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THE BBC MICRO

DOWN

ALISON GAZZARD

Now the Chips Are Down

Platform Studies

Nick Montfort and Ian Bogost, editors

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Now the Chips Are Down

The BBC Micro

Alison Gazzard

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Series Foreword

How can someone create a breakthrough game for a mobile phone or a compelling work of art for an immersive 3D environment without understanding that the mobile phone and the 3D environment are different sorts of computing platforms? The best artists, writers, programmers, and designers are well aware of how certain platforms facilitate certain types of computational expression and innovation. Likewise, computer science and engineering have long considered how underlying computing systems can be analyzed and improved. As important as scientific and engineering approaches are, and as significant as work by creative artists has been, there is also much to be learned from the sustained, intensive, humanistic study of digital media. We believe it is time for humanists to seriously consider the lowest level of computing systems and their relationship to culture and creativity.

The Platform Studies series has been established to promote the investigation of underlying computing systems and of how they enable, constrain, shape, and support the creative work that is done on them. The series investigates the foundations of digital media—the computing systems, both hardware and software, that developers and users depend upon for artistic, literary, and gaming development. Books in the series will certainly vary in their approaches, but they will all share certain features:

- a focus on a single platform or a closely related family of platforms
- technical rigor and in-depth investigation of how computing technologies work
- an awareness of and a discussion of how computing platforms exist in a context of culture and society, being developed on the basis of cultural concepts and then contributing to culture in a variety of ways—for instance, by affecting how people perceive computing.

Acknowledgments

The BBC Micro was my first computer. It is a machine I will always remember taking pride of place in our living room as I sat with my dad playing the games he would program. He would later show me how to program my own simple games and animations, as I typed in line after line of code from listings found in books, or we would spend afternoons working our way through countless plays of *Granny's Garden* and *Repton*. That original machine now takes pride of place in my own living room, and the archive of those games, books, and manuals remain in my loft. So first and foremost I would like to thank my parents for buying the family Micro, and for many of the memories that found their way into this book.

Those memories were sparked once again in 2012 during my first visit to The National Museum of Computing (TNMOC) in Bletchley. It was there that I met Owen Grover, who replaced the burned-out capacitor in my Micro, and Chris Monk, who runs the educational program at the museum and encourages visiting school groups to spend an hour programming the Micros using BASIC. Chris provided many valuable insights into the BBC Micro, and went out of his way to find some of the many manuals that I worked my way through while researching this book. I am thankful to the museum for providing access to its archive as I read through racks of magazines, and to the visitors who provided their own recollections of the machine on the Sundays that I would help out in the BBC Micro classroom. I will never forget the Sunday, not long before Christmas, when Chris, Dave Sussman, Steve Clark, and I sat programming a Christmas-tree graphic in BASIC to show to visitors in the classroom, and how it took four

programmers a good half hour to find where a comma had been omitted in the code.

TNMOC also led me to David Allen, who not only gave an insightful talk into his time working on The Computer Literacy Project but also allowed me to follow up with further questions, which I am truly thankful for. The insights provided by those who helped to develop the platform and those who created content for it were extremely helpful to me while I was writing this book, and for these insights I would like to thank Sophie Wilson, David Braben, and Tim Tyler. Sophie's detailed comments on the draft of my manuscript provided further commentary into the development process, for which I am very grateful. I would also like to thank Jon Silvera at FUZE for not only providing his own history of the Beeb but also supplying me with my own Special Edition FUZE casing to go alongside my Micro in the living room.

At the UCL Institute of Education I would like to thank those who attended my lunchtime seminar at the London Knowledge Lab during the early stages of writing this book. Your questions and own memories of using the machine in the classroom all helped to shape some of the research in this book. I would like to thank my colleagues Andrew Burn, John Potter, and Diane Carr for their support while I was writing the book, and John and Andrew for their comments on some of the chapters. I would also like to thank Neil Selwyn, Jussi Parikka, and Tom Apperley for recommendations, advice, and feedback during the writing process.

Some of the material in part II of this book was presented at the 2013 History of Games conference and at the 2014 Game History Annual Symposium, both held in Montreal. I would like to thank not only the organizers of these events but also the attendees and panel members for their insightful comments about computing in various parts of the world in the 1980s. Some of the research presented in chapter 4 about the game *Elite* was published as "The Player and the Platform: Exploring the (Hi)stories of *Elite*" in *Game Studies* 13, no. 2 (a special issue devoted to the History of Games conference), and some of the research presented in chapter 5 about the game *Repton* was published as "Remembering Repton: An alternative history of co-creativity in 1980s Britain" in the June 2015 issue of *Kinephanos* (a special issue devoted to the cultural history of video games).

This book would not have been possible without the early comments provided by Ian Bogost and Nick Montfort, the editors of the Platform Studies series, and by Doug Sery at the MIT Press. I would like to thank them for their help in the early stages of preparing the book. I would also like to thank the anonymous reviewers and everyone at the MIT Press.

Last and by no means least, I would like to thank Steve for giving me the space and time to write the manuscript, for listening to me talk through ideas, for his own history of microcomputing in the 1980s, for reading multiple drafts of the book, for providing me with many cups of tea, for his continued support, and for proposing a week after I had finished the first draft. This book is for him, as although it was the ZX Spectrum that started his journey into programming, it was, in many ways, the Beeb that brought us together.

Introduction

[This is] not some distant future, which we and our descendants can blissfully ignore, but one which is imminent and whose progress can be plotted with some degree of precision. It is a future which will involve a transformation of a world society at all kinds of levels, and while taking place slowly at first, will gather pace with sudden force. It's a future which is largely moulded by a single, startling development in technology whose impact is just beginning to be felt. The piece of technology I'm talking about is, of course, the computer.

Christopher Evans, *The Mighty Micro* (Gollancz, 1979), 1

The political, social, and economic climates of Britain in the 1970s were bleak. It is a decade remembered for power cuts, a lack of waste disposal, miners strikes, union opposition, and changing governments. As the end of the decade neared, broadcasters and journalists began to create a wave of panic about Britain's place in the global economy. While other countries were already positioning themselves within the electronics and micro-electronics market, Britain was seen to be falling behind. Disheartened by a lack of government response to the issue, the British Broadcasting Corporation (BBC) and other media outlets began to expose some of the issues and fears related to this perceived lack of technological advancement, including the 1978 episode of the BBC's television series *Horizon* titled "Now the Chips Are Down" and Independent Television's 1979 series *The Mighty Micro*.

Both the *Horizon* episode and the ITV series were seen by some as casting the growth of microcomputing in a pessimistic light for future workers, yet at the same time Britain needed to be seen to position itself as a country at the heart of innovation within a global context. And a generation of users needed to be educated as to how to understand and use this new wave of technology. In 1980 the Microelectronics Education Programme (MEP) was announced and financed by the Departments of Education for England, Northern Ireland, and Wales with the aim to “help schools to prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive.”¹ Subsequently it was also discussed that a more general education about microcomputers was needed, and who better to do this than the British Broadcasting Corporation, the company that had sought to “entertain, educate and inform” us about the world we live in.²

From this the concept of the BBC Microcomputer was born. In January 1982 the BBC launched its Computer Literacy Project with the aim “to introduce interested adults to the world of computers and computing, and to provide the opportunity for viewers to learn through direct experience how to program and use a microcomputer.”³ It was this philosophy that ran through the development of the scheme. In addition to developing a series of television programs, the BBC would support a range of courses, books, and software for both teachers and learners along with the licensing of its own microcomputer to use throughout the campaign. After an outline of the proposed machine was given to various microcomputing manufacturers in the UK, Acorn Computers was chosen by the BBC to develop the machine that would be connected to the Computer Literacy Project—a machine that would subsequently be named the BBC Microcomputer. Therefore, not only was a nationwide computer literacy program developed and rolled out, but so too was an accompanying piece of hardware developed by Acorn Computers and subsequently recognized as being at the forefront of the campaign.

In contrast with other microcomputers designed in Britain during the 1980s, much of the BBC Micro’s final design was influenced by the Computer Literacy Project. This gave the machine a particular ethos for those envisioning its use in both the home and educational markets, thus leading to questions about what computer and digital literacies might or should be. At the same time, the design of the platform was based not only on what the BBC thought the public and the schools might need but also on a wider media campaign. The machine had to be capable of being displayed on both pre-recorded and live television programs, and therefore its functionality had to allow for recording the output signal to show

viewers on-screen examples clearly so that they could potentially follow along at home. Furthermore, beyond the home use of the platform, the Computer Literacy Project places the BBC Microcomputer into a wider discussion about not only technological determinism but also how the political and media climates of the late 1970s became directly related to the machine's production, to its supply, and in many ways to its legacy. Therefore, this book places the birth of the BBC Microcomputer in the context of 1980s Britain—that is, of a country undergoing political and educational change as it was trying to erase dystopian views of the perceived future. As Paul du Gay et al. state in their book *Doing Cultural Studies*, “Throughout the 1980s Margaret Thatcher’s radical programme of reform was represented in large part as a cultural crusade, concerned with the attitudes, values and forms of self-understanding embedded in both individual and institutional activities. The Conservative Party’s political project of reconstruction was simultaneously defined as one of cultural reconstruction, as an attempt to transform Britain into an ‘enterprise culture.’”⁴

In parallel to this the BBC Micro is remembered as a machine designed as part of a centralized project envisioned by a media corporation and Acorn Computers, the company that created and manufactured the machine. Instead of focusing on single entrepreneurs, the creativity of the platform and potential enterprise created from it are examined in light of the uses of the hardware and software developed for the machine. It is for this reason that the origins of the BBC Micro have to be explored via an examination of the early capabilities of multi-platform content generation and consumption in the 1980s. These factors were central to the BBC Micro’s influence on the public, but this is not the only focal point for the multiple literacies that this approach enabled. Literacies related to computer programming and software creation were encouraged, but so too was an understanding as to how to access information across a wide range of related media services, hardware literacies, and “do-it-yourself” computing. This led to the dissemination of ideas related to how to use the machine among local communities as a way of continuing to develop the possibilities of this new learning not originally anticipated by the Computer Literacy Project, or even by the hardware embedded within the BBC Micro itself.

This is not a book about firsts in the timeline of microcomputing, nor is it a history of the BBC Micro or Acorn Computers. It is a book about particular platform-specific case studies identified through hardware and software innovations facilitated by the machine. As Paul Atkinson notes in his discussion of “firsts” related to the evolution of computers, “it has

to be accepted ... that for such complex technological products there is no relevant, single 'first'—rather, there is a series of related innovations, taking place in different locations, often at very similar times, each having a claim to having pushed the development of computing forward in one of a number of ways.”⁵ Although it is possible to understand what was unique about the BBC Micro via its platform-specific characteristics, and how these characteristics were used and sometimes manipulated by others in an attempt to push the boundaries of what the machine could offer, these characteristics of the machine can also be situated in light of other events within microcomputing cultures. Therefore, instead of attempting to write a comprehensive history of the BBC Micro, I have attempted to provide snapshots of particular components unique to its design and placement within a microcomputing market while being aware of other influences for both producers and consumers during the microcomputer explosion in 1980s Britain.

