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CHAPTER EIGHT

The Unmaking of the Micro

In December 1984 an unlikely scuffle broke out in the Baron of Beef, a Cambridge pub favoured by the city's high-tech scene, between rival computer company bosses Sir Clive Sinclair and Chris Curry. The reason for the fracas was a newspaper advert criticising the reliability of Sinclair's computers, and implying that an Acorn made a better Christmas present because buyers would not have to take it back in the New Year when it broke down. Witnesses reported that slapping and jostling ensued, before the two continued their disagreement at a nearby wine bar. The incident was overblown by a tabloid press delighted by the idea of brawling computing tycoons, but it was a hint that all was not well in the home computer industry by the end of 1984.

It would be a nice literary flourish to suggest that the glory days of the home computer ended then and there, but really there was no single dramatic moment when the home micro turned from wonder technology of the future into technological cul-de-sac. Nevertheless, 1984 was the beginning of the end for the home computer, as it was originally understood, and for many of the companies that made them. After being caught short by insatiable demand at Christmas 1983, manufacturers stocked up in anticipation of a repeat seasonal sales bonanza, which never came. Christmas 1984 was a disaster. Hundreds of thousands of computers went unsold, leaving the industry facing the dawn of 1985 with a multimillion-pound hangover.* Among the worst hit was Acorn, which had stocked up on Electrons after technical troubles had restricted its Christmas sales the year before. 'We couldn't make them fast enough in '83,'

*David Thomas in *The Amstrad Story* estimates that of the 1.7 million machines that were built in 1984, just 1.35 million were sold.

recalls Steve Furber. 'By '84 we'd cracked it but... unbeknown to us, the market had moved on, so there were a quarter of a million Electrons in a warehouse that we couldn't sell in the Christmas of '84.'

1985 brought a series of headlines about financial troubles in the home computing industry. Acorn shares plunged to a record low of 23 pence in late January, from a 1984 peak of 193 pence. Trading in Acorn shares was soon suspended and Sinclair cancelled plans for a stock-market floatation. On 1 February, Oric proudly launched a new computer, the Stratos. The next day, Oric went into receivership. It was bought by the French firm SPID a few months later, surviving as a largely French business for another couple of years. Computer prices tumbled during 1985 as computer manufacturers dumped stocks to raise funds and retailers slashed prices. In late 1984 an Acorn Electron cost £199, Sinclair's recently released QL was £399.99 and the new Commodore 16 was £139.99. A year later all three machines were half price, despite being bundled with generous packs of software and other goodies. The vicious circle of dumping and price cutting cost the companies producing the machines heavily. In June, the *The Times* reported that Acorn had made a £20 million pre-tax loss in the first half of 1985 alone.

Some sort of market shake-out had long been suggested in the press, but the victims were expected to be the smaller companies. Jupiter Cantab and Grundy had already disappeared before 1983 was out. Dragon Data called in the receivers in June 1984, but was pulled back from the brink thanks to a buyout from the Spanish Eurohard SA. A similar process was playing out in the US, albeit among larger companies for whom home computers were not the core business. Both Mattel and Texas Instruments dropped out of the market after losing the price war to Commodore. Atari persisted, despite being badly hit by a collapse in the video game console market, but was reckoned to have lost \$500 million during 1983/84. Commodore remained a force to be reckoned with, but after the shock ousting of founder Jack Tramiel in 1984, the company

would lose much of its direction. Smaller companies and new entrants to the market were always going to be at a disadvantage in a market that favoured established firms. Yet as the likes of Acorn and Sinclair began getting into noticeable financial difficulties in 1985, it was clear that there was a much bigger problem looming over the whole industry. Pundits began comparing the cheap computer with the short-lived 1970s craze for hula hoops. Why did people no longer want home computers? Had a whole industry been built on a passing fad?

Maturing markets

We still have computers in our homes. However, they are of a very different type to those of the early 1980s, separated by far more than just technological development, but by profound changes in how we expect to use them. What happened around 1984 was the unmaking of a particular type of home computer and of the mode of home computing that went with it, and its replacement by rather different types of computer and different notions of what they were for. In part the home computer's success was its own undoing. Growing computer familiarity, the original *raison d'être* of the microcomputer boom, undermined the need for introductory machines and the sense that computers were there to be explored. A little of the mystique and the urgent need for computer literacy faded as computers become more commonplace. Programming became less important with so much off-the-shelf software available. For all but the most curious or dedicated, the computer became more of a software player than an intricate puzzle to be mastered. In magazines, type-in programs began a slow decline in the face of ever more reviews for ready-made software, and cover-mounted cassette tapes packed with programs. The computer bought by parents to help the children's education, but mostly used for games, became a familiar story, written about in disparaging terms in computer magazines as people were implored to exploit their micros' capabilities to the full by trying something serious. In 1984, market researcher Gowling reported the results of a survey

into computer attitudes among parents and children, recording growing doubts about the educational merits of computers bought for children.¹ Parents had started with ideas that computers would be good for skills development and technical familiarity, but found educational software simplistic, and worried that computers were just expensive games machines, the thing most home computers *were* being used for.

There is a close correlation between this sense of disillusionment with home computers and the rise of computer games. Use plays an important part in defining what a technology is. The torrent of games from the industry overshadowed the potential of home computers as useful household tools or worthy educational aids. The best example is the ZX Spectrum, originally designed with games more in mind than its predecessors, but still intended as an exploratory and general-purpose computer too. By 1984 about 400 educational titles, 400 computing tools and 900 assorted applications had been released on the Spectrum; clearly, at least some people found the Spectrum useful for accounts, word processing and other applications. However, in the same time frame, around 3,500 games were released for the machine. Any general-purpose aspirations of the Spectrum were overwhelmed by the gaming culture that had developed around the machine.

Cheap home computers became widely perceived as toys, not helped by the fact that many of them *were* toy-like in appearance and increasingly sold in toy shops, where they had to compete with other toys. 'All the computer companies were going bust in '84, and you know why?' asks Oric's Paul Johnson. 'The BMX bike. Home computers were toys, which were bought for children... It was a toss-up between a computer and a BMX bike.' After finding a Far Eastern supplier of cheap bikes, Oric came up with an inventive plan to save the company. 'If you bought an Oric you got a free BMX bike, but we couldn't get the letter of credit together because things were getting so rocky,' recalls Johnson.

Others had used home computers as far more than toys, in spite of the drawbacks of the machines on offer. Many people

had tried to use basic home computers as useful tools, often going to some lengths to upgrade them to make them better suited as word processors, calculators and accountancy systems, hinting at a latent desire for more general-purpose utility. As users began to outgrow introductory computers, there was a growing sense that the future was not so much in simple introductory or games computers, but serious machines with the power for more sophisticated applications. In the world of professional computing, IBM's launch of the PC in 1981 had a profound impact. PCs were far too expensive for the home computer market at first, but the status of IBM helped to legitimise the idea of personal computers as useful tools for office-type applications in professional environments; why could the same not be true of computers in the home?

