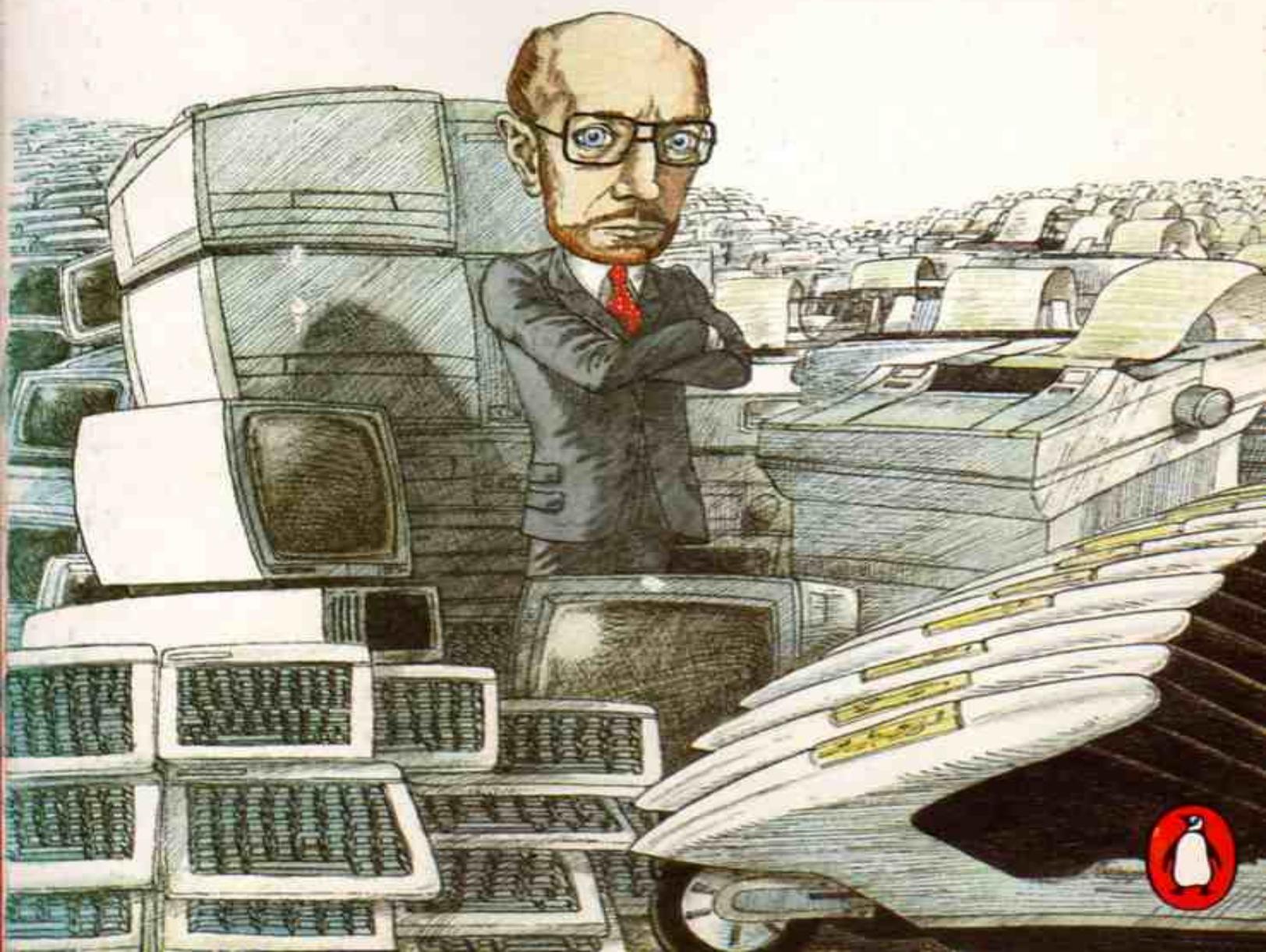


IAN ADAMSON AND RICHARD KENNEDY

SINCLAIR **AND THE** **'SUNRISE'** **TECHNOLOGY**



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SINCLAIR AND THE 'SUNRISE' TECHNOLOGY

The Deconstruction of a Myth

Ian Adamson and Richard Kennedy

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This book is dedicated to the memory of Giordano Bruno, Jacques de Molay, Domenico Scandella and all the others, plus, lastly, 'in order to establish certain principles', Anarcharsis Cloutz.

'I am the Daughter of Fortitude and ravished every hour from my youth, for behold, I am Understanding, and Science dwelleth in me.'

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Finally, thanks and much more to Gillian and Fran, without whom...

INTRODUCTION

I rather like those books where each chapter begins with a quotation.

Samuel Johnstone

Why does Sir Clive Sinclair merit our undivided attention? Why devote an entire book to the examination of one man's enterprise? Britain has produced more seductive personalities than Sir Clive and hordes of anonymous entrepreneurs more successful in business. So why bother chronicling the oscillating development of the Sinclair empires?

The obvious answer to all the above questions is that Clive Sinclair is a household name in the UK and a businessman of international repute. For millions of home-computing hobbyists the 'Uncle Clive' persona and the Sinclair logo were synonymous with the microboom of the early 1980s. As guru to a new generation of computing enthusiasts, Sinclair and his ZX range of micros took the high streets by storm, putting the home into home computing. For those bitten by the computing bug the inside story of the Sinclair microrevolution can now be told!

However, why should 'England's thin, unprepossessing inventor' (as the Wall Street Journal describes him) be a familiar figure even among those who don't know one end of a microcomputer from the other? His commercial activities over a quarter of a century have linked the man and his products to the hope of economic progress through individual entrepreneurship. Harnessing high technology in the interests of the small business, Sir Clive's individual style of management has been presented as the heroic endeavour of an enterprising David taking on the Goliaths of industry. For a time, 'Thatcher's favourite entrepreneur' was seen as one of the few businessmen with the flair and imagination to challenge the Japanese domination of the consumer electronics market. Unfortunately, initial success was followed by a combination of marketing and managerial mistakes that has taken the shine out of this 'sunrise' industry. As we shall see, the tarnished history of Sinclair's endeavours tends to repeat itself, revealing the weaknesses inherent in the Sinclair style.

The fall of this modern-day Daedalus calls into question the validity of the popular perception of Sir Clive and his companies. What the public has is a view that is essentially a myth. The fact that in a popular survey Uncle Clive can be nominated as one of the top ten scientists of all time reveals the power of this myth. Regrettably, while one might be able to shrug off the general woeful ignorance of the populace and treat it, as Sir Clive does, as a mindless horde of potential consumers, the virus of mythopoeia has struck deeper. Listen to the words with which one of the new centres of learning in this country proposed as an honorary Doctor of Science the man 'whose qualities, as inventor and educator, we [the University of Warwick] attempt to emulate... His sense of what society will need, of what the consumer will want, and of what technical problems can be overcome, stems from a humane and well-balanced personality...' And this is no isolated instance. The Royal Society presented Clive with the Mallard Award, supposedly for 'outstanding contributions to the advancement of science or engineering or technology leading directly to national prosperity in the UK', because of 'his entrepreneurial and innovative inventions of pocket calculators, personal computers and small television tubes of flat design ... his brilliance as an entrepreneurial and innovative inventor'

This sort of hyperbole is less than accurate, as will be seen in the course of our text. While writing a review and assessment of Sir Clive's career we found ourselves unwittingly engaged in an exercise of demystification. Sir Clive undoubtedly has talents, but they are not those popularly ascribed to him. Apparently, as a consequence of the Snarky Principle (i.e., 'What I tell you three times is true'), the attributes of 'inventor', 'innovator' and 'entrepreneur' have hitherto resisted erosion by reality.

In terms of 'invention' Clive produces primarily ideas for products rather than conforming to the Oxford English Dictionary's definition, 'One who devises or produces something new by original contrivance'. The definition may apply to workers on the Sinclair R&D team, but there is little evidence to show that Sir Clive himself plays such a role. 'Innovator' is more like it - one who 'brings in or introduces novelties' (OED) - but the head of Sony, for example, is not styled thus when a product like the Walkman is produced. So why Sir Clive?

We came round to the view that it is the paucity of Sir Clive's product ideas rather than their multiplicity that should be a source of wonder. While other unsung inventors produce such things as the computerized running shoe (marathon man Clive might have been expected to come up with that one!), the fingertip pulse monitor, the pocket computer database and a plethora of microchip-dependent products sold by mail order and generating quiet profits for their producers, Sir Clive puts his greatest energies into his obsessions, as witness the twenty-year pocket-TV saga. Market-motivated corporate effort allied to true inventiveness could produce a variety of products, ensuring a broad product base, avoiding the problems of a company overly dependent on a single product area for its cash flow and generating enough resources to allow the pursuit of personal fetishes via corporate R&D.

So what lessons can be gleaned from the Sinclair story? Well, far from promoting the entrepreneur as a necessary good, the floundering career of Clive Sinclair offers valuable (if not especially encouraging) insights into the dangers of relying on small businessmen to resolve the evils of unemployment and inflation, which are the defining elements of the commercial environment they inhabit and from which they profit. Far from smothering reality with a cosmetic veneer of progress, can this be an example of the received truth that the individual pursuit of wealth precipitates only intermittent commercial success coupled with short-term employment, the accumulation of personal wealth and the realization of personal whim? It is not the solution to unemployment. It does not address the structural weaknesses of moribund capitalism. Instead the 'small-business' solution is a short-term expedient and a historical regression. Although by no means morally or even pragmatically defensible, conventional corporate enterprise depends on the experience, endeavour and imagination of an entire workforce in the creation of a commercially viable commodity. It is inclined towards long-term employment because its operational structures are informed and determined by the relationship between a historically defined productive capacity and the developmental requirements of future products. In other words, stable, long-term corporations (certainly those profiting from a workforce with a solid union base), examining a product whose profitability requires the replacement of existing productive structures with a cheaper workforce, tend to dispose of

product rather than employees. In contrast, the profitability of the 'new-style', hi-tech enterprise à la Sinclair relies ultimately on the surplus value generated by a cheap workforce in the creation of products developed by a well-paid technical elite. Such a structure is unstable by definition. The composition of the technical elite is determined by the specific parameters of the commodities that are under development. The manufacturing resources are purchased via a subcontractor and selected according to the availability of capital equipment, and/or 'development' grants, and/or the general malleability of the workforce - which is directly proportional to the threat of unemployment. (It is no coincidence that the last generation of Sinclair products was developed in affluent Cambridge but manufactured in impoverished regions of Scotland and Wales.) The valorisation of the technical team's efforts and the job security of the manufacturing force are contingent largely on the commercial potency and practical viability of the entrepreneur's vision.

Sinclair's personal success and fortune do nothing to support the view that Britain's hope of economic recovery lies in the prosperity of the entrepreneurial minority celebrated by Thatcher's Conservatives (and financially bolstered by the rest of the nation). Far from offering a hope for the future, Sir Clive's millions and his corporate failures merely confirm that there is money to be made from exploitation of the pernicious symptoms of economic decline.

That individuals can profit from high unemployment and the cheap raw materials available in a contracting component market is hardly an earth-shattering revelation. Sinclair's failure to live up to the political role to which he was assigned will surprise only the most literal devotees of Thatcherite dogma. Thus we've chosen to resist expounding the obvious or attempting to enlighten those hopelessly blinkered by ideology. Our central concerns emerge as the presentation of a detailed case history that reveals the inherent fallibility of the 'entrepreneurial solution' to economic crisis and the durability of media-generated mythology.

When we interviewed the man himself we found Sir Clive courteous, accommodating and charming, leaving us with little in the way of a personal axe to grind. If we were looking for a ruthless entrepreneur to

expose to the pressures of gutter journalism, Clive Sinclair would come pretty low on our list of viable victims! This said, it soon became clear to us that the public's image of Clive Sinclair is almost entirely a product of public relations. At the peak of his success it was Sinclair mythology that bestowed a seal of credibility on his companies' products, promised a technological future based on research that was tethered to the economies of high-street manufacture and promoted business methods that were embraced by the state but discredited by practice.

The myths surrounding the man may be insignificant in their own right but merit close analysis when they are used to validate destructive economic strategies. However, it must be admitted that the more we learned about Sir Clive and his businesses, the more determined we became to set the record straight. The Sinclair PR machine has undoubtedly contributed to the commercial success of a handful of products, which in turn has played an important role in promoting Sinclair's image as inventor, innovator and all-round hi-tech don. Sinclair Research's microcomputer products provided the hi-tech industries with a popularist figurehead who for a while proved acceptable to both the City and the consumer. It's impossible to overstate the value of such a commodity.