Microcomputers in 1980s Britain

One of the most important points to consider is just how the BBC Microcomputer was created by both the BBC and Acorn Computers. Understanding some of the initial developments surrounding the BBC Micro requires first discussing the BBC's Computer Literacy Project.

Founded by John Reith in 1922, the BBC created the “template for public service broadcasting in Britain.”⁶ The service is primarily funded by a license-fee structure. Anyone who purchases a television set in Great Britain or Northern Ireland must pay a fixed fee in order to watch television content. The license fee enables the BBC to produce content in the public interest and keeps it from having to accept advertising, as commercial television channels must. In response to this funding structure, the BBC as a corporation is, in many ways, defined by its responsibility to produce radio and television content for the masses that adheres to a set of conditions. Reith fought hard to fend off politicians' attempts to influence the BBC and to make it the BBC's mission “to enrich people's lives with programs and services that inform, educate and entertain.”⁷

In the 1960s, a series titled *Horizon* was born. According to its mission statement, “The aim of *Horizon* is to provide a platform from which some of the world's greatest scientists and philosophers can communicate their curiosity, observations and reflections, and infuse into our common knowledge their changing views of the universe. ... We shall do this by presenting science not as a series of isolated discoveries but as a

continuing growth of thought, a philosophy which is an essential part of twentieth century culture.”⁸ It was this philosophy that led to the airing of the 1978 *Horizon* program titled “Now the Chips Are Down.”

“Now the Chips Are Down” is often cited as having been the starting point of a wider discussion about the integration of the microcomputer into British society and of a drive toward increased computer literacy among the public.⁹ It painted a picture of a new wave of technology, starting with a computer reading a book to a blind man, following a trajectory of the development of computing from valve technologies through to silicon chips and the microcomputer. But rather than offer a positive outlook on the benefits of the microprocessor and the rise in computing power, the program offered little consolation to its viewers. Instead, the wording became increasingly negative. It spoke of a “new war” arising from the development of arcade games generating an income of a quarter of a billion pounds, and how the rise of the microcomputer would result in “100 petrol pump attendants [being] unnecessary.” In an article titled “Computing for the Masses? Constructing a British Culture of Computing in the Home,” Tilly Blyth writes that the program “tapped into a bigger culture of concern about the nation’s response to its changing economic position and developing technology.”¹⁰ As the program unfolds, so does the scaremongering. Word-processing software is said to be taking jobs from typists, and it is observed that even the skills needed to paint a chair can be “absorbed into the machine.” In a dissertation titled “The Making of the Micro,” Thomas Lean observes that the program “on one hand [promotes] more leisure time, easier lifestyles and greater productivity [but] on the other, massive unemployment and other unpleasant social implications, and a Britain further in decline in the face of computerised foreign competition.”¹¹

In October 1979, one of the other major television channels in Britain, ITV, aired *The Mighty Micro*, a series of six programs about the development and some of the possible effects of the silicon chip.¹² *The Mighty Micro* was written by Christopher Evans, who published a book with the same title; the front of its jacket included the sentence “This could be the most important book you ever read—it might even be the last.”¹³ Again, in a time of scaremongering, both the book and the television series not only detailed the past and the present but also attempted to predict the future in the short, medium, and longer terms. (The “long-term future” referred to in the last chapter of Evans’ book is the period 1991–2000.) Not only did Evans focus on the possible evolution of the microcomputer; he also tried to predict political, social, scientific, psychological, and even “bizarre” issues (meaning moral and ethical problems that the misuse of

computing power might provoke). According to various media outlets, computers (often unnamed ones) were about to infiltrate daily life.

Coincidentally, the United Kingdom entered another phase in its political history around the same time. Margaret Thatcher, who had become the leader of the Conservative Party in 1975, became the UK's first female prime minister on May 4, 1979. Moving into the political limelight at a time of unrest among the media about the role of computing in industry, culture, and society, the newly formed Conservative government had members who were eager to understand this phenomenon and who thought "something should be done."¹⁴ France, Sweden, Denmark, the United States, Canada, and Japan were all more advanced in their thinking about supporting their national microcomputing industries. Histories charting the rise of the microprocessor in the US often dominate accounts of what was happening at this time. Martin Campbell-Kelly and other historians noted that in the mid 1970s, in parallel to the development of Intel's 8080 microprocessor, "other semiconductor manufacturers were starting to produce their own microprocessors—such as the Motorola 6800, the Zilog Z80, and the MOS Technology 6502."¹⁵ The development of such processors has subsequently been linked to the development, in 1977, of the Apple II, characterized by Campbell-Kelly et al. as a "real personal computer" after an era of hobbyist computing. However, from the British perspective the UK was already falling behind, even though British companies were manufacturing a variety of microcomputers. The Conservative government wanted to promote computing and information technology in order to be seen as forward thinking, but also as a way of showcasing Thatcher's new economic policies related to entrepreneurial thinking.¹⁶ A new position was created: Minister of State for Industry and Information Technology. The first to hold it was Kenneth Baker. In his biography, Baker writes that "the microchip ... was to affect not just the technological and electronic industries but every industry in the country, through revolutionising the processing of information, the design of its products and the control of the manufacturing process."¹⁷ The government decided to support research and development in the field of information technology by increasing the amount of funding available from 1979 to 1984 by £250 million.

Although these events did not directly influence the development of the BBC Micro, or even influence the BBC in its original decision making, the political climate at the time did help to promote the possibilities offered by new microcomputers. Neil Selwyn cites 1979 as a "turning point" in the UK's relationship with the computer for numerous reasons, including "the election of Margaret Thatcher's Conservative government,"

“the early development of UK-produced computers,” and “a rising media interest in new technologies.”¹⁸ For Selwyn these factors allow for the “discursive formation of educational computing,” yet the BBC Micro was only one of the microcomputers driving this shift.

Before the BBC campaign promoting an understanding of computing even began, a microcomputing race was getting underway. The evolution had already begun for those in the know about these new processors, with the ability to assemble do-it-yourself home computing kits and eventually ship them to others in the know. Although not new, and formed within a long line of mainframes and other larger computing systems, the microcomputer was seen in Britain as accessible. Whereas in the United States hobbyist computer kits such as the TRS-80 had seen a wave of computing culture emerge, to be replaced by consoles such as the Atari VCS or more powerful machines such as the Commodore 64 and the Apple II, in Britain in the 1980s interest in computing was, for many, centered on home-grown computing cultures. According to Campbell-Kelly et al., in the US “during 1977 three distinct paradigms for the personal computer emerged, represented by three leading manufacturers: Apple, Commodore Business Machines, and Tandy, each of which defined the personal computer in terms of its own existing culture and corporate outlooks.”¹⁹ However, in the UK there were other companies manufacturing microcomputers for home use, among them Sinclair, Newbury, Tangerine, Research Machines, Transam, Nascom, and Acorn. Though some companies were more successful than others, each had a role to play in the British microcomputing scene.

Part of that scene began in the communities of Cambridge, where groups of people were already excited by the possibilities that smaller computing systems could offer. Cambridge as a site for engineering and technological innovation was nothing new. According to Kirk and Cotton’s introduction to *The Cambridge Phenomenon*, “around 4000 companies exploiting technology and innovation in some form or another have been set up around Cambridge since Tim Eiloart founded Cambridge Consultants in 1960.”²⁰ However, according to Kirk and Cotton there had already been a “handful of engineering companies” before 1960, including “The Scientific Instrument Company (founded 1881), the Pye Group (1896) and Marshall of Cambridge (1909).”²¹ The Cambridge scholars Charles Babbage and Alan Turing are both widely recognized in the history of computing in Cambridge.²² However, it was after Labour Party leader Harold Wilson’s “white heat of technology” speech, delivered at a conference of the party in 1963, that technology companies really began to grow in the Cambridge area.²³ Yet for those inside the Cambridge computing

scene during the late 1970s and the early 1980s the future was now, the possibilities were endless, and the need for more than one company offering computers to consumers started to become a desirable concept for those with the expertise to do so.

In the 1980s, microcomputers were seen as a “potent symbol of ‘new technology.’”²⁴ In fact 1982 was declared the British Information Technology (IT) Year, coinciding with Kenneth Baker’s appointment as the Minister for Information Technology in the Department of Trade and Industry. As Maureen McNeil notes, the terms associated with microelectronics and microcomputers were replaced with the term “information technology” as a way of broadening the spectrum of the new information revolution and focusing not only on hardware but also on the “conceptual nature” of what was being produced alongside its innovative qualities.²⁵ In line with Margaret Thatcher’s proposals, 1980s British computing is in many ways recognized for entrepreneurs and their machines—for example, Clive Sinclair’s ZX80 and ZX Spectrum computers and his C5 electric car. As a way of trying to convince the general public that Britain could survive the recession of 1979–1983, which resulted in the loss of manufacturing jobs and in some ways drove the dystopian views of the rise in microcomputing, “the positive associations with IT were further amplified through other vocabulary extensions—the ‘sunrise’ industries, Britain’s ‘sunbelt’ (the area of the country in which the high-skill end of IT industries were concentrated).”²⁶

The promotion and media coverage of IT entrepreneurs in Britain at the time not only helped to demystify the microcomputer but also helped to educate consumers about microcomputers. The BBC campaigned for general computer literacy but this was not the only way of educating the public. The publicity that Sinclair received in the media directed the public’s attention toward the new revolution. “At the end of 1981,” according to Maureen McNeil, “200,000 households in the UK had computers. By the end of 1983, there were 2 million such households and Britain had the highest number of home computers per capita of any nation in the world. By early 1984, somewhere between 11 and 14 per cent of UK households were equipped with these machines.”²⁷ Although the BBC Microcomputer was by no means the only machine to be used by the British public, its inception is a prime example of how such a project came to life when other machines were already on the market.

Aware of the current media climate and of debates about computer use and subsequent literacy of microcomputing in the UK in early 1980, Sheila Innes, then Head of Continuing Education, sent two people from her team, David Allen and Robert Albury, to investigate what could be

done in order to drive microcomputing education in the UK. In a recent retrospective, David Allen recalls Innes saying “There’s this thing called microelectronics, I want you to see if there’s anything in it.”²⁸ The BBC had already delivered an Adult Literacy Campaign from 1972 to 1976, and had broadcast an associated television series titled *On the Move*. Indeed, the history of the BBC’s links with educational programming goes back to 1971 and a partnership with The Open University. Offering distance-learning courses, including degrees, The Open University used the BBC as a means of transmitting programs for its students to watch. However, it was *On the Move* in particular that influenced the BBC’s attitude toward computer literacy. As David Allen notes, the television program was used as a stimulus for more hands-on education. The BBC had a strong belief in the hands-on philosophy. As Allen states, you had to “use it to control it.”²⁹ This philosophy formed the backbone of the Computer Literacy Project and the BBC Microcomputer: controlling the platform was very much at the heart of where users began their journey into what the machine could do.

