The Mighty Microcosm: Home Computers and User Identity in Britain, 1980-90

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Introduction

This paper concerns the home microcomputer:[1] a recent phenomenon, but a vanished one requiring a surprising degree of historical contextualisation. Mass-market computers, under current received assumptions, tend to follow one archetype (what used to be known as the IBM PC standard, but has extended so far beyond its original, hardware-based specifications, and become so ubiquitous, as scarcely to require definition.) A computer, typically, is a light-grey metal box with separate keyboard and monitor; employs a Microsoft operating system on an IBM-derived architecture using an Intel-derived microprocessor; and is primarily set up for use as an office tool, though it can be persuaded to perform many other tasks. These conventions are not general, but outside their domain there is frequently understood to be a single dominant minority option (at whatever level: the

[1] Most analyses from a sociological, cultural or broad historical perspective use the term 'personal computer' or 'PC' to denote any single-user, direct-access console (usually microprocessor-based) designed according to the principle of individual user control. This usage is respectable, and in some important contexts the term adopted by the historical actors themselves. In some situations including the Britain of the mid/late 1980s and early 1990s, however, the term almost exclusively denoted a proprietary IBM PC or one of its clones (cf the broadly-recognised 'PC versus Mac' distinction.) The generic for a microprocessor-driven computer throughout my period was *microcomputer*. A casual survey of the sources suggests that the abbreviation *micro* was strongly preferred in the first half of the 1980s, but had lost most of its ground to *computer* by decade's end.

Apple hardware platform, the Linux family of operating systems, the Firefox browser…), with the plurality of further possibilities interesting few users. Some form of compatibility or interoperability with established standards and expectations is in any case paramount: except in a few niche markets, it is considered a practical necessity.

The rise of microcomputing to a mass consumer phenomenon, however, took place in the absence of these assumptions: around 1980 there was no prescribed mode in which to use a computer, no established size or shape, no firm consensus on hardware or software. This was true in the USA, where Apple, Commodore, Atari, Tandy RadioShack and other firms battled to establish the supremacy of their own platforms from the late 1970s, well before IBM's entry to the field; but it was most strongly observable in various other, mostly Western European states, where all these producers battled home-grown competition and where, more importantly, alternative cultures of computer use and interpretation flourished in response to localised needs and beliefs.

Britain in particular is often held to have undergone a conversion around 1980 to what David Skinner has described as a "millennial" view that information technology held the key to the future, that human potential was liable to be redefined in terms of information and communications literacy, and that interaction with computer technology was somehow *intrinsically* educational.[2] The roots of this tendency are sometimes located in Christopher Evans' popular bestseller *The Mighty Micro* ("This could be the most important book you ever read — it might even be the last…"), which predicted vast changes

[2] David Skinner, "Technology, consumption and the future: the experience of home computing," PhD thesis, Brunel University, 1992, 32-69.

in human society within the order of ten to twenty years;[3] whatever its origin, the position informed two projects imposed at national level: the fledgling Thatcher government's scheme for an 'information revolution' to restore the moribund post-industrial nation to its former status, and the more humanistic initiatives clustered around the state-owned British Broadcasting Corporation (BBC)'s Computer Literacy Project.[4] Though distinct in ethos, the two agendas reinforced each other at the level of schools provision and general consciousness-raising, with the result that the microcomputer's ambient presence, as measured by per capita ownership among the general public, became the highest in the world. Guided mainly by this British context, I consider the 'home computing' era as a distinct historical episode characterised by tremendous heterogeneity and underdetermination.

This episode is remembered with much affection; but also, inevitably, through the presentist lens which makes its differences into foibles or errors. Gordon Laing's recent *Digital Retro*, a glossy, coffee-table celebration of microcomputer hardware aimed at a largely British audience, synthesises the projections of cheerful eccentricity and (charmingly) perverse territoriality:

> Long before Microsoft and Intel ruled the PC world, a multitude of often quaint home computers were battling for supremacy in a melting pot that would shape the IT industry for years to come. Products from established electronics giants clashed with machines which often appeared to have been knocked together in a backyard shed by an eccentric man from Cambridgeshire. Plenty actually were.

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[3] Christopher Evans, *The Mighty Micro*, 1979; 2e, rev Robin Webster, London: Coronet 1980

[4] A useful contemporary source on the Project's context is Paul Kriwaczek, "BBC Television's *The Computer Programme*: evolution and aims" in "The BBC Computer Literacy Project: has it succeeded?", papers of Professional Group Committee C6 of the IEE, December 1982 (copy in British Library.)

> Compatibility? Forget it! Each of these computers was its own machine and had no intention of talking to anything else. Much like their owners, in fact, who passionately defended their machines with a belief verging on the religious.[5]

Implicit here is the view that heterogeneity was established at the level of the machines themselves (ie, by the producers, with users as zealous followers) and intrinsically doomed (the producers' actions having an air of hubris.) Many industry insiders, having observed a world of systems unable to correspond with other systems, believe the 'shake-out' which led to the Intel-IBM-Microsoft monolith was in hindsight inevitable.