Throughout the 1970s and the first half of the 1980s the commercial realization of technological innovation in the UK was impeded by the inability of investors to keep abreast of the increasingly sophisticated demands of the consumer (whether the consumer be Joe Public or the Ministry of Defence); ignorance precluded an informed assessment of market potential. Sir Clive's personal success story encouraged financial speculation in such markets; his corporate failures confirmed the City's worst suspicions. In other words, one of the most damaging consequences of Sinclair's brief reign as the high priest of hi-tech was that his downfall called into question the viabilities of the new technologies as investment options.

The Sinclair story reveals that, generally speaking, while his companies profit from technological innovation, their apparent tendency to take a short-term approach to corporate planning and product development tends to impede rather than encourage significant technological development

within the group. In many respects our chronicle illuminates the strengths and weaknesses of the new electronic industries as a whole. Ironically, recent developments in wafer-scale integration at Sinclair Research reveal genuine innovation as the company struggles to survive. Only time will tell whether these latest developments will amount to salvation or swan-song.

The threads of the Clive Sinclair story that we wish to explore overlap in time, and do not lend themselves to a simple chronological treatment. Whilst the long-term micro-buff may have no difficulty in following the sequence, others may find it occasionally confusing. We advise recourse to the full Sinclair chronology in the Appendix to keep a temporal perspective.

[1] BREADBOARDS AND BEDSITS

The hero of our story, Clive Marles Sinclair, entered the world on 30 July 1940. His engineer father ran a successful machine-tool business, and early life was comfortably cushioned by the upper- middle-class income the family enjoyed. Young Clive was sent to Boxgrove Preparatory School and was destined for a good public school when commercial catastrophe struck the Sinclair clan for the first, but not the last, time in this narrative. George William Carter Sinclair had gone for the broadening of his business base by diversifying into the import of miniature tractors. The venture collapsed, and company and income vanished. Possible parallels with the C5 fiasco aside, the practical result of this was to set the twelve-year-old Clive on an epic trek through thirteen different schools in some five years. His somewhat matriarchal mother kept shifting him along *'because it wasn't really what I wanted'* (Fortune, 8 March 1982). Sinclair himself has stated that he was *'very bored'* at school (quoted in William Kay, *Tycoons* (Piatkus, 1985), p. 156), liking only mathematics and English as subjects, and it is certainly understandable that his social development was hindered by the lack of stability. Becoming, as he admits, *'insular'* (Fortune, *ibid.*), he compensated by becoming a fanatic about the rapidly evolving radio and electronics field. His interest in mathematics was of some practical use here, and it is easy to imagine how, for a retiring and insecure child, a solitary, self-contained and esoteric hobby became obsessive, much as Sinclair products have led kids today to become bitten by the computing bug. Presumably, then as now, homework, healthy play and a full night's sleep all suffered for the cause!

The foundations of the technology that Clive Sinclair has pressed into service throughout his career were established when he was seven years old, with the invention of the transistor in 1947. This signalled the end of the thermionic valve, with its problems of size, heat production and limited life. With the new technology of the transistor, silicon started its inexorable advance into all aspects of our lives. The first transistors were simple replacements for triode valves, silicon crystals with introduced impurities that gave them their amplifier and current-switching capabilities. These solid-state devices, using the semiconducting properties of germanium and

silicon, had forerunners in the early crystal wireless sets, in which simple crystals were used for their property of passing an electrical current in only one direction. Clive would have used these, and the triode valves that replaced them, as he pursued his non-curricular studies with soldering iron and the breadboarded circuits that preceded the printed circuit board as the base on to which the components were soldered. Around the time he left his final school, St George's College, Weybridge, at the age of seventeen, transistors were becoming ubiquitous. Commercial products used them, and they were cheap enough for the fanatical or well-heeled hobbyist to incorporate in constructions of one sort or another. As Sinclair recalled:

At school I got interested in mathematics, and that led on to electronics. It was a positive advantage that I arrived in the field just at the time that semi-conductors became available to individuals, as opposed to large research laboratories. It was an exciting and stimulating time, and electronics became more interesting with every month that passed. (Designer, July 1982.)

The era of the valve and the comforting orange glow of a warming-up wireless was over, and Sinclair was following his nose for the future, wherever it led him.

It did not lead him to a higher education. Whether family finances played a part in the decision or not, Sinclair's scorn for the electrical engineering courses on offer at university is documented. Since he wanted to pursue only electronics, he had '*no desire for such a broadly based course*' (Practical Computing, July 1982). Although he spurned the advantages of a university education himself, he was within a few years to find himself indebted to the system. Many of his products required the skills of bright young men fresh from the academic curricula that the young Sinclair, perhaps prematurely or ignorantly but certainly contemptuously, had dismissed. However, our early academic drop-out first needed a job.

As a hobbyist he had taught himself enough electronics to start contributing to magazines servicing the needs of others like himself. To start with he became a technical journalist, an editorial assistant at Practical Wireless magazine, drawing on his knowledge of the state of the art, derived from the original research papers to which he had graduated in his reading.

I knew I wanted to start a business, and the first thing was to find out how. Being a technical journalist seemed like a good idea, as it was an attractive and lucrative way of being employed; it got me about and gave me considerable freedom, and it also gave me the opportunity of learning at someone else's expense. (Designer, July 1982.)

This set of reasons is typical of Sinclair's thinking, as the reader will appreciate as we proceed.

The next opportunity that came Sinclair's way was to attract the attention of Bernard Babani, who was looking for someone who knew about the emerging semiconductor field. At Bernard Books Sinclair became the editor of a series of technical works aimed at the hobbyist constructor. Ending up writing some of them himself, he had found a suitable niche. They rolled off his typewriter at a great speed, with such resonant titles as Practical Transistor Receivers, Transistor Subminiature Receivers Handbook for the Home Constructor and Modern Transistor Circuits for Beginners. The books were successful; indeed, some are still available. Sinclair apparently enjoyed the work of editor/author: *'I wrote most of them myself, and learned more than anyone who ever read the things'* (ibid.). It is presumably a measure of his mature judgement of youthful hackwork that a good ten of his published works are omitted from his Who's Who entry.

While he was with Bernard Books Sinclair joined the Mensa organization, which placed him in the top 2 per cent of the population as far as intelligence (or at least the capacity to answer IQ test questions) goes. As a precocious youngster, confident of his skills and contemptuous of those who didn't possess them, the attractions of the implicit elitism of this organization are easily seen. He has remained an enthusiastic member, eventually becoming chairman.

Sinclair's enthusiasm for business had been subdued but not inactive while he made his living as circuit designer and scribe. In 1961 he thought he'd found a backer for his miniature radio project and registered Sinclair Radionics Ltd, but the deal fell through after he'd handed in his resignation. Supporting himself for a while as a freelancer, producing articles and a couple more books for Bernard Babine's publishing house, soon palled, and he went back to work as a journalist, this time for Instrument Practice, a

more serious trade paper. Apart from the salary, this obviously exposed him to the whole burgeoning semiconductor industry, and he authored a British Semiconductor Survey in this period.

Our budding entrepreneur finally got started in 1962, when Sinclair Radionics burst into the public eye with adverts for a 'micro-amplifier'. For a mere twenty-eight shillings and sixpence (roughly £1.42, but representing a lot more buying power in those far-off days) the hobbyist would receive a kit of parts which he (or, conceivably but improbably, she) could make up, 'in under 2 hours using ordinary tools' into 'the smallest [amplifier] of its type in the world'. Pictured standing on a half-crown in the advert, the amplifier measured just $\frac{3}{4}$ by $\frac{3}{8}$ by $\frac{1}{2}$ inches. For the benefit of the younger generation of computer users, this is about 19 by 9.5 by 12.7 mm, and illustrates the start of the Sinclair miniaturization fetish. That the fetish was apparently shared by many others, and would later be justified as elegance in design, has contributed much to the Sinclair product range. Orders poured in for the amplifier to Histon Road, Cambridge, premises shared with Polyhedron Services and Cambridge Consultants Ltd (CCL), with whom Sinclair had much interaction in later years. CCL took on one Nigel Kember to pack the components and dispatch them to the eager public on Radionics' behalf, since Sinclair was not eager to repeat his earlier mistake and was keeping his full-time job in the meantime. Some time in 1963, after the Sinclair Slimline pocket radio had appeared (forty-nine shillings and sixpence, 'build it in a couple of hours', 'the set you will never want to be without'), he gave up security as a wage slave and devoted himself entirely to building up Radionics.

Alfred Marks, acting as advertising agent for Sinclair's magazine mail-order assault, remembers his first encounter and early days working with Sinclair:

Babani had this red-haired fellow working for him, who smoked cigarette after cigarette, stubbing each one out half way and lighting another immediately. He had designed an amplifier, so called, which was no bigger than a threepenny piece. First advert I did for him appeared in Radio Constructor, for which I charged, I think, £23.

The micro-amp wasn't exactly an overwhelming success, but he was selling transistors, and he then produced his first radio, the Slimline. We advertised this in the practical papers, and the thing which Sinclair did which was very, very important, he always went in for good presentation. His leaflets, instructions, packaging and suchlike were all good.

The case used to house the Slimline was a pillbox, a standard model, and the circuit used three transistors, although later he brought it down to two. He used trimmers to tune the thing with, as capacitors. I asked him why he didn't use a reasonable capacitor - because these trimmers were fragile, flimsy things - but to no effect. (Interview, 25 September 1985.)

One should note for the benefit of non-technical readers that the supposition could be made that the higher cost of the 'reasonable' capacitor might well have played a part in Sinclair's ignoring Alfred Marks's suggestion for improving the quality of the product.

The business's profitability in those early days was heavily dependent on a supply of reject metal-alloy transistors (MAT). Rejected by Plessey for their original purpose in early transistorized computers, they were nevertheless good enough for use in the circuits Sinclair designed for the Radionics products. With a cheap purchase price as 'rejects', they were tested by Sinclair and his team before either being incorporated in the kits or sold as separate transistors for a reported profit of up to 700 per cent.

I bought them, tested them myself and selected them into different categories, gave them type numbers which I invented, and then wrote articles about them for their applications in radios. (Clive Sinclair, BBC Radio 4, 18 January 1978.)

Having married into business Ann Sinclair (née Trevor-Briscoe) found herself pressed into service:

The transistors used to arrive in sacks. About three or four sacks would arrive, about the size of a sack of potatoes. I had test equipment consisting of a box that gave a different pitched buzz according to the transistor, and I must have tested a million of them altogether. It really

became monotonous, because I'd no sooner finished one sack than another would turn up. (Ann Sinclair, ibid.)

High profits on components helped the cash flow, and again represents a consistent Sinclair trait of both minimizing component costs and maximizing revenue. Sound commercial practice in entrepreneurial terms, of course, but one that can arguably be carried too far. In connection with cheap and recycled components, one industry source told us a story of early Radionics days that bears repeating. Texas Instruments at Bedford used a large batch of reject transistors as hardware for a driveway. Sinclair found out about this, presumably through industry contacts, and rather than shrugging his shoulders at a missed opportunity negotiated a price for digging the whole lot up again!

The second Radionics product was the micro-injector, the Micro-6. This signal injector, again using a couple of recycled MAT transistors, was packaged in the same-sized box as the famous matchbox radio, introduced in September 1964. This just squeezed in under the wire, or inside the matchbox, as the 'Smallest Radio in the World'. Since size featured so prominently in the promotion of both this and the earlier Slimline, it is worth noting that neither product can be accurately described as a 'first', since as early as 1959 adverts for pocket radios and indeed for a wrist radio smaller than the Micro-6 can be found. Although improved components and Sinclair's circuit designs undoubtedly made the Radionics products better radios, this is one area where he didn't get in first. The advertising approach was paying off, however, with double-page spreads that changed with each issue and innovative approaches to grab the attention of the hobbyist. Alfred Marks again:

I had a picture of this thing [the Micro-6] held in a hand, and a map of Europe on the opposite page, and lines coming out [from foreign radio stations]. Now you could get these stations - you could pick up Russia and so on, largely due to the power of the transmitters, of course. What the advertisement didn't say was that most of them came in together! They were toys, but they did a job. He had a lot of trouble with the battery holders at the start - he always rushed to get things into production. (Interview, 25 September 1985.)

Apart from the significant comment in the last sentence, we can now pause to assess our subject's initial entrepreneurial success.

These early products typify other aspects of the Sinclair approach. Compared with the small size of the goods, the scale of the adverts is noteworthy. From his first half-page ad Sinclair adopted a high profile in the magazines, graduating to regular double-page spreads by January 1964. Looking through them, one is also struck by the evident policy of varying contents and layout incessantly, in stark contrast to the general run of tedious and pragmatic advertising of the time. Superlatives, exhortations, patriotism, testimonials, drawings and photos are permuted month by month. The power of heavy advertising has remained the major marketing weapon for Sinclair ever since.