Excavating the Platform

For many reasons the BBC Micro was more than just the hardware platform. The widespread adoption of sharing the responsibility of the Computer Literacy Project across several BBC and government departments is discussed in *The Legacy of the BBC Micro*, a report, published by the charity Nesta in May 2012, that lists the BBC Education Officers, BBC Enterprises, Engineers, the Department of Industry, and the Departments of Education and Science as all playing roles in the project.³⁰ Alongside this, the Computer Literacy Project was also enhanced by a range of television and radio programs broadcast by the BBC, educational programs run in schools, a correspondence course, and a range of books and magazines published by the BBC and by various publishing companies.

These multiple outputs potentially encouraged linked forms of learning by users drawing on similar examples in a variety of ways. This multiple-platform approach can be seen as an early example of what Henry Jenkins and others define as “convergence culture,” with the BBC Micro platform at the heart of the campaign (see figure I.1).³¹ As the flagship machine for the range of television shows that were aired by the BBC, the BBC Micro was seen as a vehicle to educate the general public about using microcomputers. Although the BBC is not allowed to actively advertise products in its programs, its links to the BBC Micro were apparent from the symbol of the owl found both on the machine and in the opening titles

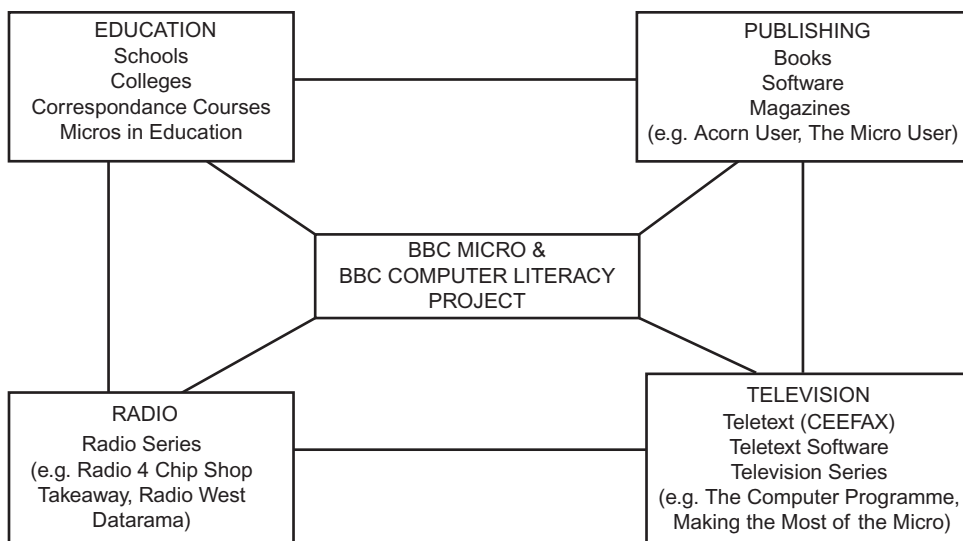


Figure 1.1

The BBC Micro and the Computer Literacy Project in the context of other services and media outlets.

of *The Computer Programme* and of the follow-up series, *Making the Most of the Micro*. Although the BBC Micro was not directly advertised as part of the television shows, the links to the platform were there in small parts of the design of related media content. Subsequently, the project relied on the convergence of multiple outlets that could be used to promote the machine indirectly as well to aid in general learning about a range of microcomputers in Britain. The widespread use of different media outlets—television, radio, and home education courses—encouraged further conversations among the public and wider engagement and participation in the generating of knowledge about the machine.

Today, as we are so often reminded, we live in an age of “participatory culture.”³² The development of the Internet and, in turn, the World Wide Web has seen many participants fuel their creativity in a variety of ways, among them blogging, writing Wikipedia entries, uploading YouTube videos, and “modding” (modifying) video games. However, this creativity is not a new phenomenon. Although hack spaces, game creation, co-creation, and sharing software are all current topics of media discussion and debate, these practices occurred before these terms became part of our popular culture and of what is often defined as a “new media”

vocabulary. As many have written, new media often draw on older forms of media.³³ The computing technologies of today would not have been possible without previous developments in microcomputers, processing powers, memory, and disk space. Beyond technological progression, our cultural understandings of these machines have grown with the familiarity of processes and with the acknowledgment of the change through our societal uses, embedding computers at the heart of most of what we do in the digital world. The integration of these systems into our workplaces, homes, and social spaces relies on the audience's understanding, recognition, and use. The ability to understand how to use some of the many computers of the time was made possible by access to computer clubs, information transferred among friends on school playgrounds, and dedicated magazines related to each platform. All these scenarios enabled a form of offline "collective intelligence" for users to seek help beyond the more media-driven outputs and thus now enable a further way of being able to examine the role of a particular platform at the time.³⁴ In order to understand the link between the platform and its uses, this book takes a media-archaeological approach to Platform Studies as a way of excavating the archives of the components that were connected to the BBC Micro, not only in terms of hardware, software, and pieces of code, but also by documented user accounts and the multitude of platform-specific magazines that were published during the time the Micro was in use.

In their discussions of what defines the study of platforms, Nick Montfort and Ian Bogost emphasize the importance of the relationships among creativity, design, expression, and culture, all potentially leading to the underlying features of platforms in terms of both the hardware and the layers of operating systems, software, and peripherals.³⁵ "In addition to allowing certain developments and precluding others," Montfort and Bogost write, "platforms also function in more subtle ways to encourage and discourage different sorts of computer expression."³⁶ Therefore, to understand the platform it is essential not only to understand the basic underlying technological processes of the machine but also to understand how it could be manipulated and developed further by the user. Though we can't time travel back to the 1980s to get a full understanding of the user in relation to the machine, we can place the BBC Micro within a larger historical context surrounding computing at the time, including what has been documented through television programs, magazines, user manuals, games, software and the progression of the hardware during the lifespan of the platform. Examining archives in this way allows for a greater understanding of the processes, functions, uses, and experiences

of the platform that media archeology allows over more general media-historical narratives.³⁷ Similarly, this approach highlights how elements of the platform, examined in this way, continue to link to some present-day practices across present-day platforms. “Media archaeology,” Erkki Huhtamo and Jussi Parikka write, “rummages textual, visual, and auditory archives as well as collections of artifacts, emphasizing both the discursive and the material manifestations of culture.”³⁸

It is through the study of the platform that these discussions can begin. In the case of the BBC Micro, much of the research has to take place through archives, noted histories, and in some cases fan nostalgia through online web communities. The source material for these investigations will include magazines held in the archives of the National Museum of Computing and by dedicated users who have scanned and archived documents for others to download and/or read online. Thomas Lean notes the importance of magazines during the 1980s microcomputing era: “The communication they facilitated between different groups made magazines an integral component of the microcomputing system.”³⁹ Platform-specific magazines such as *The Micro User* and *Acorn User* contained game code, DIY examples, reviews, and general news, all of which help to paint a larger picture of the role of the BBC Micro in both culture and society. In line with Erkki Huhtamo’s methods of exposing “alternative histories” of media practices, this book not only examines the BBC Micro platform in its capabilities as a computing machine but also examines the surrounding cultural, industrial, and educational histories as part of its creation and its limited success within the boundaries of the United Kingdom. Although the histories of the BBC Micro platform have been preserved through countless retellings of the Computer Literacy Project and related nostalgia to regenerate a new age of computer programming literacy, there is often little or no discussion beyond these factors. Even at the time of its inception the BBC Micro was not always given as much page space as cheaper machines such as the Sinclair ZX Spectrum, especially outside Britain. The BBC Microcomputer is allocated less than half a page near the end of *The Personal Computer Handbook: A Complete Practical Guide to Choosing and Using Your Micro*, in a section titled “A guide to other machines,”⁴⁰ whereas entire pages were devoted to Apple, IBM, Sinclair, Commodore, and Atari machines. Tracing what Huhtamo calls the “topoi” or common “cultural vessels” of recurrent themes that run through the histories of 1980s British computing and those of other global microcomputing cultures both past and present gives each chapter a focal point for discussion in light of the unique qualities offered by the BBC Micro that led to platform-specific innovation and creation.⁴¹ These case studies also

piece together another facet of microcomputing through an examination of the BBC Micro platform in order to place British computing cultures within a wider global context so often focused on more popular and therefore more dominant machines.

However, in constructing “alternate histories” there has to be some degree of caution as to what one is finding, how it could be interpreted, and the resultant projected reading that is then implied. For Huhtamo, the meaning of media archeology is a “critical practice that excavates media-cultural evidence for clues about neglected, misrepresented, and/or suppressed aspects of both media’s past(s) and their present and tries to bring these into a conversation with each other.”⁴² It is by uncovering some of these lesser-known global histories through the connected hardware and software practices facilitated by the BBC Micro that we can start to see the role it played in early hypermedia, game creation, digital mapping, networking, and creativity as its users found ways of adapting and creating content for the machine. For although all platforms enable creativity, it was through modifications, software creation, and the overcoming of technological hurdles by both users and companies that the BBC Micro became a machine of many possibilities rather than one directed solely at education.

The Plan of the Book

The book is divided into three parts, which draw upon one another and upon the central theme of the BBC Micro as a platform for users to potentially access multiple literacies. Part I, titled *Hardware and Software Literacies*, consists of chapters 1 and 2, which examine the BBC Micro’s introduction into the mainstream market, how the Computer Literacy Project played a pivotal role in this development, and how communities of users embraced the machine through hardware and software practices. Chapter 1 develops a more extensive look at the histories of the Computer Literacy Project, examining the links between the British Broadcasting Corporation and its role in raising national awareness of the cultural and technological implications of microcomputers. Chapter 1 also highlights the role of Acorn Computers as the chosen developer and manufacturer of the machine, and how that role helped to shape the design of the hardware. Chapter 2 opens with a discussion of the integration of BBC BASIC as one of the software literacies that the machine enabled before focusing on the hardware development associated with the BBC. These developments include the use of ROM expansions as workarounds for limited memory within the system. Discussions surrounding earlier cultures of hardware

hacking, software copying, and DIY communities are further developed by understanding the outreach and capabilities of the machine through its use within schools and colleges, as well as through a growing number of households. Present-day discussions of maker spaces and hack spaces are challenged through an examination of 1980s DIY principles seen in terms of the inbuilt input and output capabilities that were unique to the BBC Micro.