The result is that the 'home micro' itself is sometimes decried as a false step. In rejecting the concept of linear progress, scholarship in the history of technology has tended to note how a sense of such 'progress' is routinely constructed regardless, with the historical relevance of cases which do not fit the pattern question-beggingly denied. Thus the present dominance of the office-oriented PC means that the multifarious home micros cannot signify, in spite of their undeniably high sales and penetration into 1980s life; the solution is to write them off as an unsustainable craze, an interpretation found even (at very little historical separation) in George Basalla's classic *The Evolution of Technology*:

> By the mid-1980s the home computer boom appeared to be nothing more than a short-lived and, for some computer manufacturers, expensive fad. Consumers who were expected to use these machines to maintain their financial records, educate their children, and plan for the family's future ended up playing electronic games on them, an activity that soon lost its novelty, pleasure, and excitement.[6]

This argument is particularly seductive with reference to the specifics of the British case. Having, as a primary design consideration, the cost-cutting

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[5] Gordon Laing, *Digital Retro*, Lewes: Ilex 2004, back cover

[6] George Basalla, *The Evolution of Technology*, Cambridge: CUP 1988, 185

agenda necessary for volume sales in a recessive post-industrial market, home-grown British machines lacked (so the argument runs) the capabilities of the 'real' computers found in offices, which followed American archetypes, most importantly IBM-compatibility. When their intrinsic novelty appeal to the consuming public wore off, the machines were swallowed up into the bedrooms of the nation's male adolescents: their appeal as gaming machines derived from the fact that they lacked the capacity to do much else. They were no match, however, for the dedicated gaming consoles produced by Sega and Nintendo; these Japanese operations pushed their marketing into Europe in the late 1980s, just as the price of 'serious' PCs went into sharp decline relative to earnings, and between the two poles the various 'home micro' forms were squeezed out of existence.

The received account, then, holds that

- broad compatibility and heterogeneity are mutually exclusive, with compatibility the evidently superior state
- heterogeneity must therefore be a transient phenomenon (ie, all markets "shake out"), which in this case was briefly prolonged by particular economic circumstances
- events are determined by the fiscal and rhetorical strategies of producers, not by users or intermediaries

It will be apparent that this account, though typical of some internal literature and believed by some of the actors concerned, is already a straw man to most current historians of technology. Economic determinism and producer-focused studies are problematic and distinctly unfashionable, and the project to find alternatives is well-established.[7] In fact we already have a user-led microcomputer study in Christina Lindsay's recent work on the US-originated TRS-80, which my study parallels to an extent.[8] My purpose in further bayonetting the straw figure is partly to provide a comparable outlook from a largely unexplored national context; but, more importantly, to apply a nuanced account of production and use to suggest why heterogeneity survived in the forms and to the extent that it did — and does.

In the next section, I establish the supposition of short-sighted producer territoriality to be unsafe, examining one significant producer which promoted a strikingly compatibilist agenda; and in the section following, I look at how this agenda was altogether lost from view as the users, for reasons perfectly comprehensible at the technical as well as the social level, isolated their own platforms and ensured non-compatible development for the technologies involved. In the final section, I consider what 'development' meant in this context: the tendency to focus on hardware metrics is flawed (partly for reasons of presentism) and must be resisted. I conclude with the suggestion that the "shake-out" which closed the micro era was not only a contingent development, but in fact never progressed as far as is commonly supposed.

[7] See in particular Nelly Oudshoorn and Trevor Pinch, "Introduction: how users and non-users matter" in Oudshoorn and Pinch, eds, *How Users Matter: the Co-construction of Users and Technology*, Cambridge, Mass: MIT Press 2003, 1-25

[8] Christina Lindsay, "From the shadows: users as designers, producers, marketers, distributors, and technical support" in Oudshoorn and Pinch, eds, *How Users Matter*, 29-50

Producers look outwards: a forgotten compatibilist agenda

The received view of 'eccentric' British microcomputer production outlined above is patterned heavily on the policies of Clive Sinclair, the entrepreneur and inventor whose products dominated and partially defined Britain's home micro experience from its gathering as a mass phenomenon around 1980 until around 1982/3. Sinclair's biographers note his rather accidental enrolment in microcomputing, which was secondary in his personal agenda to a variety of other technology areas.[9] Accordingly Leslie Haddon, who produced the first significant socially-informed study of the home micro phenomenon, exhibited Sinclair treating the microcomputer essentially as a revenue stream. A policy of design "down to a price point" created cheap, affordable machines for the masses: these were both riotously successful (hence iconic and pattern-forming), yet too limited or too unusual to have much prospect of communicating with 'serious' (at the time, almost exclusively US-originated) computers, in whose architectures robustness and interoperability played a greater role relative to cost.

