourhood BBS and enter the online world".

Promises of an 'online' world of interconnected *personal* computers were suddenly common in the magazines. By contrast to the interconnected mainframe systems that existed at the time, BBS's were ruled by a completely different set of principles. Most BBS set-ups were not owned by companies or educational organisations, such as the ARPAnet and later Internet nodes; they were constructed and operated by single individuals (sysops or system operators) who often were intrigued by the concept of setting up a system and showing off their programming or homebrewing skills. The user was also granted special privileges to enter the sysop's domain and usually granted increased privileges if he contributed to the collection of files, demos and articles on the system. One of the major motivations was to pursue the logic of the 'hands-on' imperative and construct something that could then be accessed, and enjoyed, by someone else. Soon BBS's developed more sophisticated interfaces and featured turn-based games (such as Risk and Tradewars 2002) that allowed many users to play a few rounds a day in a strategy or fantasy game. Some BBS's were linked by more complicated software and permitted the establishment of national forums were computer hobbyists discussed everything, from *Star Trek* to tips and secrets on how to accelerate particularly tricky algorithms. It can, in fact, be argued that the active role of the user in the BBS subculture generalised concepts that ultimately found their complete expression in the Internet of the mid-90's and that its immediate effect in the late seventies was to progressively supplant the magazine as the major binding force of the computer hobbyist community.

Conclusion

While the computer appeared in the popular consciousness in the wake of the Second World War, it did not become an element of daily life until well into the eighties and early nineties. Originally, the computer was designed and constructed as a centralised facility for number crunching. By the nineties, most people associated computers with *personal* computers as its uses shifted to the individual: word processing, internet communication and entertainment. The reality of this increased popularity can be explained to a large degree by the influence on mainstream culture of the computer hobbyist community that blossomed in the seventies. This community embodied an American middle-class subculture trend to embrace technocratic values and to become familiar with the inner workings of technology. This cultural impetus was crucial in wresting control of the computer from large corporations such as IBM and resulted in the creation of a microcomputer industry focused on the interest of private individuals in the comfort of their own homes.

The community's language and frame of reference was filled with icons and themes borrowed from a series of cultural influences inherited from the early fifties. Science fiction themes descended from works by Isaac Asimov and Robert Heinlein as well as the television series *Star Trek*. Other references to mathematical and artistic constructs derived from the works of artists such as M.C. Escher and the cognitive research of Alan Turing in the field of computer science. The hobbyist's sensibility accepted computer-generated imagery and mind-twisting puzzles as forms of art loaded with important messages. These formed a bridge between the computer hobbyist's magazines and the more 'serious' publications that existed for decades before the microcomputer revolution, such as *Scientific American* and *Popular Science*.

Through the conception of the project in computer hobbyist publications, we have seen how elements of technocratic worldviews are inherent to the community's views of itself. We have also seen how the construction of the community was dependent on the availability of a national forum for the emergence of role-models, of mentors to emulate. The magazine also served as catalyst for the marketplace, from which a sense of community and achievement evolved. With the advent of technological innovations centred on club-to-club communication, the magazine also became a vehicle for the exchange of ideas, experiments – and a very potent tool in the establishment of a sense of *legitimacy* to the bonds that tied the community together. Finally, the magazine served as a forum not only to establish prestige, but to discuss various perceptions of what the next "stage in the revolution" of computing would be. Some commentators, such as Ted Nelson, favoured a radical computer liberation movement. Others, like David Ahl, preferred to hope that computers would become objects of learning and teaching and would therefore affect most humans by their empowering capabilities. Overall, however, most computer hobbyists saw in the machine an object of profound social change. With the emergence of the BBS as a tool for long-distance asynchronous communication, which recursively relied on the computer as its main vehicle, the valorisation of the personal computer was, by 1980, complete.