Part II, titled Making and Playing Games, develops the idea of communities and literacies further by examining three case studies. Chapters 3–5 all explore Bobby Schweizer’s discussion about how “specifications for platforms influence rather than determine.”⁴³ Chapter 3 takes a look at *Granny’s Garden*, an educational game that was used in primary schools. Although the primary focus of chapter 3 is on the game itself, the role of the platform and limited supply of machines in schools are also discussed. Economic and political constraints are traced through government incentives surrounding the purchase and use of microcomputers more generally. *Granny’s Garden* is situated in among a wave of educational games that arose in the 1980s, in the UK and elsewhere, as a way of developing computer literacies and problem-solving skills. However, the development of learning seen in *Granny’s Garden* was not necessarily always about the software itself; in some cases it was about other extensions of using the software, such as using the game as a different form of “literature.” Chapter 3 examines *Granny’s Garden* in the context of more current dialogues about the role of media and games in education as a wider area of debate that continues in educational discourse. With this in mind, chapter 4 takes the idea of learning and games in a slightly different direction, examining the world of independent programmers and software innovation through a case study of *Elite* and of that game’s links to the software publisher Acornsoft. *Elite* is a seminal game that was developed on the BBC Micro platform. Many people could not afford the BBC Micro for their homes, so it was not always seen as a machine purely for game-playing activities; for that reason, *Elite*’s links to the BBC Micro are often lost in later writing about the game. *Elite* not only paved the way for *Eve Online* and other space-trading games; it is also often recognized as an important game to come out of the 1980s British game development scene. The ingenuity of *Elite*’s developers, David Braben and Ian Bell, is evident from how the BBC Micro’s hardware limitations were overcome so that the capabilities of the game’s final design could be realized. These themes are continued in chapter 5, where the game series *Repton* is examined in more detail.

The theme of obsolescence and ingenuity continues in part III, titled *Extending the Platform*. The shift in focus toward peripherals used in connection with the BBC Micro is discussed in chapters 6 and 7. The Teletext adapter, which allowed for computer programs to be downloaded via television aerial systems and the BBC's CEEFAX service for free, is discussed in chapter 6. The Teletext adapter could be used as a basic software distribution system before the Internet and the World Wide Web came into wider use, and shortly after its introduction the term "smart television" was used. Chapter 6 examines the use of the Teletext system in light of how content is downloaded and distributed today via the Internet through a variety of platforms. The Teletext adapter is placed within a wider context of the networked capabilities of the BBC Micro and other microcomputers including systems and services such as local-area networks, Prestel, bulletin-board systems, and email. The history of Teletext and the development of Mode 7 on the BBC Micro are discussed in order to provide further links between the design of the BBC Micro's hardware and other technologies that were available before the BBC Micro was designed. Chapter 7 goes on to examine the next incarnation of the BBC Micro, the BBC Master, and the integration of the Philips Laserdisc player in the 1986 Domesday Project. The BBC's Domesday Project, initiated to mark the 900th anniversary of the Domesday Book, was a large-scale collaborative project in which students in schools all over the UK were invited to submit short descriptions of their day-to-day lives in the towns and cities they lived in, and photographs to go with them. The information collected from the schools was combined with Ordnance Survey maps of the UK, as well as video footage in order to create an early hypermedia-like experience. Laserdiscs were used as storage media in order to link the still photographs and the video, showcasing not only the limitations of the computer hardware but also the solutions used to work around them. The Domesday Project also highlights earlier forms of participatory culture in the context of our current abilities to digitally map content using services such as Google Maps.

Chapter 8 examines the legacy of the BBC Micro platform and the recent developments of the Raspberry Pi in order to recreate some of the original purpose of the BBC's Computer Literacy Project and the BBC's move toward increasing awareness of programming literacy through its new Micro Bit computer. The chapter charts Acorn's developments from the Archimedes to the ARM chip now often used in "hidden packages" (such as smartphones). By using a combination of hardware- and software-specific examples, and by examining some of the advertised and

known uses of the BBC Micro, chapter 8 considers the Micro's place in history as a vehicle for various literacies but also as the machine for and of the user that pushed the boundaries of what could be achieved in order to produce something completely new.

The book offers not only a discussion of the BBC Micro platform as a piece of hardware, but also discussions of its creators, its users, its critics, and its advocates. As Katherine Hayles wrote, "Technologies do not develop on their own. People develop them and people are sensitive to cultural beliefs about what technologies can and should mean."⁴⁴ It is by tracing these cultural contexts that we can start to see some of the ethos of the BBC Micro platform continuing in conversations and debates today.

A website to accompany the book, available at www.bbcmicrobook.com, contains examples and images mentioned in the text as a nod to the multiple-media approach that the Computer Literacy Project facilitated.

A Note on Terminology

The BBC Microcomputer was often referred to as the BBC Microcomputer, the BBC Micro, or even just the Micro. These terms, along with the more colloquial name "the Beeb," are used interchangeably throughout this book. Where microcomputers other than the BBC Microcomputer are discussed, "microcomputer" and "micro" are not capitalized. Variants of the platform's name will be used throughout this book in order to avoid repetition and to highlight how the machine was discussed in other forms of documentation.

Notes

Introduction

1. R. Fothergill and J. S. A. Anderson, "Strategy for the Microelectronics Education Programme (MEP)," *Innovations in Education & Training International* 18, no. 3 (1981): 120–129, at 120.
2. For more information about the mission and values of the BBC see BBC, "Inside the BBC—Mission and Values" (http://www.bbc.co.uk/aboutthebbc/insidethebbc/whoweare/mission_and_values/).
3. BBC Continuing Education Television Computer Literacy Project, n.d. (<http://www.computinghistory.org.uk/det/7182/BBC-Computer-Literacy-Project/>).
4. Paul du Gay et al., *Doing Cultural Studies: The Story of the Sony Walkman* (SAGE, 1997), 1.
5. Paul Atkinson, *Computer* (Reaktion Books, 2010), 13.
6. For more information on the history of the BBC see "History of the BBC" at http://www.bbc.co.uk/historyofthebbc/resources/in-depth/reith_1.shtml.
7. BBC, "Inside the BBC—Mission and Values."
8. See "BBC Two's Horizon Celebrates 40th Birthday with New Series This Autumn" at http://www.bbc.co.uk/pressoffice/pressreleases/stories/2004/08_august/19/horizon.shtml.
9. For more on "Now the Chips Are Down" see Magnus Anderson and Rebecca Levene, *Grand Thieves & Tomb Raiders: How British Videogames Conquered the World* (Aurum, 2012), 18; Thomas Lean, "The Making of the Micro": Producers, Mediators, Users and the Development of Popular Microcomputing in Britain (1980–1989), PhD dissertation, University of Manchester, 2008; Tilly Blyth, *The Legacy of the BBC Micro: Effecting Change in the UK's Culture of Computing* (Nesta, 2012).
10. Tilly Blyth, "Computing for the Masses? Constructing a British Culture of Computing in the Home," in *Reflections on the History of Computing*, ed. Arthur Tatnall (Springer, 2012).

11. Lean, "The Making of the Micro," 55.
12. During the 1980s in the UK, the population only had access to four terrestrial television channels: BBC One and BBC Two (transmitted by the BBC), ITV (often called Channel 3), and Channel 4 (which began to broadcast on November 2, 1982).
13. Christopher Evans, *The Mighty Micro* (Gollancz, 1979).
14. For more about the political climate at the time of the Micro, see Neil Selwyn, "Learning Love the Micro: The Discursive Construction of 'educational' to Computing in the UK, 1979–89," *British Journal of Sociology of Education* 23, no. 3 (2002): 427–443.
15. Martin Campbell-Kelly et al., *Computer: A History of the Information Machine*, third edition (Westview, 2014), chapter 10, section 2.
16. For more about the politics in the UK during the 1980s and the relationship with between politics and microcomputing, see Lean, "The Making of the Micro."
17. Kenneth Baker, *The Turbulent Years* (Faber & Faber, 1993), 59.
18. Neil Selwyn, *Telling Tales on Technology: Qualitative Studies of Technology and Education* (Ashgate, 2002), 24.
19. Campbell-Kelly et al., *Computer: A History of the Information Machine*, chapter 10, section 6.
20. Kate Kirk and Charles Cotton, *The Cambridge Phenomenon* (Third Millennium, 2012), 12.
21. *Ibid.*
22. See Haroon Ahmed, *Cambridge Computing: The First 75 Years* (Third Millennium, 2013).
23. Kirk and Cotton, *The Cambridge Phenomenon*, 12.
24. Charles Crook, *Computers and the Collaborative Experience of Learning* (Routledge, 1994), 1.
25. Maureen McNeil, "The Old and New Worlds of Information Technology in Britain," in *Enterprise and Heritage*, ed. John Corner and Sylvia Harvey (Routledge, 1991), 120.
26. *Ibid.* 121.
27. *Ibid.*, 124–125.
28. David Allen, The Surprising Back Story of the 1980s BBC Computer Literacy Project (public lecture, National Museum of Computing, November 14, 2013).
29. *Ibid.*
30. Blyth, *The Legacy of the BBC Micro*.
31. In 2006 Henry Jenkins defined "convergence culture" in a multitude of ways, ranging from "where old and new media collide, where grassroots and corporate media intersect, where the power of the media producer and the power of the media consumer interact in unpredictable ways" to "the flow of content across multiple media platforms, the cooperation between multiple media industries, and the migratory behaviour of media audiences who will go almost anywhere in search of the kinds of entertainment experiences they want." See Henry Jenkins, *Convergence Culture* (New York University Press, 2006), 2. The diagram of connections represented here in figure I.1 is based on a similar schematic drawn up by the BBC showing the links between areas responsible for the Computer Literacy Project (see Blyth, *The Legacy of the BBC Micro*, 15).
32. See Jenkins, *Convergence Culture*.

33. See Jay David Bolter and Richard Grusin, *Remediation* (MIT Press, 2000). Bolter and Grusin note that all new media (a term not restricted to digital media) draw on relationships to older media forms. This is one of the recurring themes of this book.
34. Henry Jenkins draws on Pierre Levy's concept of "collective intelligence" as a way of discussing how online audiences may "leverage the combined expertise of their members." See Jenkins, *Convergence Culture*, 27 and Pierre Levy, *Collective Intelligence: Mankind's Emerging World in Cyberspace* (Perseus Books, 1997), 20. I would argue that the collective intelligence of audiences is also made possible by a range of "offline" communities in the 1980s through outlets such as computer clubs, the school playground, and letters pages in magazines.
35. Nick Montfort and Ian Bogost, *Racing the Beam: The Atari Video Computer System* (MIT Press, 2009), 4.
36. *Ibid.*, 3.
37. For a more detailed discussion of media archeology versus media history, see chapter 2 of Wolfgang Ernst, *Digital Memory and the Archive* (University of Minnesota Press, 2013).
38. Erkki Huhtamo and Jussi Parikka, eds., *Media Archaeology: Approaches, Applications, and Implications* (University of California Press, 2011), 3.
39. Lean, "The Making of the Micro," 117.
40. Peter Rodwell, *The Personal Computer Handbook: A Complete Practical Guide to Choosing and Using Your Micro* (Barron's, 1983).
41. Erkki Huhtamo writes that "new products are promoted as being packaged into formulas that are meant to strike the observer as novel, although they have been put together from ingredients retrieved from cultural archives." These ingredients can be described as "topoi" that can be found as recurring themes in media artifacts. Therefore, although some of the hardware or even software on the BBC Micro is not necessarily "new" in the sense that it is the first, it can still be seen as innovative and unique to the platform and thus situated in a wider context of similar techniques and processes to help shape the ensuing discussion. See *Media Archaeology*, ed. Huhtamo and Parikka, 27–47.
42. *Ibid.*, 28.
43. Bobby Schweizer, "Platforms," in *The Routledge Companion to Video Game Studies* (Routledge, 2014), 41.
44. Katherine Hayles, "The Condition of Virtuality," in *Digital Dialectic: New Essays in New Media*, ed. Peter Lunenfeld (MIT Press, 1999), 94.