The advertising emphasis is tied in with the advantages of the mail-order mode of merchandising. Although advertising costs may be high, all sales are firm and prepaid, as long as you have the product to satisfy the demand, or can get it before the punters get too voluble about the strain on their patience. The temptation, of course, is always to assume you can get it to the market quickly, and launch early, taking advantage of the initial cash-flow boost. The heavily advertised initial launch for the mail-order market, premature or not, has another advantage to the entrepreneur seeking to maximize initial profits before broadening the marketing into retail outlets. Sinclair's view on this has become a theory:

Mail order is a very useful way to get the story across. Not that big a proportion do buy on mail order, but they do see the ads, and that helps to prepare them for buying when the item appears in the shops. (Tycoons, p. 158.)

We can also identify here the start of what has been termed the 'one-per-person product' philosophy. The personal radio, using an earpiece, epitomizes an approach to product design and market identification that, from the Slimline radio via the calculators, the various pocket television models, on to the C5 and the projected personal cellular radio of 1986, has exerted a great influence on Sinclair. If the product is personal, you both maximize the market and have the additional handle of an absurd but effective pride in personal ownership that works to your marketing

advantage, as long as the price is affordable to the individual enamoured of apparent progress or equipped with the gadget mentality.

Concern with those elements of product design unconnected with function is also apparent even in these early hobbyist kit days. There is a grasp of the elements of modernity in both naming and external appearance. Compared with the names allocated to other radios, such as 'Minuette', 'Skygnome', 'Sky-Scout', 'Sky-Roma', and 'Ocean-hopper', the 'Sinclair Slimline' and the 'Micro-6' are elegant titles redolent of the modernity of the era of the 'tranny', bobbysox and sideburns into which the world, with Sinclair's help, was sweeping. As Alfred Marks commented, 'Clive had a penchant for names.' The name given to the nylon strap you could buy 'for wearing the Micro-6 like a wristwatch', which gloried in the appellation of the 'Transrista', although grotesquely memorable, was surely one of the less successful attempts of this period. Sinclair was however soon to discover the use of letters and numbers to create a suitably seductive air of science and the laboratory, titling his next major product the Sinclair X-10. This wonderful new pulse width modulated amplifier ran into the first advertising standards problem of Sinclair's career. A contemporary journalist recalls that Wireless World refused to take Sinclair's subsequent advertising for the X-10 because of complaints over the performance claimed for the amp. Its stated output was 10 watts R.M.S., but in reality it was capable of only a quarter of that.

Similar trends or trendinesses to those apparent in the concern with product names can be seen in his preoccupation with the external appearance of the products. The era of plastic had arrived, but the word is scrupulously avoided in all the ads. Instead, much is made of the Slimline case being 'deep royal blue with gold lettering' and 'designed by a professional artist' (probably Clive's brother Iain). The Micro-6 has a 'smart minute white, gold and black case'. A 1966 product, the Micro FM, hailed (by Sinclair) as 'the world's first pocket-size FM tuner-receiver' has even more design features: 'polished and brushed two-tone aluminium front panel', 'spun aluminium tuning control'. 'In styling,' we are informed, 'this is the most elegant, most professional-looking design in miniaturized equipment ever made available to constructors, and is one you will be very proud to possess.' The punters, even those hobbyists from whose ranks Sinclair had

risen and who presumably shared his view that 'small is beautiful', had to be given some reason to fork out the not inconsiderable sum of £5.19.6d other than the innovative circuit. Apparently many would have been limited to admiration of the aesthetics and denied the benefit of audio pleasure, if Marks's recollection is accurate that 'it never worked. It did not have a proper aerial and just did not go.' Needless to say this is not the impression given by the ads! Such quibbles should however quail before the relentless innovatory urge that the mere existence of a product should surely justify - especially since it probably did work if you lived next to the transmitter.

Before black became a characteristic colour, brushed aluminium reigned supreme in Sinclair's style philosophy. When in 1966 the Stereo 25 appeared, this 'all-purpose de-luxe pre-amp/control unit', which was available only in its ready-built form, the public was informed that its appearance 'reflects the professional elegance which characterises all Sinclair designs'. 'Professional' emerges as a favourite Sinclair buzz word, in several of its senses, in the course of his career, as we shall see in connection with later projects. As a final note indicative of Clive's design philosophy, we should perhaps mention here that an early aversion to on/off switches is apparent; the pocket radios are all switched on by inserting the earpiece.

The theme of smallness and cheapness masquerading as design elegance has been mentioned already. The tendency of Sinclair designs to be pared to the bone on grounds of production cost and complexity can also be seen in these early days. One veteran electronics journalist recalls the early Sinclair circuit designs as 'innovative but corner-cutting', and the X-10 amplifier 'used switched pairs of output transistors ... which relied rather too heavily on the concept of zero rise-time' (Practical Computing, July 1982). Apart from this criticism of quality, there is also the fact that the power it could deliver was grossly over-rated in the adverts. Since it was being sold to people who knew about such things, its reputation was not high, once enough hobbyists had built this '100 per cent British Design'.

The X-20 amplifier soon added to the range was more realistic in its claims, since it could almost deliver the stated power at full stretch. Alfred Marks,

who had no compunctions about stretching truth within limits, found himself cast in an invidious role in relation to technical claims:

He would make a breadboard and it would work. As his ad agency, it was not my business to measure the statistics given to me. However, if he said, '12-watt output', it eventually got to the point where I said, 'Is this peak or R.M.S.? And into what impedance?' (Interview, 25 September 1985.)

As a result of this approach it is noticeable that the technical specifications in the ads did get more precise. The power of the advertising itself was perhaps more effective than some of the amplifiers. Despite the reservations some had over claimed performance versus actual results, retailers found that demand for Sinclair products was high enough to make it worth their while holding both kits and built items in stock, even though the discounts they could get were low.

The hi-fi boom of the 1960s was a good vehicle for Sinclair Radionics. In 1966 the company moved to Newmarket Road, Cambridge, and Clive moved with it. The Z-12 amplifier replaced the X-10, with the number being rather more meaningful this time, and was supplied ready built. This achieved 'laboratory standards of performance', whatever those may be, but advertising aside it is remembered as quite a good amplifier. Later this same year, with a power supply and the Stereo 25 control unit, Radionics had a hi-fi range aimed at a different sort of hobbyist. Now you didn't have to do all the soldering of components on the circuits, but could still get that satisfying DIY feeling by linking the separate elements of your system together. Apart from the Micro-FM already disparaged above, Sinclair was overcoming design and production problems and producing items that, although firmly aimed at the budget end of the market, were enjoying some success in the hi-fi field.

The other major event of 1966, certainly in terms of Sinclair obsessions, was the demonstration, at the Radio and TV Exhibition of October, of the Sinclair Microvision pocket television receiver. Alfred Marks considers this 2-inch-screen television:

the one great glory of Sinclair's life. He staged such a press reception, the likes of which you've never seen. The whole of Fleet Street was there. Unfortunately they asked rude questions which were technically devastating. For the advertisements we stuck a picture of the Acropolis on the screen so it looked as if it were working ... It would work if you were in luck [but] the chances of it working were slight, (ibid.)

Trumpeted in the adverts as providing a 'worldwide sensation', the 'world's first pocket TV' with 'exclusively designed tube and loudspeaker' is hailed as an 'amazing Sinclair triumph'. The reader is promised that it will be available 'early 1967' at a cost of 49 guineas. The announcement was a bit premature, since the world had to wait for another nine years to pass, and a lot of taxpayers' money, before the obsession of Sinclair with the pocket television matured into product. We shall come across many other instances of overoptimism in Sinclair promises for the future in our peregrinations towards the promised lands of consumer electronics, but nine years is the current record.

Early in 1967 the Microvision disappeared from the ads, and the eager electronics enthusiasts were offered instead the Micromatic.

Apart from not offering a wrist strap, packing the kit bits in a 'see-for-yourself sealed polystyrene pack' and giving the 'beautifully styled case' a 'polished aluminium front panel', this is in fact our old friend the Micro-6. Despite the fact that 'never in the history of radio has any kit been so elegantly presented' this facelift fell a little flat on the market.

The hi-fi units were doing well, however, and the company turnover reached £100,000 in this year. A loudspeaker, the Q14, was produced. In 1968 the Neoteric 60 amplifier - the name is an obscurantist synonym for 'new, recent, modern' - was launched. Alfred Marks again:

It was a slim, well planned amp. It was an integrated amplifier, produced with a great array of controls using little flat tabs instead of knobs. They were good amplifiers, [but] the Neoteric's steel lid hummed like mad because it was too close to the transformer. The lid 'sang', and that was another product that died a natural death, (ibid.)

This ready-built unit, available from the retail trade, and the System 2000 amplifier, FM tuner and loudspeaker system introduced later in the year marked an attempt by Sinclair to break into the 'proper' hi-fi market, bypassing the hobbyists who had provided the base of his operations to date. Although competitively priced and modernistically styled (black and brushed aluminium), the products didn't make a great impact. This was partly due to the above-mentioned problems on the Neoteric, leading it to vanish quickly from sight, and the fact that the FM tuner for the System 2000 was a poor design, even in its mono version, while with the stereo decoder added it was almost impossible to tune into a station.

The hobbyist market was promised the same year the IC-10, a monolithic integrated-circuit amplifier, all the circuitry on a single chip, but it had to wait a good while. Production problems again, but at least this time they were connected with genuinely innovative technology. Although the problems were with the producers (Plessey) Radionics had to deal with the waiting punters. Letters were sent out apologizing for the delay, and it was only towards the end of the year that supplies became available. This did not end the problems, since the IC-10 didn't live up to its promise, as Alfred Marks remembers:

It was Clive who first made an integrated circuit available to the public - the IC-10. Then an integrated circuit was a miracle, but the IC-10 wouldn't peak at 3 watts really, and flopped. It was probable, although only rumour, that the IC-10 was a product which Plessey were not too happy to have in their stable, anyway, (ibid.)

Radionics had, with a combination of mediocre design and production problems, failed to make significant inroads into the off-the-peg hi-fi market. Retrenching slightly, it initiated the Project 60 range of modules with the Z-30 amplifier. The name again might be thought to give a false impression; it actually delivered between 15 and 20 watts R.M.S. according to Sinclair's specifications. Linked with the Stereo Sixty pre-amp and control unit, and the following year's active filter unit, FM tuner and a new amplifier, the Z-50, the DIY hi-fi freak had a variety of options at a reasonable price, and the module range survived longer than any other Sinclair hi-fi products.

In February of 1971 Radionics moved to Enderby's Mill in St Ives. With 'thousands of square feet at 4 shillings per' (CCL Company History, Rodney Dale), it was classed as a derelict warehouse, and hence cost only a seventh of the market rate. Though discovered by Tim Eiloart of Cambridge Consultants, that company had no capacity to make use of such a vast space - 7000 square feet plus. Sinclair took on the main mill, and its six floors, and let Cambridge Audio (part of the AIM group, which had grown out of the Cambridge Consultants Ltd activities) use the smaller ancillary premises. He installed himself in a cavernous office on the top floor, and doubtless considered himself to have arrived. Alfred Marks reminisces:

It was like something out of an Orson Welles drama. You went up and there was a girl sitting outside the door at the desk, a fierce young lady, an embryo dragon, and the doors were huge sliding doors. You slid them back, and there was Clive at the far side of the room beyond acres of carpet and nothing else - a marvellous setting, (ibid.)

After nine years of operation Radionics had, despite some ups and downs, grown fairly steadily. It had declared profits to the year ending May 1971 of £85,000 on a turnover of £563,000, was employing 54 people, and had acquired huge cheap premises in an area with low wage rates to help it continue in the same way.

[2] CALCULATING PROFITS

The first intrusion into daily life of the exponentially increasing density of components that could be packed on to a small slice of silicon was the calculator. The Sinclair Radionics success story hinges on the calculator. From a moderately successful electronics and hi-fi company Radionics was swept by the tide of cheap calculating power packaged for the pocket or the briefcase into the major league - briefly.

The electronic calculator, making use of logic circuits to perform the arithmetic operations required, first appeared in the late 1960s. These were desktop models, complex to produce and expensive. The key to the decreasing cost and size as the decade progressed was again the semiconductor transistor technology built up on the silicon chip. 'Hard-wired', i.e. fixed, logical pathways could be laid down on a chip, so that the pattern of voltages representing the numbers to be manipulated was changed in the appropriate ways. By 1970, the large-scale integration (LSI) technology for packing huge numbers of components on to a single sliver of silicon had advanced to the point where all the simple arithmetic operations (addition, subtraction, multiplication and division) could be achieved by the circuits formed on a single chip. Calculators became smaller, and portable, in the sense that they could be crammed into a briefcase or a poacher's pocket if you didn't mind the weight. The reductions in size pushed the price up rather than down, however.