In American popular culture, the microcomputer revolution gave middle-class individuals the chance to explore their creativity while performing seemingly useful tasks in a technocratic context. The pervasive nature of the forward-looking texture of American imagery, which had always presented the process of progress as an unavoidable and desirable phenomenon, resulted in a cultural impetus to construct concrete representations of future technologies. This impetus resulted in a sizeable number of hobbyists exploring what computers could do for individuals, by contrast to corporations. Along the way, new uses (word processors, spreadsheets, BBS's) were discovered as valid and useful applications of the microcomputer, which over the course of the eighties and early nineties, led to the mainstream acceptance of the Internet.

At the same time, the process by which computer hobbyists' interests entered the mainstream eventually transformed the magazines themselves by shifting the focus from technology to the nascent "microcomputer business". By the early nineties, the few surviving publications from the first phase no longer focused on hardware or software projects. The imagery completely shifted and even *Byte* in the nineties featured photo-realistic covers with images of recent computer models and listed its articles with catchy phrases in an effort to draw readership from professionals in the microcomputing field - which by now was referred to as the *personal computing* business.

The period from 1975 to 1980 was a unique era, when technologically-literate individuals saw the opportunity to explore skills and ideas that the larger corporate guns had neglected. In doing so, they constructed a community preoccupied with realising many of the promises that had been foretold by major voices of American culture since the early thirties. They succeeded in bringing the computer closer to the individual in the factual adoption of the technology by large proportions of the population. All the major questions they tackled, however, regarding artificial intelligence and the ultimate relationship between human and machines remain, to this day, open for discussion. These questions, however, are now closer to the mainstream imagery than ever before.

More important, however, is the transformation in the popular mind of what a computer represents. The popular image of the computer as a facility is fading while it remains strong in the real world of corporate America. In the popular imagery, the PC has expanded to fill that void. In movies such as *The Net* (1995), *Hackers* (1996) or *Anti-Trust* (2001) the fear of the IBM-style corporation controlling individuals through a manipulation of the mainframe facilities has given way to a more subtle fear of a subversion of the distributed, individual-oriented facilities that have emerged under the forms of the Internet and the PC. Arguably this is a sign that although the popular imagery of technology has undergone constant shifts and changes over the last quarter century, many themes nurtured by decades of forward-looking progress remain firmly rooted (one might even say unresolved) in the popular discourse that permeates American culture.

Bibliography

Primary Sources

80Micro, March 1982; September 1982.

Byte, September 1975 – March 1981; July 1982; March 1983; June 1985; September 1985.

Creative Computing, September 1974 – January 1980.

Dr Dobbs journal of tinyBASIC calisthenics and orthodontia (running light without overbyte) , January 1976- December 1980.

Popular Computing, December 1980; February 1981.

Popular Electronics, January 1972; September 1973; March 1974; January 1975; February 1976; June 1976; August 1978; April 1980.

Popular Science, October 1978; November 1979; January 1980.

Scientific American, March 1976; August 1977; January 1978; December 1980.

Nibble, July 1979; March 1980; August 1981.

Secondary Sources

Abrahamson, David. *Magazine-made America : The cultural transformation of the postwar periodical*. New Jersey : Hampton Press, 1996.

Ahl, David. *The Best of Creative Computing.* Morris Plains : Creative Computing Press, 1980.

Ash, Brian ed. *The visual encyclopaedia of Science Fiction: a documented pictorial checklist of the science fiction world.* New York: Harmony Books, 1977.

Ashley, Michael. *The History of the Science Fiction magazine*. London : New English Library, 1979.

Asimov, Isaac. *Robot Visions*. New York : Roc Books, 1991.

___________, *Gold.* New York : Bantham Books, 1996.

___________. *Caves of Steel*. New York: Doubleday, 1953.

__________. *The Naked Sun*. New York: Doubleday, 1956.

Aspray, William. *John von Neumann and the Origins of Modern Computing*. New York : Ticknor & Fields, 1984.

Bennahum, David S. *Coming of Age in cyberspace*. New York : Basic Books, 1998.

Berners-Lee, Tim. *Weaving the web : the original design and ultimate destiny of the world wide web.* New York : HarperBusiness, 2000.