Chapter 1

1. Manpower Services Commission, *Something Must Be Done* (1979).
2. Blyth, "Computing for the Masses? Constructing a British Culture of Computing in the Home," 234.
3. Charles Moir, "Review—BBC Micro," *Practical Computing*, January 1982.
4. John Radcliffe and Robert Salkeld, "Towards Computer Literacy—The BBC Computer Literacy Project 1979–1983," National Archive of Educational Computing (<http://www.naec.org.uk/organisations/bbc-computer-literacy-project/towards-computer-literacy-the-bbc-computer-literacy-project-1979-1983>).

5. For more about the MK-14 and one user's attempts to re-create one, see "MK14 V2.0" at <http://mymk14.co.uk/>.
6. For more about the Acorn System 1, see Mike Cowlshaw, "Acorn 6502 Microcomputer Kit" at <http://speleotrove.com/acorn/index.html>.
7. Sinclair Radionics became Sinclair Instrument Ltd in August 1975, then became Sinclair Research Ltd in 1981.
8. This is a term Steve Furber now uses in retrospect; it was not used by the team to describe themselves at the time. See Thomas Lean (interviewer), National Life Stories. An Oral History of British Science, Steve Furber (interviewee), October 22, 2012 (<http://sounds.bl.uk/Oral-history/Science/021M-C1379X0078XX-0003V0>).
9. Douglas Fairbairn (interviewer), Oral History of Sophie Wilson, January 21, 2012, Computer History Museum, 18.
10. Lean (interviewer), National Life Stories. An Oral History of British Science, Steve Furber (interviewee), October 22, 2012.
11. Email message to author, March 9, 2015.
12. In Blyth, *The Legacy of the BBC Micro*, Steve Furber recalls the "cutting of the umbilical cord from the prototype to the development system." Furber also recalls how the portrayal of events on the day the BBC came to view the micro were exaggerated in parts in *The Micro Men*—for example, "the wire cutting episode that caused the BBC Micro prototype to come to life was actually about three hours before the BBC arrived, not three minutes after." See Lean (interviewer), National Life Stories. An Oral History of British Science, Steve Furber (interviewee), August 20, 2012 (<http://sounds.bl.uk/Oral-history/Science/021M-C1379X0078XX-0002V0>).
13. Radcliffe and Salkeld, "Towards Computer Literacy—The BBC Computer Literacy Project 1979–1983."
14. ACORN Computers Limited, *BBC Microcomputer Service Manual* (ACORN Computers, 1985), 2.
15. "The Micro Buyer's Survival Kit," *The Home Computer Course*, 1983, 6–7.
16. Radcliffe and Salkeld, "Towards Computer Literacy—The BBC Computer Literacy Project 1979–1983."
17. Continuing Education Department, BBC Microcomputer Hardware Specification (BBC Broadcasting Centre, n.d.).
18. "BBC Model B," *The Home Computer Course*, 1983, 89.
19. BBC Microcomputer System Technical Specification Issue 3, September 1981.
20. "BBC Model B," 89.
21. Email message to author, October 21, 2014.
22. *Making the Most of the Micro*, "The Versatile Machine" (BBC, January 10, 1983).
23. BBC, *Welcome* (British Broadcasting Corporation, 1981), 3.
24. Microvitec Cub monitors were also popular as display devices among BBC Micro users, particularly in schools. Like a PAL television set, these ran at 50 MHz and had a display size of 625 lines.
25. The line displaying "16K" would be replaced by line displaying "32K" in the Model B version of the BBC Micro.
26. BBC, *Welcome*, 5.
27. The word "affordance" is used here to mean "the perceived an actual properties of the thing, primarily those fundamental properties that determine just how the

- thing could possibly be used.” Donald A. Norman, *The Design of Everyday Things* (MIT Press, 1998), 9.
28. BBC, *Welcome*, 6.
 29. Lev Manovich, *Software Takes Command* (Bloomsbury Academic, 2013), 2.
 30. BBC, *Welcome*, 9.
 31. Ibid.
 32. Nick Montfort et al., *10 PRINT CHR\$(205.5+RND(1)); : GOTO 10* (MIT Press, 2012), 10.
 33. Manovich defines modularity as “the organization of a cultural object into clearly separable parts” See Manovich, *Software Takes Command*, 211.
 34. The word “remediation” is used in reference to Jay David Bolter and Richard Grusin’s book *Remediation: Understanding New Media* (MIT Press, 2000).
 35. Jay David Bolter and Diane Gromala, *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* (MIT Press, 2003), 86.
 36. BBC, *Welcome*, 15–16.
 37. Warren Sack, “Memory,” in *Software Studies*, ed. Matthew Fuller (MIT Press, 2008), 190.
 38. BBC, *Welcome*, 17.
 39. “Roger McGough,” BBC—Poetry Season (http://www.bbc.co.uk/poetryseason/poets/roger_mcgough.shtml).
 40. The type of play experienced here by the user would be what Sutton-Smith defines as “play as progress” as they experimented with the machine. In his book *The Ambiguity of Play*, Sutton-Smith equates “play as progress” with both animal and children’s play and although this is not always discussed through adult-centered play, this is implied. His notion of “Playful forms of play” are the most useful in thinking about some of the learning created by the Welcome cassette programs as these “are the games of those who have a creative capacity for playing.” Brian Sutton-Smith, *The Ambiguity of Play* (Harvard University Press, 1997), 9 and 46.
 41. BBC, *Welcome*, 18.
 42. Janet H. Murray, *Hamlet on the Holodeck* (MIT Press, 1997), 126.
 43. Murray states “I use the word ‘encyclopedic’ to refer to both a technical and cultural phenomenon: to the unequalled storage potential of the new medium and to its promise of an infinite tablet, a library as big as the world.” Janet H. Murray, *Inventing the Medium: Principles of Interaction Design as a Cultural Practice* (MIT Press, 2011), 66. Although this library was relatively smaller in the early 1980s, the possibilities of the machine were still drawn upon in opening up the user to the possibilities of encyclopedic capabilities.
 44. Jussi Parikka, “Copy,” in *Software Studies*, ed. Matthew Fuller (MIT Press, 2008), 76.
 45. David Ahl, “Hammurabi,” Atari Archives (<http://atariarchives.org/basicgames/showpage.php?page=78>).
 46. An example of a BASIC listing for Hammurabi can be found at <http://www.dunnington.u-net.com/public/basicgames/HMRABI>
 47. David Morley, *Television Audiences and Cultural Studies* (Routledge, 1992), 201.
 48. On television-viewing habits during the time under discussion, see Morley, *Television Audiences and Cultural Studies* and David Gauntlett and Annette Hill, *TV Living* (Routledge, 1999).

49. "The Computer Programme," *Just One Thing After Another* (BBC, January 18, 1982).
50. David Allen, "Confessions of a TV Producer," *Acorn User*, October 1982, 11.
51. David Allen, "The Computer Programme and beyond," *Acorn User*, August 1982, 10.
52. *Making the Most of the Micro*, "At the End of the Line" (BBC, March 14, 1983).
53. *Ibid.*
54. For further definitions of multiliteracies and media literacy, see Bill Cope and Mary Kalantzis, eds., *Multiliteracies: Literacy Learning and the Design of Social Future* (Routledge, 2000); Kathleen Tyner, *Literacy in a Digital World* (Erlbaum, 1998); David Buckingham, *Media Education: Literacy, Learning and Contemporary Culture* (Polity Press, 2003).
55. Buckingham, *Media Education*, 35.
56. Jussi Parikka, *Digital Contagions: A Media Archaeology of Computer Viruses* (Peter Lang, 2007), 162–163.
57. Robin Bradbeer, Peter De Bono, and Peter Laurie, *The Computer Book: An Introduction to Computers and Computing*, ed. Susan Curran and David Allen (British Broadcasting Corporation, 1982), 5–7.
58. Angelos Agalianos, Geoff Whitty, and Richard Noss, "The Social Shaping of Logo," *Social Studies of Science* 36, no. 2 (2006): 241–267, at 257.
59. See du Gay et al., *Doing Cultural Studies: The Story of the Sony Walkman*, 5.
60. *The Times* (London), January 4, 1983.
61. James Sumner, "'Today, Computers Should Interest Everybody': The Meanings of Microcomputers," in *Zeithistorische Forschungen / Studies in Contemporary History*, volume 9, 201 (<http://www.zeithistorische-forschungen.de/16126041-Sumner-2-2012>).
62. "BBC Micro Advert," *Electronics and Computing Monthly*, December 1982.
63. The statistics can be found on pp. 20–21 of Blyth, *The Legacy of the BBC Micro*.

Chapter 2

1. For histories of microcomputing in these countries, see Martin Campbell-Kelly et al., eds., *Computer: A History of the Information Machine*, (Westview, 2014); Melanie Swalwell, "Questions about the Usefulness of Microcomputers in 1980s Australia," *Media International Australia, Incorporating Culture & Policy* no. 143 (May 2012): 63–77; Jaroslav Švelch, "Say It with a Computer Game: Hobby Computer Culture and the Non-Entertainment Uses of Homebrew Games in the 1980s Czechoslovakia," *Game Studies* 13, no. 2 (2013) (<http://gamestudies.org/1302/articles/svelch>).
2. "Before Acorn became involved with consumer-orientated computers," Lean comments, "it had manufactured the Acorn System series of hobbyist, industrial and laboratory microcomputers." See Lean, "The Making of the Micro," 225.
3. See Norman, *The Design of Everyday Things*.
4. Whereas Lev Manovich recognizes the modular nature of software and how this can provide a step by step approach to learning how to use a program, among other discussions, modularity can also be discussed through the materiality of hardware, how this is constructed, and re-constructed. For discussions of "modularity" and software, see Manovich, *Software Takes Command*.

