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The Boom

Buying from a computer shop could be a bewildering experience in 1983. You enter in search of expert help, tentatively move your way past the screens flashing with the newest games, racks of computer magazines and programming books, and find a pale teenager who seems to work here. ‘You want to buy your first computer?’ he asks ‘Well, let’s see what we’ve got in stock... want to learn about computers? How about trying a ZX81? A bit old, and black and white, and the keyboard is a piece of plastic, but it’s cheap and there’s lots of software for it... Perhaps a BBC Micro? It’s the one the kids use at school, and it’s been on television a lot, and its got Econet, the Tube, a printer port, ah but it’s £400... maybe something cheaper? The Oric’s quite nice if you like a 6502 machine, but there’s loads more games for the Spectrum... You don’t like the rubber keyboard? I’d offer you an Electron but we’ve got none in, so try a good old VIC-20, it’s only got 5k of RAM but we sell an expansion pack. Maybe a Commodore 64 instead? It can do sprites and the sound is fantastic! Or we’ve got a Jupiter Ace, Dragon 32, TI99/4A, Atari 800? There’s a special offer on the Mattel Aquarius, but between you and me, nobody seems to want one...’

The early years of new technologies tend to be messy periods of divergent philosophies, experimental ideas, emerging standards, and technical and commercial failures. In the early days of flight, designers flew, and frequently crashed, all sorts of unlikely looking contraptions. There was no generally accepted right way for designing an aeroplane, so different ideas were tried out until it was discovered what worked best. Much the same could be said of home computers in the early 1980s. With few firm ideas of what a micro should look like, what it should do and how it should do it, computer manufacturers

came up with a wide variety of designs. In late 1983, *PCW* listed some 26 different home computers available for under £500, and even more would follow the year after. The diversity of design bred impassioned debate over which machine was best, but there could never be a clear winner in this technological game of Top Trumps, as all of them had their strengths and weaknesses to play off against each other.

Quite apart from the variety, the sheer numbers sold were amazing. By the end of 1983, a home computer seemed to be at the top of every Christmas list. By December, major retailers were reporting a surge in demand for computers far beyond their expectations and the plans of the manufacturers, who struggled to meet the huge number of orders. Retailers ordered 200,000 of Acorn's new Electron, a 'ridiculous' figure complained one Acorn marketing manager to the press. Sinclair, after stockpiling 100,000 machines over the quiet summer months, reported to have received orders for 200,000 in one week of November alone. Manufacturers of less popular machines were reckoned to be benefiting from the shortages, as people bought whatever they could find rather than go home empty-handed. It was an extraordinary end to a year that saw an estimated 1.1–1.8 million home computers sold in Britain.¹

There is no neat narrative through the boom years. Too much was happening at once in too many companies, yet some salient themes stand out. As well as a sales bonanza and a carnival of technical diversity, the home computer boom was a cultural event. Most of those computers were going to people who had no experience of what a computer was and what it could do. In homes across Britain, millions of people experienced that strange first moment of making a computer do something, an experience for which the magic has been lost for every generation that followed. Better still, so many of the machines they were using were designed and made in Britain, albeit normally assembled from chips made in the Far East. Nonetheless, the boom had an element of patriotism to it, as British ingenuity was celebrated. After years of industrial decline, the invention of these fantastic

new devices, the opening of new computer factories and the export of British computers around the world was presented as a national success story.

In 1983 Britain proudly boasted the highest level of computer ownership in the world. About one in ten British homes had a computer, ahead even of the USA and technologically advanced Japan. A tiny percentage by today's saturated standards, it was seen as a triumph at the time. The claim even found its way into the 1983 Conservative Party manifesto, which was anxious to take some credit for it, declaring, 'we have speeded this progress by supporting research and spreading knowledge of the technologies of tomorrow'. In 1982 Margaret Thatcher, a science graduate as well as a free-market thinker, proudly presented a Sinclair ZX Spectrum computer to the Japanese Prime Minister. For a Britain in recession, the home computer boom and the accompanying growth of the microcomputer industry were touted as a sign of economic progress and of national inventiveness.

A distinct type of home computer emerged from Britain in the boom years. As we have seen already, the influence of computer literacy was strong, and ensured that programming and education were prominent features in design and marketing. Simultaneously, the emergence of games as a major use meant that designs came to be optimised more for entertainment than they had been before. All of this had to be achieved at a low cost. The most vibrant sector of the market was in cheaper machines costing under £200. Design to such a price point necessitated design economies and led to simpler machines than those generally favoured in the USA or Japan, the other major microcomputer-developing nations of the day. The result was a series of comparatively simple and low-cost machines, which mashed education and exploring the computer with entertainment and fun.

The Speccy

Several companies dabbled in making low-cost computers in the early 1980s, but the most influential in establishing the

concept was undoubtedly Sinclair. Having already introduced Britain to the affordable home computer with the ZX80 and ZX81, Sinclair extended the concept in 1982 with a colour successor, the ZX Spectrum, arguably the most famous British home computer of all. With the loss of the BBC contract a recent memory, Clive Sinclair joked that the Spectrum could have been called 'Not the BBC Micro', when announcing the machine. But while the Beeb was a hefty piece of electronic engineering with everything but the kitchen sink built in, the Spectrum was small and sleek, a masterclass in inventive minimalism, and on sale at less than half the price.