As early as 1983, industry pundit Martin Banks was musing in *Personal Computer World* that programs that offered tangible benefits to users were vital to the long-term survival of the home computer industry.² As 1984 drew to a close, the *Guardian's* computer correspondent wondered if the 'Indian summer' of cheap computers was coming to an end, and predicted a final rush of first-time buyers before people moved upmarket to buy 'real' computers.³ The low-cost, simple home computer was reaching a watershed moment. Its appeal among consumers, at least those not interested in games, was waning. For manufacturers the introductory computer market was beginning to turn into a race for the bottom, as prices were cut and stocks of discontinued machines were dumped. Yet at the same time there seemed to be a demand for more powerful and more useful machines, and even before the crash of 1984, several manufacturers were trying to move upmarket, towards more professional-styled 'real' computers. Not all of them would make it.

A quantum leap

After the overwhelming success of the ZX81 and ZX Spectrum, just what Sinclair might do next was a keen topic of speculation in the computer press. Journalists alleged that the ZX83 would

be a professional computer rather than home micro, a portable business machine with built-in Microdrives for storage, and Sinclair's flat-screen television as a display. Considering that the first successful portable computer, the Osborne 1, had been a briefcase-size 'luggable' weighing 23 pounds and costing \$1,795, the prospect of Sinclair cutting down the size and price of portable computing was an exciting one. There was also talk of a direct successor to the Spectrum, not to mention plans for the Low Cost Colour Computer, or LC3, later compared by Sir Clive Sinclair to a Nintendo console. 'The place was an ideas factory,' remarks ZX83 designer David Karlin. 'You wouldn't believe the number of ideas and conversations and different people's opinions about what things should be and what things might be.' Whatever the ZX83 turned out to be, there was an expectation that Sinclair would come up with something extraordinary, but then it did advertise for the best computer designer in the world to do it. 'I only discovered later that the job had been advertised as Sinclair wanted the best computer designer in the world, which I got mercilessly ribbed about by people for years afterwards,' chuckles David Karlin. Headhunted to develop the ZX83, Karlin had previously worked for Fairchild Semiconductor in California. While there he had been much impressed by the high-performance Xerox Alto and Xerox Star workstations developed by the nearby Xerox Palo Alto Research Center (PARC). The Xerox workstations introduced many innovations, notably a high-resolution screen with graphical user interface, soon to be adopted by Apple. They were top-of-the-line systems for demanding tasks, such as artificial intelligence work and office automation. 'I thought these were fantastic,' remarks Karlin. 'What you would be able to do with that kind of high-quality screen on a really good machine was just staggeringly obvious.'

Karlin's scheme for the ZX83 was suitably ambitious. 'What I wanted to build was essentially a sub £1,000 Xerox Star. It was going to have a big enough screen to be usable for real business work. The Xerox Star was ten grand... what we

needed to do was build something that did what that did for a grand.' It was the sort of radical cost reduction that Sinclair had done so well at in the past, but there were other issues at hand too. The company had already been in talks with mainframe computer manufacturer ICL, the established British equivalent of IBM, over a collaboration on a business microcomputer. Yet set against this move into the professional market was the need to build on the success of the ZX81 and Spectrum. 'For Clive Sinclair the starting point was, what would be a better Spectrum that might take us in that kind of direction?' suggests Karlin, considering the situation over 30 years later. 'I think it's fair to say that in everything that followed, those two viewpoints were never actually reconciled. However, a sort of uneasy marriage of the two resulted in the QL.' In many ways the QL, as the ZX83 became, or Quantum Leap to give it its full name, seems a compromise between developing a true business computer and making a more powerful machine for the upmarket home computer user. 'All of the ingredients of my £1,000 Xerox Star were going to be in there,' explains Karlin. 'And a colour display, which I wasn't that bothered about, but a Spectrum successor games machine had to have colour.'

On the innovative and professional front, the QL had an 85-column screen for effective word processing, a 256 colour palette and fast, high-resolution, bit-mapped graphics far beyond those seen on most micros before. Rather than the unique user port of the Spectrum, the QL had serial ports to connect directly to standard peripherals. It also offered built-in local networking, available as an upgrade on the Spectrum, but once again the Xerox Star workstation was an inspiration too: 'There were all these workstations that were networked to each other and we looked at all these cool things we could do with them, and thought how fantastic it was. So that was totally obvious to me that it was something you should have,' recalls Karlin. There was innovation with the software too: built-in office applications developed by software house Psion; the new Super BASIC, offering the structured programming features that professional and education users favoured; and

a sophisticated operating system named QDOS, developed by experienced software engineer Tony Tebby. QDOS offered an early windowed working environment and pre-emptive multitasking, the novel ability to have more than one program running at once, with the computer dividing processor time between the different tasks.

On the home and economy side, rather than use disc drives, the project had relied on a pair of built-in Microdrive high-speed tape recorders, slower than conventional floppy discs but readily available. At the heart of the machine was a new 32-bit processor, the first to appear in a home computer. The Motorola 68008 offered far more capability than the old Z80, but this too was a cost-driven compromise. The 68008 was the lower performance, budget version of the Motorola 68000. The 68008 was a 32-bit processor but with a narrower 8-bit data bus that took longer to transfer data to and from memory. To cater for games users there was a pair of joystick controller ports, and for the home user a television adaptor was added. 'I'd designed everything to have a dedicated display,' recalls Karlin. 'That got dropped and there was a reinstatement that it had be usable with a domestic telly as an option, and to be honest the QL's telly interface was bolted on at the end and wasn't very good.' Rather than go to the expense of a typewriter keyboard, the QL was instead fitted with a new evolution of the membrane, but with sculpted plastic keys offering a much-improved typing experience compared to the dead flesh buttons of the Spectrum. 'It had to have a proper keyboard,' recalls Karlin, 'but the keyboard had to be at a Spectrum-type cost.' The whole thing was wrapped up in an elegant case designed by Rick Dickinson.

Taken as an overall package, the QL was probably the most advanced home computer to date. Aside from the obvious economies, it really did offer a leap in capability over the Spectrum, Commodore 64 and even BBC Micro. Compared to existing professional machines, the QL was an advanced package of features at a surprisingly low cost. It was far slicker than the IBM PC, offering capabilities more like those found in Apple's revolutionary Macintosh, launched not long after it,

but at a fraction of the price of either, just £399. Making the point abundantly clear, the QL's television advertising featured Sir Clive Sinclair taking a running jump over a row of more expensive competitors. Despite a few grumbles over the keyboard and the Microdrives, the general reaction after the QL launched in January 1984 was that it was an innovative, professional-looking machine which would probably shake up the market just as its predecessors had. Yet despite the advertising claiming that the machines would be shipped within 28 working days, there was one rather major problem: the QL was not actually finished. 'Six months later and six months better would have been a wonderful thing, I believe,' sighs David Karlin. 'Instead what we had were six months of pain.'

The technical details of what went wrong with the QL have been forensically examined elsewhere.⁴ Suffice to say that what followed the launch was a difficult period when the development team did their best to get the troubled machine working and into production. 'When the machine came into manufacturing, all kinds of horrible stuff had to be done to make it just about work, and fairly heroic engineering efforts were made,' recalls David Karlin, 'but it really did only just work, and lots of them didn't quite work.' The biggest problem, according to Karlin, was in reliably transferring data between the Microdrives and the computer. However, there were also problems when software was late and buggy, and complications when a second processor replaced the planned purpose-designed ULA for controlling keyboard, sound and serial.