It was not the chip itself that was the problem, but the ancillary devices that consumed space and added weight: a keypad for input, the visual display, and the ancillary electronics. The circuitry had to translate keypresses into the correct form of electrical information for the chip, and retranslate the output for display. Crucial to any portable machine was the fact that all this required a power source, and the size of battery required to give a reasonable period of use made the 'portable' calculator, independent of mains power, more of a backpack, rather than pocket, proposition.

There was an obvious market waiting for anyone who could produce a true pocket machine, and Sinclair identified this as a new area of endeavour for the Radionics R&D team. Again, the motivation was for a 'one-per-person'

product. There was no reason why Radionics could not have produced calculators earlier, since they could have competed directly with the first imported versions, but this is not the sort of market that arouses Sinclair's interest. His miniaturization mania was in this case appropriate to the product, enhancing utility and portability, rather than being a pursuit of smallness as its own justification.

The Radionics advertising manager of the day, Chris Fawkes, recalls Clive's approach to him with the concept:

At first there was not really much more than an idea to sell. The meeting started by Clive showing us what was basically a drawing on the back of an envelope, of an idea he had had, which was for the Sinclair Executive, a very small calculator. He had this idea for a product, he had a conviction that it would sell in fairly high volume, but in answer to the standard questions as to how are you going to sell it, what sort of volumes are we talking about, and so on, he said, 'Well, no, you tell me, this is why I'm talking to you.' (BBC Radio 4, 18 January 1978.)

The Radionics R&D team, mainly Chris Curry and Jim Westwood, managed to package around the Texas Instruments GLS 1802 chip (which itself had some 7000 components built on to it) a circuit of 100 or so other components and the display. The package was of suitable size, but the battery was the problem. Most of the power was needed for the LED (light-emitting diode) display. Whereas the rest of the circuit drew its minimal power requirements only when actually calculating, the display had to be on all the time the calculator was in use. The clever solution was to use the persistence of the display diodes, which did not turn off immediately but continued to glow for what, in the millisecond units of electronics, was a fair while, and a similar persistence in the contents of the chip memory. By turning the power to the display and chip on and off rapidly enough the display would appear constant, and the chip would retain its memory, but power requirements would be minimized. Such a pulsed power supply to the display reduced power requirements by a factor of at least ten.

This crucial breakthrough allowed the calculator to be driven by hearing-aid batteries, and in due course the Sinclair Executive was launched in June

1972. At £79.95, it had not only a low price tag as things were in those days (everything else with the same functions was way above £100), but it was also stylish, lightweight and a genuine breakthrough in size. Its design, or at least its external appearance, won it a place in the Museum of Modern Art in New York, as well as a London Design Centre Award. The aesthetic external case was designed by Richard Torrens. Presumably overriding political scruples with aesthetic considerations, the Czechoslovak Institute of Industrial Design also honoured this quintessentially elitist executive toy. The flexible plastic case was black, the Bowmar LED display was red, and the whole thing was 5 by 2 inches and the same thickness 'as a cigarette packet'. The latter point was presumably of significance to Sinclair, who was a heavy smoker of Capstan Full Strength in pre-marathon days.

The Executive was a great success among those who could afford it. The advertising agency Primary Contact produced sophisticated ads in up-market magazines, and Harrods stocked it. The profit margin was high, even with a product that went increasingly into retail outlets and to those developed portions of the world where executives took to it like ducks to water. This was because component and manufacturing costs certainly didn't exceed a quarter of the selling price. Some 80 per cent of the production was exported, and it reportedly earned some £2m in export sales during its eighteen months of active life. A significant coup, albeit a one-off, was a British reversal of the usual direction of technology flow when \$1.5m worth of Executive calculators were sold to Japan. The oriental response to the reliability of the circuitry, which was not particularly impressive, and the service facilities being in St Ives if you wished to invoke the 5-year no-quibble guarantee, is not recorded!

As an impressive expense-account bauble, the Executive was correctly targeted, professionally marketed, highly profitable, and of limited use. That it was a simple four-function calculator, although with a percentage function allowing repeated calculations, was not a disadvantage, since this was state of the art. The problem was the battery life, which was a few hours only. If you wanted to bring it out just for a few swift calculations in a meeting, creating a good impression of being a businessman with the latest tools of hi-tech at your command, and remembered to turn it off, you could get it to last for a couple of weeks. Forgetting to turn it off not only ensured

that it would be dead when you brought it out next, thus creating rather the wrong image, but such a constant drain (much higher than that for which they had been designed) on the batteries could cause them literally to explode!

The success of the Executive set Radionics off on a swift growth curve. The hi-fi products were still being produced, with the Project 60 kits doing good business despite their by then well-known characteristics of being 'underspecified and over-rated', as John Pemberton recollected it. (Rating referring to the power output, not its reputation.) System 2000 was followed by System 3000, with a new speaker, the Q30, but despite colour ads in the magazines the market penetration by means of retail sales didn't take off. It was worthwhile, in sales terms, to persist with the products, but the production and quality-control problems were still there, even if design was better, as the Radionics design team was expanded with bright and enthusiastic graduates who occupied the top two floors of the Mill.

The other product line that started in 1972 was instruments. A small multimeter with a digital display, the DM1, designed by AIM (part of the Cambridge Consultants Ltd nexus) was put into production. Using a Nixie tube for display, and a polypropylene case with built-in pushbuttons, it was novel, cheap at £49 and produced an enthusiastic response when advertised. Too enthusiastic, in fact, since the delay between sending your money and getting the product was so long - a matter of months in some cases - as to make even Sinclair feel an apology was necessary. The ads incorporated a public statement of incapacity to meet demand in response. By the time production had geared up enough to satisfy the initial demand, the deficiencies in the product, especially the display, had become known and demand fell. The price was reduced later in the year, but it was not a great success.

However, with the DM2 digital multimeter, designed by John Nicholls and launched in February 1975, the instruments side started on a steady growth. It was not an area in which Sinclair played a part, since he thought the instruments uninteresting. The instruments were reliable, well engineered for production, the sub-contracted assembly unproblematic, and steady product development was shown over the years.

The calculator boom was on, however, and in true entrepreneurial fashion the Executive generated enough profit to finance the next products, moving down in price, and up in facilities offered. John Pemberton, who joined Radionics shortly after the Executive launch, and was responsible for the external design of all Sinclair products up to the ZX80, remembers the atmosphere among the design team as *'fun, because the technology changed so quickly, the market was volatile, and it was a team of clever young people in their early twenties'* (Interview, 22 October 1985).

The top two floors of the Mill at St Ives held the design and development team, Sinclair's lavish office, and the full-size snooker table. With contracted-out assembly Radionics was employing only 70 people in early 1972, rising to 130 or so by the end of the year. Of these the R&D department was some 20 or 30 people, Sinclair's hand-picked bright boys from university, Cambridge Consultants or Mensa contacts. The number of employees expanded in 1973, when component and finished-product quality-control departments were set up, in response to poor product reliability. Still, turnover per employee was £14,000 in 1972-3, and £17,000 in 1973-4.

The success of the Executive generated a turnover of £1.8m in the year ending April 1973, using a capital base of just over £300,000. The follow-up product was the Cambridge, incorporating some mathematical functions and a constant facility, which was launched in August 1973 at £24.95 exc. VAT. This had a notoriously unreliable on/off switch, which was a minimal-cost design solution, fine for production, but with the problem that after some use it would be impossible to switch the calculator off. A few months later the Executive Memory, with the additional function the name implies, and 'a new black and white styling' came out at £24.95 plus VAT. This was the way the market continued, with prices for comparable calculators roughly halving each year, and more functions being packed into the machines occupying the top end. Texas Instruments was the first chip producer to manufacture calculators, cutting off the likes of Sinclair from leading-edge chips, but the main threat came from the East. The Japanese, especially Casio and Sharp, with high-quality standards and a flair for creative plagiarism and price competition were the threat at the lower end.

Radionics kept ahead of the game for a while, with the Sinclair Scientific in 1974, which had reverse Polish notation, which meant, for example, that in order to add 2 and 4 you had to enter 2, then 4, then the plus symbol. This perversity, which was easier to present to the chip, was not the most attractive method to those who had to use it, however powerful its facilities. It was noteworthy for having a keyboard the same as the Cambridge, but packing twelve functions on four keys, a Sinclair trait that would later be epitomized by the Spectrum keyboard, and for being a semi-custom chip (a modified Texas Instruments chip).

In early 1975 the Oxford range was produced, with a larger, non-pocketable size. The size was due mainly to the 9-volt PP3 batteries, which were only just adequate to their assigned task and gave a short life. The 100 was a simple four-function machine, at £12.95 plus VAT; the 200 gave you a percent key and a memory for your extra seven quid, and the 300 was the scientific model, with an impressive range of functions, at £29.95. They all used the same case, 6 by 3 by 1 inches, but were distinguished by their 'click-action' keys being 'colour-coded yellow, blue and avocado'. That they all used the same case was a handy by-product of a deal with Gillette, who had enlisted Radionics' aid in designing a desktop calculator, but then pulled out, probably wisely, from this new market area. As the Financial Times reported on 10 March 1976, the 'abortive US venture did not cost [Radionics] real money since the tooling costs were covered'. Never one to miss out on the recycling possibilities of either components or cases, the outcome of the 'unsuccessful courtship' was put to good use by Sinclair. The other event connected with the Gillette deal was that Michael Pie, then Radionics' technical director, left to take a job with the US shaver giant. He will return in our next chapter.

In 1975 Radionics was Europe's biggest manufacturer of calculators - not that there were many competitors. The success, attributed to 'control of chip design, but not in-house' and 'styling, aggressive marketing and easy reputation in the form of design awards' (a Radionics spokesman quoted in the Financial Times, 10 March 1976), was at its height, and the fall would not be long delayed. In March 1975 the monthly throughput of calculators was raised to 100,000, compared with 40,000 in September 1974, and 30,000 in March of the same year. The decline in sales forced a cutback to

60,000 a month later in 1975, and the boom was over. Receiving the Queen's Award to Industry, for both exports and technological innovation, in April must have seemed a bit of a hollow honour when the accounts showed that although the 1974-5 turnover was up 50 per cent, to £6.3m, profits were minuscule at £45,000.

The Japanese were forcing the pace in calculators. They not only had LCD (Liquid Crystal Display) technology, but the low-power consumption CMOS chips. LCD displays are low in power consumption, although they don't glow like an LED. That they are now ubiquitous in both calculators and watches, and have expanded to use as display screens in portable computers, is a testament to the appropriateness of their technology. Sinclair's dedication to the LED failed to find a response in the public, not least because the power drain meant the cost of batteries was high, as was the inconvenience factor. Lack of quality control, allied to both initial design problems and those of implementing redesign with the contractors responsible for production, gave the calculator range the same variable reputation all the products enjoyed. The no-quibble guarantee was exactly that - you got a new calculator or whatever with no questions asked, whether you'd built it yourself or not. John Pemberton recalls one calculator that had been chewed by the owner's Labrador, but still got replaced. Fine in theory, and in practice if you lived in Britain, although not if you found yourself sending your replacement back a few weeks later. The Japanese approach, with reliability and availability, won out in the markets. There were always problems in engineering for production and gearing up to volume with the Sinclair calculators. The problems were exacerbated by out-of-house production, but even after both quality control was instituted and the production of calculators was brought into the Mill in 1976 they did not go away.

Being forced to abdicate from the bottom end of the calculator market and under pressure (in terms of both price and functions incorporated) at the higher end, the calculator market was obviously dying for Radionics in 1975. Innovative entrepreneurs have little stomach, and less capacity, to compete in a crowded market where production capability, product reliability, aggressive pricing and marketing are all required. A new product would be needed soon to keep the 'innovative' ball rolling, and generate the

high initial profits needed by both Radionics as a commercial enterprise and Sinclair's R&D effort on the pocket television and flat screen. Since the TV was not ready, despite major investment, something else was needed. Integrated circuitry had provided the capability to put a quartz timing crystal and the chips to decode and drive a display into a watch case, but the first of these were expensive. There was a market gap here, and Sinclair chose a digital watch as the next product for Radionics. Unfortunately, for a company with a need for a high-profit, high-sales and high-technology product to refurbish the cashflow prospects, the timing and design were wrong.