Known before release as the ZX82, the Spectrum took the ZX81 as its starting point. 'To the extent that there was a specification, the guidance was we should improve the graphics and we should add colour. That was about it,' recalls Richard Altwasser, the Spectrum's hardware designer, who began by drawing up a specification: 'Defined the graphics system, the rest of the hardware features, worked hard with Nine Tiles, mostly Steve Vickers, to define further extension to Sinclair BASIC. And that became the specification. The whole thing was done really rather quickly.' The Spectrum emerged as a much more capable design than the ZX81, not only with colour graphics, but with many other improvements, such as more memory, extended BASIC, sound and an improved keyboard. The whole thing was wrapped up in another distinctive black case from Rick Dickinson, and the thought put into the choice of textures, colours and shape created a design classic. At the bargain price of just £125 for the 16k version or £175 for the 48k version, the Spectrum was the cheapest colour computer on the market when it was released, and soon became a firm favourite of games programmers and players.

When the ZX80 and the ZX81 had been released there had been little experience with what people would actually use computers for in the home. However, the Spectrum's designers had more of an idea of what people would use their machines for than before. 'By that time we had some experience with the ZX80 and we knew that people were doing programming

and that quite a lot of people were playing games,' recalls Richard Altwasser. The use and reception of the earlier machines, including their use for entertainment software, was accordingly factored in to the design of the Spectrum. 'Because of the games development, the Spectrum was a logical next step,' remarks Sir Clive Sinclair. 'We improved the keyboard and we put in colour.' It would be a stretch to say that the Spectrum was designed as a games computer, but it certainly seems to have been intended to have more potential as an entertainment device. 'I don't recall the design brief would have said games, except in as much as saying it needed to have high-resolution colour graphics,' explains Altwasser. 'Which is obviously something that would make games very much more attractive.'*

Despite games being considered more in its design, in most other respects the Spectrum was as much a machine for exploring computing as the ZX81 had been before it, but with increased potential as a general-purpose computer too. Early Spectrum adverts mentioned business software about as much as they did entertainment, and described the machine as suitable for 'professional-level computing', as well as learning to program. 'I imagined that the computer would be used for practical purposes in peoples' homes as well,' explains Richard Altwasser, 'without at that time perhaps having too clear an idea, or too close a constriction, of what those practical applications might be.'

The machine took shape quite quickly over 1981 and 1982, with software development led by Steve Vickers at Nine Tiles software consultants, and the hardware largely the responsibility

*Colour was not universally thought necessary for a microcomputer in the early 1980s. With limited memory and processing power available, monochrome displays offered higher resolution, allowing for more detailed graphics or clearer text for productive purposes. Some machines offered different screen modes, where the number of colours available could be traded off against the screen resolution, from low-resolution colour to high-resolution monochrome.

of Richard Altwasser, working in Sinclair's cramped Cambridge offices. 'In one sense that was quite simple because all you needed was a sharp pencil and a drawing board, and a notepad to do some calculations on,' recalls Altwasser. 'The circuit board layout was done with little bits of black tape sticking on a light box. The whole thing was done manually. In one sense it was simple, crude you might say, in another sense it was very time consuming and quite risky.' While the Spectrum's development proceeded quite smoothly, such simple working methods could lead to problems. One issue, recalled by Altwasser, occurred when Ferranti in Manchester missed out a single connection on the ULA physical layout, the mask of the chip used to produce silicon wafers packed with numerous individual chips. With a connection missing none of the initial batch worked, bar one. 'On the mask that they used to produce the wafer, there was a little bit of dust, and that little bit of dust fell in exactly the place that the engineer who did the track layout forgot to put the aluminium connection,' chuckles Altwasser. 'We found out of all the chips on the initial wafer, that there was only one that actually worked.'

Colour was one of the defining features of the Spectrum, but for technical and economic reasons, it used a rather distinctive means to achieve it. The Spectrum was intended to use a television for its display, but the limitations of the PAL system used in British colour televisions were problematic for displaying high-resolution colour computer graphics. 'You haven't got a high-resolution colour monitor to display high-resolution colour graphics, so I decided to adopt some of the principles that had been used on TVs for graphics on Ceefax and teletext,' explains Richard Altwasser. 'That is to say, have a block of pixels in a character block, but have one or two colours, a foreground and background colour associated with that.' A computer display is made up of thousands of individual dots, or pixels. A conventional colour image would require colour information to be stored for each individual pixel. Instead, the Spectrum stored a simple monochrome bitmap image, then split the screen into a number of different

colour blocks. Each block could be assigned a foreground and a background colour, or INK and PAPER in the Spectrum's BASIC. Essentially, the screen was colourful but the graphic was not, it just happened to appear in a part of the display that was colourful. 'It certainly is cheaper, of course. If you have to have every single pixel where you have to have a byte or more for colour that would be a huge amount of memory,' remarks Altwasser. As the Spectrum relied on the same memory bank for video information and program storage, another way of saving costs, this method was also more efficient for getting data out of the memory quickly enough to provide a television signal. Looking at the Spectrum's display is a bit like viewing a black and white picture through a multicolour overlay. It could lead to 'colour clash', an odd effect when the underlying graphic moved between blocks assigned to different colours. For example, a red figure walking across the screen would appear to be half blue as it crossed from a red block to a blue block. In practice programmers found ways to mitigate the problem, and it contributed to the distinct graphical style of many Spectrum games.

