Lean, Tom. "Epilogue: Back to the Future?." *Electronic Dreams: How 1980s Britain Learned to Love the Computer*. London: Bloomsbury Sigma, 2016. 247–260. *Bloomsbury Collections*. Web. 26 Apr. 2023. <<http://dx.doi.org/10.5040/9781472936653.0012>>.

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Epilogue: Back to the Future?

Last Christmas my parents bought me a computer. They have prior form at this sort of thing. Back in the 1980s they gave my eight-year-old self a Commodore 64 (mainly wasted on playing games), then spoiled me with an Acorn Archimedes in the '90s (it actually did help with the homework, but the games were better on friends' Amigas). For Christmas 2014, I unwrapped a Raspberry Pi, the £25 computer touted in the media as the heir to the BBC Micro, ZX Spectrum and other early 1980s micros. A simple little machine developed in Cambridge, just like its 8-bit predecessors, the Pi is a credit card-sized computer intended to make programming and learning about computers easy and fun. Much like the microcomputers of the 1980s, the Pi is a computer to be understood rather than merely used, yet it is not just the technology that invokes the 1980s but the hopes attached to it.

The Pi has been hailed by the media and politicians as a fix to the looming skills shortage in the British high-tech economy. It is the device that will empower a new generation to understand computers and learn to code. It is not just a product, but a movement. The Pi has inspired books, computer magazines, 'Raspberry Jams' where users get together with their Pis, after-school computer clubs, a cottage industry supplying gadgets to plug into it and a community of users learning from each other through online forums. The machine was so popular when it was launched in 2012 that the website crashed under the demand, a very modern revisiting of the lengthy delays for mail-order 1980s machines. In these and in so many other respects, the rise of Pi resembles the 1980s microcomputer boom in miniature, and this is not a coincidence. The Pi is a very conscious recreation of 1980s computing for the twenty-first century.

‘It starts with: where the hell did all the students go? It starts with us waking up in 2005 struggling to find people to study computer science at the University of Cambridge,’ explains Eben Upton who worked at the Computer Laboratory at Cambridge at the time, and is now the CEO of Raspberry Pi Trading Ltd. ‘We’d coasted for a couple of decades on the back of the computer literacy initiative in the early 1980s and suddenly it evaporated.’ In his spare time Upton started building simple computers at home, and in 2008, by then working at semiconductor giant Broadcom, he found his interest piqued by an email conversation circulating around the University Computer Laboratory. It had the title line ‘Redo BBC Micro’ and suggested that a modern-day BBC Micro could interest children in learning about computers, leading them to computer science at university and jobs in the high-tech economy. ‘There was a missing piece. The recruitment woes were down to the lack of a bit of hardware,’ explains Upton. ‘And this idea from about 2008 that we could do something that was in this sort of area, and it kind of went from there.’

The original hope was to create a successor to the BBC Micro, but early discussions among the growing number of people backing the idea encountered an uncanny echo of a situation faced by the Computer Literacy Project’s founders. ‘Raspberry Pi has a really good brand now, but we didn’t want a brand. We wanted to call it the BBC Micro,’ explains Eben Upton. ‘We discovered that the BBC can’t do that anymore. You can’t have a state industry like the BBC turn up and compete in the computer industry!’ In other ways the Pi has been fortunate in aiming not to repeat the mistakes of the earlier British computer companies. ‘It’s a source of inspiration and cautionary tales,’ remarks Upton. ‘It showed that there was a market for a thing nobody really thought there was a market for... and that people like hacking on stuff.’ Thanks to worldwide distribution through the Internet, the Pi benefits from the economies of scale of a large market unthinkable to earlier home computer companies. While a few imitators have

appeared since its launch, the Pi has not yet had to fight dozens of close competitors; indeed, much of the British high-tech industry has united in praise of Pi. As of early 2015, five million Pis have been sold, far more than the Raspberry Pi Foundation's 'wildest dreams' of perhaps selling 100,000. 'It turned out, like in the 1980s, that there was a latent demand for this stuff,' notes Upton. Indeed, the need for some sort of educational computing device has been widely felt.