The multiple chips used in existing watches could obviously be integrated on to a single chip, to provide cheap component cost. Sinclair Radionics designed the circuit and passed it out for manufacture to Mallard. According to Sinclair, Mallard 'did not think there was a future in digital watches. They could have made them [the chips], but they did not want to. We were told it was a matter of corporate policy at Eindhoven [Mallard HQ]' (quoted in Practical Computing, July 1982). Quite why Radionics should be dependent on Mallard's views is unclear, unless Radionics was unwilling to commit itself to a firm contract of sufficient size to interest Mallard. Why this misunderstanding, whatever its nature, led to the delay of eighteen months claimed by Sinclair is also mystifying. The chip production was passed to ITT, who did the job, but with further delays and poor chip yield. This was presumably partly to do with the new process (new at least as far as production went) of integrated injection logic used to produce the chip. ITT settled a court action brought by Sinclair in respect of these problems for £50,000, so the company must have accepted responsibility in some respects.

Whether it was the Sinclair chip design or ITT's production, or a combination of both, the Black Watch when finally launched in November 1975 was a disaster. At first it was a kit product, at £17.95, for the mail-order hobbyist market, and was later available as a ready-built item (£24.95). Production was in-house, but must mainly have consisted in sending out replacements after the first orders had been fulfilled.

The Black Watch was designed on the basis that other companies in the market had misjudged the market by emphasizing 'jewellery-style cases', and that digital watches were being bought as '*a new form of technology*' (Financial Times, 10 March 1976). The trouble was that this particular piece of new technology had serious flaws. The black plastic case, with three sections, one for the five red digits of the LED display and two flexible panels to press (a 'touch-and-see case' with 'no unprofessional buttons' as the ads had it) allowed you to see either hours and minutes or minutes and seconds, depending on which bit you pressed. Described as 'styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash' it also had the likelihood of 'no working'. Static from your nylon shirt, nylon carpets or air-conditioned office could blow the chip, freezing the display, and its accuracy was also temperature dependent. The three flexible portions of the case (two on the front, the third on the back to set the time), which acted as switches by pressing together two foil contacts, frequently malfunctioned, and the batteries with which it was initially supplied lasted all of a couple of weeks.

The hobbyists who bought the kits might have enjoyed the challenge of assembly, but the in-house production must have been somewhat problematic. According to Practical Wireless, reporting on the kit in June 1976, after you'd varnished the circuit board and soldered the components, enjoying as the ads said your 'evening's straightforward assembly', you had to tussle with a temporary arrangement to hold the batteries. Sinclair advised a bulldog clip, but PW found this 'almost impossible', and advised the use of two wooden clothes pegs, two drawing pins and a piece of wire instead.

This allowed you to get the uncased circuit working, whereupon you settled down to checking the timekeeping on successive days, adjusting the trimmer according to whether the watch gained or lost time. After you had achieved the adjustment or lost patience with the process, which as PW said was 'not difficult, rather a little tedious through having to wait four days to complete the watch' (not quite the same as the ads' promise that 'From opening the kit to wearing the watch is a couple of hours' work') you then fitted it into the case. Unless you had made 'very small solder joints' you would not be able to fit both the printed circuit board (PCB) and the copper

screen that Sinclair had added (after the problems with static had emerged) in an attempt to protect the chip into the 'clip-together case'. This cannot have helped efficient production, especially when the clips moulded into the case didn't always do their job properly.

Despite claims to have sold 'almost 20,000' of the Black Watch by February 1976, and that world sales 'had passed £1m' by July, the Black Watch sank soon after. This was despite a new chip claimed not to have the same problems with static, and batteries that lasted a sensible length of time. The Black Watch cannot be said to have disappeared without trace, however. The effect on cash flow was disastrous, and with nearly as many watches being returned as were sent out, Radionics' reputation for design and quality control took a further blow. When Norman Hewett enters our story, in July 1977, he would find Black Watches still being dealt with as returns!

Despite a classic Sinclair repackaging job on salvaged or spare Black Watch components, which produced the Sinclair Microquartz car clock in 1977, the Black Watch bungle cost Sinclair dear. The entrepreneur who had laid down a business principle of avoiding borrowing, and financing the company's growth out of profits, now found himself without the cash to bring a new product to the market. The no-borrowing principle was already breached, quite apart from the forward financing provided by keen mail-orderers, by taking National Research Development Corporation (NRDC) money for the flat-tube television project. The staunch advocate of laissez-faire policies as regards business was in those days someone who also believed that the government of the day should back the vision of 'innovators' with hard cash.

The NRDC funding was derived from its involvement with Dr Denis Gabor, the inventor of the flat-screen television tube in the 1950s. Having supported this original work, when Sinclair picked up the project in the early 1970s the NRDC put in half the development costs over the next few years, amounting to around £250,000.

However, the development of the Microvision pocket television, with its miniature but conventional tube, was also consuming money, as was research into electric vehicle motors at Cambridge University which

Radionics was financing. With a turnover of £6.3m to March 1975 Radionics had managed a profit of only £45,000, and the problems in the calculator market plus the watch fiasco produced a loss of £355,000 for 1975-6 on a turnover of £5.6m The only product making money was the DM2 digital multimeter, a steady but unspectacular seller to hobbyists and laboratories. It worked properly, unlike its predecessor the DM1, which had got the thumbs-down from the technical press, and despite its 'cash-fragile' case enjoyed a good reputation. For Sinclair, however, 'instruments were profitable, but dull' (Computing, 17 February 1983). Certainly he played little part in their design or production - one John Nicholls arrived with a set of instrument designs, built prototypes and pre-production models, and then put them out for manufacture. As Norman Hewett recollects, 'Instruments were essentially a company within a company.' He also made the cogent point, in terms of the success of the instruments, that, 'The instruments weren't funnies in the sense of packing stuff in ... the multimeters were fairly routine, with a metal case and plenty of room, and anybody in a competent firm could put them together.' Such sensible production led to good quality and a reputation for value for the instruments, instead of the dubious reputation, mitigated by the no-quibble guarantee, of the hi-fi and calculators.

Sinclair was faced with the choice, as he said, '*of scrapping the TV or seeking outside finance*' (Management Today, March 1981). Despite the option (apparent or realistic) to retrench, both Sinclair's ego and his obsession with the pocket television prevented him from seriously considering this businesslike step. As he says, 'We could have cut ourselves back... but having put twelve years and £500,000 into developing the Microvision TV, I just couldn't bring myself to do it.' Outside finance was duly sought, and N. M. Rothschild merchant bankers assisted in drawing up a list of potential suitors. Rothschild was selected in the usual Sinclair contactee fashion; he had 'met Lord Rothschild up in Cambridge, and he was impressed with what we were doing' (Tycoons, p. 160). Quite what impressed Lord Rothschild is unclear; it was certainly not the trading figures! The General Electric Company (GEC) was approached, but declined to have anything to do with Radionics, since in the opinion of Sir Arnold Weinstock, the GEC chairman, Sinclair would react badly to being told what to do. Other possible partners not surprisingly wanted to take an

extensive look at this financially troubled company, low on management skills and dealing mainly in the volatile calculator market, before they committed themselves. This didn't suit Sinclair, who needed cash fast. His bankers infuriated him by suggesting calling in the receiver, but then he approached the National Enterprise Board (NEB) in June 1976.

The NEB was set up by the Callaghan administration in 1975, inheriting the government's shareholdings in British Leyland, Ferranti, Rolls-Royce and ICL, with a brief to prop up important lame-duck companies and extend venture capital in high-technology areas too long term or risky to gain funding from the City. Sinclair Radionics, as a British firm competing both at home and overseas, even if unsuccessfully, with the Japanese calculator invasion, and promising the television as an imminent new product, was considered too important, symbolically, to be allowed to go to the wall. The then head of the NEB, Lord Ryder, approved of the Sinclair mode of consumer-based technological entrepreneurship, and the NEB put in £650,000 for a 43 per cent equity in August 1976. Doubtless Sinclair's notable powers of persuasion played a part in securing the backing. This enabled the miniature television, the TV1A, seen by Lord Ryder as a wonderful British challenge to the Japanese, to go on sale in January 1977. It sold at £225, supported by a £20,000 advertising campaign extolling its virtues. Mainly, these were that it was small, so compact that it was difficult to manufacture, and would work anywhere in the world, more or less, on VHF or UHF. The 2-inch screen, of conventional design, was difficult to see unless you held it, or supported it, directly in front of your eyes, at a distance of less than 2 feet, and the sound quality from the piezo-electric crystal speaker was poor, although you could always plug in an earpiece. The user was confidently informed that at 'a normal reading distance, the 2-inch screen is as big as a full-size screen'. Promoted as an asset to the travelling businessman, it was 4 by inches at the front (the end you looked at) and 6 inches deep. The low-power tube was designed and manufactured by Telefunken, and the circuit incorporated several integrated circuit chips.

The dream of ten years was on the market, and Sinclair doubtless awaited the eager clamour for this latest manifest vision of the future from the public, ready to have their lives revitalized by the opportunity to watch the

testcard while waiting for the bus to work. The initial response was encouraging, but there were production problems...

[3] TAXPAYERS AND TECHNOLOGY

The launch of the pocket television was not the panacea for Radionics' problems that Sinclair had sought, and the NEB had hoped. In fact, things went from bad to worse on the cash-flow front, since there were production and quality problems with the television. As was apparently an all-too-common practice in Radionics, it had been rushed into production, and the problems were such that fewer than 200 sets a month were being manufactured on the production lines set up in the Mill. Rather than a full-blooded production effort, the company was effectively running a pilot plant.

As a result of minimal cash flow from the television, and increasing Japanese penetration of the calculator market, particularly at the budget four-function chainstore end of the market, the NEB found that its initial investment hadn't turned the tide for Britain's answer to the canny Orientals. Despite Lord Ryder's departure from the NEB, losing Sinclair a personal ally, and his replacement by Sir Leslie Murphy, the decision was made to continue to support Radionics. This was done by means of a further £1.65m. of equity purchase, giving it control of the company with a 73 per cent stake in July 1977. There was also a £1m. loan facility extended, of which two-thirds had already been taken up by the end of the year.

Sinclair was now out of the driving seat, as the agreement on this tranche of taxpayers' money required him to take on a managing director who would have effective control of the company. A buy-back clause in the contract would however allow Sinclair to regain control if profits exceeded £3.5m. a year for any two out of three consecutive years. He had sufficient confidence in the television and other products fermenting in his mind to declare publicly that this was 'a tall order, but not impossible' (Guardian, 13 December 1977). Privately, it must have been during this period in which he was subject to the state's appointed representatives that he decided to cut his own losses and start afresh. That Sinclair had a certain pride in, and commitment to, Sinclair Radionics, the company he had founded and built up, is not the point. The NEB equity purchase made him a minority shareholder, so diminishing his control, bringing in constraints on his

activities and making him answerable to others in a fashion to which he was unaccustomed and hostile. Sinclair Radionics was still 'his' company, accustomed to his style, and relying on his ideas and the skills of his technical team for future money-spinners. The conflict of styles of management, cavalier versus corporate, is the major emphasis of this chapter since it illustrates the Sinclair phenomenon in a variety of ways.

The hope for the NEB was still that the miniature television would save the company. The Sovereign calculator and the Cambridge series were being produced, but although further calculator models were launched in the next year or so, the Japanese assault led by Sharp and Casio was taking the market by storm. Their production standards, manufacturing and marketing capabilities, allied with their ability to engage effectively in the cost-cutting tactics necessary to expand a company's share of a mature market, had eclipsed Radionics.

The company Sinclair had created then employed some 300 people, including the women on the calculator and television production lines, who made up around half of the total workforce. The technical staff directly involved with basic research numbered around 15, more than half of them on the flat-screen project. There were 25 or 30 technicians, draughtsmen and engineers concerned with product development and production processes. The movement of production in-house for these products, rather than solving quality problems, merely ensured that there were no outside contractors to blame. The justification for accepting the rate of returns that lack of production standards and quality control ensured was the 'no-quibble' replacement/repair guarantee. For any product sold in the shops, rather than through mail order, and especially for products exported, this is not a solution likely to endear itself to either the consumer or the retailer. It also ensures that the company's reputation declines rather than grows.

Nicholas Barber was appointed to the Radionics board to look after the NEB's interests, and a managing director was sought who would be acceptable to both parties. Barber took the role of acting MD in the meantime. He found a discrepancy between the NEB's intent to back high technology and the idiosyncrasies of the Radionics set-up:

Certainly we [the NEB] were investing in Clive Sinclair, but we don't back individuals or magic inventors with black boxes, we back companies. I think that one or two 'i's needed dotting and 't's crossing in the accounts at that time. (BBC Radio 4, 18 January 1978.)

After a couple of nominees had failed to become established, a likely candidate was found. Norman Hewett was on the job market from his position in charge of GEC's heavy cables division, and after approaching the NEB he was appointed to run Radionics. He recollects that:

I went to see Sir Leslie Murphy at the NEB, and he said that this company had had some ups and downs and technical problems in the past. In his view Sinclair was a brilliant chap technically, but he probably wanted some help on the management side, and that they had at the moment a wonderful product, a miniature TV.