The keyboard was another design economy. After the criticism of the flat-membrane keypad of the ZX80 and ZX81, it was an obvious target for improvement, but cost and company style dictated another inventive improvement. 'It's part of the company culture we weren't going to simply buy one off the shelf,' remarks Rick Dickinson, invoking the firm's innovative approach. 'You're not going to take some bog-standard keyboard off some steam-powered computer and slap it on as the starting point; it was the first thing you'd throw out. Can't put that in, it's like having a steam engine in a modern car.' The solution was an enlarged membrane keyboard overlaid with a sheet of rubber 'dead-flesh' keys that moved when they were pressed. The new keyboard was a bit spongy to type on, but addressed the fundamental criticism about tactile feedback. 'If you distil what differentiates a Sinclair computer keyboard from other computer keyboards at the time, it was moving keys,' explains Dickinson. 'We needed to create the impression

of when you press the thing that's supposed to be the key top, it goes down and you can feel it'. Providing a whole 40 moving key keyboard with just four parts had a neat efficiency too. The BASIC, largely developed by Steven Vickers, was an expanded version of that on the ZX81. As the number of commands increased, some keys had as many six different functions, and it would take users some time to get used to the various combinations of shift keys used to access them all.

The Spectrum met with a positive response from the computer press. Aside from minor niggles, such as judgements that the BASIC was slower than the BBC Micro, that the sound was a bit quiet, and some people disliking the keyboard, most reviewers seemed to find far more to love than to hate. *Personal Computer World's* reviewer David Tebbutt declared that Sinclair had set an example of how to produce a decent colour computer at a uniquely low price. *Your Computer's* reviewer Tim Hartnell judged that 'despite minor faults, the Spectrum is way ahead of its competitors'. The response from the public was highly enthusiastic. Sinclair's stand at the *Personal Computer World* show in 1982 was mobbed by a crowd several people deep trying to place orders. After escaping the hubbub, Richard Altwasser found himself listening to a pair of teenagers discussing the machine. 'They were enthusing about the ZX Spectrum, the features of it, they'd been on the stand, read the literature,' remembers Altwasser. 'Listening to these two going on about what a wonderful machine it was, it sort of made all the late evenings, all the travel up to Manchester and back, well worth it.' Although it held general appeal, the Spectrum became particularly popular with the youths who saved pocket money or nagged parents to get their hands on one. The Spectrum was exciting and, despite its compact size, offered a lot of computer for not a lot of money. Once again, Sinclair was overwhelmed by the heavy demand. Despite taking criticism for how long it took to fulfil orders, it still managed to sell 200,000 units by the end of 1982. 'The response was incredible, it was mind blowing, everybody wanted one. Christmas was the time, the classic Christmas gift and they

were sold out,' recalls Rick Dickinson. 'It was an incredible time, despite the criticism. But you can criticise away, people wanted them.'

The Spectrum had the same basic interface port as the ZX81, non-standard but easily open to exploitation by the many kitchen table inventors and small electronics firms that developed peripherals for it. Sinclair itself also launched a series of devices to plug into it. The company's normal genius for inventive product names fell somewhat short with the ZX Interface 1 and ZX Interface 2, but it showed the intent for the Spectrum to be at the heart of an expanded system. The £19.95 Interface 2 enhanced the Spectrum's entertainment capacity by adding a slot for game cartridges, and joystick ports. Unfortunately, there were cheaper joystick interfaces on the market, and the expensive £14.95 cartridges were little used. The £29.95 Interface 1 was rather more interesting, adding a standard RS232 interface to link to other peripherals, or network up to 64 Spectrums together, useful for the schools market. Its other use was to connect the Spectrum to another of the company's inventions, the ZX Microdrive.

One of the things that marked out a home micro from a serious business computer by this point was the use of floppy disc drives. Discs offered far faster and more reliable data storage than cassette tapes, but they were very expensive, something home users might aspire to own but few could afford. Announced at the Spectrum's launch, but only vaguely described on advertising that noted it was 'coming soon', there was some mystery to the ZX Microdrive at first. Rumoured to be some sort of cheap miniature floppy disc drive, it was widely seen as the device that could transform the Spectrum into a professional machine. When it finally went on sale in 1983, after many delays, there was some surprise when the Microdrive turned out not to be a disc drive at all.

The Microdrive was a wonder of miniaturised mechanical engineering, a whirring little black box that read tiny cartridges packed with a continuous loop of nearly five metres of cassette tape that whizzed through it at high speed. The so-called

‘stringy-floppy’ was far slower than a disc for accessing data, but compared to the endless wait watching a colourful loading screen as a cassette loaded, the Microdrive was blindingly fast. Adverts boasted that it could load a 48k program in just nine seconds. Despite a certain amount of tutting in the press that it was not the anticipated disc drive, the device was well received. *What Micro* even reckoned it might be more significant than the Spectrum if other companies started taking up the idea. However, with use the tape stretched, causing reliability problems, but the real killer of its commercial fortunes was the delay in producing it. In the year and a half between the Spectrum’s debut and the first Microdrive shipping, hundreds of Spectrum programs were released on cassette tape. At an initial price of £4.95 per Microdrive cartridge, software houses were reluctant to support the new format, and cassettes remained the default option for Spectrum data storage.

With its extra features, the Spectrum finally cracked the schools market for Sinclair by being included in the government’s new Micros in Primary Schools scheme. It was too late to stop the BBC Micro dominating the education market, but it was a stamp of approval for the machine nonetheless. Although many people would find serious uses for the Spectrum as they learned what computers could do, the Microdrive delays dealt a blow to its fortunes in the professional market. Instead, as we shall see, the Spectrum’s reputation would be made as a games computer, arguably one of the most influential games computers of all time.