Overwhelmed by demand for its earlier products, the company was no stranger to criticism over delivery dates, but the QL took it to new levels. Sinclair took a beating in the press for the delays and for cashing mail-order customers' cheques when the machines were far from delivery. In April, QLs began to be shipped to customers, but with a curious addition sticking out of the back. 'We have a lump of firmware that is simply impossible to get onto the size chip that we can use on the board. What do we do?' recalls David Karlin. As an interim solution to get machines to customers

while the designers completed a redesign, QLs were shipped with a kludge containing the missing firmware sticking out of one of the expansion ports, to much derision in the computer press.

The saga was damaging to the company's reputation and finances, and the QL delays became something of a cruel in-joke in the pages of magazines. One suggested that there was in fact just one QL doing the rounds, returned to Sinclair when it failed, then dispatched to a different customer to repeat the cycle. By July, kludge-less QLs were being shipped in volume to customers, but the machine's fortunes had been dealt a blow it would never recover from. 'I'm very sad at what might have been,' muses David Karlin. 'There was a slot in the computing world that was eventually claimed by Apple with the Mac. I think we had a really good shot at it, and we came two inches away from actually getting there... I think we did some fantastic work, but we clearly did a couple of things spectacularly wrong, and what's annoying is that the difficult stuff, the stuff that was really innovative and groundbreaking, we actually did really well in a way I don't think was bettered, not by Apple, not by anybody, for a good long time afterwards'.

Other companies slipped in their jump from home computer to business machine too. At about the same time as Sinclair was trying the QL, Commodore misjudged the market completely with a new, professional-styled computer, the Plus/4. While the QL had at least tried to advance technology, the Plus/4 was a backwards step, inferior in most respects to the older Commodore 64, yet more expensive and incompatible with the wealth of software that kept the C64 so popular. At the time Commodore was joining the race to the bottom in the home computer market with a new line of cheap, low-specification machines intended to undercut competitors: the lacklustre C16 and the rubber-keyed C116, intended as Commodore's answer to Sinclair. Commodore management then tried to turn them into business computers, by adding memory, built-in applications and a few other features to create

the Plus/4. Derided in the press as the Minus/40, by 1985 £300 Plus/4s were being dumped at £49.95 at Dixons, only £10 more than the almost as unsuccessful C16.* The move from home micro to professional personal computer was not an easy one.† User expectations were higher, more capability was important and the abandonment of a trusted brand with a large software base was a difficult commercial decision.

There have been various explanations given for why the QL was launched prematurely: to fit into expensive, pre-booked advertising slots; to give Sinclair a financial boost before a planned stock-market floatation; or to beat the Apple Macintosh to market, which it did by 12 days. The Apple Mac was inspired by the same Xerox workstations that had influenced the QL, but with a \$2,495 price tag and few of the same design economies, it was an unqualified success, a textbook exercise in style, marketing and innovation. The Mac's designers built the computer and floppy disc drive into the same simple, yet stylish box as the screen. With the disc slot positioned to give the compact computer a cheeky smile, they created a design classic. Underlying the style was a host of innovations: a powerful Motorola 68000 processor, the full version of the cut-down chip in the QL; a new 3½-inch floppy disc drive, far more compact than the older 5¼-inch discs; and most prominently a computer mouse driving a graphical user interface (GUI), the first on an affordable personal computer. So novel was a GUI to most people that reviewers had to explain the whole idea of what a computer desktop with its icons and windows was, and how you could click on things with a mouse pointer to make

*Yet again, while they may have been failures in Britain and the USA, Commodore's cheap machines would find some success in less-developed markets. The C16 was popular in Mexico and the Plus/4 in the Eastern Bloc.

†In 1985, Commodore launched the Commodore 128, a much-improved and largely compatible successor to the 64. Although the C128 fared better than the Plus/4, it was not the same success as the C64.

things happen, rather than having to type confusing commands. Not only was the GUI incredibly user-friendly, but it looked great too, just like everything else about the Mac.

It was a radically new concept for what a personal computer was, backed by a slick marketing campaign that cemented Apple's place as the computer company that did something different. Most famously, a 1984 Super Bowl advert, directed by Ridley Scott of *Blade Runner* fame, and costing around \$500,000 to film, made headlines around the world. With the promise that Apple's 1984 wouldn't be like Orwell's *Nineteen Eighty-Four*, a colourfully dressed female athlete raced the thought police through a grey Orwellian world to smash Big Brother, a clear allusion to IBM, with a sledgehammer. Great successes have a way of overshadowing failures; Apple had tried to make a similar machine in 1983, the Lisa, which at a very expensive \$9,995 had far less impact. However, with the Mac they scored a terrific success and created a revolutionary product that pointed to the way personal computers would develop in future.

In Britain, where the Mac was initially priced at around £1,975, it was simply too expensive to have quite the same impact as it did in the US, outside the circle of media and creative types who took to it with enthusiasm. There was a clear gap in the British market for something cheaper yet similarly innovative and professional, but with the failure of the QL it would be some time before it was filled. In the meantime, the 1984 breakthrough computer in Britain would not be the Sinclair QL or the Apple Macintosh, but a machine from a new contender in the computer market, the Amstrad CPC464.

The Amstrad

The most remarkable thing about the CPC464 was not just that it offered a fresh concept, but that it was a success despite the odds stacked against any new contender in the computer market in 1984. Amstrad's founder was not one of the techie-turned-entrepreneur figures who had hitherto dominated British computing. Alan Sugar was a straight-talking salesman

from the East End of London, with a gruff persona and a bottom line of giving customers what they wanted. Starting out small, trading stereos from the back of a van, Sugar built up Amstrad (a contraction of *Alan M Sugar Trading*) into a major supplier of consumer electronics to the high-street chains. Critics accused Amstrad's products of being cheap and cheerful, but they were decent performers, and good value for money. Car stereos, CB radios, hi-fi, video, televisions – Amstrad successfully tried its hand wherever it might turn a profit, but never at computers, at least until a Brentwood electronics consultancy named Ambit received a visit from one of its neighbours.

'Amstrad turned up in the autumn of '83, I suppose,' recalls Ambit's Roland Perry, 'saying, "This is all very hush hush, but we, Amstrad, want to enter the home computer market."' Amstrad had something approaching a prototype to show, but computer development had turned out to be a bit more complicated than first envisaged. 'They said, "We've got this couple of lads who said they're going to design the board for inside it. They seem to be having a bit of trouble."' Amstrad's computer was half finished. There was a case, but no working computer to fill it with. 'The whole thing was finished down to the hole you had to screw the top and bottom together, everything. They said, "Can you just fit us a board in here?... We need it in a couple of weeks, please."' An experienced Cambridge-educated electronics engineer with a long involvement with microelectronics, Perry explained that it took around a year to develop such a machine from scratch. 'And they said, "Well, I'm sorry – you've only got three months."'