We must be aware at this point that while the idea of a 'conventional,' non-heterogeneous mode of microcomputing existed in 1980, IBM did not enter the field until the following year. The established standard was Digital Research's CP/M operating system for disc-based microcomputers, commercialised around 1976-7, which allowed a variety of manufacturers' machines to run common software. Having been designed for Intel's 8080 processor, CP/M could also operate on the compatible-by-design Zilog Z80, a

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[9] Ian Adamson and Richard Kennedy, *Sinclair and the Sunrise Technology: the Deconstruction of a Myth*, Harmondsworth: Penguin 1986. Cf also Thomas Lean, "'What would I do with a computer?' The shaping of the Sinclair computer, 1980-1986," MA thesis, University of Kent, 2004, 14-34

popular choice of international manufacturers including Sinclair.[10] Yet Sinclair machines lacked the capacity to run CP/M; graphical, memory and other limitations would have ruled out compatibility with most contemporary software. The minimal abilities of Sinclair micros such as the ZX-80 and ZX-81, says Haddon, limited them to being *self-referential* machines — computers used for the simple intrinsic thrill of using a computer, lacking any significant outside application.[11]

Haddon's encapsulation of the Sinclair ethic is sound, and the concept of self-referentiality is a useful analytical tool. Problems emerge only when we take Sinclair machines as archetypal of British micro production — an easy mistake to make, given the iconic status of Clive Sinclair as an individual and the early market dominance of his firm. In fact, Haddon also records the rather different ethic of Commodore, an established US producer which from around 1982 challenged Sinclair in Britain (and dominated other European markets) with a machine advanced enough to be a 'software player' for home use, yet still excluded from broad compatibility by pricing considerations.[12] Yet it is only by considering machines not addressed in Haddon's survey that we can understand that heterogeneity was not a producer-inspired phenomenon. *Expansibility* could provide a gateway from one machine, devised to meet whatever technical, financial or marketing constraints, to any number of environments.

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[10] The chips used were in fact Z80 clones manufactured by Nippon Electric (now NEC.)

[11] Leslie Haddon, "The home computer: the making of a consumer electronic," *Science as Culture* 2, 1988, 7-51, on 27-36. This point was followed up by David Skinner: "Technology, consumption and the future," 168-9, 252-3

[12] Haddon, "The home computer," 36-42

Grundy Business Systems' NewBrain, launched in 1982, for instance, was a tiny, portable, cream and brown unit priced at £267, which when not plugged into a monitor could give output through an idiosyncratic calculator-style LED matrix embedded in the front panel. Yet its modest 32-kilobyte memory was designed to be expandable to two megabytes — an incomprehensible figure for any but a research or commercial application.[13] Based around a Z80A microprocessor, the machine was able to run CP/M, in which state it could not only share data with 'conventional' US-originated systems, but could run their software and be operated successfully by their skilled users. In all meaningful senses, the expanded NewBrain *was* conventional. Commercial happenstance, rather than any predestined consequence of heterogeneity in design, drove it out of the market.

We find a richer demonstration of this point when we look at Acorn, a much longer-lived producer which at one stage challenged Sinclair for dominance. On the surface, and in the received internal history, Acorn seems more closely to fit Laing's bill of 'eccentricity' than its rivals. The company operated in much the same academically-inflected Cambridge context as Sinclair Research, but without the cost-cutting production instincts of Clive Sinclair himself; its success was founded on the nationally-specific niche markets of the BBC Computer Literacy Project and Micros in Schools initiative; it is popularly stereotyped as a responsible for robust and often startlingly innovative equipment which was nonetheless expensive, esoteric and unlikely ever to connect with a mass audience. Although the firm is now defunct, it maintains a dwindling but active band of loyal adherents who still make

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[13] Laing, *Digital Retro*, 102-105. The figures quoted refer to the higher-specified of two models launched.

active use of Acorn hardware and software and decry IBM's intervention, and the present Intel-Microsoft hegemony, as a rather embarrassing false step.

We might imagine, then, that its early designers might have maintained a similarly lofty indifference to the American-dominated compatibility agenda. This was most certainly not the case, as is visible in the very fabric of the hardware in question.

The machine which principally established Acorn as a significant force in microcomputing was commissioned by the BBC to support the Literacy Project, christened the 'BBC Micro' and widely distributed to British schools, as well as through open retail, from 1981. The machine as delivered was typically incompatible with contemporary (pre-PC) standards: built around a processor which could not run CP/M, with Acorn-specific operating and filing systems and a specially-written dialect of the Basic programming language. Yet it was also tremendously expansible machine. Its back and underside bristled with connector sockets, including, cryptically, something labelled "the Tube." This Tube, it emerged, was planned to connect to an external unit housing a *second microprocessor*. The base unit would continue to handle mundane tasks like input/output, but the second processor would perform the actual calculations and define other parameters such as storage capacity: more than anything, it would determine the character of the computer.