The sawn-off BBC Micro

If imitation is the sincerest form of flattery, then one of the biggest compliments paid to the Spectrum was in its influence on competitors. Sinclair’s formula for a low-cost computer was widely influential and several manufacturers introduced machines following a similar philosophy to target the same market. On the other side of Cambridge, Acorn began developing a machine to compete with the ZX Spectrum to give it a bite at the booming market for cheaper computers.

‘It was a market-driven initiative,’ recalls Steve Furber, who did much of the Electron’s hardware design. ‘The BBC Micro had been hugely successful, but if only we could engineer the cost down a bit, there was potentially an even bigger market, particularly in the home.’

Compared to the BBC Micro, the Electron had fewer interfaces, simplified sound and fewer screen modes, and performed a little more sluggishly too. Perhaps most important were the features that were retained, with many of the Beeb’s admired capabilities shoehorned into a box half the size and cost. ‘We actually built a cardboard mock-up of what we thought the Electron should look like,’ recalls Steve Furber, ‘it was basically shrunk down to the size of the keyboard.’ The Electron had the same 6502 processor, the same size 32k RAM, and the same fully featured BASIC as the BBC Micro, and had a typewriter-style keyboard. Advertising emphasised its similarity to the machine children used at school, and it was compatible with much BBC Micro software. The Electron was essentially a sawn-off BBC Micro, but with a price of just £199. At only £24 more than a 48k Spectrum, and with several refinements Sinclair’s machine lacked, the Electron was a serious contender to it.

It took considerable ingenuity to squeeze so much of the BBC Micro’s capability into a package half the price, but the Electron still represented a retrograde step for Acorn. If the BBC Micro had been an innovative top-of-the-range product that led the market, the Electron unashamedly followed the market. It was an uncomfortable move for a company more culturally attuned to advancing technology. ‘We felt the market was moving forwards, that the way to go was to higher capability,’ explains Steve Furber. ‘So building this product, which was going the opposite way, to compete more directly with Sinclair, we were not very enthusiastic about. But technically it was very challenging.’

The trick to the Electron was again a ULA, probably the largest then fitted to a home computer, combining such functions as sound, internal timing and display control in a single chip. Acorn’s previous ULA were designed by hand on

a big sheet of translucent paper on a glass office wall. Such was the size of the Electron ULA and all that it had to do that, according to Steve Furber, 'the glass wall would have been too big.' Instead, ULA development tools were written on the BBC Micro; the older machine quite literally gave birth to its diminutive successor. There were over 100 chips on the BBC Micro circuit board, but the Electron had about 14. The enormous ULA was the making of the Electron, but also contributed to its downfall. Christmas 1983 should have established the machine as a market leader, but ULA problems meant there were nowhere near enough Electrons to meet the huge demand. Acorn missed out on a sales bonanza, as people bought whatever micro they could find. The Electron would come back to haunt Acorn, but fortunately enough for the consumers there were plenty of other machines to choose from, some of them even supplied by other companies from Cambridge.

The Cambridge connection

Acorn and Sinclair were but the best known of a cluster of computer companies around Cambridge in the early 1980s, including Camputers, Jupiter Cantab, Tangerine and their subsidiary Oric. To the press of the time it was Britain's very own Silicon Valley, or Silicon Fen at least – another shining example of the sorts of high-tech knowledge industries that would pull the nation out of recession and into a more prosperous future. Silicon Fen itself was just one aspect of a larger scene of scientific and technical industries developing around the university town, sometimes referred to as the Cambridge Phenomenon. Between the mid-1970s and mid-1980s, over 200 high-tech businesses were formed in the Cambridge area, many connected with electronics, software or computing in some way or another.² For budding high-tech entrepreneurs it was a good place to set up shop. The surrounding businesses offered both potential customers, and consultants to advise on all manner of specialist and obscure technical issues.

Cambridge University was another factor in the growth of the phenomenon. This source of ideas, academics turned entrepreneurs and skilled personnel was particularly important to Acorn. 'Most of the staff of Acorn in the early days came from Cambridge University,' reflects Sophie Wilson. Over half of the hundred-odd graduates employed by Acorn by 1985 had studied at Cambridge. Among them were Wilson, Hermann Hauser, Steve Furber and Andy Hopper, one of the company's directors and also a lecturer at the university. From Hopper's academic research and connections came the inspiration for Acorn's Econet network and, later, the revolutionary ARM microprocessor.

The mobility of ideas and people is key to the growth of high-technology clusters. Entrepreneurial individuals with an idea often outgrow the companies that employ them and split off to found new firms. Through its co-founder Chris Curry, Acorn was partly an offshoot of Sinclair. So too was Jupiter Cantab, founded in 1982 by former ZX Spectrum designers Richard Altwasser and Steven Vickers, who had the idea of producing a computer of their own, the Jupiter Ace. 'We saw a commercial opportunity and took it,' explains Altwasser, whose successful sideline writing programming books had already given him some entrepreneurial experience. The unique selling point of their computer was using FORTH as its programming language instead of the common, but often disparaged, BASIC. 'Steve came up with this idea of FORTH,' recalls Altwasser, 'I played with it and very quickly convinced myself that FORTH was a very much more appropriate language for this type of home computer than BASIC, mainly because it was very much faster and more flexible.'