Perry began assembling a team to finish the machine. The project was top secret at the time and the Amstrad logo had to be taped over on the prototypes. Perry replaced it with the code name 'Arnold', coincidentally an anagram of his own name. The name also added to the subterfuge by hinting that Ambit's mysterious client might be Arnold Weinstock, the industrialist behind heavyweight electronics firm GEC. 'I hawked this around my chums,' recalls Perry, 'and said we need

to fill this gap in here, and after a couple of weeks I put together a team of people who were foolish enough. They'd worked together on things before and some of them were hardware experts and some were software experts.' It was a hurried start to a time-pressured project, but Perry managed to recruit a set of small companies that could do it, notably MEJ Electronics and Locomotive Software. Typical of the pragmatism that sped the development, the original plan to use a 6502 processor was quickly dropped for a Z80, simply because Locomotive had recent experience creating a Z80 BASIC. A more technophilic company might have agonised over the choice, but Amstrad went with something that would work quickly.

Amstrad was a company driven more by the vision of a product than by introspective debate over its technical details. Perhaps unsurprisingly, one thing it did have ready was the case to put the computer in, which was central to the whole concept. Everyone else was selling a home computer that plugged into a television and a cassette recorder. Often, the bits did not work together at first, and at least some apparently faulty computers had nothing wrong with them apart from being incompatible with the television and cassette deck they were connected to. Amstrad's plan was to bundle the whole lot together: a keyboard computer with built-in cassette recorder, and monitor bundled in as well. 'We thought: it's big, and it's a bit ugly,' recalls Perry of first seeing the prototype. 'What we were really impressed about was that they'd got the injection moulding done. They'd got the keyboard done and everything was there. This was the whole thing. You didn't have to buy bits separately and plug it in.' It was another little step in user-friendliness, but had advantages all around. Building and selling a complete package avoided compatibility problems, meaning fewer faulty returns for retailers, and it had the unique selling point of not tying up the family television with a computer.

Amstrad had prior form at this sort of boxing up. In the 1970s it was common to build a home stereo from a separate radio tuner, tape deck, turntable, amplifier and speakers.

Amstrad pioneered the tower stereo, an all-in-one unit with everything built in, manufactured cheaply and sold at an attractive price. The CPC applied the same concept to the home computer. The old Commodore PET had done similar, but cheap micros had moved away from the all-in-one to cut costs. Amstrad had a genius in finding other ways to keep its costs down, not just by keeping the number of components down, but by sourcing parts and building products wherever they were cheapest, often in the Far East. Amstrad's complete computer was startlingly good value: £329 with a colour display, or £229 with a business-like green on black screen. There was much truth in Amstrad's advertising boasts of 'a complete workstation for the price of a home computer'. 'Workstation' just sounded so much more professional than microcomputer too.

The professional look was the other attraction of the all-in-one bundle. Dismissing Sinclair's machines as 'pregnant calculators', Sugar decided that his machine would be a home computer that looked like the sort of computer customers were used to seeing at an airport check-in desk. With its big case and screen, the CPC looked more like a 'real' computer than anything else in its price range. As the bottom dropped out of the cheap computer market, it was just the sort of package that would appeal to buyers looking for a more serious computer. However, Amstrad was careful to stress it could do games just as well. One advert, featuring a middle-aged man in a suit and baseball cap playing a racing game, reminded readers that the CPC could do business as well as '180 miles per hour'. The message was simple and effective – this was a genuinely general-purpose machine that was both fun *and* serious.

A new product in a mature market

The CPC was carefully designed to a price point. The colour monitor actually used a normal television tube, rather than the more expensive components of a higher definition professional monitor, but it still looked good. There were surprisingly few components laid out on the neat computer-

designed motherboard, key to keeping the cost down. 'It became quite obvious to us that you needed to put as much of the electronics as possible inside one chip in a gate array,' recalls Perry. The trick, once again, was to use a ULA to do the job of dozens of other components. 'It was all terribly symbiotic; gate arrays are cheaper than lots of TTL, and you also can't copy them. We were very worried about people producing clones.' Not for the first time in the story of the British home computer, the curse of the Ferranti ULA struck. The design team visited Ferranti's factory in Manchester to check the first chips off the production line. 'We plugged it in to see if it worked, and it didn't! Damn damn damn!' recalls Perry. 'The main thing that was wrong with it was that the on-board crystal oscillator wouldn't oscillate.' Amstrad found a second supplier in Italy rather than waiting for the problems to be fixed. Time was money.

Established machines were supported by large back catalogues of software, against which new rivals struggled to compete. Instead of just hoping a CPC software scene would develop, Amstrad created one itself. About 50 prototype computers were hand assembled, with the logic that everything that the ULA was supposed to do was covered by built-in TTL chips in a Gate Array Simulator board. 'GAS boards. We had a sense of humour in those days,' laughs Perry. The GAS board machines were dispatched in great secrecy to software houses to build a stockpile of games and applications before the machine was even launched. When the CPC came out there were nearly 50 software titles available. To further support the machine, Amstrad was soon selling disc drives and printers, started a user club and published a magazine, *CPC464 User*. Alan Sugar's contacts with big-name retailers like Dixons, meant Amstrad could get the CPC straight onto the shelves across the country. The pieces were all in place to help the CPC become a major success.

There had been little precedent to guide the earlier computer companies. They were all pioneers in a new market where customer expectations had not yet formed. Amstrad

was different. They learned from what went before and made a shrewd assessment of what customers wanted. On most home computers the cursor keys did not do anything until something was typed out on the screen to move the cursor around it. On Alan Sugar's computer they moved the cursor around the screen whether there was anything there or not, so a novice user playing with it in a shop wouldn't be disappointed by it not doing anything.* As the market-leading Commodore 64 offered 64k of memory, it was no coincidence that the CPC464 did too. Computer journalist Guy Kewney was even recruited to confidentially review the machine for Amstrad before it came out. 'Who do I make machines for?' muses Roland Perry, 'I used to make machines for magazine reviewers: it's not as strange as it sounds, because I made them for somebody who was reasonably skilled and adept at the machines... Something that passes that test will therefore almost automatically be good for your average family man who wants to buy a computer for the family.'

The CPC was a product well matched to a maturing home computer market, the right concept at the right time: a serious looking computer, good value with its bundled cassette recorder and monitor, and with plenty of software on offer. When it was released, on time, in June 1984, the CPC was a massive success. Journalists praised the machine as excellent value for money. Two hundred thousand CPC464s were sold that year,⁵ many during the Christmas rush, at about the same time as a certain disagreement in a Cambridge pub, and as other manufacturers saw their sales crash. Always game for publicity, Amstrad promptly announced a new game, *This Business Is War*, featuring likenesses of Chris Curry and Sir Clive Sinclair throwing computers at each other, although it does not seem to have been released.

*Sugar's influence showed up in the manual too, which included a programming exercise on salaries, with such outputs as 'ASK FOR A PAY RISE' and 'ASK FOR A BIGGER CAR'.