5. Lean, "The Making of the Micro," 226.
6. Montfort et al., 10 *PRINT CHR\$(205.5+RND(1)); : GOTO 10*, 158.
7. John Radcliffe and Robert Salkeld, "Towards Computer Literacy—The BBC Computer Literacy Project 1979–1983," National Archive of Educational Computing (<http://www.naec.org.uk/organisations/bbc-computer-literacy-project/towards-computer-literacy-the-bbc-computer-literacy-project-1979-1983>).
8. John Coll, *BBC Microcomputer System User Guide*, ed. David Allen, issue 1 (British Broadcasting Corporation, 1984), 385.
9. David Allen, "The Surprising Back Story of the 1980s BBC Computer Literacy Project."
10. See Blyth, *The Legacy of the BBC Micro*.
11. Stuart Goodwin, "Sophie Wilson 2007 Interview with Stuart Goodwin," Stairwaytohell, autumn 2007 (<http://www.stairwaytohell.com/articles/SG-SophieWilson.html>).
12. Harry Fairhead, "Review: BBC Model B," *Electronics & Computing Monthly*, December 1982 (<http://www.gondolin.org.uk/hchof/review.php?id=22&mcid=15>).
13. Vivien Marles, BBC Computer Literacy Project—an Evaluation, n.d., 9.
14. Paul Shreeve, *Me & My Micro* (National Extension College Trust, 1984).
15. "Getting Down to BASIC," *Making the Most of the Micro*, BBC, January 17, 1983.
16. Wendy Chun, "On Software, or the Persistence of Visual Knowledge," *Grey Room* 18 (winter 2004): 39.
17. Christina Lindsay, "From the Shadows: Users as Designers, Producers, Marketers, Distributors and Technical Support," in *How Users Matter: The Co-Construction of Users and Technologies*, ed. Nelly Oudshoorn and Trevor Pinch (MIT Press, 2003), 32.
18. Speech! from Superior Software became a more widespread way of using speech on the Micro and was featured on Roger Walter's solo LP *Radio Chaos*.
19. Acorn Computers Limited, "Speech Upgrade Instructions," 1983 (http://acorn.chriswhy.co.uk/docs/Acorn/Tech/Acorn_SpeechUpgradeInst.pdf).
20. For a scan of the July 1986 Retail Price list for Acorn Computers Limited, see http://acorn.chriswhy.co.uk/docs/Acorn/Brochures/Acorn_APP87_RetailPriceListJuly86.pdf.
21. For a scan of ROM fitting instructions by Computer Concepts of Hemel Hempstead, Hertfordshire, see http://acorn.chriswhy.co.uk/docs/CC/CC_ROMFittingInst.pdf.
22. Bridget Somekh and Niki Davis, "Getting Teachers Started with IT and Transferable Skills," in *Using Information Technology Effectively in Teaching and Learning*, ed. Somekh and Davis (Routledge, 1997), 139.
23. Mike Rawlings, "Sideways Storage," *Acorn User*, March 1986, 85.
24. Advanced Technology Products Limited, "Sidewise User Manual," 1983, 1.
25. "AMX Pagemaker Advertisement," *Acorn User*, June 1986, 31.
26. Tony Quinn, "Hold the Front Page," *Acorn User*, June 1986, 143.
27. John Chesterman and Andy Lipman, *The Electronic Pirates: DIY Crime of the Century* (Routledge, 1988), 68.
28. For more on maker cultures, see David Gauntlett, *Making Is Connecting* (Polity Press, 2011).
29. For more on this, see <http://arduino.cc/>.

30. Gauntlett, *Making Is Connecting*, 64.
31. For more on this, see <http://technologywillsaveus.org/resources/thirsty-plant/>.
32. Mark Hatch, *The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers*, Kindle edition (McGraw-Hill, 2014), introduction, section 3.
33. Part one of Chris Anderson's book *Makers: The New Industrial Revolution* (Random House, 2012) is titled "The Revolution" and contains references to the punk phenomenon of the 1980s and to 'zine publishing. Anderson notes that "photocopiers were becoming common, and from them arose a 'zine' culture of DIY magazines that were distributed at stores and shows and by mail." These practices were also linked to mail order and the ease of being able to distributed music for four-track tapes and vinyl pressing small-batch singles and EPs as discussed in books such as Amy Spencer's *DIY: The Rise of Lo-Fi Culture* (Marion Boyas, 2005). These practices were evident in 1980s computer culture in Britain in the selling of computer games on tapes and floppy disks, of kit computers, and of computer parts advertised in magazines.
34. See <http://techshop.ws/>.
35. David Skinner, *Technology, Consumption and the Future: The Experience of Home Computing*, PhD dissertation, Brunel University, 1992, 181.
36. Lean, "The Making of the Micro," 109.
37. Skinner, *Technology, Consumption and the Future*, 179.
38. Mike Harrison, "DIY Sideways ROM Board," *BBC Micro User*, February 1984.
39. Hatch, *The Maker Movement Manifesto*.
40. Coll, *BBC Microcomputer System User Guide*, 493.
41. Mike Shaw, "DIY: Making a Game Paddle," *BBC Micro User*, March 1983, 20.
42. To aid in using a BBC Micro to convert recorded voltage into values understood by users a BASIC command was provided. As was mentioned in the preceding chapter, the BBC Micro had its own variant of BASIC. One of the commands written into BBC BASIC was the ADVVAL command that converted the voltage sensed in the resistor into a digital output.
43. "Everything Under Control," *Making the Most of the Micro*, BBC, February 28, 1983.
44. Jeffrey Pike, "The Truth, The Whole Truth," *Acorn User*, June 1986, 133.
45. RH Electronics Sales Limited, "Light Pen for the BBC Microcomputer User's Manual" (S-Print, n.d.) (http://acorn.chriswhy.co.uk/docs/RHE/RHE_LightPenUM.pdf).
46. Alexander R. Galloway, *The Interface Effect* (Polity Press, 2012), 30–31.
47. In a review of the BBC Buggy and the Edinburgh Turtle published in the August 1983 issue of *The Micro User*, Mike Cook notes that the Buggy was priced at £160 whereas the Turtle, which contained its own microprocessor so it didn't have to rely solely on waiting for commands input via the BBC Micro, was priced at £350. See Mike Cook, "Battle of the Buggies," *The Micro User*, August 1983.
48. Simon Beesley, "BBC Buggy," *Your Computer*, April 1983, 51.
49. Cook, "Battle of the Buggies," 27–28.
50. Seymour Papert, *Mindstorms: Children, Computers, and Powerful Ideas*, new edition (Basic Books, 1993).
51. Angelos Agalianos, Geoff Whitty, and Richard Noss, "The Social Shaping of Logo," *Social Studies of Science* 36, no. 2 (2006): 241–267, at 244.

52. "Logo on the BBC Micro," *Acorn User*, August 1982, 3.
53. BBC/Economats, "The BBC Buggy Assembly and Operating Manual," 1983, 3.
54. "Everything Under Control," *Making the Most of the Micro* (BBC, February 28, 1983).
55. Sherry Turkle defines Claude Lévi-Strauss' notion of bricolage as "a style of working in which one manipulates a closed set of materials to develop new thoughts." See Turkle, ed., *Evocative Objects: Things We Think With* (MIT Press, 2007), 308.

Chapter 3

1. Saul Metzstein, "Micro Men" (BBC, October 8, 2009).
2. WHSmith stores also sell magazines, newspapers, books, stationery, and digital media.
3. In Britain, children typically enter secondary school between the ages of 11 and 16, as if they choose to continue secondary education they may remain in secondary school until age 18. Primary school is for children between the ages of 5 and 11. Some primary, middle, and secondary schools have different age requirements.
4. Kenneth Baker, *The Turbulent Years* (Faber & Faber, 1993), 61.
5. For more on the Micros in Schools scheme, see Blyth, *The Legacy of the BBC Micro*, 29–30.
6. Selwyn, "Learning Love the Micro: The Discursive Construction of 'educational' to Computing in the UK, 1979–89," 431.
7. "Making the Most of the Micro," "Getting Down to BASIC" (BBC, January 17, 1983).
8. See Joe Telford, "Teaching Toddlers," *Acorn User*, August 1984, 104; Mike Bibby, "Spreading the Micro Gospel in Education," *Acorn User*, March 1983, 46.
9. Clive Kelly, "Where Infants Pick up a Micro Instead of a Crayon," *The Micro User*, August 1983, 22.
10. Acornsoft advertisement in *Acorn User*, March 1984, 88.
11. Blyth, *The Legacy of the BBC Micro*, 37.
12. Mark Green, "Granny's Garden Creator Interview," Pixelatron, August 7, 2010 (<http://pixelatron.com/blog/grannys-garden-creator-interview/comment-page-1/#comment-3830>).
13. Martin Campbell-Kelly, *From Airline Reservations to Sonic the Hedgehog: A History of the Software Industry*, new edition (MIT Press, 2004), 208.
14. Mizuko Ito, "Education vs. Entertainment: A Cultural History of Children's Software," in *The Ecology of Games*, ed. Katie Salen (MIT Press, 2008).
15. Richard Jones, "Search for the Mary Rose—and Discover the Direction Software Should Take," *The Micro User*, January 1984, 51.
16. It isn't clear which version of *Adventure* Matson played. In any case, his comments about the playing the game can be found in an interview with Mark Green available at <http://pixelatron.com/blog/grannys-garden-creator-interview/comment-page-1/#comment-3830>
17. Nick Montfort, *Twisty Little Passages* (MIT Press, 2003), 4. In *Inventing the Medium* (p. 426), Janet Murray favors the term "interactor" over "user" to describe people interacting with the texts presented to them.

18. Although Baker states that some microcomputer programs in schools did not encourage written-literacies, *Granny's Garden* encouraged these literacies in other activities that could be conducted in relation to the game content. See Clive Baker, "The Microcomputer and the Curriculum: A Critique," *Journal of Curriculum Studies* 17, no. 4 (1985): 449-451, at 449.
19. On Easter Eggs in games, see Mia Consalvo, *Cheating: Gaining Advantage in Videogames* (MIT Press, 2007), 19.
20. Cave-exploration games and text adventure games are mentioned early in Jason Scott's 2010 DVD documentary *Get Lamp*. The cave in the game *Adventure* is mentioned later in the documentary by one of the game's developers, Don Woods.
21. James Paul Gee defines a "virtual identity" as "one's identity as a virtual character," a real-world identity as who the player is in real life, "a nonvirtual person playing a computer game" and "projective identity" in terms of the player playing as a character (the as is emphasized by Gee as stressing the "interface between—the interactions between—the real-world person and the virtual characters." See Gee, *What Video Games Have to Teach Us about Learning and Literacy*, 48-54.
22. The character Grotbags was introduced in the ITV television series *Emu's World*, first aired in Britain in 1982.
23. For a more recent discussion of what failure means in games, and of how it can act as a catalyst to encourage us to continue playing, see Jesper Juul, *The Art of Failure: An Essay on the Pain of Playing Video Games* (MIT Press, 2013).
24. Katie Salen and Eric Zimmerman, *Rules of Play: Game Design Fundamentals* (MIT Press, 2004), 81.
25. *Ibid.*, 80.
26. Gee, *What Video Games Have to Teach Us about Learning and Literacy*, 88.
27. 4Mation Educational Resources, "Granny's Garden Manual" (4Mation, 1983), 8.
28. Montfort, *Twisty Little Passages*, 38.
29. Mark Green, "Granny's Garden Creator Interview," Pixelatron, August 7, 2010 (<http://pixelatron.com/blog/grannys-garden-creator-interview/comment-page-1/#comment-3830>).
30. *Ibid.*
31. *Ibid.*
32. Lean, "The Making of the Micro," 189.
33. David Smith and Sue Segger, "Granny Comes to Holyport: The Use of an Educational Adventure Game with Children with Severe Learning Difficulties," *European Journal of Special Needs Education* 1, no. 1 (1986): 23-28.
34. Katie Salen, "Toward an Ecology of Gaming," in *The Ecology of Games* (MIT Press, 2008), 9.
35. 4Mation Educational Resources, "Granny's Garden Manual," 7.
36. For a more detailed discussion of Mode 7, see chapter 6.
37. An author's note near the back of the *Granny's Garden* game manual jokingly says that Granny is drinking gin while the children are playing in the garden.
38. Although this quotation pertains to a later-released version of *Granny's Garden* for PCs, the structure and the main themes of the game were the same. See David Whitebread and Angela McFarlane, "Developing Children's