With the Spectrum complete the pair founded Jupiter Cantab to work on a FORTH computer. That the Jupiter Ace was designed at Richard Altwasser's home says much about how few resources were required to design a viable microcomputer if the designers knew what they were doing. 'Your equipment needs were not great. On the software side we had a Z80 development kit, which was just a small box

and a monitor,' recalls Altwasser. 'On the hardware side it was really just a drawing board with a light box.' Their creation looked rather like a white ZX81, with similar specifications – a Z80 processor, monochrome display and just 3k of RAM. However, the hardware was rather different, more expandable, and FORTH made for faster and more efficient programs than BASIC.* Given the many different variants of BASIC used by different computers and the accepted importance of programming at the time, a FORTH computer was not a bad concept. Indeed, the Ace's rejection of BASIC for FORTH generated considerable press attention when it was released. 'I think we thought that for those people interested in programming, the arguments in favour of FORTH, in speed and flexibility, would be attractive,' explains Altwasser. 'Going to FORTH was no greater disadvantage than going to yet another variant of BASIC.' However, as colour graphics and ready-to-play software became more important, the Ace was left as something of a niche product, whose popularity was probably among programming enthusiasts. Selling perhaps 5,000 units in total, it was far overshadowed by Altwasser and Vickers's more famous creation for Sinclair.

Oric

The most significant of the other home computers to emerge from Cambridge in the boom, and perhaps the most serious challenger to the ZX Spectrum, was the Oric-1, the futuristic name simply an anagram of Micro without an M. In another sign of the success of home computers, the industry was starting to interest investors, among them David Wickins, the millionaire owner of British Car Auctions. Wickins got talking to the directors of Tangerine Computer Systems, but preferred not to co-invest in the venture capital funded firm. Accordingly, a new company, Oric, was set up to target the lower end of the market where Sinclair were doing so well. Tangerine had already

*Key differences include a second expansion port, sound and dedicated video circuitry on the Jupiter Ace.

produced the Microtan 65 hobbyist computer, and was working on a professional workstation, the Tangerine Tiger. The Oric-1 would take it into the consumer market and directly into competition with Sinclair's products. 'We were creating a Spectrum type of computer,' explains Oric-1 hardware designer Dr Paul Johnson. 'We knew it had to be under £200 to keep within people's budgets.' Oric's development was contracted out to Tangerine. 'The deal was £100,000 for the design of the machine and 50 pence a unit for the first 100,000 units,' recalls Johnson. 'That was a lot of money then for just designing a computer, when I was churning this stuff out. It didn't take me long to design the Oric.'

A similar size to the Spectrum, the Oric-1 followed the same low-cost colour computer concept, but in a more refined fashion. 'The Spectrum was crap compared to the Oric,' argues Johnson. 'You had that horrible keyboard and little sound chip – it just didn't measure up at all.' The Oric-1 offered yet another variation on how to provide a cheap keyboard, with small plastic keys, and despite not being typewriter style, it was well regarded and well laid out. 'Keyboards were expensive then and the industrial designer came up with this very clever design, he put a cam action on the push-down keys,' recalls Johnson. 'It gave you a nice feel.' One of the most startling features of the Oric-1, and a clear advantage over the Spectrum, was the sound quality, with almost a fifth of the circuit board area taken up by a large speaker. 'We put a General Instruments sound chip into it and the sound out of the Oric was monster,' explains Johnson.

Oric's advertising stressed the machine's suitability for both the home and business, but according to Johnson, the assessment of their target market was realistically more about entertainment: 'You can use it for business, you can use it for this, you can use it for that... We knew what it was going to do – kids were buying them for playing games.' Just as with so many other computers of the time, the Oric-1's launch suffered from technical problems and delivery delays, with some people waiting up to three months for their machines. *PCW*'s reviewer

wryly noted that the first two review machines it had received had not worked. Despite the teething problems, the Oric-1 was recognised as generally excellent value for money. In spite of its refinements it managed to briefly undercut the ZX Spectrum when it first appeared. Indeed, at a launch price of £99.95 for the 16k version, or £169.95 for the 48k version, the Oric-1 was the first colour home computer for under £100, although a price cut in the ZX Spectrum gave it only a brief advantage.

‘When you design a new computer like the Oric your biggest problem is who’s going to supply software for it,’ explains Paul Johnson. ‘You had to convince the software vendors that this was going to be a big seller, that was the problem.’ By the time the Oric-1 was launched in January 1983, Sinclair had already sold 200,000 Spectrums, and there were already around 350 assorted games available for it. Although the Oric-1 attracted the support of several software houses and sold around 160,000 units in Britain, it was never able to challenge the established position of the Spectrum. However, the Oric-1 and the later Oric Atmos would find a ready market in France, largely unintentionally.

As Paul Johnson was finishing the hardware design, he found himself with four unused logic gates. ‘I can’t waste four gates. I’ve got to use them for something because otherwise they’re doing nothing,’ recalls Johnson, who managed to shoehorn the circuitry to drive a monitor into the unused capacity. France and Britain use different standards for television displays, the SECAM and PAL systems, meaning that British computers normally needed special adaptors to work with French televisions and the results were often poor. However, French televisions also had SCART connectors, which turned out to be readily compatible with the Oric’s monitor connector. Small technical decisions can sometimes have surprising consequences. Most of the other cheap computers only had an RF television connector. According to Johnson, the Oric’s ready suitability for the French market gave it a decisive

edge: 'Our major sales were in France. We had 80 per cent of the French computer market with the Oric, and the reason we got that was unintentional.' While it may have been an also-ran in Britain, the Oric-1 occupied a similar niche in France to the ZX Spectrum in Britain.