1985 brought improved versions of the CPC with a built-in disc drive. In what was probably an economy measure, Amstrad adopted the otherwise obscure 3-inch disc drive. Little used by other companies, it became something of an Amstrad signature. More important was the release of another Alan Sugar concept, the PCW8256 word processor. For just £460,* the PCW was an all-in-one computer, 3-inch disc drive and green screen monitor, sold with a keyboard, printer and word-processing software. It was a neat and professional-looking product, an appliance for word processing, a machine explicitly sold as an application rather than as a computer. That it was also capable of running BASIC, games and other software were just bonuses to its primary purpose. However, with financial programs and other applications, the PCW eventually found some favour as a more general-purpose office machine too. Television adverts featuring a dumper truck of typewriters being unceremoniously tipped into a scrapyard made the primary point of the PCW abundantly clear. The PCW series were machines for people who wanted to type, not people who wanted to compute. Within eight months of launch Amstrad sold 350,000 of them.

For all their success as consumer products, as computers the CPC and PCW series were far from bleeding-edge technology. A *Personal Computer News* reviewer reckoned the CPC464 to be a very nice machine but 'rather old fashioned'. The Z80 CPU at the heart of Amstrad's machine had already been used in home computers going back to the old TRS-80 and NASCOM of 1977, but it did little to dampen appeal for the machines among those they were aimed at. Alan Sugar would later observe that his computers could be powered by a rubber band for all their buyers cared about the processor within them. The technology in itself was less important to

*Most sources list the price of the PCW as £399. However, while Amstrad's advertising of the PCW stressed the price prominently as £399, this was without Valued Added Tax (VAT) at 15 per cent, which was noted in rather smaller letters on adverts.

Amstrad's success than its clever application in well-priced and well-marketed consumer products.

Amstrad's rising fortunes stood in stark contrast to the struggles of other microcomputer makers at the time, perhaps most pertinently Sinclair, by now much concerned with non-computer projects. On a snowy day in January 1985, the long-awaited Sinclair C5 electric vehicle was revealed to a cynical press reaction. Just like the ZX80, the C5 was small and made of white plastic, but the minimalist personal vehicle shared none of the good fortune of the minimalist personal computer. A £399.99 battery-powered tricycle in a streamlined plastic shell, the C5 was capable of 18 miles per hour and could cover five miles on a penny's worth of electricity. Unfortunately, it looked terrifyingly vulnerable next to a heavy goods vehicle in traffic, and became an endless source of fun for newspaper cartoonists. It did not help the press reaction that it was manufactured by Hoover and was scurrilously rumoured to be powered by a washing machine motor. C5 production ended in August 1985, the affair having dented Sinclair's credibility and finances even more than the QL. It would be another 16 years before the success of the American Segway suggested that maybe there was something in the idea of an electric personal transporter after all.

Between overdraft and other debts, Sinclair owed a reported £25 million by mid-1985, a time when the press was filled with stories that newspaper baron Robert Maxwell was about to step in to save the company from financial disaster. Ultimately it came to nothing, and Sinclair bought time by offloading 160,000 pocket televisions and computers to Dixons for the bargain price of £10 million. Seeking to refresh the Spectrum, Sinclair had released the Spectrum+ in 1984, but the machine was a stopgap with few improvements beyond a QL-style keyboard, and met an underwhelmed reaction: 'no one in their right mind is going to buy the Spectrum+ if they already own a Spectrum', wrote Chris Bourne in *Sinclair User's* review. The new machine also suffered from high failure rates, reputedly as high as 30 per cent, adding to Sinclair's

financial problems. January 1986 brought the new Spectrum 128, a more comprehensive upgrade, with more memory, better sound and a host of other improvements. However, the big news came in April 1986 with the shock announcement that Clive Sinclair had sold his computer business for £5 million to Alan Sugar. That the deal was suggested to Sugar by Dixons said much about how the home computer business had changed to something far more retail influenced than driven by technology companies. For Alan Sugar it was a decisive way of expanding his 20 per cent stake in the home computer market into a decisive a 60 per cent majority.⁶ Amstrad abandoned the QL,^{*} not to mention a range of secret projects Sinclair had in the works, such as the Loki super-home computer and the Pandora portable, and went on to apply the Amstrad touch to the Spectrum. The Spectrum+2, sketched out by Amstrad before the buyout was complete, featured a built-in cassette player, joystick ports and typewriter-style keyboard, and finally optimised the machine into the games player that users had come to regard it as. For Clive Sinclair, as he made clear in an interview with *Sinclair User*, it was a chance to escape a business that had become run of the mill, and go back to pioneering something new.[†] It was the end of an era. The Cambridge inventor had been replaced by the Brentwood businessman as the face of the British computer industry, and all had not been going well at Acorn either...

^{*}The unfortunate QL would have a surprising legacy after one of the machines somehow got into the hands of a Finnish teenager named Linus Torvalds who learned to program with it, not least because there was so little software available. A few years later Torvalds, albeit working on a PC, developed the Linux kernel at the heart of Linux operating systems.

[†]Sir Clive Sinclair was back in 1987 with the Cambridge Computer Z88, an innovative portable computer. However, the market had moved on by this point, and while technically successful it was far from the commercial success of Sinclair's earlier machines.

The advantages of no people and no money

After the share price collapse, Acorn's finances were in a poor state by early 1985. The company escaped the receivers thanks to two multimillion-pound rescue packages negotiated with computer and office equipment giant Olivetti, which effectively turned Acorn into a subsidiary of the Italian firm. Olivetti bought rather more than it had bargained for when it saved Acorn. Aside from a few vague rumours in the press of an advanced new machine, and upgrades of the BBC Micro, Acorn had not released a new computer since the Electron in 1983. Behind the scenes the company had actually been rather busy working in secret on something called the Acorn RISC Machine – ARM, a completely new type of microprocessor. 'It was in the middle of the ARM development where Acorn's finances went through the floor, so that was fairly traumatic,' recalls Steve Furber. 'Olivetti had effectively committed to the rescue without really knowing about the ARM project at all. So we kind of treated it as sufficiently secret that we didn't even let people who were trying to invest money to rescue us know much about it.'

Around 1983, Acorn had been working on second processor expansions for the BBC Micro and considering what might succeed 8-bit processors in its next computers. Always technically focused, it was rather unimpressed by the performance of the new 16-bit processors available, particularly their slow interface with memory chips, and thoughts turned to why someone could not design a better processor. Or why could *they* not design a better processor themselves? 'We were toying with this idea,' recalls Steve Furber. 'The commercial microprocessors that we could buy... we don't like them, you know, so should we design our own?' Although Acorn had designed ULAs, microprocessor design was considered something of a black art requiring serious investment and resources. 'We started thinking that maybe we would have to design our own and this was clearly a ludicrous thing to think,' remembers Sophie Wilson. 'We went off to Israel to visit

National Semiconductor, and it was what you might expect, a big building full of engineers working away. And they weren't being that successful building the 32016.* But they then took a trip to Arizona to visit microprocessor developers the Western Design Centre, which was working on a successor to the 6502 microprocessor. Instead of an expansive facility, they found themselves in a suburban bungalow staffed by a mix of engineers and students. 'They'd got some big machines, but basically it wasn't the shiny office block; it was quite a sort of cottage industry-type of design centre,' recalls Furber. 'We very definitely came away from that visit... with the idea that if they can design a microprocessor maybe we can.'