The lack of computer science graduates has also become a concern to the games industry. Once the *bête noire* of computer literacy, video games companies have become vocal lobbyists for computer education, alongside the growth of their economic and cultural clout. In late 2014, NESTA estimated that there were over 1,900 games companies in Britain, contributing about £1.7 billion to the nation's gross domestic product.¹ A few of its products, notably the *Grand Theft Auto* series, have even reached the status of cultural exports. New platforms, distribution through online stores, crowd funding, mobile gaming and indie games companies have all contributed to an industry that is probably more diverse now than at any point since the boom years. Once again small programming projects and individual efforts, particularly mobile phone apps, have become viable. Few of the companies from the 1980s endured the evolution of the industry, but many of the people have, building careers on the start home computers gave them. 'A lot of people, me included, were put into a wonderful position when we were very technically literate at a very young age,' explains David Braben, now CEO of games developer Frontier Developments, after a 30-year career in the games industry started with *Elite*. 'I'm very lucky enough to have been there at the right time to take advantage of it.'

'The BBC Micro went into schools in very big numbers and that created a familiarity,' explains Braben. 'We had computer science A levels and O levels, and by the mid-'90s applications were at the highest level they've ever been.' In the early 2000s, computer studies in schools shifted to Information and Communications Technology, ICT, with more emphasis

on using technology than on understanding how it works and programming. 'I had stand-up arguments with certain politicians about this. I thought it was unforgivable what they were doing,' recalls Braben, who became one of the co-founders of the Raspberry Pi Foundation in 2008: 'What I hope we've done is given to people who are motivated to play with technology today, the opportunity to do what we did.' Others intimately involved with developing British computers in the 1980s also seem to see the Pi as the heir to the sort of computing they helped to create. 'Raspberry Pi buzz is kind of the first time I felt an echo of the buzz that the BBC Micro generated in the early '80s,' remarks BBC Micro designer Steve Furber.

Powering the Pi is something more than a spiritual legacy of the home computer boom, an ARM microprocessor, descended from the chip dreamt up at Acorn in the mid-1980s. In 1990, Acorn set up Advanced RISC Machines (ARM) as a joint venture with semiconductor firm VLSI Technology and Apple. Rather than manufacturing chips, ARM built up partnerships with technology companies across the world, designed the technology, then licensed it out. By 1999, Acorn's stake in ARM was worth more than the rest of the company, and after a complex series of financial manoeuvres they went their separate ways.* Still headquartered in Cambridge, ARM Holdings, as the company is now known, went on to become the most significant British high-technology firm of recent years. Its relatively modest financial results (profits were a mere quarter billion pounds in 2014) completely understate its significance. 'ARM has been monstrously successful. I mean, it's the flagship of the UK's semiconductor industry today,' concludes Steve Furber, now a professor at the University of Manchester. 'It still doesn't make anything; it just does designs and licences them.' In a way, ARM is a very real manifestation of another dream of the 1980s computer boom; a company

*The remaining parts of the Acorn computer business became Element 14, and survives today in Cambridge as part of wireless and broadband communication giant Broadcom.

that makes its money from making knowledge rather than making physical things. As of 2015, some 50 billion ARM processors have been sold around the world by ARM's various partners. As well as the unseen ARM chips embedded into the systems around us, they turn up in many of the new high-tech devices of recent years. Android tablets, Apple iPhones and iPods, Amazon Kindle e-readers and smart televisions are just some of the places where this legacy of the 1980s home computer boom might be found quietly working away.

A revolution revisited

Behind 1980s computer literacy and the home computer boom was an idea of information technology as a transformational force. It was not just about education or computers, but about using information technology to rejuvenate the economy and society at large. Behind the Pi are similar hopes. 'We're getting another bite at the cherry. White Heat all over again,' suggests Eben Upton, invoking the 1960s 'White Hot Technological Revolution' and its vision of a new Britain forged through science and technology. 'Computing is the cheapest way to get you into engineering. What you're really teaching people is to think like an engineer,' argues Upton. 'This is an attempt to reboot that enthusiasm. What will we see out of it? We'll see one or two generations of start-ups... You'll see businesses will find it easier to recruit qualified, motivated young engineers.'

Computer literacy is back on the agenda. So too are the concerns that originally led to it. The declarations of a microprocessor revolution have long faded, but its underlying view of computers as a disruptive technology is as applicable today as ever. The news over recent years has been filled with stories of traditional businesses facing competition from information technology-driven rivals: London black cab drivers protesting against Uber, the smartphone application that allows anyone with a car to be a taxi business; high-street bookstores, music shops and electrical retailers being put out of business by Internet retailers, e-books and downloaded MP3 music files.

The list of such disruptions is long and varied, but the essential process at work would be familiar to 1970s information technology prophets like Christopher Evans. Indeed, in many ways we are still living in the same information technology revolution that was widely predicted in the 1970s. The electronic smart gadgets and disruptive technologies of the twenty-first century are but new implementations of older ideas.