An industrial rebirth?

We need to leave the cloistered design offices of Cambridge to appreciate another aspect of the microcomputer-driven economic revival. At the height of the boom, home computers were not just being designed in Britain but were also made in Britain, rather than just being outsourced to the Far East. The major ZX81 and ZX Spectrum production line was at Timex in Dundee, a city hit by a decline in traditional industries like shipbuilding, but with a growing high-technology sector. Commodore set up a factory in Corby, promising 1,000 jobs in a town that had a 30 per cent unemployment rate after the closure of the steelworks, and qualifying for hefty government redevelopment grants, naturally announced by Information Technology Minister Kenneth Baker. For a time, computer factories pointed to a brighter, high-tech future for the manufacturing sector.

The Dragon 32, a Welsh home computer backed by the Welsh Development Agency, is perhaps the best example of how computers came to symbolise industrial renewal. The Dragon was the brainchild of Tony Clarke, the managing director of Swansea-based toy company Mettoy. The machine was intended to cash in on children's growing interest in playing with computers instead of Mettoy's traditional lines, which included Corgi die-cast toy cars. The Dragon, produced by Mettoy subsidiary Dragon Data, was something of an oddity among home computers. Rather than the common Z80 or 6502 microprocessors, it used a Motorola 6809. This earned it some interest from people concerned about processor details, but sadly not so much from software companies, whose expertise lay in programming computers

with more popular processors. However, some common design heritage shared with the Tandy TRS80 Colour Computer, about the only other 6809-based home computer, meant that some programs written for the 'Co-Co' would work on the Dragon too.

A robust machine with a typewriter-style keyboard, 32k of RAM, colour graphics and good value at £199, the Dragon initially sold quite well, some 32,000 machines by early 1983. Yet at least part of this success was from Mettoy's contacts with major retailers, and the shortages of other brands of computer at the time. Whatever the Dragon 32's technical merits, its fame rested most on the new factory built to produce it in the Welsh steel town of Port Talbot. Journalists could not help but compare the town's declining heavy industry with this futuristic new start-up and the future it represented. Less well publicised was the fact that this proudly Welsh machine was actually designed for Mettoy by PA Technology, yet another Cambridge-based consultancy.

Overseas exports were another aspect of this apparent economic success story. Other European countries were slow to develop their own personal computer industries, and large parts of the continent had their introduction to the microcomputer age through British machines. Indeed, some of the lesser-known computers enjoyed better fortunes overseas than they did at home. Dragon computers would later find a home in Spain, and Oric did well in France. The low cost of Sinclair's machines proved well suited to Communist countries, and cheap Spectrum copies were still being made in Eastern Europe in the 1990s. For a few years it seemed that Britain was not so much leading the rest of Europe in the personal computer race, as helping Europe find the starting blocks in the personal computer race.

There was a steady trickle of optimistic reporting at the start of the 1980s about British computers being exported around the world: trade deals signed to introduce the ZX81 and Spectrum to China; Acorn supplying BBC Micros to Indian schools, after the Queen gave 30 of them to India on a state visit; there was even an Arabic version of the ZX81 with the

text on the right-hand side of the screen. The reality behind the headlines was a bit more complicated. A recent report on the legacy of the BBC Micro suggests that, while the machine sold well in Australia, Holland and South Africa, there was actually disappointment that its overseas sales did not match the media hype.³ The biggest hope of British companies was breaking into the US market. Like a trained Shakespearian British actor dreaming of success in Hollywood, there was something aspirational about British ingenuity making it big in the country that invented the personal computer, but it was also a major market.

The two companies to try hardest to crack the US were Sinclair and Acorn. In a reversal of the normal flow of American ideas and products into Britain, by mid-1981 Sinclair was doing rather well directly supplying American enthusiasts by mail order. Shipping up to 20,000 ZX81s a month, Sinclair was reputed to be outselling Commodore, Apple and Tandy.⁴ In 1982, Timex produced a licensed Americanised version with double the memory, named the Timex TS1000. Sold in stores across the USA, the TS1000 was initially something of a sensation. Timex was overwhelmed with queries, and sold over half a million of the little machines in the five months after its launch. Unfortunately the success was short lived. By the following year sales had plummeted, and neither discounting nor the release of the improved TS1500 could stop Timex from pulling out of the computer market in 1983. The \$100 computer was an interesting novelty for a time, but there was not the same need for such extreme design economies in the affluent US market as in Britain. Nevertheless, the appearance of the TS1000 was enough to jolt some American computer producers into projects to make even cheaper computers, albeit with limited commercial success.*

*Among these were the Commodore C116, part low-cost successor to the VIC-20, part 'Sinclair killer', launched in 1984; and the Tandy MC10, released in 1983, both distinctly backward steps for the companies involved.

Sinclair's US sideline was not a long-term success. However, it was profitable for a time and Timex's problems did little to harm Sinclair. By comparison with the TS1000, Acorn's attempt to enter the US market was a disaster. In 1983, Acorn tried introducing the BBC Micro into the US, on the back of sponsoring public broadcaster PBS to show *The Computer Programme*. The many expansion opportunities of the BBC Micro were part of its appeal, but unfortunately American consumer products had to comply with strict electronic emissions standards laid down by the Federal Communications Commission (FCC). 'The design of the BBC Micro was really not good for the US market because it had so many ports,' explains Steve Furber. 'When you do the emissions test you have to stick a metre of cable in every port, so the more ports there are, the more wires there are transmitting radio interference.' The machine gained a couple of pounds of shielding to stop it leaking radio waves, but the reworking delayed its official release until after PBS's broadcast of *The Computer Programme*, leaving it as advertising for a product that was unavailable. More fundamentally, the US computer market was a tough environment by 1983. Apple was already entrenched in education establishments, Commodore was battering Atari and Texas Instruments in a vicious price war for domestic customers,* and building a dealer network in the large country was a challenge. 'A glorious failure,' concludes Steve Furber. The venture cost Acorn millions and would have serious consequences for the company's future finances.