It sounded interesting as a challenge and I had dabbled with a Sinclair calculator, although it did go wrong and I should have been warned, perhaps. I went along and got on well personally with Sinclair in the discussion ... Although he obviously didn't really want anybody, he thought we could get along. I suppose he thought any sucker would do and this one appeared less obnoxious than some.

Although I had the mandate to try and improve the management and financial structure, it was put to me that I had to do this and keep Clive sweet, since he was the kingpin from the inventive technical point of view. (Interview, 16 October 1985.)

However, the official version of the story has it slightly differently: '[Sinclair] was not a little surprised when the NEB appointed Norman Hewett out of the blue.' (Rodney Dale, *The Sinclair Story* (Duckworth, 1985), p. 81.)

It is obvious that the NEB, via Nick Barber, was aware of a potential problem in putting Sinclair into a subsidiary position, not only in terms of his shareholding, but in terms of control. The couple of Barber quotes below illustrate the point, and also a favourite description of the time - buccaneering. That piratical adventurers should be an appropriate analogy

for people perceived as the mainstay of a company into which millions of pounds of the taxpayers' money were being poured seems surprising, but perhaps represented an unconscious or repressed awareness of the truth of the matter.

One has to be careful to strike a balance between systematic management disciplines and the buccaneering spirit that has given the firm its strength. (Nicholas Barber, quoted in the Observer, 30 October 1977.)

We have tried ... to be very careful in this case [Radionics] to try and find the balance between introducing some systematic management but not stifling the buccaneering spirit. After all it is that which comes first, and I'm not just talking about Clive here, but there's a marvellous team of people at Sinclair, and they haven't come to work for that company for nothing, they're excited by that environment. (Nicholas Barber, BBC Radio 4, 18 January 1978.)

Let us note here, and then pass on, that Sinclair's notorious temper, and the undoubted loyalty he inspires in his chosen associates, may well have played some part in these views, since they were expressed after some time spent dealing with Sinclair. The buccaneering spirit had not managed to come to any accommodation with the need for managerial control during the rollercoaster ride of Radionics' growth, even if it was perceived as a true need, which is doubtful. As far as management goes, the answer is that there was little evidence of it on anything other than a pragmatic level. Sinclair's participation in all aspects of the company was pervasive, but unsystematic. As *The Sinclair Story* expresses it:

The company had grown very quickly - too quickly. There was no real management structure, and though Sinclair is the first to admit that management was - and is - his weak spot, self-flagellation is no solution to such a fundamental problem. He had not seen the need to reorganize the company as it grew ... Sinclair knew little about managing people, production lines and stock control; he was trying to be in charge of everything himself: design, development, manufacturing and marketing, (p. 78.)

For a company that at its high point had touched a turnover of £6.3m. and been one of Europe's biggest calculator producers, the management expertise was minimal. Sinclair has indeed consistently, throughout his career, admitted (in what he presumably hopes is a disarming fashion) that management is his weak spot:

[At Radionics] I didn't know how to start recruiting management. (Management Today, March 1981.)

It was impossible for me to do both the long-term planning and run the company on a day-to-day basis. I had always recognized the need for a professional managing director ... There are plenty of good professional managers around; the only trouble for us was getting one when we needed it most. (Guardian, 13 December 1977.)

After the NEB came in [in 1976] it was clear that we needed a managing director to run the company day-to-day. I wanted that as much as the NEB. But it was very difficult to find someone. (Financial Times, 29 September 1978.)

Such problems have been encountered and overcome by many lesser companies that started out as one-man bands and went on to success. We should remember that at the point we're talking about, Radionics had had a turnover greater than £1m. for four years. If we take this as an arbitrary point at which a company chairman uninterested in performing management tasks might well have looked hard for an efficient managing director, we are entitled to assume that the problem was not one of identifying suitable candidates, but of coming to terms with delegating control. When asked about Sinclair's repeated statements on his own lack of managerial capacity and the company's need for it Norman Hewett responded:

Well, he'll say that whenever it suits him ...

So he thinks basically that nothing is beyond him, and that he can run a business?

Yes, I would hazard a guess that, apart from the technicalities, which are pioneering, frontiers of knowledge and so on, which are hard and worthy, therefore, he thinks the other aspects of business are basically mundane, known, and the proper business of hired functionaries. It isn't so much that he can't do it, it's more that it's not the sort of work that's worthy of him.

So why doesn't he get efficient managers?

You have to understand that he doesn't understand the price you have to pay to acquire and use these people ... he doesn't appreciate that it's one thing to have a butler, but another to live up to the style of life that will justify you having one. It's no good having a butler and insisting on running into the kitchen, grumbling about every course and bringing it in yourself. In other words, he's not willing to acclimatize to management. (Interview, 16 October 1985.)

Put more bluntly, the Observer (30 October 1977) probably had it right:

Clive Sinclair, left as chairman to run the research side and chart the overall course of the firm, says he had always planned to bring in a professional to handle day-to-day management. Nobody disbelieves him, but, says an associate, 'If it hadn't been for the NEB's influence, he would have ended up treating Hewett as an office boy.'

Norman Hewett brought with him into Radionics his financial director from GEC, Derek Holley. The pair of them set to work to bring, if not order out of chaos, then information and structure out of an idiosyncratic jumble, which had no longer the justification of making money. Derek Holley recollects the initial problems:

Nick Barber had really sorted Clive out. He'd spent about four months [at Radionics] and had sorted out all the problems that Clive had created, like all the little special people that were on the payroll, the family and all that. Typical small family business stuff. Then we had the poet who was on the payroll, George Barker ... he was some distant relative of Clive's, but this was part of Clive's general image, that he liked to be seen to be helping people ... He was given a retainer fee of

£1000 a year, paid quarterly. I can't remember what the justification for it was, he was just paid it, and it was part of the costs of running the company. (Interview, 13 November 1985.)

Exercising poetic licence in advertising copy perhaps? More potentially embarrassing for a subsidiary of the NEB, set up by the Labour government, was the £1000 donation to the Cambridge Conservative Party. This was paid once a year by standing order, and escaped Holley's scrutiny until after the payment had gone through. The problem was solved by Sinclair paying back the money to Radionics, and making it a personal donation. Such staunch support for political principles would be rewarded when the wilderness years of Toryism were ended.

Holley had other problem areas to sort out in the realms of financial control:

The thing I stopped when I got here was that, in this immediate vicinity of St Ives, any employee of Sinclair, and in fact people who weren't employed by Sinclair, could go into virtually any garage, any restaurant, any pub ... and charge it to Sinclair's account. There was no control whatsoever. Again, it might have been set up with all good intention, which I believe it was, but it had grown like Topsy, and there was no control, (ibid.)

Such systems, or lack of system, had remained unchanged throughout the growth of Radionics from a family firm to a multi-million-pound business. Derek Holley attributes this to the type of personnel Clive chose:

Because of the nature of the man, the people he employed were of a similar nature, in respect of their business dealings, so therefore they had no incentive to get these systems changed, because it suited them to operate that way, because they were exactly the same as Clive. So you had sales managers, production managers, research and design managers all of a very similar ilk, none of whom wanted any constraints on their operation. So they didn't want to have to sign a petty-cash voucher or raise a purchase order when they wanted to do something, (ibid.)

Sinclair's resentment of the bureaucratic NEB activities is well documented, and his version of events has been promulgated relentlessly. We have the advantage at this point of the testimony of people who, in contrast to Sinclair, who has a public persona to protect, have nothing to gain but the satisfaction of setting the record straight. To us, the authors of what was originally to have been a straightforward account of a techno-hero of the late twentieth century, what we found on investigation was a contorted fable. One noteworthy aspect of this is the response we received on approaching people involved in the story for information. Sir Clive's capacity to produce what is normally termed 'loyalty' among his underlings is often noted:

[The Radionics R&D team] were so loyal that they stuck in with Clive to the end. Clive is incredibly good at selecting the right people.' (Interview with John Pemberton, 22 October 1985.) The team spirit among the ex-Radionics design team is strong enough to bring them all together again each Christmas to replay the 'great parties' that they used to have on the top floors of the Mill. This relation is, or is perceived to be, reciprocal: 'One thing about Clive is that he had a terrific loyalty to staff.' (Interview with Alfred Marks, 25 September 1985.)

So far, so good. Obviously this is a skill or attribute of Sinclair's relations with his technical staff that serves him well. However, the relation manifests itself in peculiar ways. Those not incorporated in Sinclair's 'family' have a great many more complaints about his ways of dealing with both people and business, some of which are to be found within these pages. More revealing, however, is the frequency with which a defensive reflex comes out of the blue when Sinclair's associates are approached. Any writer pricks up his ears when an initial approach for information produces responses such as 'I won't be part of a character assassination' (telephone conversation with John Nicholls) or 'The story is grey, not black or white. I don't want to contribute to a muck-raking story' (telephone conversation with Nicholas Barber). Over and above a probably justified distrust of those members of our trade plying it in the gutter, such responses raise questions of whether the truth, in so far as it can be unearthed, might be potentially damaging. It certainly shows an awareness of truth being in short supply.

However, enough of these interpolations and back to the witnesses. The brief from the NEB to the new managing director had been minimal:

The NEB didn't have any views much, except that they hoped and prayed that I would be instrumental in getting Radionics into profit. (Interview with Norman Hewett, 16 October 1985.)

Hewett was given a block of Radionics shares by the NEB to provide a personal incentive over and above his proven professional competence. This didn't please Sinclair, who thought the NEB was giving away bits of his company. The new MD and his aide set about the task:

Derek Holley reorganized the financial side and tidied it up a great deal, since it was in a pretty terrible shambles. I insisted that I wanted a monthly report and account from the various managers. It took quite a long time to get this over, particularly to Sinclair, who was in charge of research. His dignity did not really allow him to give me a report, much, so he never did it properly, but now and again he issued a rather lengthy lecture cum edict as to the future progress of the company as it was going to be. Apart from him, the others did co-operate, the manufacturing and finance chaps. So we knew the worst within a few months, (ibid.)

The best of this was the instruments side; steadily profitable and unproblematic, and producing some 20 per cent of the turnover.

Calculator production was continuing, but putting together the Sovereign and Cambridge models in order to sell them at a loss was not good business, and hardly justified the NEB support for 'Europe's one remaining calculator company', as Nick Barber put it - Radionics produced the diplomatically named Enterprise calculator at £9.95 in October 1977, but its display of red digits reflected its effect on profits. It was followed by the Enterprise Programmable scientific calculator nine months later, but that was the last stab at an innovative product. Other calculators introduced in this period - the President, President Scientific and Settler models - were all made in Hong Kong. The latter was a betting calculator produced for Sporting Life (who funded the research costs) that calculated accumulator odds and the like, and was surprisingly successful. However, the fact remained that the

pioneer of the pocket calculator was now reduced to importing desktop models from the Far East. We asked Sir Clive recently if with hindsight he could have survived in the calculator market:

No, we weren't a big enough company. Calculators became a mature industry. There wasn't much technical change, so we couldn't put any fresh innovation in. The heart of the calculators were the keyboard, the chip and the display - the chip was the major cost item most of the time. We didn't make the chip or the display. We could perhaps have made the display, and we certainly set up a pilot plant for that at one stage. But the chip we couldn't manufacture ourselves, we didn't have the financial resources for that. We certainly did talk to people about manufacturing the chip for us in the UK, but it didn't work out. Effectively, we had to buy the chips from Japan, the dominant suppliers, which says really that if you allow the Japanese to take the component market, you sooner or later say goodbye to the finished product. (Interview, 6 November 1985.)

It was an extended farewell, however, Holley recalls

... sitting at a board meeting here where [Sinclair] actually said that LCD calculators would never take off, and we decided to continue to manufacture the old LED type. On a technical basis that was the only time I could fault him. That "led us as far as calculators were concerned, because within six months every calculator made anywhere was LCD, and at lower battery cost and longer battery life. The development engineers were pressing to develop an LCD display calculator, but Clive rejected it. (Interview, 13 November 1985.)

In the light of the fact that LCD technology has now proven itself, not only in calculators but in computer screens and even pocket televisions, Sinclair's aversion to this technology has not stood him in good stead.

The last calculator project was for a credit-card-sized calculator, which got as far as a printed circuit board, but the Japanese came in with far thinner models (LCD displays are also thin) and the calculator era was over. Before their demise they gave Norman Hewett his first taste of the Sinclair style of marketing:

[Sinclair] would insist on these early launches, and he was always warned against it by his PR chap and other people in Radionics. 'Never mind about not having a production model,' he'd say. 'By the time that everyone gets around to placing orders we'll be ready.' So wooden mock-ups are made ... I don't remember a single calculator finished model being photographed, not even a prototype model. (Interview, 16 October 1985.)