It is important, given what followed, to understand that user acquisition of a second processor was promoted as a probable *routine* aspect of the microcomputer experience. Early popular descriptions of the machine (even under its production designation as the 'Acorn Proton') cite the port allowing a Z80 second processor, and refer specifically to expected CP/M capability.[14] The BBC's consultants did nothing to deflect this agenda, and indeed were

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[14] See for instance Robin Bradbeer, *The Personal Computer Book*, 2e, Aldershot: Gower 1982.

committed to the principle of broadening user experience. The conception of a system grown from a base was an elementary strategy in what would now be called 'future-proofing,' and was perhaps at the root of the company's plans: according to co-founder Chris Curry, the very name 'Acorn' (invoking "great oaks…") was chosen, in connection with earlier hardware, to imply expansibility.[15]

The user-group newsletter *Beebug*, in 1982 still primarily addressing new users seeking information on the possibilities of the machine, described it as "only really half a computer," promoting the assumption that ultimately for most users' needs a second processor would be added. The separation of parts was a positive advantage, not only to break up the expenditure but because processor choice would depend on intended use. Possibilities promised from the outset were a 6502A similar to the existing processor, the Z80 for CP/M, and the more powerful 16032 (later 32016), which could address 16 megabytes and would be capable of running Xenix, a microcomputer implementation of the Unix environment long established in research computing.[16]

Acorn's pre-announced second processors were slow to arrive. Yet the perceived need was such that another Cambridgeshire company, Torch Computers, began to market add-on hardware. The Torch Disc Pack (**figure 1**) was designed to fit beneath the microcomputer and included in one unit twin disc drives and a Z80 second processor, thus supplying the principal hardware requirements of what had become identified as the 'small business' market (ie, those businesses not large enough to have begun computerisation in the pre-micro era.) It ran CPN, a reasonably effective CP/M clone.

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[15] *Practical Computing* 5(10) October 1982, 62

[16] *Beebug* 1(6), October 1982, 22; *Acorn User* 2(12), July 1984, 7

Meanwhile, Acorn licensed an implementation of CP/M itself from Digital Research for its putative Z80 product, announcing in October 1983 that the package would include Cobol, a Basic compatible with the Microsoft dialect, and US-originated applications software.[17] Shortly before the long-delayed arrival of this unit in the summer of 1984, the problem of established third-party competition was solved by Acorn's acquisition of a controlling stake in Torch, whose compatible products survived as an independent line.[18]

By this point the IBM PC and its clones had redefined the international business market; CP/M was wilting in the face of Microsoft's IBM-sanctioned MS-DOS. Meanwhile, Acorn was establishing considerable pre-publicity for an alternative conception of the expansion principle: a "business machine," which would provide the function of the unexpanded 'home' machine plus business-oriented second-processor package in a single product. Following early reports that the new machines would be known as 'Professional Workstations', Acorn began pushing concertedly the phrase 'ABC' (**figure 2**) — for 'Acorn Business Computer.'[19] Ultimately eight models were pre-announced; they included, at the higher end of the scale, an "academic" machine running Xenix, and a firmly business-oriented machine whose second processor was the Intel 80286, the chip at the heart of the IBM PC-AT and its clones. This machine was publicised as IBM-compatible, featuring "ikon [*sic*] software and high-resolution graphics."[20]

In fact, the machine was to be shipped not with MS-DOS, but with the system Digital Research hoped would both emulate and supplant it. Acorn and

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[17] *Acorn User* 1(10), May 1983, 6; 1(12), July 1983, 12; 2(3), October 1983, 7

[18] *Acorn User* 2(11), June 1984, 7

[19] Guy Kewney, *Personal Computer World* 7(10), October 1984, 86

[20] *Acorn User* 3(3), October 1984, 7-8

Digital were reported to be working closely together to make sure the forthcoming Concurrent DOS 286 — which would give MS-DOS compatibility, run Digital's Macintosh-like user interface GEM, and make use of advanced possibilities of the 80286 not seen on the IBM/Microsoft platform — was available for ABCs as well as for PC-AT clones, permitting full data interchange capability between the two.[21]

It might be objected that the ABC, unlike the bolt-on second processor, is irrelevant to the home micro: surely Acorn was seeking to enter the established, separate market of business computing? This is the case; but if it were *simply* the case, Acorn would have released a straightforward PC clone (by 1984 a fraught and hazardous task in terms of market share acquisition, but technically almost a rote exercise) with no reference to its home machines, which was in fact the path taken by Commodore. Acorn's strategy incarnates the position that compatibilism could be promoted in a manner that retained some heterogeneity of form.

We will never know what would have happened if the ABCs had ever entered volume production. Following an acute slump in value, Acorn's shares were suspended at its own request in February 1985: the firm had suffered a trading crisis blamed chiefly, in contemporary accounts, on overproduction of an existing model (the Acorn Electron) ahead of an unforeseen industry downturn. Acorn survived only through cash injections on an arrangement amounting virtually to acquisition by Italy's former large-computer monolith Olivetti.

It is notable that Acorn maintained its identity, and was allowed to continue development along independent lines. We may reasonably surmise that it

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[21] Guy Kewney, *Personal Computer World* 7(12), December 1984, 100-101; Peter Bright, ABC 310 benchtest, *Personal Computer World* 8(4), April 1985, 121-126

was *constrained* to do so: Olivetti manufactured IBM PC clones under its own badge, and was evidently keener to support a small, research-oriented manufacturer, whose ideas could serve localised niches and might be of long-term benefit, than an expansionist operation targeting its existing, rather competitive demographic.[22] Whatever the explanation, it is a fact that only one of the ABC specifications was commercialised — the 32016 machine, always aimed at research rather than business — in very limited quantities and under the revised name 'Cambridge Workstation.'[23] The series overall was dropped, rapidly forgotten, and the company thereafter focused on maintaining its existing home and educational markets alongside a number of high-specification, low-volume research niches.