*Among Commodore's more imaginative marketing strategies was to offer a \$100 discount on a Commodore 64 computer if customers traded in an older computer. With Sinclair-Timex TS1000's discounted to around \$50 at the time, Commodore found itself inundated with new TS1000's bought purely to apply for the discount.

Keeping up with the Commodore

While British companies were trying to break into the US market, US computer firms were touting their wares in Britain. The price of Atari's home computers dropped considerably after the introduction of the overpriced £395 Atari 400 and £695 Atari 800. By 1983, they were retailing for around £160 and £400 respectively, and new models were starting to appear, such as the £160 600XL and £250 800XL. Texas Instruments had replaced the £750 TI99/4 with the improved TI99/4A, priced at about £200, in 1983. Atari did better than Texas Instruments, but neither company made a great deal of impact on the British market. Domestically produced computers tended to offer more for the money and were better supported by British software producers. By contrast, Commodore became a major player in Britain, not to mention around the world.

While British companies resorted to ULA's as a poor-man's way of producing custom chips, Commodore benefited hugely from its ownership of MOS Technology, with its chip design and fabrication capabilities. The VIC-20 had been made possible thanks to MOS's Video Interface Chip (VIC), providing a cheap means to generate sound and colour graphics on a home computer. History repeated itself with the Commodore 64, which grew out of a new pair of chips originally developed by MOS to provide advanced graphics and sound for a top of the range games system. The first was the VIC-II graphics chip, developed by a team led by Albert Charpentier, which examined the graphics facilities offered by other home computers and video games, then adopted the best features that they found.* Simultaneously, Robert Yannes developed the Sound Interface Device (SID) chip. As an electronic music hobbyist, Yannes had been disappointed with

*One of the most significant features of VIC-II was its sprite capability. Sprites were small graphical objects, which simplified the creation of animations.

the primitive sound of most computers. His design for SID offered sophisticated audio capabilities, more like those found in professional synthesisers than in home computers. VIC-II and SID was a powerful entertainment combination and gave Commodore's engineers the basis for a remarkable machine, developed with much haste.

'I'd worked for Phillips... to bring a product from inception and design to market it would take them at least two years,' remarks Kit Spencer, who led the machine's marketing. 'We effectively did the Commodore 64 in six months. Everything was in parallel. It was crazy times.' Alongside the rapid development of the 64 by a small team of engineers lead by Charles Winterble, Spencer directed a comprehensive marketing effort to support and sell the machine when it was released. 'Previously Commodore had not been very good at launching its products,' recalls Spencer. 'We'd done a better job in the UK on the whole. And I was determined we were going to do that one right.' When the Commodore 64 was released in 1982, there were already manuals, programming guides and a software list to entice people to buy it and encourage others to create software for it.

Priced at \$595 on release in 1982, the Commodore 64 was competitively priced and had a major selling point in its 64k memory, which was larger than most competitors. 'I decided it wasn't going to have a name like VIC or PET. I was going to put the biggest sales point right there in the name,' recalls Kit Spencer. With memory probably the only number on a computer that really mattered to consumers at the time, the 64k featured heavily in a major \$20 million advertising campaign. As a visual reminder of the 64's memory, many adverts featured elephants, famed for never forgetting anything. It says much for Commodore's confidence in its product that other adverts featured competitors' machines too. One campaign featured a line-up of computers from Apple, IBM and Tandy, each declaring that it had computed that the Commodore 64 was better than it were on price and memory grounds.

Even in a booming market the Commodore 64 was a distinct success. ‘When I launched it at CES, one of the headlines of my press conference was “we’re going to sell a million of these computers in the next year,”’ reminisces Kit Spencer. ‘I went back a year later and said, “I’m going to have to apologise. I said we’re going to sell a million computers. We didn’t. We sold one and a quarter million.”’ Retailing at around £350 in 1983, the machine was soon one of the top sellers in Britain too, with 240,000 Commodore 64s sold that year. Together with over 410,000 VIC-20s, it was enough to place Commodore in second place for sales after Sinclair in 1983. Estimates vary, but over its long life as many as 17 million Commodore 64s were made, making it the most produced computer model in history.

The good, the bad and the indifferent

In contrast to the superlative power of the Commodore 64, the computer boom also saw a series of cheap and cheerful machines produced to cash in on the huge demand that had been unleashed. Following the success of the innovative ZX81 and Spectrum, several other companies produced low-cost machines. Some, like the Electron and Oric, were perfectly respectable micros by the standards of the time they were released. The same could not be said of some of the others, basic computers with hardly a hint of innovation nor claim to do anything more than play games or be vaguely useful to the beginner, machines whose only redeeming quality was being cheap.