Bush, Vannevar. "As We May Think" (1945). In *From Memex to Hypertext: Vanneuar Bush and the Mind's Machine*, edited by James M. Nyce and Paul Kahn. San Diego : Academic Press, 1991.

Booker, M. Keith. *Monsters, Mushroom Clouds and the Cold War : American Science Fiction and the Roots of Postmodernism, 1946-1964.* New York : Oxford University Press, 2001.

Boorstein, Daniel. *The Republic of Technology*. New York : Harper & Row, 1978.

Boyer, Paul. *By the bomb's early light: American thought and culture at the dawn of the atomic age.* New York: Pantheon, 1985.

Campbell-Kelly, Martin and Aspray, William. *Computer : A history of the information machine.* New York : Basic Books, 1996.

Carter, John. *The Creation of Tomorrow :Fifty years of American Science Fiction*. New York : Columbia University Press, 1977.

Ceruzzi, Paul E. *Reckoners: the prehistory of the digital computer, from relays to the stored program concept, 1935-1945.* Estport, Conn. : Greenwood Press, 1983.

__________. *A history of modern computing* Cambridge : The MIT Press, 1998.

Chposky, James and Leonsis, Ted. *Blue Magic: The People, power and politics behind the IBM personal computer.* New York: Facts on File, 1988.

Clareson, Thomas. *Understanding Contemporary American Science Fiction : The Formative period (1926-1970)* Columbia, S.C. : University of South Carolina Press, 1990.

Cortada, James W. *Before the Computer : IBM, NCR, Burroughs and Remington Rand and the industry they created, 1865-1956*. Princeton : Princeton University Press, 1993.

Cringley, Robert X. *Accidental Empires : how the boys of silicon valley make their millions, battle foreign comptetition and still can't get a date*. New York : HarperBusiness, 1996.

Cutcliffe, Richard and Reynolds, Terry ed. *Technology and American History*. Chicago : University of Chicago Press, 1997.

Dick, Philip K. *Do Androids Dream of electric sheep?* New York: Bantam Books, 1968.

___________. *Ubik*. New York: Bantam Books, 1966.

Doherty, Thomas. *Teenagers and Teenpics: the juvenilisation of American movies in the 1950's.* Boston: Unwin Hyman, 1988.

Douglas, Jack ed. *The technological threat*. New Jersey : Prentice-Hall, 1971.

Ermann, David and Williams, Mary and Gutierrez, Claudio eds. *Computers : Ethics and Society.* New York : Oxford University Press, 1990.

Freiberger, Paul and Swaine, Michael. *Fire in the valley : the making of the personal computer, 2nd ed* New York : McGraw Hill, 2000.

Goodstone, Tony ed. *The Pulps : Fifty years of American Pop Culture*. New York : Chelsea House, 1970.

Goldstine, Herman. *The Computer from Pascal to von Neumann.* Princeton : Princeton University Press, 1972.

Hafner, Katie and Lyon, Matthew. *Where wizards stay up late : the origins of the internet*. New York : Simon & Schuster, 1996.

Heinlein, Robert. *The Puppet Masters*. New York : Doubleday, 1953.

___________. *Starship Troopers*. New York : Doubleday, 1955.

___________. *Stranger in a strange Land.* New York : Doubleday, 1958.

Himanen, Pekka. *The Hacker Ethic and the spirit of the information age.* New York : Random House, 2001.

Hofstadter, Douglas R. *Godel, Escher, Bach : a golden eternal braid.* New York :Basic Books, 1979.

___________. *Le Ton beau de Marot : in praise of the music of language*. New York : Basic Books, 1996.

___________. *Metamagical Themas*. New York : Basic Books, 1985.

Ierley, Merritt. *Wondrous Contrivances : Technology at the threshold.* New York : Clarkson Potter, 2002.

Kidder, Tracy. *The Soul of a New Machine*. Boston : Back Bay Books, 1981.

Lerner, Frederick Andrew. *Modern science-fiction and the American literary community.* Metuchen : The Scarecrow Press, 1985.