Hewett has been criticized for bringing inappropriate big-business practices into a small firm, but he made efforts to adjust. He and Sinclair went to the 1977 Las Vegas Consumer Electronics Show, so that he could get a feel for the industry, and he was willing to adopt flexible attitudes. On the premature launches of calculators, he goes on to say:

I was new to the industry, and as far as I was concerned maybe this was the way it was always done, and maybe it was true that, in a fast-moving industry, [Sinclair] was right, and two months' delay would diminish your market, (ibid.)

What did concern him, however, was the problems in producing such prematurely launched products. Asked if early launches caused production problems:

And quality problems, yes. With the calculators, more quality problems, probably, than production problems as such. We had a reasonable set-up for calculators, and on the whole what was then knocked out tended to be pretty good. Nevertheless, there was never enough time or money spent on continuing quality control, (ibid.)

Whatever Hewett's inexperience with the arcana of electronics, his conflicts with Sinclair are hardly concerned with the technical and research arena. They were concerned simply with the logistics, efficiency and profitability of producing goods for sale. While Holley was sorting out and systematizing the financial structure, Hewett was faced with the reorganization of a development, production and marketing system that had hitherto hinged on the predilections and practices of one man. In the best of circumstances there would have been frictions. With the new regime attempting to 'set the company up in a proper way with proper procedures,

I don't mean in a big business way, we would have regard for the type of industry we were in and how fast moving it is' (interview with Derek Holley, 13 November 1985) in a context of Clive's 'lack of faith in Norman Hewett's experience and personality' (The Sinclair Story, p. 82), his resentment at his financial masters calling a tune that introduced constraints and the challenge to habitual practices and methods, there was going to be conflict.

Hewett saw his role as reforming the company and providing an efficient set of interactions within the various sectors of the company. The various department heads, which Hewett saw as autonomous within their spheres of responsibility, were seen by Sinclair as his people, necessary to keep the show on the road, but in the final analysis subservient to the founder. They in turn had a loyalty to Sinclair, and a history of abiding by his decisions. Sinclair had hoped that the imposed MD would, while relieving him of tedious tasks, effectively fall under his control. The blunt and businesslike Hewett, however, set Sinclair up as research director, since this was Sinclair's main avowed interest, and then expected to be left to manage.

The first and immediate problem was the television production, without which there could be no upturn in the company's fortunes. The television had suffered from the classic Sinclair style:

It had been launched, but was still in production engineering. It had been launched, but wasn't available - this was typical. (Interview with Derek Holley, 13 November 1985.)

There was a backlog of orders, so the first problem was to get production levels up. This was not easy, given the way it had been handled once the design came out of the research department:

Clive never had a development phase. What in my old-fashioned heavy-engineering experience happens is that something comes from the research department, then there is a production-development phase which is largely production-oriented, as well as market-oriented, and design. All that was sort of swept out into a vague slide between the research department, through Clive's office, that says, 'Well, we'll have a blue thing round it', and more or less straight into production. The

delay was unacceptable, so he didn't recognize the need. (Interview with Norman Hewett, 16 October 1985.)

Sinclair's view was apparently that any product of which a working breadboard prototype existed was finished. The inefficiencies and stresses that Sinclair's system had produced became Hewett's problem. The problems of past history didn't help:

When I went there one of the biggest departments was the one dealing with customers' returned goods, returned for repair and a complaint-calculators, Black Watches and so on. Over a dozen people doing nothing but deal with complaints, which was a big drain on the technical capacity of the place, (ibid.)

There were lots of orders waiting to be filled for the television, orders that would bring in the desperately needed cash, but the need for a product of quality produced in sufficient quantity faced severe obstacles:

They had the mini-TV which they were trying to get into production, but it was being developed while they were manufacturing them. If you try and develop a product while you're trying to manufacture it, it isn't a very jolly sight... there must have been 100 or 150 modifications that had to go through because of inadequacies in the design. The prototype worked, but it was extremely difficult if not impossible to assemble properly, and in fact there were technical snags which had not been properly foreseen or ironed out in the earlier stages. So you had to have technicians doing a lot of the assembly ... the assembly that the girls couldn't do because it was either too difficult or there were too many modifications and the girls couldn't be updated in time, (ibid.)

It was not that the staff at Sinclair were lacking in the skills, but continuance of the small-scale company attitudes and informal lines of communication that had worked in the early days at Radionics was inappropriate to the task in hand:

I would certainly pay tribute to the people involved in manufacturing at that time, and indeed the technical chaps. The thing has never been

developed as a prototype as a separate operation at all ... so that the technical boys were forever being cursed by the production people because the thing can't be made, and it doesn't work properly, this or that is an unreliable component, and so on. The technical people would say, 'We know, we haven't had time to look at all this ... we'll have to change this.' Then the production people say, 'We've got a million items in stock, but we haven't got any of what you're talking about!' So production staggers on. The tendency was to set everybody about each other's ears in a way which was really most unfair, most regrettable, because they were really competent and capable fellows, (ibid.)

The production figures gradually increased, as did the quality of the television design itself. The inefficiencies of the process affected the profitability of those televisions that did get sent out, and ate away at the theoretical 40-50 per cent profit on the £200 retail price. From this notional costing margins were reduced by the remedial work that had to be done, the need to employ technicians on the assembly line, purchase costs when components were changed, and so on. It gradually came into profit as production reached some 2000 sets a month in early 1978. Having product available was a separate matter from exercising quality control over the sets that came off the end of the line, of course. Dixons and other retailers started to complain about quality, and the repair and replacement of defective sets decreased profit margins further, as well as discouraging high-street sales. The American Express order, for 10,000 sets, threw up even more problems. Although home sales were declining, the American market was crucial, being the best market for a novel and expensive gimmick. The New York office was inundated with defunct or defective sets from the American Express sale, and quality became as crucial as quantity. Hewett's attempts to improve this aspect met with resistance from Sinclair:

Another thing friend Clive isn't keen on is spending money on quality control. Quite often, when there was a meeting where production and engineering needed to be brought together, I wanted to have the quality-control manager in as well, because this is of the essence. Clive was always against having him there! 'Don't have him in,' he'd

say. 'He just causes problems and trouble!' Not only did he not want to be involved with [quality control] himself, but he didn't want to know about them or their problems. Extraordinary fellow, (ibid.)

Although our readers, cognizant of earlier history, might at this point in the story not find it so extraordinary that Sinclair possessed the attitude Hewett described as 'if you make it, and it just works, then get it to the customer and if possible forget about it, we don't have to deal with the consequences'. Hewett was finding it increasingly difficult to deal with Sinclair, from whom he expected at the least passive co-operation. Instead, he was put in a position where he received minimal co-operation, maximal irritation, and interference. The conflict was one of style rather than personality:

Personally he didn't dislike me, neither did I personally dislike him, although I got professionally very annoyed with him in many ways, (ibid.)

That the management styles conflicted is not in doubt. Derek Holley admits that Hewett was at a disadvantage in making the transition from the heavy electrical industry to consumer electronics and may not have adapted sufficiently. The wider problem was Sinclair's character, and his resistance to any changes, however businesslike, that ran counter to his own views. His then wife said, in response to the question of whether the NEB was putting constraints on Sinclair and his ideas:

Well, I think constraints is a bit strong. If he has an idea and wants to put it into action usually his reasons for doing so are very strong indeed, and considering that he's also very much a fighter, I wouldn't like to be the one trying to put a constraint on him ... He has a very quick temper indeed, and a rather noisy temper. Also being quick-tempered he doesn't hold grudges. If he's angry he's angry and everyone in the workshop knows about it. To a certain extent the business is him, it's his ideas and his innovative powers that have made the business what it is, and I think anybody that tried to stop him doing that would be very foolhardy, because you'd end up with another run-of-the-mill business. (Ann Sinclair, BBC Radio 4, 18 January 1978.)

It is worth emphasizing that, as of the time of the NEB's initial funding, what Sinclair had made the business was a company so close to bankruptcy that his financial advisers had thought that bringing in the receiver was the correct course of action. Sinclair's 'innovative powers' had been given due leeway, with work supposed to be proceeding within his allocated fiefdom of the research labs. His 'ideas' on how to run a company had not proved themselves in practice, however much Sinclair wished to place the blame on the volatile calculator market, and something had to be done. Sinclair's complaints about the Hewett period are, as a presumably considered case, petty. The commissioning of a business plan by Hewett, on the advice of Nick Barber, is presented as a sneaky act on Hewett's part. The likely reason for the resentment is suggested by Clive's biographer's comment: '*not that Sinclair had much faith in management consultants anyway*' (The Sinclair Story, p. 83). Clive's constraint that all recruiting was stopped by Hewett was mildly countered when we asked him about it with the comment that it's standard practice to halt and reassess recruitment when in financial difficulties, and that anyway it wasn't Sinclair's job.

The true trouble lay in the fact that Sinclair thought it was all his job. A typical difference was over market research. Sinclair's view was that he knew what the public wanted:

It has to be done on the basis, I think, of understanding why people like products or dislike them. It's no use saying to somebody, 'Would you like a pocket TV?' when no such thing exists. The question comes out of the blue to them, they haven't any chance to think about it. It's much more useful to think oneself, you know, will people like them once they've had a chance to play with them. (Clive Sinclair, BBC Radio 4, 18 January 1978.)

Hewett was rightly dubious of Sinclair's powers of prediction in this area. He felt that the company was exposed and vulnerable with a single profitable product, and the fact that the saleability of this product was based on faith in Sinclair's vision. As he says:

When the development of a product has taken the place of market research, you presume that by developing it it's going to be sold, whether the public wants it or not. You have to assume they will,

because you've already burnt your boats. (Interview, 16 October 1985.)

Hewett commissioned some market research on customer reactions. This showed that people didn't want a 2-inch screen on a miniature television, because it was too small, but would have been happy with a 3-inch screen. There was a board meeting at which it was agreed that any future model would be a 3-inch version, against the objections of Sinclair to paying attention to survey results:

He announced at the time that he didn't believe it. I said, 'What do you mean, you don't believe it? Are you saying that it hasn't been carried out properly?' 'It's all rubbish,' he said, and had no arguments to support his position. So when you ask if he's rational from a business point of view, I think his reaction to that sort of thing is such that you have to say he isn't. He's not objective. He rejects things that run counter to his egocentric views ... they're not acceptable, (ibid.)

With this sort of resistance, Sinclair and Hewett seem to have existed in a state of continual tension between the Sinclair style of business by internal certainty and the conventional but commercially sound approach of Hewett. Although public dissent was minimized, Hewett recalls that he occasionally was forced to play his trump card in the face of Sinclair's resistance:

Once or twice I simply had to lay it on the line and say that if I didn't get co-operation I should have to say to the NEB that it wasn't on any more, and recommend that they take other steps. He didn't want that because he didn't want the money pulled out, of course, (ibid.)

Hewett, fighting a financial battle on the production and marketing fronts, and attacked from the flank by Sinclair, was in an unenviable position. The gradual progress towards an operating profit as television production improved, though slow, was perceptible, but imposing his control on Sinclair as well as doing the job he was supposed to perform was impossible. Derek Holley says:

[Norman Hewett] had the opportunity to stamp on Clive from day one, and did that quite effectively for two months, and then let the reins go.

Gradually, as Clive saw that he could overcome this interloper from the NEB, which is how he saw him, it created problems, and that ended up with him leaving ... I find it very difficult to accept that Clive ever [circumvented Hewett] because he had this grand plan to do. It's just the way he operated, and he genuinely believes that the way he operates is right. I don't think there was any grand design, it's just that he operates by instinct, and those instincts don't happen to suit the surrounds. (Interview, 13 November 1985.)

Sinclair's incapacity to delegate responsibility and allow people to get on with their jobs, to accept that 'his' company could run without his control, led him to continue the informal command lines by which the company had previously functioned:

In fairness, he never interfered with how I ran the accountancy and finance, because quite honestly he didn't understand it, and he let me alone. The ones he interfered with most were the production and marketing departments, because marketing in particular is not an exact science, and he had his own views on marketing, and that was the way the company was going to operate its marketing policy, so the marketing director stood no chance, (ibid.)

The circumstances changed when the bottom dropped out of the US market, by that time the only market there was. Contrary to Sinclair's vision, there was a distinctly finite market for a £200 gimmick, even in the States, especially when reliability and quality were dubious. Norman Hewett's suspicions about its marketability confirmed, he told the NEB that he thought the end was nigh:

I wasn't proposing to leave, I was proposing to do what I could to minimize the damage and get them out of it if I possibly could. I made it clear to Barber that co-operation from Sinclair was minimal, and he often used to countermand my instructions behind my back, so I wasn't very hopeful. (Interview, 16 October 1985.)