Take, for example, the £89.95 Mattel Aquarius. Mattel may have been a toy company best known for the Barbie doll, but its 1979 Intellivision games console had been quite an innovative design and a great success. The same could not be said of the Aquarius. Seeking a quick way into the home computer market, Mattel bought a design off the shelf from Radofin Electronics, a Hong Kong-based manufacturer of Intellivision components. The result was a cheap Z80-based computer, with a calculator-style keyboard and pitiful 4k of

RAM, less than 2k of which was actually available for BASIC programs. 'Aquarius: System for the Seventies' was the slogan apparently suggested by one of the machine's creators. The tale is possibly apocryphal, but the truth is that the Aquarius was quite an advanced home computer by the standards of about 1980. It was just a shame that it was released in 1983, by which time it was underpowered and seemed like a toy, even set against other games computers.

Much the same could be said of the little Tandy MC10, developed as a low-price alternative to the Tandy Colour Computer, one of Tandy's successors to the TRS-80. Looking rather like an inflated ZX80, albeit with colour graphics, sound, 4k of RAM and a chiclet keyboard, the MC10 was probably intended as Tandy's answer to the Timex-Sinclair TS1000 or TS1500. In the buoyant computer market of 1983, even these stunted creatures were thought to have a chance. Despite struggling to find much nice to say about the MC10 beyond 'average' and 'adequate', *Personal Computer World's* reviewer was forced to concede that the MC-10 would sell, if only because people trusted the Tandy brand. *PCW* actually gave the Aquarius quite a positive review as a computer for beginners and was optimistic about its future. However, the Aquarius was in production for a mere six months, and the Tandy MC10 for around a year.* At least the old ZX81, often derided as a toy, had dreams of helping with the home accounts or maybe even running a power station someday. Neither the MC10 nor the Aquarius had any such pretensions. They were just cheap computers made to cash in on a booming market.

The Japanese are coming

Amid the baffling diversity of the home computer boom, there was at least one serious attempt at standardisation. In 1983

*Unpopular in the USA and Britain, the MC-10 was another machine that found success in less developed markets. In particular, an MC-10 clone, the Matra Alice, achieved some success in France.

the major Japanese computer and electronics companies got together with Microsoft to agree a standard specification for building a computer – MSX.* Essentially, it was a common blueprint that each member of the MSX group could build from, eliminating the confusion and compatibility worries of consumers and software developers alike. The reality was rather messier, as manufacturers were allowed to add extra features around the MSX standards to build machines for different market niches. The result was over 250 different types of MSX computer, retaining a core of compatibility, but offering widely different features, such as light pens, video discs or advanced sound – Yamaha's MSX computers could even be plugged into the company's synthesiser keyboards.

Nevertheless, MSX was a powerful idea and a serious threat to the established home computer producers, not just because it offered the advantages of standardisation, but because it was Japanese. Japan's post-war economic miracle had seen it export masses of cheaply produced cars, televisions, transistor radios, hi-fis, calculators, typewriters and other products. National industries around the world had found that they could not compete with efficient Japanese production methods, supported by protective trade barriers in Japan. To domestic computer companies in the US and in Britain, MSX was the threatening foreign invader they had long expected. Back in 1980, Jack Tramiel had launched Commodore's efforts to build a cheap home computer with a warning that the Japanese were coming. By the time MSX appeared, Commodore, Apple and others had established strong positions in the US market, against which MSX made little headway.

Big in Japan, MSX also achieved some success in such countries as Brazil and Holland, but in Britain MSX was seen as a threat to the burgeoning domestic industry. In 1984, as British computer manufacturers met the government to

*The MSX standard demanded a Z80 microprocessor, at least 8k of RAM, Microsoft MSX BASIC, common video and sound chips, and standard keyboard layouts and expansion connectors.

discuss the implications of MSX for their businesses, Roger Kean in a *Crash* magazine editorial decried MSX as 'selling British innovation down the drain for the sake of a convenient standard'. For all the concern, MSX made little impact in Britain, but it probably said more about the market at large than about any deficiencies in MSX as a technology. As the market had matured, introducing any new computer had become increasingly difficult, even one backed by most of Japan's electronics industry. Buttressed by software houses and relationships with retailers, the established players were in a dominant position.

The maturing market

What had started off as an open market – where seemingly anybody could combine a few chips, a keyboard and a pretty case, and expect it to sell – had evolved quickly into something more restrictive. By about 1983, market conditions favoured established machines, such as the ZX Spectrum, BBC Micro and Commodore 64, over newcomers. Not only were these machines well known, but they were well supported by books, magazines, retailers and software companies. Buyers did not want to be stuck with a machine they could not easily get software for. The well-established machines with their extensive back catalogues were safe bets. A virtuous circle developed. People bought computers that offered a good choice of software, and because these computers sold in the greatest numbers, software companies were motivated to create yet more software for them.

Big chain retailers, the likes of WH Smith, Dixons, Boots and Laskys, had done much to bring the computer out of the shadows of mail order and into the bright lights of high-street sales, but they were selective in what they sold. It was far easier for the big chains to concentrate their efforts on selling a handful of types and the software to go with them, than expect inexpert staff to navigate the technical minutiae of every machine on the market. Once a retailer had put a product onto its shelves, it was in its best interests to get behind it

with advertising, giving another advantage to a selected few products.

Not all of the home computers launched in the early 1980s could be successful. The machines that did best in the tumultuous years of the boom were not always the best, or the cheapest or the most technically advanced. They were ones that built up brand recognition, relationships with retailers, software catalogues, shelves of books, magazines and loyal users. For those that did not, some sort of market shake-out was inevitable at some point. Yet as 1983 drew to a close, microcomputing was on an all-time high, and people were finding all sorts of interesting uses for their machines, some of them ahead of their time.