Much as the home computer boom was fuelled by the recession of the 1970s and early '80s, since the economic downturn of 2008 there has been growing momentum behind a modern-day computer literacy. Once again, computer education is seen as a solution to a deficit in the understanding of information technology, and ultimately as a way of regenerating the economy. In 2011, the NESTA *Next Gen* report into the future of the games and visual effects industries highlighted how a skills shortage was disadvantaging Britain in the face of foreign competition. *Next Gen* placed much of the blame on deficiencies in computer education, and called for a renewed emphasis on computer science in schools rather than ICT. In 2012, a Royal Society report on computing in schools, chaired by Steve Furber, recommended a 'restart' of computing in schools, including an emphasis on engaging children with programming. At about the same time as the Royal Society report, Education Secretary Michael Gove declared an end to unimaginative ICT in schools, and its replacement by teaching that promotes a more fundamental understanding of how computers work. The hope, again echoing the 1980s, is 'skills which the jobs of the future and, for that matter, the jobs of the present, demand,'² as Gove put it in a speech to the BETT educational technology conference. The technology and the terminology have changed, and the current buzz phrase is 'digital literacy', but the promises and hopes attached to information technology remain the same.

Over the last few years the BBC has launched a renewed effort to get the nation, particularly children, interested in computers. 2015 is the year of the BBC's 'Make it Digital' scheme, a large-scale effort to inspire greater understanding of

the opportunities of new-information technologies. A *Doctor Who* game to introduce programming concepts, and a drama on the creation of *Grand Theft Auto*, seem rather far from the worthiness of *The Computer Programme*, but there is a similar hope to interest, inspire and instruct. Having overcome the objections of commercial rivals, the Corporation plans to give away a million Microbit educational computers, similar in concept to the Raspberry Pi, from late 2015. Britain is rediscovering computer literacy, for much the same reasons as it grasped the original iteration so tightly. 'I want to have a functional industrial economy in 40 years' time when I come to draw my state pension,' concludes Eben Upton. 'I want to grow old in a First World country, and we're not going to have one if we don't fix this.'

1980s computer literacy advocates hoped that computing would bring about a new sort of high-technology Britain. Information technology and its understanding has become entwined with economic development. There were 6.8 million people employed in manufacturing in Britain in 1979. By 2010 there were just 2.5 million in the sector. The jobs that have replaced traditional manufacturing have been in services, software, the financial sector, creative industries and other areas dependent on information technology. This reorientation of the economy was widely predicted in the 1970s as a consequence of microprocessors. Political and economic factors, globalisation and the neglect of the British manufacturing industry from the 1980s have undoubtedly been major forces in this shift. However, computer literacy and the computer boom helped to pave the way for this very different sort of economy, by creating a workforce familiar with information technology.

For many people in Britain, 1980s home computing really was a passport to the future. 'In the area around Cambridge any number of people cite their experience of playing around with the BBC Micro, whether it was like me principally with software or whether it was soldering up little boards,' observes David Braben. 'They got such a technical familiarity they've

now gone on to found big-tech companies.’ The broader trend was confirmed in a 2012 report on the *Legacy of the BBC Micro*,³ in which many respondents to a survey of former users commented on the importance of their earlier microcomputing experiences to their current jobs in the technology and creative sectors. Much the same can be said of the other machines of the 1980s, not least the ZX Spectrum, which far outsold the BBC Micro. ‘I’ve spent some decades in the computer industry, recruited no end of software engineers and bumped into loads of people whose early experience of computing was with the ZX Spectrum,’ recalls Richard Altwasser. ‘I think there are a large number of people out there who can look back and say, “Why did I have a career in computing? Well, the ZX Spectrum was an important part in that.”’

8-bit nostalgia

Legacies are normally bequeathed by the dead, but the machines of the home computer boom are still very much alive and enjoying an active retirement. One aspect of this is how popular culture has appropriated 1980s home computing and the feelings of nostalgia it evokes. Home computers appear on nightclub flyers for ‘80s nights’, on retro T-shirts and as passing reference in jokes and news reporting.* In 2009, the BBC broadcast *Micromen*, a well-received drama based on the rivalry between Acorn and Sinclair in the 1980s. Filled with in-jokes and cameos, and portraying Clive Sinclair as far more of a mad genius than he ever was in real life, *Micromen* was something of a caricature, which made for greatly enjoyable television precisely because it appealed to something people were already

*Two favourite examples of recent months came from the run-up to the 2015 UK General Election, when Labour Party leader Ed Milliband declared his love for *Manic Miner* in a radio interview; and comedian and journalist Charlie Brooker sparked a Twitter debate over which home computer each political party leader had owned as a child.

familiar with. A fond retelling of history, *Micromen* was not entirely historically accurate, but nostalgia never is.