It was still an ambitious undertaking, but thanks to their university connections, a rather different type of processor came to mind than anything used in a home computer before. 'Andy Hopper dumped on my desk at work the first technical papers on RISC,' remembers Sophie Wilson. Over in the US IBM and postgraduate classes at Stanford and Berkeley universities had just published projects on designing RISC processors. 'That was interesting, because these were much simpler, even than the 6502... The Stanford team and the Berkeley team were small, so maybe we could do this.' The RISC philosophy was based on the observation that microprocessors with complex instruction sets, where a single instruction might execute a series of operations, were actually rather inefficient in practice. The key to a RISC processor was to use simpler instructions, Reduced Instruction Set Computing, and use the space saved on the chip to build in ways of executing them more efficiently, most importantly pipelining. Put simply, a processor typically works by fetching an instruction, decoding it into a form it can understand, then executing it. However, it only moves on to the next instruction when the first instruction is complete. Pipelining fed in new instructions continuously. As the first instruction is

*The 32016 was part of Motorola's new series of 32-bit microprocessors.

executed at the end of the cycle, a second was being decoded, at the same time as a third was being fetched. Pipelining was the difference between hand crafting and assembly line, a way of using the processor more efficiently, with consequent overall improvements in performance.

A RISC processor could be both simpler and more efficient than existing complex instruction set (CISC) designs, and the whole idea rather appealed to Furber, Wilson and, importantly, director Hermann Hauser. 'I did instruction design Tetris in my head for a long time and Hermann joined in the conversations,' recalls Wilson. 'This was one of the unique things about Acorn. The guy in charge was technically interested in everything and involved in everything.' As ARM was gestating, Acorn's fortunes declined alarmingly. Hauser's support for the new development was fortunate, and the research and development group escaped the redundancies hitting the rest of the company. 'Hermann had a lot of confidence in the group and its ability to generate ideas,' adds Steve Furber. 'We were in a quite well-protected environment.'

ARM1 took shape from 1983 to 1985, developed by a small team lead by Wilson working on the instruction set, and Furber on the architecture. It was a tall order for a small company, but they were a skilled team, and used to working closely together and clearly enthused by the task. 'Very exciting, designing our own processor having never tried it before,' remarks Furber. The inherent simplicity of the RISC concept was an undoubted strength too. 'Hermann's proud statement is that he gave us these two clear advantages: the first one was no money and the second one was no people,' chuckles Furber. 'The pressure to keep the ARM simple was very strong. If we'd allowed the complexity to grow at all then our chances of completion would have diminished very rapidly.' Wilson puts it even more bluntly: 'We had to design a simple, small processor because it was the only thing we were capable of designing.' To date RISC had largely been of pure academic interest and compromises had to be made to turn its academic concepts into a commercial product. As Wilson sums it

up: 'Our slogan was simply MIPS for the masses. Millions of instructions per second for the mass audience. A processor that was cheap and high performance.'

On 26 April 1985, the first ARM chip prototype arrived at Acorn from chip fabricator VLSI Technology and was soon working. Later, Steve Furber rang a reporter to announce that they had developed their own new processor. 'This reporter simply refused to believe me,' laughs Furber. 'So it came as a bit of a surprise to everybody, not just us, when this processor worked.' Not only did it work, but it was fast and efficient. According to Furber, the ARM1 outperformed the contemporary Motorola 68020 despite being made of a tenth of the numbers of transistors.* ARM also had the seemingly supernatural ability to work without power. 'I set up the chip with an ammeter in the power-supply circuit, switched it on, started it running programs, looked at the ammeter and the ammeter was reading zero, which wasn't quite what I expected,' recalls Steve Furber. 'I discovered I hadn't actually connected the power to the chip, yet it was sitting there running programs.' It turned out that the chip was drawing power from the various components it was connected to. This low-energy consumption, far lower than they had expected, would prove to be enormously important in the future, but the original intent was simply to develop a processor for Acorn's new breed of computers.

After initially using ARM as another Tube second processor for the BBC Micro, Acorn released its new range of ARM-powered computers, the Acorn Archimedes, in 1987. At £799 for the basic model in the series, they were premium products but wowed reviewers with their spectacular graphics and high performance. A graphical user interface operating system, initially the rather basic Arthur, but soon replaced by the superior RISC OS, made the machines particularly user-friendly. Although the machine inspired much love among enthusiasts who recognised its powerful capabilities, its main use was in schools upgrading from BBC Micros. By the time the first Archimedes models

* 25,000 transistors on ARM1, 250,000 on the Motorola 68020.

came on the scene in 1987, there were already several powerful rivals entrenched in the home and business markets.

The new order

The main rivals to the Archimedes in the home computer market, the Atari ST and Commodore Amiga, inspired as much fondness and rivalry as earlier micros had, but overall they had more similarities than differences. They both offered a powerful 16-bit 68000 processor, a real keyboard, floppy discs, breathtaking graphics and sound, extensive expansion and a mouse driven GUI. In short they offered Mac-like features, but with glorious high-resolution colour graphics, while the Mac was only monochrome, and at a fraction of the price. The ST was even nicknamed the 'Jackintosh' after Atari's new head, Jack Tramiel, ousted from Commodore but once again fulfilling his maxim of making 'computers for the masses not the classes' by taking on the Mac.* Commodore was so proud of the Amiga's graphics that at its gala launch it got pop artist Andy Warhol to show off its artistic potential by making colourful screenprint-style pictures of Blondie singer Debbie Harry. The racy machines set the pulse racing of many a computer journalist. Guy Kewney wrote in his review of the machine for *PCW* that the £1,500 Amiga was the computer he had wanted the industry to produce for the last two years, and reckoned it far faster than a Mac at less than half the price. *PCW*'s reviewer of the ST declared that it was the first machine to excite him since the QL dashed his hopes.

*The history of the Atari ST and Commodore Amiga is confusingly entwined. After being forced out of Commodore in 1984, Jack Tramiel responded in typically bellicose style by buying the struggling Atari in 1985 and using it to declare war on his old company. Unbeknownst at the time, Atari had been funding a small start-up called Amiga Corporation to develop an advanced computer chipset. Not favouring its chances under the new regime at Atari, Amiga Corporation quietly arranged to be bought up by Commodore, leaving Jack Tramiel to order Atari to develop a new machine to take on the one it had just lost.

Like the Archimedes, the Amiga and the ST were a generation ahead of the old 8-bit machines, but their higher prices and powerful capabilities created confusion as to whether they were home computers at all. Originally an Amiga cost around £1,500 and an Atari ST £750, putting them into the professional computer price bracket. *The Advanced Home Computer Course* thought that the Amiga suffered from an identity crisis as to whether it wanted to be a serious home computer, cheap business machine, or expensive and impressively powerful games machine. 'I'm still not sure whether to classify it as a home or business machine,' was PCW reviewer Peter Bright's verdict on the ST. The lowering of prices by about 1987, £399 for an ST, and the release of cheaper models, notably the £499 Amiga 500, nudged the machines more into the powerful home computer category, but the confusion remained and the reasons for it are understandable enough. The 16- and 32-bit machines were so unlike the 8-bit machines that they went far beyond the original conception of what a home computer was. In capability, design, use and marketing they became something rather different.