The second processors, however, were now generally available to be taken up; they were not, in any significant quantities. The typical BBC Micro remained in the same essential state from its purchase until its replacement by a wholly different machine. To understand this, we must turn to the users.

Users look inwards: attractions of the closed computer microcosm

Why would users deliberately constrain themselves to machines offering fewer than the established range of possibilities, and offering no compatibility with the majority of other machines? We might consider price, convenience, divergent predictions about future standards, or the desire for more specialised compatibility within an existing niche. All were certainly factors, but all have been discussed within the established literature of the user's role.

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[22] Cf Martin Banks, "Making Acorn fit the space," *Times*, 6 August 1985, 23A

[23] Rumours of extant specimens of other machines in the range (in particular the 310) are probably correct. A number of machines were sent out for review, which indicates that prototyping reached an advanced stage.

Here, my focus is instead on the particular value, epistemic and operational, of a *closed* machine.

It would be strange to open any discussion of 'closedness' in an information-processing context without adverting to Paul N Edwards' influential 1996 study *The Closed World*, which ranges over the history of America's Cold War to illuminate the potential and actual effects of a discourse based on the concepts of encirclement, containment and conforming systematisation. Edwards' general definition of a closed world as "a radically bounded scene of conflict, an inescapably self-referential space"[24] certainly matches my understanding of the sense in which early home micros were 'closed.' Yet Edwards' cases of closedness are broader, more cosmic and more liminal than what I wish to evoke here. The closure of the early home micros consisted in a perceptual filtering, a reduction of their natures to a set of limits and principles small enough to be understood, or at least ranged over in full, by a single user.

The most appropriate metaphorical device to describe home micro closure is the *box* — a rigid and regular structure with defined limits. This 'box' could be the system memory, or the video display area, or the number of processor operations possible in unit time, or the physical machine case itself. Such features were in fact routinely presented diagrammatically in box form (**figure 3**.) The significance of the limiting box is that it told the users 'what they were up against': it defined the parameters of the microcomputing exercise. Microcomputers were born into a world whose established computers (large-system minis and mainframes), though relatively inaccessible, routinely performed tasks that did not seem possible within the micro box; the trick was to find out whether it could be done. Creativity in

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[24] Paul Edwards, *The Closed World*, Cambridge, Mass: MIT Press 1996, 12

home micro culture, by and large, did not proceed by finding ways to escape the box, but by chafing against its insides.

This was particularly true for a specific subset of the user base. While it is true that — as Christina Lindsay indicates with reference to the TRS-80 microcomputer — all users serve to 'co-produce' the machine's identity in various senses,[25] I feel it is valuable to single out a specific group of *producer-users*, mostly software creators, whose activities fully spanned the commonplace contemporary categories of 'producer' and 'user.' In the early years of the home micro era it was commonplace that so-called 'bedroom coders,' hitherto isolated lay users, received publishing deals from major software houses, with many going on to professional programming careers; indeed, it is often impossible to locate a 'professional' expertise which did *not* partake of the 'hobbyist' or 'tinkerer' culture to some extent. Martin Campbell-Kelly's paper in this session presents a distinction between the 'professional' applications and hardware on which much US business-oriented software was developed, and the microcomputers into which it was squeezed for end use. In British home micro culture, this was rarely a possibility: developer and end-user were up against the same box.

The limitations of that same box, however, opened the possibility of *mastery* — of a truly deep and integrated understanding of the unit as a whole. The first step in that process was one of *investigation*. If the boundaries of the box were known, its interior could be mapped: users quickly discovered that producer-supplied maps were sketchy or incomplete, and to a great extent constructed the nature of their relationship with the machines whilst remedying the deficiency, at first haphazardly and then more systematically. 'Peeking' and 'poking' (respectively, reading from and writing to memory

[25] Lindsay, "From the shadows," 38

locations) were essential tools in this endeavour. Jeff Minter, subsequently acclaimed as a cult games programmer on the Commodore platform, was fortunate to obtain a head-start through access to a Commodore PET in 1978; though his experience is typical:

> [A]lthough I had achieved competence at BASIC programming, I really had no idea how things actually worked inside the heart of the machine… [Initially, peeking and poking] seemed completely mysterious, because I had no idea what it was they actually did. I knew it was something to do with accessing parts of the machine's inner memory, and we used them mainly to try and make strange things happen by altering values in a location called, mysteriously, 'zero page'.
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> We gleaned from magazines that BASIC stored some working variables in this zero page area, and by fiddling around and changing those values you could do odd things — like speeding up the flash rate of the cursor until it became a blur, or reducing the keyboard auto repeat rate so that the merest touch of a key would spew out loads of characters all at once. Sometimes, messing with these values did nothing at all, and sometimes it crashed the machine solidly. I can't say that I used PEEK and POKE on zero page to any great end, or really even knew what I was doing at all - it was all very much just voodoo… POKE about and see what happened, without really understanding why.[26]