The machines themselves are also still going surprisingly strong. Retrocomputing, collecting or using old computers, has become a popular passtime enjoyed by many thousands of people. The hobby seems driven by a quirky mix of enduring design appeal, nostalgia, collecting and personal fondness for technologies that once played a part in the collectors' lives. Much of it has been enabled by the countless websites and Internet forums devoted to old computers. Online, individuals and communities have built up vast archives of games, magazines, adverts, interviews and all manner of home computer-related ephemera. Internet auctions have enabled a thriving trade in old computers, and machines that once would have changed hands for a few pounds in a 1990s car boot sale now fetch high prices on eBay. Not all the activity is virtual, but much of it is enabled by a large community of interest. In late 2013, Elite Systems, originally a 1980s developer of ZX Spectrum games, managed to crowdfund a replica ZX Spectrum keyboard to be connected to tablet computers. Each year brings fresh retrocomputing books, many self-published or crowdfunded by nostalgic fans: fondly produced histories of computers and companies, encyclopedias of classic games and memoirs from home computer pioneers. In an appropriate touch, there is even a magazine devoted to the subject, *Retro Gamer*, now running for over a decade. The home computer is a nominally obsolete technology enjoying an active second life.

The old games have survived just as well as the computers. Not only do people retrogame on original machines, but emulators for playing on modern computers and mobile phone recreations have made classic titles accessible without original hardware. More ambitious still has been the reimagination of classic games for new computing platforms, carefully treading the line between remaining faithful to the spirit of the original and exploiting new technology. A good example is *Elite: Dangerous*, a new version of a fondly

remembered original, released in 2014. ‘We’ve tried to get the feeling of enjoyment of the earlier *Elites* but put it in a proper modern context,’ remarks David Braben. ‘It’s an astonishing change, but what it’s enabled us to do is some very interesting things.’ Alongside modern graphics and new paths to follow through an open-ended universe, *Elite: Dangerous* is impossibly larger than the original, with 400 billion star systems to explore in a galaxy accurately modelled on the Milky Way. That it was made possible thanks to £1.5 million crowdfunded from 25,000 people, presumably mainly fans of the original *Elites*, is another sign of enduring appeal.

To many of those involved in 1980s microcomputing, the ongoing interest has come as something of a surprise. ‘I think if you’d asked me to predict that in 1982, I certainly wouldn’t have done,’ reflects Richard Altwasser on the continued appeal of the ZX Spectrum more than 30 years later. ‘I don’t get the retro thing,’ remarks games programmer Jon Ritman. ‘But it’s very nice that I probably get one email every couple of weeks now from somebody... to tell me how much of their school life I ruined. And I always write back “another notch on my keyboard!”’ Emulation and modern recreations have kept classic games alive on new platforms, but for many people only the original hardware will do.

Old microcomputers are highly collectable. Much like stamps or coins, computers are aesthetically interesting as individual items. You can ‘collect the set’ from specific manufacturers, or search for the rare and unusual. In 2014, an original Apple I, one of perhaps 50 still in existence, sold for \$365,000 at auction. Few other machines command such exceptional prices, yet at any time there are hundreds of people bidding in online auctions for vintage computers, software and even peripherals. Yesterday’s technology of the future has become today’s collectable from the past. ‘Collecting computers is no different from collecting anything else,’ argues Jason Fitzpatrick. ‘You start off buying the machines you once had in childhood, [then] you start thinking, “well, there’s the machines I couldn’t afford and now they’re cheap I’m going to get those

too..."Then the ones that weren't even released in this country, and then you start looking for the rarer and more exotic machines. That's what happened with me. It's a habit that kept on growing into a huge collection.' To judge from various vintage computer Internet discussion groups, most computer-collection machines end up hoarded away, displayed almost as art, or even actively played. Jason Fitzpatrick's collection had a rather different fate: 'I saw the light and decided that this is pointless. So I decided I either had to do something with this, or I stop doing it.'