Levy, Steven. *Crypto : how the code rebels beat the government – saving privacy in the digital age*. New York : Penguin Books, 2001.

Levy, Steven. *Hackers : heroes of the computer revolution*. New York : Penguing Books, 1984.

Marx, Leo. *The Machine in the garden: technology and the pastoral ideal in America*. New York: Oxford University Press, 1964.

Mott, Frank Luther. *The History of American Magazines*. New York: Appleton, [1930-1968].

McCartney, Scott. *ENIAC : the triumphs and tragedies of the world's first computer*. New York : Walker and Company, 1999.

McDougall, Walter A. *The Heavens and the Earth: A political history of the space age.* New York : Basic Books, 1985.

Moorcok, Michael. *The Comelius Chronicles*. London: Chasm Publishers, 1966.

Noble, Daniel. *America by Design : Science, technology and the rise of corporate capitalism.* New York : Alfred A. Knopf, 1977.

Nye, David. *Electrifying America : Social Meanings of a new technology, 1880-1940.* Cambridge : The MIT Press, 1990.

Ohmann, Richard ed. *Making and selling culture*. Hanover : University Press of New England, 1996.

Orvell, Miles. *The Real Thing : Imitation and authenticity in American culture, 1880-1940*. Chapell Hill : University of North Carolina Press, 1989.

Patterson, James. *Grand Expectations : the United States, 1945-1975.* New York: Oxford University Press, 1996.

Peterson, Theodore. *Magazines in the twentieth century.* Urbana : University of Illinois Press, 1964.

Porush, David. *The Soft Machine : Cybernetic Fiction*. New York : Methuen, 1985.

Pursell, Carroll. *The Machine in America : a social history of technology.* Baltimore : Johns Hopkins University Press, 1995.

Ranade, Jay ed. *The Best of Byte Magazine, 1975-1990.* New York : McGraw Hill, 1991.

Reed, David. *The Popular Magazine in Britain and the United States, 1880-1960*. Toronto : University of Toronto Press, 1997.

Rhodes, Richard ed. *Visions of Technology*. New York : Simon & Schuster, 1999.

Rosenberg, Richard. *The Social Impact of computers*. Boston : Academic Press, 1992.

Schudson, Michael. *Discovering the News : A social history of American Newspapers*. New York : Basic Books, 1978.

Seed, David. *American Science Fiction and the Cold War – Literature and Film*. Chicago : Fitzroy Deadburn, 1999.

Shurkin, Joel. *Engines of the Mind*. New York : W.W. Norton, 1996.

Slotkin, Richard. *Fatal Environment: the myth of the frontier in the age of industrialisation, 1800-1890.* New York: Atheneum, 1985.

Stross, Randall E. ed. *Technology and Society in Twentieth Century America : an anthology*. Chicago : Dorsey Press, 1989.

Swade, Doron. *The Difference Engine : Charles Babbage and the Quest to Build the First Computer.* New York : Viking, 2001.

Tebbel, John William. *A compact history of the American Magazine.* New York : Hawthorne Books, 1969.

Tebbel, John William and Zuckermann, Mary Ellen. *The Magazine in America, 1741-1990.* New York : Oxford University Press, 1991.

Tichi, Cecelia. *Shifting Gears : technology, literature, culture in modernist America*. Chapel Hill : University of North Carolina Press, 1987.

Turing, Alan M. "On computable numbers with an application to the Entschidungsproblem" *Proceedings of the London Mathematical society, no. 42 (1937)* reprinted in *The Mind's I: Fantasies & Reflections on Self & Soul*, edited by Douglas Hofstadter. New York: Basic Books, 1981.

West, Thomas Reed. *Flesh of Steel : Literature and the machine in American culture*. Charlotte : Vanderbilt University Press, 1967.

Waldrop, Mitchell. *The Dream Machine : J.C.R. Licklider and the revolution that made computers personal.* New York : Viking, 2002.

Wolseley, Roland. *The Changing Magazine*. New York : Hastings House, 1973.