The theme of exploring the unknown is developed in the earliest independent published responses to the new machines. Jeremy Ruston's *BBC Micro Revealed*, for instance, is a systematic survey of areas of the machine which Acorn had not detailed in the official user guide, such as its video controller chip: the author simply interfered with things to see what would happen, memory locations serving as markers of his progress.[27] Ruston was neither an Acorn insider nor an established outside professional: he was in fact, at the

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[26] Jeff Minter, "The History of Llamasoft, part 2," 2004. Online at <http://www.llamasoft.co.uk/lshistory2.php>, accessed 23 October 2005

[27] Jeremy Ruston, *The BBC Micro Revealed*, London: Interface 1982

time of writing, a seventeen-year-old student, whose youth was carefully noted in publishers' descriptions. His producer-user's perspective was nonetheless perceived to be as valid a producer resource as anything Acorn itself created.

Once we take this on board, we can see that the machines and their ethics were profoundly subverted by users' conceptualisation of them as closed, deep boxes. Thus, for instance, producer-users drifted towards coding in the complicated assembly languages used to create fast machine code, rather than the 'friendly,' but slow and memory-hungry, interpreted implementations of Basic which had been promoted as the default route for communicating with a computer on almost all platforms.[28]

The phrase "machine code" began to appear as a totem in games advertisers' copy from around 1982. It indicated that the coding was 'serious,' that the machine was being pushed acceptably far towards its limits. Perhaps only the arcade-style games genre could easily demonstrate the benefits in a simple program; as microcomputer software complexified, however, constraints in other fields (such as the need for word-processing software to occupy as little memory as possible, to leave space for the actual document) led to the norm that established producers' software, in general, was also written in machine code. Since this code was, by definition, microprocessor-specific, the result was a powerful reinforcement of the separations between platforms.

Machine coding itself was not by and large regarded as 'unauthorised' by the British hardware producers; calls to the assembler were conventionally possible, and sometimes discussed (briefly) in introductory reference

[28] In 1982 a machine named the Jupiter Ace, launched by two Sinclair developers who had set up independently, received significant press attention for implementing Forth, a distinctly different language, in place of Basic.

manuals.[29] Yet the practice helped to subvert the producers' intent by creating new expectations which drove a wedge between the anticipated users and a smaller, 'expert' group of producer-users inclined to deeper exploration of the machine. But this deepening implied a narrowing: these sophisticated tricks relied increasingly on exploiting properties intrinsic to the machine — that is, to the particular configuration of components concerned, rather than to any external standard or compatibilist agenda. The point is very clearly demonstrated in the case of the BBC Micro's vanishing expansibility.

Fast graphical games relied on a simple principle. The information describing what should appear on the screen was stored in the same memory unit as program data — in fact, the boundary between the two was fluid in the BBC Micro, with trade-offs possible between screen display quality and program size. The commands which allowed information to be 'poked' into particular memory locations, designed for data operations, could just as easily be applied to the screen portion of the memory. This method, though more difficult to learn than the recommended 'user-defined character' facilities, was actually simpler to execute, more flexible and very much faster. The principle was widely-known (it is also described by Minter in the PET case, and was applied by Lotus in the spreadsheet case discussed by Campbell-Kelly.) However, Acorn strove specifically to prohibit it, with stern warnings in the

[29] Contrast, for instance, the Atari 800, a microcomputer 'closed' in the alternative sense that its manufacturer actively obstructed would-be programmers' access to essential features: Stephen Levy, *Hackers*, 1984; reprint, London: Penguin 2001, 317-8. This machine was not widely marketed in Britain.

official user manual. The reason, it was made clear, lay in the aforementioned Tube.[30]

Direct screen 'poking' involved firing information blindly into numbered memory locations. This was not problematic so long as the 'map' of locations corresponding to the screen was known and constant, which was the case for unexpanded machines. But the whole purpose of the Tube was to use the machine as a gateway to processors which might use other maps — possibly maps based on principles the machine's original designers had not considered, based on technology that did not yet exist.

On the other hand, Acorn had not *prevented* the unauthorised procedures; and its tidy-minded alternatives rapidly proved incapable of allowing the response and the depth of graphical experience many users craved. Further, those users with pre-existing technical literacy — who seemed the most natural constituency for the expansionist-compatibilist "half a computer" view — were precisely those most able and most inclined to apply the intrinsic techniques which worked against it. Attitudes to direct screen addressing changed rapidly. "[N]aughty" was the term used by the *Micro User*'s editorial team in September 1983;[31] the game was probably up by the end of the year, when a reader wrote as follows:

> I was wondering how Acornsoft managed to obtain the speed required for their Super Invaders. After many long nights… using the [authorised] calls in my programs, I still could not get the speed I required for my Invaders game… while examining the innermost secrets of Super Invaders, I finally discovered Acornsoft's skeleton in the cupboard (or should it be bug in the OS) — they address the screen directly! So it appears that after all Acorn's ranting about unprofessional

[30] John Coll, *BBC Microcomputer User Guide*, London: British Broadcasting Corporation 1982, 377.