In its classic early 1980s guise, the home computer had been a comparatively simple technology that was there to be explored and programmed to do things. There was little between a user and the raw logic of the underlying machine, and by poking around with programming users could build up a feel for what was going on inside the box. The more sophisticated technology underlying the new generation of machines was far more complex, but it did not need to be understood in the same sort of way. Thanks to slick graphical user interfaces, GEM on the Atari, RISC OS on the Archimedes and Workbench on the Amiga, the new generation was far more user-friendly. However, they cast a veil over what was actually going on, computers were now to be used rather than understood. Learning to program these machines was far less prominently stressed. No longer were users confronted by the BASIC prompt inviting them to try their hand at a bit of code as soon as they switched on the computer.

The first thing seen when an Amiga was turned on was a hand holding a floppy disc, symbolic of the change in computer use. The built-in floppy disc drives on each machine made it far quicker and more convenient to load software than it ever was on an 8-bit with a tape recorder. People *could* program any of the new machines, but the expectation was that typical users would just use them as software players.

The marketing that advertised the machines had changed too. Gone were the explicit promises that the computer was a passport to the future, the excitement of a revolution in the making and the lure of learning to program. In their place was an increasing focus on power and capability as manufacturers sought to differentiate their products from the older home micros: 'New Amiga 500. Now other home computers are just toys', proclaimed one Amiga advert. The versatility of the machines remained an important part of the pitch, but the vague advertising patter that the machines could do anything, up to and including running a power station, was superseded by specific claims about software. Buy an Archimedes for 'power to handle word processing, spreadsheets and project planning more quickly', explained one Acorn advert. Gradually, adverts and reviews started differentiating between the different breeds of microcomputer. The new machines were *personal computers*, the old ones merely *home computers*.

By about 1986, home computing in its original form had been overshadowed by something new. The next generation of home computers were not simple devices to be explored, understood and programmed for fun and entrainment, but powerful general-purpose personal computers for running software. Of course, there were still enthusiasts out there programming for themselves, but much of the excitement and the imagination had gone out of microcomputing. The computer had become an everyday tool, just something to be used. What happened to the new generation of so-called home computers that succeeded the 8-bit micros is a story for a different book, but not one with a happy ending. The new order, while reasonably successful for a time, would never

have such a clear run of the market as the older machines had. The Archimedes did well in schools, and the Amiga and ST became very popular for gaming. However, in the home and in professional environments, there were powerful rivals facing the home computer of the later 1980s, most notably the IBM standard PC and a new range of Nintendo and Sega games consoles.

The tap-dancing elephant in the room

The earlier Pong machines and Atari consoles had not made much impact in Britain as it went through the growing pains of computer literacy. After the computer literacy agenda faded, leaving video gaming well established in British homes, the path to market was open for a new generation of consoles in the latter half of the 1980s. Neither the 6502-cored Nintendo Entertainment System (NES), nor the Z80-based Sega Master System offered particularly advanced technology, but they were convenient appliances for gaming, the main thing home computers were being used for anyway. Why wait ten minutes for a tape to load on your micro when you could slot a cartridge into an NES and be playing a big-brand game like *Super Mario Bros* a minute later? The Japanese home computer invasion had never really arrived, but where MSX had failed, Nintendo and Sega succeeded.

The Archimedes never grew a substantial games base, but the Amiga and Atari ST were the platforms for a golden age of innovative gaming during the later 1980s and '90s. Titles such as *Cannon Fodder*, *Lemmings*, *Carrier Command*, *The Pawn*, and *The Secret of Monkey Island*, exploited the new hardware in fun and impressive ways that 8-bit programmers could only dream of.* However, the European release of the Sega Mega Drive and Super NES in the early 1990s offered 16-bit consoles

*Although it is a testament to the skills of 8-bit programmers that they were able to make respectable, if not quite as slick, conversions of 16-bit titles for veteran machines like the ZX Spectrum and Commodore 64.

with the power to compete with 16-bit computers. In a fickle market that thrived on novelty, the new consoles offered something fresher and more fun than a machine with a keyboard. The release of new hand-held consoles like the Atari Lynx and Nintendo Game Boy added more rivals, and all of the consoles were far cheaper than fully fledged personal computers. By Christmas 1991, Dixons was selling Atari STs for £299.99, but a Sega Mega Drive was only £129.99.

Things were changing in the serious sector of the personal computer market too, largely due to the growing influence of the IBM PC standard and the cold hand of conformity it represented. Quite apart from the convenience offered by standards and compatibility between different computers, the IBM PC came to dominate the personal computer world for two key reasons. Firstly, it was from IBM. Secondly, anybody could make one. For decades, IBM had dominated the mainframe computer business through firm management, a well-respected brand and carefully planned technological advances. Other than a brief experiment in making \$10,000 portables in the early 1970s, IBM was slow to move into personal computers. IBM was the computing establishment and had little to gain from starting a revolution. Microcomputers were mere toys in comparison to its data-processing machinery, and the sober-suited IBM man was part of a different world from that of the hippies, enthusiasts, inventors and entrepreneurs who had spawned the microcomputer. Apocryphally, one analyst likened IBM developing a personal computer to an elephant learning tap dancing. Despite this, it was a matter of faith among other industry pundits that at some point IBM *would* enter the personal computer market, and that when it did, its impact would be significant.

The IBM PC was announced in August 1981 to much excitement from journalists and computing professionals. IBM's advertising campaign showed the PC helping silent movie star Charlie Chaplin advance to modern times, yet it could have been a metaphor for how the PC pulled IBM into the microcomputer era; Apple even published a sarcastic advert

welcoming IBM to the personal computer market. However, there was little especially modern about IBM's \$1,565 PC. It was largely a solid application of existing technologies rather than anything particularly innovative. Faced with a 12-month deadline, the PC-development team broke from the normal IBM way of doing things. Rather than rely on in-house IBM technology and expertise, they subcontracted development work and bought off-the-shelf technologies from outside, such as the Intel 8088 processor. The DOS operating system was licensed from Microsoft in a deal that would make its founder Bill Gates, a billionaire. Hoping to spur the development of software and hardware peripherals, IBM gave the PC an open architecture, meaning that others could easily produce things to run on it.

With this background, IBM did not own the PC. With enough lawyers, engineers, a few licence payments and a bit of reverse engineering, companies could start manufacturing legitimate 'IBM PC compatibles' or 'clones'. Already the Apple II, ZX Spectrum, Tandy TRS80 and other machines had been copied around the world, legally or otherwise. With the PC, IBM gave the world an open computer architecture to adopt, backed by its prestige. In the mainframe computer days it was said that no one got fired for buying IBM. Compared with the risks of devising a new design of computer and worrying about getting people to write software for it, a PC clone would be guaranteed support and a market. All over the world companies began producing PC compatibles – Eagle, Compaq, Columbia, Hyperion and many others besides. People could even build one themselves at home if they bought all the parts.