- Problem-Solving: The Educational Uses of Adventure Games,” in *Information Technology and Authentic Learning: Realizing the Potential of Computers in the Primary Classroom* (Routledge, 1997), 31.
39. Buckingham, *Media Education*, 37.
 40. Livingstone puts children and young people in the categories “traditionalists,” “low media users,” “screen entertainment fans,” and “specialists,” but we can see how these categories can be used to discuss other types of media and computer uses. See Sonia Livingstone, *Young People and New Media: Childhood and the Changing Media Environment*, Kindle edition (SAGE, 2002), chapter 3, section 4.
 41. Richard Cobbett, “Crap Shoot: *Granny’s Garden*,” *PC Gamer*, January 22, 2011 (<http://www.pcgamer.com/2011/01/22/crap-shoot-grannys-garden/>).
 42. See <http://www.4mation.co.uk/cat/granny.htm>.
 43. Mike Matson, telephone interview with Thomas Lean, in Lean, “The Making of the Micro,” 165–166.

Chapter 4

1. For more on the pre-crash histories of video games, see Mark J. P. Wolf, *Before the Crash: Early Video Game History* (Wayne State University Press, 2012).
2. Graeme Kirkpatrick, *Computer Games and the Social Imaginary* (Polity Press, 2013), 58.
3. See Alex Wade, “The State of the Art: Western Modes of Videogame Production,” in Proceedings of the 2007 DiGRA International Conference on Situated Play; Leslie Haddon, “The Home Computer: Making of a Consumer Electronic,” *Science as Culture*, no. 2 (1988): 7–51; Aphra Kerr, “The UK and Irish Game Industries,” in *The Video Game Industry: Formation, Present State, and Future*, ed. Peter Zackariasson and Wilson, Kindle edition (Routledge, 2012). Kerr also recognizes Haddon and Skinner’s work on how the BBC Micro played a role in software development during the 1980s, although she does not explicitly discuss computer-game software.
4. According to Graeme Kirkpatrick, “on average, around 25 per cent of magazine content in the early years of the decade was devoted to game programs readers could copy into one of the small computers of the day.” See Kirkpatrick, *Computer Games and the Social Imaginary*, 76.
5. Email message to author, February 27, 2015.
6. Melanie Swalwell discusses the microcomputer scene in New Zealand in a similar context, with active learning through the typing and tracing of code an integral part of the user’s participation in and engagement with the gaming scene at that time, something that she terms to be the “will to mod.” Her accounts of users entry in the world of programming again links to the copying of code in some cases and the experiences of “learning by doing” that was actively encouraged within the wider contexts of microcomputer creation and consumption at this time. See Swalwell, “The Early Micro User: Games Writing, Hardware Hacking, and the Will to Mod,” in *Proceedings of DiGRA Nordic 2012 Conference: Local and Global—Games in Culture and Society*, 2012.
7. Simon Dally, “The Name of the Game,” *Acorn User*, August 1982, 20.

8. Kirkpatrick, *Computer Games and the Social Imaginary*, 60.
9. See Jesper Juul, "High-Tech Low-Tech Authenticity: The Creation of Independent Style at the Independent Games Festival," in *9th International Conference on the Foundations of Digital Games*, 2014 (<http://www.jesperjuul.net/text/independentstyle/>).
10. Kerr, "The UK and Irish Game Industries," Section 2. The figure of 150,000 copies was later explained as sales from both the BBC Micro and Acorn Electron versions of the game. See Jimmy Maher, "Elite (or the Universe on 32K Per Day)," *The Digital Antiquarian*, 2013, <http://www.filfre.net/2013/12/elite/>
11. Van Burnham, *Supercade: A Visual History of the Videogame Age 1971–1984* (MIT Press, 2001), 293.
12. See <http://uk.ign.com/articles/2000/07/24/the-top-25-pc-games-of-all-time>.
13. Anderson and Levene state that Acornsoft was founded in 1979. See Anderson and Levene, *Grand Thieves & Tomb Raiders: How British Videogames Conquered the World*, 32. However, an incorporation document emailed to myself from Chris Jordan, previously of Acornsoft, shows Acornsoft was formed on October 14, 1980.
14. David Johnson-Davies, *Atomic Theory and Practice* (ACORN Computers, 1980).
15. The show asked people to send in their game designs as drawing or on cassettes and didn't anticipate that anyone would program a whole game. The prize was a BBC Micro; because the Olivers already owned one, they were given a "high resolution monitor" (a Commodore product) instead. They subsequently sold *Black Box* and *Gambit* to Acornsoft for £200. For more on the Oliver Twins, see <http://www.olivertwins.com/history/page/2>.
16. Retro Gamer Team, "Snapper," *Retro Gamer*, March 13, 2010 (http://www.retrogamer.net/retro_games80/snapper/).
17. Jonathan Griffiths, "Snappy Writing," *Acorn User*, January 1984, 53.
18. Anderson and Levene, *Grand Thieves & Tomb Raiders*, 66.
19. Retro Gamer Team, "Geoff Crammond," *Retro Gamer*, January 7, 2014 (<http://www.retrogamer.net/profiles/developer/geoff-crammond/>).
20. Tony Quinn, "Revvving up at Silverstong," *Acorn User*, July 1985, 157.
21. In 1982, before coming to Cambridge to study mathematics, Bell had created a successful game called *Free Fall*. On his website (<http://www.iancgbell.clara.net>), Ian Bell defines *Free Fall* as the "first beat-em-up," jokingly suggesting that he had invented two gaming genres.
22. Email message to author, June 20, 2014.
23. *Ibid.*
24. For a further history of arcade-game clones in 1980s Britain, see Alison Gazzard, "The Intertextual Arcade: Tracing Histories of Arcade Clones in 1980s Britain," *Reconstruction* 14, no. 1 (2014) (<http://reconstruction.eserver.org/Issues/141/Gazzard.shtml>).
25. Email message to author, June 20, 2014.
26. Andrew Hutchison, "Making the Water Move: Techno-Historic Limits in Game Aesthetics of *Myst* and *Doom*," *Game Studies* 8, no. 1 (2008) (<http://gamestudies.org/0801/articles/hutch>).
27. Edge Staff, "The Making of 3D Monster Maze," Edge, 2006 (available at http://wayback.archive.org/web/20070513045033/http://www.edge-online.co.uk/archives/2006/04/the_making_of_3_1.php).

28. Rory Cellan-Jones, "Elite: Classic 1980s Game to Be 'Kickstarted' with Sequel," BBC News Online, 2012 (<http://www.bbc.co.uk/news/technology-20187897>).
29. Anderson and Levene, *Grand Thieves & Tomb Raiders*, 112.
30. Steven Levy traces the origins of the terms "hack" and "hacker" to pranks played by MIT students in the days before mainstream computing and notes that the term was used with pride. "It was understood," Levy writes, "that, to quality as a hack, the feat must be imbued with innovation, style, and technical virtuosity." See Levy, *Hackers: Heroes of the Computer Revolution* (O'Reilly Media, 2010), 10.
31. Email message to author, June 20, 2014.
32. David Braben, "Classic Game Postmortem—ELITE" (GDC, 2011), <http://www.gdcvault.com/play/1014628/Classic-Game-Postmortem>.
33. Email message to author, June 20, 2014.
34. Ibid.
35. Braben, "Classic Game Postmortem—ELITE."
36. Email message to author, June 20, 2014.
37. Ibid.
38. Anderson and Levene, *Grand Thieves & Tomb Raiders*, 116–117.
39. Braben, "Classic Game Postmortem—ELITE."
40. Francis Spufford, *Backroom Boys: The Secret Return of the British Boffin* (Faber & Faber, 2003), 103.
41. Ibid., 105.
42. Fell, "Elite—An Outstanding New Game from Acornsoft."
43. Anderson and Levene, *Grand Thieves & Tomb Raiders*, 109.
44. Tristan Donovan, *Replay: The History of Video Games* (Yellow Ant, 2010), 120.
45. This is defined by Mark J. P. Wolf in his categories of space in video games. Wolf categorizes Battlezone within his definition of "interactive three-dimensional environment" as a way of positioning the player in the first-person viewpoint. *Elite* seeks to do this, but it also plays with the graphics moving on the z axis to highlight the three-dimensionality of the space in each of the three viewpoints to generate the illusion of moving through space. See Wolf, *The Medium of the Videogame* (University of Texas Press, 2001), 63–65.
46. Ed Byrne, "Elite," in *Space Time Play: Computer Games, Architecture and Urbanism: The Next Level*, ed. Friedrich von Borries, Steffen P. Walz, and Matthias Böttger (Birkhäuser, 2007), 104.
47. "Micromail," *The Micro User*, January 1985, 176.
48. Jesper Juul, *The Art of Failure: An Essay on the Pain of Playing Video Games*, 5.
49. "The Great Elite Battle Is Joined," *The Micro User*, April 1985, 127.
50. "National Elite Championships for Micro Show," *The Micro User*, May 1985, 23–24.
51. Ibid.
52. Michael Nitsche defines the "fictional space" of the gameworld as one "that lives in the imagination, in other words, the space 'imagined' by players from their comprehension of the available images." See Nitsche, *Video Game Spaces* (MIT Press, 2008), 16.
53. Raiford Guins, *Game After: A Cultural History of Video Game Afterlife* (MIT Press, 2014), 182.
54. Jenkins defines transmedia storytelling as "stories that unfold across multiple media platforms, each medium making distinctive contributions to our

understanding of the world, a more integrated approach to franchise development than models based on urtexts and ancillary products.” See Jenkins, *Convergence Culture*, 239.

55. Maher, “Elite (or the Universe on 32K Per Day)”
56. See <http://www.frontier.co.uk/about/>.
57. See the original Kickstarter page for *Elite: Dangerous* at <https://www.kickstarter.com/projects/1461411552/elite-dangerous>.
58. For more about “spreadable media,” see Henry Jenkins, Sam Ford, and Joshua Green, *Spreadable Media: Creating Value and Meaning in a Networked Culture* (New York University Press, 2013).
59. Kirk and Cotton, *The Cambridge Phenomenon*.