[31] "Naughty, but fast," *Micro User*, September 1983, 113

> programming practices, they forgot to send an internal memo to their own subsidiary company…[32]

We must remember that Acornsoft, like most large software houses of the period, distributed a significant quantity of software which had been developed externally by single producer-users, who would in any case have been beyond the reach of this hypothetical memo. Partly through specialist-press discussions such as the ones referred to here, direct screen addressing and other machine-intrinsic tricks became widely-understood commercial norms, whereas the second processor concept never caught on. The vast majority of software used on BBC microcomputers, across the lifetime of the platform, was developed in a fashion intrinsic to the Acorn 'world,' conforming largely or wholly to the closed interpretation of the machine's 1981 release.[33]

Closure subverted what seems to have been Acorn's foundational agenda, but ultimately became a factor in the organisation's survival, as an astute retail dealer noted in response to the February 1985 crisis:

> Because of the penetration of the [BBC Micro] in schools and universities, we have a generation of young experts who are intimately familiar with it. These assets are the real capital of Acorn, and not the depressed shares currently suspended on the Unlisted Securities Market. What the finance market is getting wrong, the pressure of continuing demand will soon put right…[34]

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[32] David Young and Michael Young, "Skeleton unearthed," *Micro User*, December 1983, 131-2

[33] Later machines had more memory, which some coders took advantage of to create more powerful software; but the quoted memory increases from the original 32 to up to 512 kilobytes disguise some fundamental limitations in the data-handling capacity of all single-processor BBC micros. The machine's graphics and processing speed were never successfully extended.

[34] John Law, letter to the *Times*, 19 February 1985, 24A

Closure, moreover, facilitated the aesthetic separation which allowed influential user stereotypes to emerge. Before 1981/2, Sinclair micros were the machines of choice for hobbyists, mathematically-inclined enthusiasts and even school-sector educationalists. The shift of the platform (in common with that of Commodore) towards a 'gamer' profile, and the wholesale co-option by Acorn of the former niche, were initiated largely by the specification and marketing of subsequent machines; but they were accelerated and completed by the users, in particular by the producer-users' activity in software production and journalism. Tom Lean's recent analysis of this point, stressing the role of the specialist press, is illustrated through the covers of periodicals including *Sinclair User*, whose shift in tone between 1982 and 1987 is particularly striking.[35]

Concepts of progress in a closed micro world

We have so far noted briefly the role of *depth* — detailed engagement with the machine itself, opening up possibilities unavailable on a more generalist or compatibilist understanding — as a key motivation in the closing of a microcomputer platform. This formulates explicitly, I believe, a notion implied by one user in Lindsay's TRS-80 study, with the comment that the "guts" of the machine were accessible, which can be read beyond the simple hardware level and can be placed alongside such obvious factors as convenience, reliability, familiarity and nostalgia in assessing the continuity in active use of some 1970s/80s micros today.[36] We might choose to go further and consider 'depth' as a metric of machine performance — a notion which

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[35] Lean, "What would I do with a computer?," 44-66

[36] Lindsay, "From the shadows," 44

may have some interesting consequences for current understandings about computer technology.

Computer 'power' is very widely understood in terms of hardware performance. 'Moore's Law,' the remarkably enduring observation that the complexity of the integrated circuit which can be produced at given cost will double in unit time, seems to promote a powerful focus on numerical quantification through various metrics of hardware ability and capacity. A computer with a faster processor or more memory, most users now assume, is a 'better' computer, and will naturally take the place of its predecessor when the price is right. A naïve observer might therefore assume that home micro platforms which did not receive constant innovation from the relevant producers would naturally have died off in the face of better-specified machines elsewhere. This involves, of course, a presentist projection of the present hegemonic situation into an era before its formation, and in any case ignores niche continuations of the type identified by Lindsay.

Yet the reader who has taken this on board may nonetheless be taken aback at an actual instance of user-centred comparison. In February 1988 'Lloyd Mangram', the collective editorial persona of the games-oriented and Sinclair-specific magazine *Crash*, challenged a correspondent over the relative merits of the Sinclair Spectrum (a six-year-old archetype, inflated in later models with facilities such as an integral tape player, but fundamentally operating in its closed 1982 form) and the recent Atari ST (with its 16-bit processor, large memory and graphics routinely described as 'arcade quality,' unquestionably a superior machine in terms of hardware metrics, and competitively priced.) The editor showed no hesitation:

> [T]here's no sense abandoning the Spectrum now when the standards of 16-bit games (in graphics, particularly) are filtering down to the 8-bit programmers… the

> argument that 'it's ancient' is a nonstarter. The 'latest' technology is always hyped and it's very easy to be a victim of fashion.[37]

This comment was, of course, made unattributably in a periodical which relied on the survival of the Spectrum user base for its own existence; yet the fact that it was made at all, in an editorial voice which was presumably expected to be taken seriously, deserves analysis. It goes beyond the undeniable claim that the range of high-quality games software is greater for the Spectrum than for the newer machine; more importantly, the established skills base of producer-users is vastly greater. The Spectrum hardware may be less powerful, but it is understood in far greater depth by those whose task it is to create an effective gaming experience — which has become the primary purpose of the closed Spectrum world. This unquantifiable property is continually enhanced, precisely *because* the supporting hardware is not; the Atari ST *could* credibly be represented as lacking this guarantee of service to the user.