IBM's entry into the market is often explained as the moment when the personal computer became respectable, as the established giant of corporate computing gave its stamp of approval to this upstart new technology. Yet the launch of the IBM PC made barely a ripple in the British home computer market. When it was launched in Britain in 1982, there was a certain excitement among journalists and industry pundits, but there was far wider interest in the new ZX Spectrum and

BBC Micro. The PC was explicitly a business machine, lacked the excitement of games or the worthiness of education, and was far too expensive. Yet as the dozens of idiosyncratic machines battled it out for a share of the cheap home computer market over the early 1980s, IBM's PC architecture gained ground in the professional computing sphere, and the appearance of cheaper IBM clones made the machines more affordable.

By the time the new generation of more expensive home computers tried to stake a claim as 'real' computers in the mid-1980s, the PC was well established in that position. The ease of use and technical superiority of the new machines mattered little in a market increasingly adopting the PC standard. 'Although the Archimedes was clearly vastly superior to a PC in every important performance aspect, it struggled in the market because the market had become very PC focused,' explains Steve Furber. 'A machine with the Archimedes' capabilities, so far ahead of the competition at the time, in a different environment, would have done a lot better.' Much the same could be said of the Amiga and the Atari ST, which were probably undermined by their gloriously rich games and user friendliness. As the *Guardian's* computer correspondent Jack Schofield noted of the Amiga, for many people 'anything easy or attractive cannot be serious computing'.⁷ By contrast, slow graphics and basic sound made the PC a disappointing entertainment platform. The text-based DOS operating system, used by most PC users until the widespread uptake of Windows 3.1 in the 1990s, was hopelessly old fashioned and complicated compared to a GUI. Yet in its boringness the PC was indisputably a serious computer. The growing prominence of the PC meant the very idea of a unique computer with its own idiosyncratic design, propriety operating system, individually crafted software and disregard for standards came under existential threat.

At the time rumours surfaced that familiar names of the British home computer industry were going to make PC clones, but few did. For some, financial troubles stymied plans

to make clones. 'The galling thing was we'd already started the development of a PC clone, before Compaq,' recalls Oric's Paul Johnson. 'We'd designed a PC clone that we could build for £200.' With stereo sound and superior graphics to the IBM original, and a highly integrated chip set (now referred to as core logic) to save costs, it could have been a breakthrough product. Yet it was thwarted by Oric's financial difficulties and a lack of funding to bring it to fruition. 'This was so much cheaper than anything anybody else had come up with and we'd actually got a chip set for doing this,' sighs Johnson. 'Oric could have been something really, really big.'

For other firms the issue was perhaps more philosophical. What is a standard but a generally agreed way of doing things? This was not what the most important British computer companies had been about. Whether it was Acorn taking inspiration from cutting edge university research, or Sinclair with its inventive minimalism, they were innovative companies whose thinking was not conducive to simply following what others did. On the terms of many British computer designers, IBM had not done anything special. 'When I use a PC today I cannot understand why a machine with 1,000 times more processing power has a worse user response than the machine I was using in the late '80s at Acorn,' remarks Steve Furber. 'Well, I do know why it is, but it still seems the wrong answer.'

IBM turned making personal computers into a commodities business more than the innovation game it had been for many firms before. Perhaps unsurprisingly, the British computer company that took most enthusiastically to the PC clone was the businesslike Amstrad. IBM's original PC was an over-engineered Rolls-Royce of a computer. Amstrad took the lessons it had learned from making low-cost home computers and applied them to the PC. The basic model of Amstrad's 1986 PC clone, the PC1512, was just £460 (with VAT), putting the PC into the home computer price bracket for the first time. Price apart, it would take some years, the adoption of the more user-friendly Windows operating system

and better entertainment provision to turn the boring PC into an appealing domestic appliance, but gradually the PC forced its way into the home. Squeezed between the PC and the new generation of games consoles, Amiga, Archimedes and ST production ended in the mid-1990s.* The advanced machines barely outlived the 8-bit home computers they were supposed to replace.

A failed technology?

The 8-bit home computers that survived the fallout of the mid-1980s crash were fated to enjoy a few more years of active semi-retirement. After equipping themselves with various models of BBC Micro and Master, along with software and educational resources around them, schools were in no hurry to replace the sturdy machines. The Beeb would remain a familiar sight in British schools into the late 1990s, if not beyond. Indeed, Acorn only stopped making Masters in about 1993. The ZX Spectrum+2 (as built by Amstrad), Commodore 64 and Amstrad CPC 464 all lasted in production as cheap games computers into the early 1990s, supported by a vast back catalogue of games and a continuing trickle of new titles. Surprisingly, it was thought worth revamping the old machines by creating new versions, such as the disc-drive equipped Spectrum+3, Commodore 64GS games console and improved Amstrad CPC464 Plus, albeit to limited commercial success. By the time official ZX Spectrum production ended in 1992, the basic design was a decade old. It says much about its versatility, the importance of its software base and its place in popular culture that the Speccy lasted so long; indeed, souped-up Spectrum descendants were still being made in Eastern Europe for some years after its official end of production.

*After the Archimedes, Acorn developed a further line of ARM-powered professional computers, the powerful RISC PC, which lasted in production, despite the relatively limited interest in the machine, until 2003.

The ultimate disappearance of the cheap home computer as a distinct type of computer makes it tempting to write off the whole idea as a failure. The model of computing the home micro originally espoused was overshadowed by the mid-1980s by general-purpose personal computing; most of the companies that made home computers pulled out of the market or went out of business; and the dominant IBM PC architecture owes little to the world of home computers. A more upbeat interpretation would be that the home computer was a remarkable success, when we view it as a stepping stone in computer technology, and on its original terms of reference as a passport to the future.

In 1980 the computer was a mysterious technology to most people, shrouded by misconceptions and widely misunderstood. The original idea of the home computer had been to change that, to make computing accessible to the general public, fuelled by an expectation that it was going to be important. No one really knew what was going to happen next. In retrospect, the whole computer boom could have been a giant experiment to see what happened when millions of people were handed a computer and told *how* to use it, but less *what* to use it for. The computers that started the boom were blank slates, massively flexible machines waiting for someone to find a use for them. Over the early 1980s the home computer introduced millions of people to the idea of what computing was, spawned countless new uses for the machines, and gave birth to a software industry so people did not have to program for themselves. That few wanted an introductory computer after a few years was not a mark of failure, but of success. The familiarity bred by the home computer paved the way for all the other information technologies that have transformed our lives over the subsequent years.

Today the computer, in whatever form, is a boringly everyday technology. We have grown used to machines that can conjure virtual universes on our desktops, send messages around the world in moments and put unquantifiable amounts of information at our fingertips. We take for granted incredible

technologies that were almost beyond the imagination of science fiction a few decades ago. The greatest legacy of the 1980s home computer boom is a world where computers no longer fill people with awe or trepidation, but one where we just accept these machines and the incredible things they do as perfectly normal. We live in a world where people stopped worrying, learned to love computers, got bored with them, then moved on to exploit information technology throughout their lives without thinking about it as special or particularly intimidating. The greatest lasting legacy of the home computer boom is the digital world we live in now, but the aftershocks are still with us...