Chapter 5

1. Richard Hewison, “Level 9—Past Masters of the Adventure Game?” (<http://l9memorial.if-legends.org/html/rh.html>)
2. Tony Quinn, “Rock with the Caveman,” *Acorn User*, September 1984, 155.
3. Crispin Boylan, “Interview: The Superior Software Years and the Future,” The BBC Games Archive—Digital Memories, 1998, <http://www.beebgames.com/rhinterv.php>.
4. Ibid.
5. Christopher Payne, *Top Tips for Games Authors* (Superior Software, 1986), 2.
6. Boylan, “Interview: The Superior Software Years and the Future.”
7. Ibid.
8. Ibid.
9. Email message to author, February 27, 2015.
10. Ibid.
11. Ibid.
12. Phil Tudor, “Repton Is a Sparkler,” *The Micro User*, October 1985, 78; Bruce Smith, “A Gem of a Challenge,” *Acorn User*, September 1985, 155.
13. David Andrews, “Repton Revisited to Good Effect,” *The Micro User*, February 1986, 89.
14. Edge Staff, “The Making of: Repton.”
15. Ibid.
16. James Newman, *Playing with Videogames* (Routledge, 2008), 163.
17. See Donovan, *Replay: The History of Video Games*, 142.
18. Jon Revis, “Graphics Come Pretty Basic,” *The Micro User*, November 1985.
19. Wade, “The State of the Art: Western Modes of Videogame Production.”
20. David Lawrence, “The Games Page,” *Acorn User*, January 1987.
21. James Riddell, “Nasty Newcomers,” *The Micro User*, December 1986, 21.
22. Edge Staff, “The Making of: Repton.”
23. “Hacman: Discover the Inner Secrets of Arcade Games,” *The Micro User*, April 1987, 51.
24. David Lawrence and David Acton, *Repton Infinity Instruction Manual* (Superior Software, 1988).
25. See Repton Continuum at <http://aw.drobe.co.uk/REPTON/>.

26. Hanna Wirman, "On Productivity and Game Fandom," *Transformative Works and Culture* 3 (2009), <http://journal.transformativeworks.org/index.php/twc/article/view/145/115>.
27. Swalwell, "The Early Micro User: Games Writing, Hardware Hacking, and the Will to Mod," 11.
28. Anderson and Levene, *Grand Thieves & Tomb Raiders: How British Videogames Conquered the World*, 128.
29. Tony Leah, "Heading for the Century," *Electron User*, February 1989.
30. See <http://www.superiorinteractive.com>.

Chapter 6

1. Castells situates the "network society" in relation to events "around the end of the second millennium" in which "a number of major social, technological, economic, and cultural transformations came together to give rise to a new form of society." See Manuel Castells, *The Rise of the Network Society: Information Age: Economy, Society, and Culture v. 1*, second edition (Wiley-Blackwell, 2009), 354. Van Dijk expands on this in his book titled *The Network Society*, defining such a society as "a modern type of society with an infrastructure of social and media networks that characterizes its mode of organization at every level." See Jan A. G. M. van Dijk, *The Network Society*, third edition (SAGE, 2012), 23.
2. Richard H. Veith, *Television's Teletext* (Elsevier, 1983), 14.
3. *Eng Inf: The Quarterly for BBC Engineering Staff*, winter 1983–84 (http://bbceng.info/Eng_Inf/EngInf_15.pdf).
4. *Ibid.*
5. Veith, *Television's Teletext*, 14.
6. Paul Gregg, "Teletext: New Life for an Under-Rated Source?" *Business Information Review* 1, no. 2 (1994): 63–74.
7. See *Teletext System User Guide* (ACORN Computers Ltd, 1983), 42. It is also noted in the user guide that "not every magazine and every page is necessarily transmitted."
8. Veith, *Television's Teletext*, 16–17.
9. Prestel originally went under the name "Viewdata," but that name could not be registered as it consisted of two words in general use. However, "Viewdata" continued to be used and was often used since as a way of separating British Teletext and videotex systems from similar systems found in Canada, France, Germany, the United States, and Japan. See *ibid.*, 107.
10. *Prestel User Guide* (ACORN Computers Ltd, 1984), 2.
11. See Lev Manovich, *The Language of New Media* (MIT Press, 2001), 218. Manovich defines the database as "collections of individual items, with every item possessing the same significance as any other."
12. Veith, *Television's Teletext*, 15.
13. Steve Gold, "Teaching Old Dogs New Tricks," *The Micro User*, March 1985, 130.
14. "Orders Pour in for Teletext Adapter," *The Micro User*, July 1983.
15. David Allen, "Here Comes Auntie," *Acorn User*, September 1982.

16. Magazines such as *The Micro User* and *Acorn User* offered discounted Teletext adapters through mail order in some issues of their magazines, such as the May 1988 issue of *Acorn User* offering the adapter at a discounted price of £134 (inclusive of value-added tax and delivery).
17. Gordon Horsington, "Save Programs, Save Pounds," *The Micro User*, May 1987.
18. Jerome Aumente, *New Electronic Pathways: Videotex, Teletext, and Online Databases* (SAGE, 1987), 10.
19. Paul Leman and Steve Swallow, "Teletext Mode 7," *BBC Micro User*, April 1983, 7.
20. Veith, *Television's Teletext*, 83.
21. See Tom Blackburn, "Alien Invasion," *The Micro User*, February 1984; Jim Notman, "A Screen Editor for Teletext," *The Micro User*, August 1984; Notman, "Take the Toil out of Typing in Your Programs," *The Micro User*, May 1984.
22. Notman, "A Screen Editor for Teletext."
23. Christopher Stop, "Choose Chunky Mode 7 Letters," *The Micro User*, November 1984.
24. Notman, "A Screen Editor for Teletext."
25. W. J. G. Overington, "Telesoftware," *Computing* 5, no. 18 (1977): 25.
26. J. Hedger and R. Eason, "Telesoftware: Adding Intelligence to Teletext," *IEE Proceedings* 126, no. 12 (1979): 1414.
27. *Ibid.*
28. Mike Bayman, "Telesoftware Is on Its Way for the 1980s," *Electronics and Power*, January 1980.
29. M. White, "Telesoftware—a New Educational Resources?" *The Radio and Electronic Engineer* 54, no. 3 (1984): 114–116.
30. *Ibid.*
31. L. T. Mapp, "Telesoftware for Beginners," *Journal of Educational Television* 7, no. 1 (1981): 25–27.
32. White, "Telesoftware—a New Educational Resources?"
33. ACORN Computers Limited, "Teletext System User Guide," 9.
34. *Ibid.*
35. "Programs Programme," *Sinclair User*, July 1983.
36. J. Billingsley and R. J. Billingsley, "Software Distribution Via Broadcast Television Signals," *Electronic Letters* 21, no. 10 (1985): 444–445.
37. White, "Telesoftware—a New Educational Resources?"
38. See, for example, "Ceefax Guide," *The Micro User*, May 1988.
39. Malcolm Hall, "Teletext for Your Micro," *Acorn User*, October 1983.
40. "BBC Announces Closure of Telesoftware Service (1989)," <http://teletext.mb21.co.uk/gallery/ceefax/telesoftware/closure.html>.
41. *Ibid.*
42. "Telesoftware: The End of an Era?" *The Micro User*, October 1989.
43. *Ibid.*
44. Blyth, *The Legacy of the BBC Micro*, 12.
45. Allen, "The Surprising Back Story of the 1980s BBC Computer Literacy Project."
46. See "Making the Most of the Micro Live" (BBC, October 2, 1983).
47. Allen, "The Surprising Back Story of the 1980s BBC Computer Literacy Project."
48. Paul Drury, "Desert Island Disks: Jez San," *Retro Gamer*, 2015.

49. Jason Scott, *BBS: The Documentary*, 2005, <https://archive.org/details/BBS.The.Documentary>.
50. Castells, *The Rise of the Network Society: Information Age: Economy, Society, and Culture v. 1*, 2009.
51. "Microweb," *The Micro User*, July 1984, 102.
52. Henry Jenkins defines "participatory" as offering a contrast to "older notions of passive media spectatorship." "Rather than talking about media producers and consumers as occupying separate roles," he adds, "we might now see them as participants who interact with each other according to a new set of rules that none of us fully understands." Jenkins, *Convergence Culture*, 3.
53. Are Leistad, "The Norwegian Connection," *The Micro User*, April 1984, 91.
54. "At the End of the Line," *Making the Most of the Micro*, BBC, March 14, 1983.
55. "Econet given the ITC Seal of Approval," *BBC Micro User*, April 1983.
56. On page 165 of Gauntlett and Hill's book *TV Living*, Teletext is characterized as "quite mundane." Respondents discussing their use of Teletext describe it as having "blocky graphics" and looking "severely dated." Others see the growth of the Internet at this time as something that would supersede much of Teletext's use.

Chapter 7

1. In many ways the BBC Micro could be seen as a Gesamtkunstwerk linked to multi-media practices. As Charlie Gere notes, "historically multimedia can be traced back to any number of beginnings, including Greek tragedy, to various other practices involving combining sounds, words and images, or to Richard Wagner's concept of the total artwork, the Gesamtkunstwerk." See Gere, *Digital Cultures* (Reaktion Books, 2002), 86.
2. England, in 1086, was defined as anywhere south of the River Ribble and the River Tees, which were the boundaries between England and Scotland at the time.
3. John Goddard and Peter Armstrong, "The 1986 Domesday Project," *Transactions of the Institute of British Geographers* 11, no. 3 (1986): 291.
4. *Ibid.*
5. In his book *Convergence Culture*, Henry Jenkins uses the term "collective intelligence" from the theorist Pierre Levy to "refer to the ability of virtual communities to leverage the knowledge and expertise of their members, often through large-scale collaboration and deliberation." (See Jenkins, *Convergence Culture*, 281.) Although the information for the Domesday Project was not collected through online provision, it was only possible by crowdsourcing information from local areas in order to gain insights into the daily life of some of their inhabitants as well as photographs taken in those areas. People contributing to the project had to collaborate, albeit without always knowing who they were collaborating with to make the project a success.
6. Vannevar Bush, "As We May Think," *Atlantic Monthly*, July 1945 (<http://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/>).
7. Ted Nelson, *Literacy Machines* (self-published, 1981).
8. For more on the histories of CDs and DVDs see Anne Friedberg, "CD and DVD," in *The New Media Book*, ed. Dan Harries (BFI, 2002), 33.

9. Microsoft discontinued sales of Encarta in June 2009. More information available at, <http://www.microsoft.com/uk/encarta/default.msp>
10. Gere, *Digital Cultures*, 141.
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Chapter 8

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29. See <http://www.raspberrypi.org/about/>. "A Levels" are a qualification in England, Wales, and Northern Ireland that students can take when they are usually aged between 16 and 18. These are one of the qualifications sought before gaining entry to university or the workplace.
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