The idea of a user's preference for a 1988 archetype over a 1982 archetype being down to 'fashion' would be easily comprehensible in most fields — but not in computing, thanks perhaps to the grip of Moore-mindedness. We need to bear in mind that metrics — numerical encapsulations of 'power' or 'ability' or 'quality' — are not objective guides to anything actually experienced; typically, in fact, they are marketing tools (and we should be aware that, as such, they do have agency to influence user and producer choice.)

The case I have discussed is perhaps one of the more extreme, but the tendency to seek improvement through ingenuity within closed limits, rather than through the expansion of those limits, was quite general in British home

[37] *Crash* 49, February 1988, ?page

micro culture. The fact of this ingenuity was widely appreciated by the least expert of users, even when the technicalities were not. To return finally to the BBC Micro platform, what was at stake is captured precisely in the title of Francis Spufford's recent popular essay on the 1984 Acornsoft-released game *Elite*: "The universe in a bottle."

The "bottle" here (my 'box') was the 22 kilobytes of memory which could (at a stretch) be found for code plus data in an unexpanded BBC Micro showing a tolerably good graphical display; the "universe" was the vast assortment of star systems, carefully mapped with ethnographic, political and economic data, among which the player character roamed. The impression of scale where none could, ostensibly, be — based on a simple mathematical trick, heavily boosted by some remarkable rhetorical devices in the documentation — was without precedent in electronic leisure.[38] *Elite* redefined assumptions about the possibilities of microcomputer gaming, and came to be seen as essentially discontinuous with the BBC Micro releases of the preceding three years; yet it was based on absolutely equivalent hardware.

Today's imperatives are very different, at least so far as mainstream software development for desktop machines is concerned. The monolithic PC-derived architecture is an open box, if it is a box at all, promoting transferability and expansion; but for that reason it is shallowly understood by developers. Relatively few would understand or appreciate the task of stuffing the universe into the bottle; users would simply be obliged to acquire a larger bottle (which, thanks to vicious globalised competition in a standardised marketplace, is an inexpensive proposition.)

The relevant skills, however, persist — not only among dedicated platform continuationists of the kind discovered by Lindsay, but among those who find

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[38] Francis Spufford, *Backroom Boys*, London: Faber 2003, 71-119

the box-stuffing project appealing or useful in its own right. The 'MiniGame Compo,' running annually since 2001, has challenged closed platform specialists (usually working via emulators) to squeeze playable games applications into memory constraints typically *smaller* than could practically have been made available on the machines themselves.[39] There remain, furthermore, niche areas where this kind of activity is not merely aesthetic but practical: consider the recent tendency to assert intellectual property rights in hitherto 'abandoned' micro software applications (again, mostly games), as their limited graphical and memory requirements proved highly suited to the PDA and cellphone markets.

Conclusion: heterogeneity persists

This draft was written on a newly-installed networked microcomputer, supplied by Dell and purchased ultimately by the taxpayers of Britain, using Intel hardware to run Microsoft Office Word 2003 via the Microsoft Windows XP operating system. Both OS and application appear to have been designed around a hypothetical user whose needs and priorities are very different from my own, and both cause me significant annoyance; the policymakers in my institution have, however, determined correctly that this system better suits my needs than, for instance, a Linux installation whose complexities I do not have the time to master.

In the course of today, it's probable that I will send this draft, or some other document composed in a Microsoft proprietary format, to a user running one of the various flavours of Linux and unable resort to Microsoft applications. S/he will nevertheless have a means to read the document as it was intended to be read, mark comments if necessary, and return it to me. In the course of

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[39] Results of this competition are archived at <http://www.ffd2.com/minigame/>.

this month, at least, it's equally probable (though this is perhaps an artefact of my professional context) that I will engage in a similar exchange with one or more of the remaining adherents of the Acorn platform (running later machines than the BBC Micro, based essentially on late-1980s archetypes.) *I, personally, will notice no difference between the two processes.* The chances of technical difficulties are a little higher in the Acorn case, but this is a difference of degree rather than kind. Both cases involve communication between distinct platforms; from what has been said, it should be evident that a 'platform' need not depend on a hardware base, but may be defined through operating systems, applications, user identities, or some combination.

Heterogeneity survives, and is not in present danger. (The popularity and multi-flavoured nature of Linux shows this, I think, more clearly than the usual exemplar, Apple.) While its survival is mainly at the software level, a world in which it was correspondingly present at the hardware level could be very much like our own. Heterogeneity can survive because users have established modes of communication — protocols or translation utilities — which bridge the gaps between closed and mutually incommensurable micro worlds;[40] it will survive so long as the projected identities of users are themselves heterogeneous. 'Shake-out' was not inevitable. It was arguably the most probable outcome, in view of the economic circumstances of the period; in other circumstances, the deeply-understood platforms now considered 'eccentric' might have survived to co-exist with those alternative possibilities we now regard as mundane.

[40] This issue deserves further consideration. Familiar examples of innovations capable of performing aspects of this bridging role include HTML, XML, Java, PDF, OpenOffice.org…