Today Fitzpatrick is director of the Centre for Computer History, a museum in Cambridge with a rich collection of machines and archived computing paraphernalia. Key to the centre's appeal has been its attention to the social history of computing and the personal resonance between its collection and its visitors. 'We're always getting people talking about how nostalgic they are,' observes curator Jeremy Thackray. 'People get in touch with computers that they last used years ago and they suddenly find themselves typing things they'd completely forgotten.' To a certain generation, 1980s computers are not soulless artefacts, but bonds with past experiences. Embedded in their plastic and electronics are distant memories of *Granny's Garden* at school, saving pocket money to buy games, learning to program with parents and a million other lived experiences. 'You give them so much information – you put a lot of yourself into those machines I think. It sounds weird, but you do build a personal relationship with them,' argues Fitzpatrick.

The centre's collection has grown with donations from people in search of a good home for their once-treasured microcomputers. 'Quite often you get this little after-question, when they hand it over: "You will look after it, won't you?" It's like a pet they've taken to the vet,' muses Jason Fitzpatrick. 'And I think that's why the museum has been so successful, because we look at this from the personal point of view, not just the bits and bytes.' In common with the Pi and the wider rediscovery of computer literacy, there is an educational focus to the centre's work too. With modern computers built to be

used rather than understood, the instructional value of the simpler 1980s machines is as relevant as ever. 'These machines are really useful for understanding what a computer is and how it functions, and that comes across particularly well when we have school groups in,' notes Jeremy Thackray. Another attraction of the centre's exhibits is the chance to play with them; indeed, it is an important part of the interpretation strategy. 'Number one on our list is to have them working,' explains Thackray. 'We don't want the object in question to be a lump of plastic that people stare at. We want them to actually use it.'

The technology may have dated, but the essential appeal of the home computer as a creative machine to do *something* with remains as viable as ever. People are still creating new things with old computers. A good example is the demoscene, a subculture of users that spread across Europe from the late 1980s and is still thriving today, driven by graphic artists, musicians and programmers, creating artistic demo programs. Somewhat akin to hobbyist computing, demos rely on an intimate understating of the hardware and its quirks to create audiovisual displays once thought impossible on such simple hardware. Lively mixes of high-resolution graphics, smooth and swift animations, and surprising visual effects set to music, demos are a modern-day incarnation of the technical and creative expression of early microcomputing.

Games programmers too are still creating new titles on machines long abandoned by commercial publishers. A steady trickle of new titles for old computers appears each year, particularly on the machines that were once most popular, like those of Commodore and Sinclair. 'The reason I do it is exactly because the machines are so very limited in their capabilities,' explains programmer Bob Smith, creator of over two-dozen new ZX81 and Spectrum games. 'Being a programmer foremost, it's a great challenge for me to try and make these machines do things that they weren't considered capable of back in the day.' Just as in the 1980s, people are exploring what

microcomputers can do and pushing the technology to make them do more. In a twist on the updating of old classics like *Elite*, for new platforms, several of Smith's projects are interpretations of new games, such as *Quack*, a ZX81 version of the hit mobile phone game *Flappy Bird*. 'I like to try to pick games that would suit the retro machines,' adds Smith. 'Not only to ease the conversion to a playable game, but also to prove that some modern games are simply very good ideas, which could work on any machine.' Like many retrogamers, Smith uses editors and emulators on a modern PC, rather than original hardware, to create the titles. Modern development tools and not having to suffer the idiosyncratic keyboards of the original Sinclair machines speeds development, but the last stages have an appropriately authentic touch. 'The final games are tested on real machines,' explains Smith. 'Which is very important to me.' At the start of the 1980s the home computer was a technology for people to experiment with and discover what they could make it do. The same is still true three decades later.

Long after the crash of the computer market, the closing of production lines and a gradual slide into technical obsolescence, the home computer is still very much alive. In the twenty-first century people are still playing around with home computers, seeing what the technology does and using them to create. The legacies of the machines are all around us, embedded in popular culture and personal life stories, buried in the histories of the technologies we use today and in the companies that make them. Originally conceived as a way to make new-information technologies acceptable and accessible for everyone, the biggest legacy of home computers is a world where computer technology is commonplace. As times goes by the original machines will stop as their electronic components degrade and fail, but their legacy will remain, perhaps refreshed anew. As I was finishing this book, news broke of the launch of a new Sinclair computer. The Sinclair Spectrum Vega, a reincarnation of the Spectrum as an ARM-powered console with 1,000 built-in games, pre-sold its entire

initial production run within 36 hours of being offered to the public. Through the Pi, the Vega, popular culture and the retrocomputing community, the 1980s home computer has proved to be a remarkable survivor. The signs are that it will remain so for quite some time to come.