Sinclair, his beloved project threatened, seized his chance to get rid of Hewett. Making Hewett the scapegoat for the current ills, he communicated with the NEB directly. The next Hewett knew, Sinclair wanted to see him,

told him it wasn't working out, and the NEB had agreed they should part company. Hewett resigned, betrayed but presumably also relieved, confining himself publicly to the comment that serving three masters, the NEB, the Radionics board and Sinclair, was impossible.

So Norman Hewett departed, taking as a golden handshake the money from the Radionics shares he had been given, which the NEB, either graciously or guiltily (depending on one's assessment of the reasons for his departure), valued at the notional value they had had when he received them. Derek Holley, for his sins, got to be acting MD until a new one could be found, which turned out to be a couple of months later. With at least some significant progress under Hewett in instituting businesslike systems, and Derek Holley still controlling the finance department, the NEB presumably thought things couldn't get worse.

The NEB wasn't happy with the computer project, however. This had been, along with the flat-screen television, Sinclair's future product, and design work had started some time in late 1977 or early 1978. Basil Smith and Mike Wakefield, who were the only two working on the computer, were not a heavy drain on resources, but the project would need significant investment to get it into production. This would include the purchase of custom chips that would be economical only if contracted in runs of 20,000 or so. Since the Commodore PET and the Apple II had been launched the year before, and had brought a new maturity to the computer market in the States, the proposed machine offered an early British entry into this new hi-tech arena, in line with the NEB's avowed purpose. The decision of the NEB was to view the computer as, in Sinclair's words, 'not being within their realms of plausibility for the company at the time' (interview, 6 November 1985). With total Apple II sales of only some 9000 machines in the US in 1978, the NEB, already nervous about the amount of money poured into Radionics, was wise to view this as not the sort of development likely to show a quick cash return.

So to Sinclair's disgruntlement the project, with its personnel, was passed to Newbury Laboratories, where it attracted NRDC funding. Newbury eventually sold it to Grundy Business Systems and the product finally emerged in 1982 as the NewBrain. Although a highly regarded and

expandable machine, it came too late to the marketplace. Derek Holley contrasts this delay with Sinclair's approach:

Those guys never developed that product, they kept redeveloping it. They were technically brilliant... but they didn't have the same drive. Whereas Clive will get to a point where he says, 'Well, we've looked at it enough, and now we're going to put it into production and to hell with the consequences', they kept looking at it and redesigning it. (Interview with Derek Holley, 13 November 1985.)

Sinclair thought the cancellation of the computer short-sighted, but was already looking to hedge his own bets - his alternative company had already launched the MK14 microprocessor kit. The fact that this potential money-spinner wasn't proposed to Radionics presumably shows that Sinclair saw little prospect of, or little point in, getting Radionics back on its feet. The mounting debts of Radionics, with trading losses of £1.29m in the last eight months of 1977, and a total of £1.98m for 1979, were hardly hopeful, and even Sinclair's projection of 'zillions' of pocket television sales was not likely to get him out from under the control of the NEB. His obsession with the flat-screen project, with its NRDC funding enabling a team of some eight people to work on it, plus access to the lab facilities and his technical team kept him with Radionics, but his development of another corporate option was an open secret within the company. Norman Hewett was of the opinion that Sinclair, in parallel with the full-fledged NewBrain computer project, had a cut-down version, a ZX80 precursor, planned. We checked with Derek Holley whether Sinclair was doing work on this at the time (early 1979):

Well, we believed he was, but I don't know whether there's any evidence for it. He had this other company, Science of Cambridge, going. There was always a feeling within [Radionics] that although we had this computer under development we would never see it, that one way or another it would come out through Clive's other company, (ibid.)

Whatever else was going on at the time we shall leave to the next chapter. In Radionics Sinclair, free of Hewett, went merrily on his innovative way. At this point the efforts of the previous year to get the TV1A Microvision

production up to profitable levels had borne fruit, in that they were making up to 4000 a month. The trouble was that demand had slumped and stock was piling up. At a manufacturing cost of around £100 per set, to have 12,000 or so sitting around in St Ives and New York and moving sluggishly at best was a £1m liability. Some 20,000 had been sold, but the market at that price had died. The new, cheaper and better engineered version, the TV1B, was being developed. With a plastic case and a simplified circuit, it was single standard, working in the UK only, and true to Sinclair's marketing theories would sell at half the price, coming down to the magic £100 mark. Unfortunately the first half of the equation, the production of profit from the first version, hadn't met expectation.

So, one would have thought, careful consideration would have been given by the chairman and board of Radionics to marketing strategies, price discounting, retail deals and whatever to deal with the problem of the existing stocks? Not with Sinclair at the helm! As MD at the time, let Derek Holley tell the story:

I came in to work one morning, picked up the FT, and there was Sinclair spread across the front page announcing his new version at half the price. So overnight all that stock was devalued by 50 per cent, because nobody was going to buy a £200 machine when there it was in black and white that a £100 version was being launched in six to eight weeks' time. So we ended up selling those TVs in the US at below cost - literally below cost - not below manufacturing cost but below component cost, at giveaway prices on giveaway deals to people who wanted to use them for promotional purposes. That was the sort of thing that ended up with the NEB saying we've really had enough of this - we can't afford to go on operating under these circumstances, and why they decided to pull the plug, (ibid.)

Since they were sold off at around £60 each, and cost around £100 to produce, those 12,000 TV1As lost Radionics some £480,000. Quite a price for a PR exercise. However, the only hope of retrieving anything hung on the new £99.95 TV1B, as long as Sinclair's sense of the market was right (and the market research commissioned by Hewett wrong), and that demand would spiral, and the TV1C (for the US) and the TV1D (for Europe) could

follow to open up new markets. At least the TV1B had been designed for cheaper, semi-automated production and would not suffer the changes and delays of the TV1A in gearing up to meet the demand. If it took off, it might see the company through for the eighteen months that Sinclair reckoned the flat-screen television would take to get into production. The NEB, looking at a bad investment made worse by the incapacity of Sinclair to work with anyone he saw as an outsider, agreed to his suggestion of Michael Pye as the new MD. As we noted earlier, Pye had been technical director of Radionics from 1973 to 1976, when he'd gone off to work for Gillette. With a new marketing director, David Marshall, appointed to the board and raring to go on translating his reputation as an aggressive marketer of Camping Gaz into the electronics field, the company was geared up for a new start. The TV1B was duly launched in November 1978. Unfortunately the consumers weren't aware that it was up to them to help British technology and make manifest the market that Sinclair was positive was out there, eagerly purchasing the new one-per-person product that would follow the transistor radio and the calculator. Even Sinclair's powers of persuasion failed to conjure the illusion of a market in the face of such consumer apathy. The NEB started to look at ways of minimizing its biggest loss to date. It certainly touted the flat screen around the big electronics companies, with no success. According to Sinclair, the NEB were also desperate enough to be unpatriotic:

We had developed this pocket T V, and at one stage [the NEB] got someone else to try and sell the pocket TV to the Japanese, without having told us, the company. We discovered it because another organization we were dealing with, who also had dealings with the NEB, leaked the information to us because they thought we ought to know. (Interview, 6 November 1985.)

It's not clear, in this account, who 'them' and 'us' represent, since the owners of a company can presumably explore whatever business avenues they want. However, the split was close. The NEB had noted the steady profits that had accrued from the instruments side, which had quietly and efficiently produced multimeters and a portable oscilloscope which used the small television tube, under the guidance of John Nicholls. As Holley recalled:

There was development going on in instruments, but in a much lower key, and not in the public eye. [Instruments staff] were almost also-rans within the company, people that no one ever heard of, but they'd been reasonably successful and launched two or three instruments which had sold considerable numbers. (Interview, 13 November 1985.)

Out of the public eye, and outside of Sinclair's interests, one might add. The NEB wanted to preserve the instrument side if possible, since it was viable, and get rid of the rest, one way or another. Sinclair's consistent claim is that expressed in our interview with him of 6 November 1985:

The NEB's view became that there was no future in consumer electronics, and that the thing to do was to support our instrument side. My argument was that the only reason consumer electronics was tougher than instruments was that the Japanese had not got instruments but they darn well would, and if we backed away from everything that was difficult there wouldn't be any business left.

In fact the NEB had sunk vast amounts of money into the Clive Sinclair vision of consumer electronics over a period of three years, providing funding far in excess of any sensible investment, with nothing other than mounting losses to show for it. It was correct in considering it proven that the Sinclair brand of consumer electronics was not only 'difficult' but downright suicidal. At other times, Sinclair has claimed that his troubles started when Lord Ryder left the NEB in 1977:

They then took a totally different view of us and they did not think much of the TV business. They did not listen to me. I had a personal computer under development. They tried to sell the TV idea to the Japanese. It was a real muddle. It should not have happened that way. (Tycoons, p. 160)

All that really happened post-Ryder was, as we have seen, that responsible people, rather than merely throwing the taxpayers' money at Sinclair unquestioningly, sought to exercise a degree of control over a company in which they were a majority shareholder. The charge of lack of faith is untenable. The only valid question is why they didn't pull the plug sooner. Derek Holley's comments seem more realistic:

One of his failings is that he gets bored with things very quickly. At that time he'd got totally bored with the conventional TV anyway, because it wasn't news any more, so all his energies were directed towards the flat screen and the computer. All the problems of trying to finish the development and production of the things he'd previously been involved in were left to other people. He has always said publicly that the reason he and the NEB parted was because they wanted to concentrate on the instruments, and he didn't. The fact of the matter is, the NEB refused to subsidize him any more. It's as simple as that, and the fact that the NEB tried to salvage something out of their investment by continuing with instruments is incidental. Even that was touch and go. (Interview, 13 November 1985.)

When Sinclair is quoted as being convinced that 'the NEB had a view of me as a mad inventor who certainly couldn't run anything' (quoted in Fortune, 8 March 1982) he may well have had the right view of it, but it was one that evolved out of bitter experience. The end was in sight for Radionics. Sinclair took a £10,000 golden handshake in July 1979, and moved into the Science of Cambridge premises, where a number of his technical team joined him on being made redundant. The invaluable Jim Westwood, Dave Chasten, Michael Pye, David Southward and Nigel Searle among others shifted to the new premises, along with the rights to the flat-screen project. Sinclair was now running his own show again, and his volatile temper, which had grown more stormily unpredictable through the NEB period, was replaced by a quiet calm.

The rights to the Enterprise calculator and the TV1B, together with all stocks of parts and assembled products, were sold to Binatone for around £1m in August 1979. Binatone were to produce the set, but never did. The NEB paid off all the creditors, set up the instruments side as Sinclair Electronics in September under the control of three directors, and completed the hiving-off process in February 1980. In 1985 the instrument side was still trading steadily. The last connections with Radionics were severed in December 1984, when the agreement with the NEB by which they serviced calculators and television under the Sinclair Radionics guarantees ceased, although ironically it has repurchased from Binatone

some of the stocks of the 2-inch television tubes for use in the oscilloscopes it still makes.

The NEB had poured £7.8m, which at the time represented its largest-ever loss, into Radionics. Sinclair's subsequent comment that 'the loss was needless, we weren't losing much money, and a lot of that £7.8m was in write-off costs' seems to beg the question. It was certainly written off by the NEB, but the man they backed, while obviously absolving himself, can hardly expect others to agree with his view. The man who was to become 'Maggie Thatcher's favourite entrepreneur' helped provide ammunition for the incoming Tory government's dismemberment of the NEB, he himself walking away, with the plaintive cry of '*my case was very, very seriously mishandled*' (Management Today, March 1981) serving as his excuse. Derek Holley put it another way:

There is no doubt in the minds of many of us who worked with Clive Sinclair that there are some things that he's done that wouldn't have been done if he hadn't been around. Some things have been achieved, but it's this approach to the whole business that all the things that have gone wrong are nothing to do with him, or the way he tried to organize his business; they're to do with outside factors, and not only outside factors but outside people. That to some extent is a criticism of those of us who worked for him. He washes his hands of the £8m that the NEB lost, which is quite galling to those of us who saw what was going on. [The NEB] could have just put the company into proper liquidation. The attitude to Clive publicly would have been a lot different if that had happened. (Interview, 13 November 1985.)

The whole long saga of the interaction between Sinclair and the NEB is now told. We now move on to our hero's next endeavours...

[4] SCAMPS AND SCAMS: THE BALLAD OF THE MK14

While the events of the last chapter were gradually moving towards the day when the NEB-Sinclair partnership became so fraught as to be unworkable, in Cambridge activity was afoot that would provide Sinclair with a corporate base on which to build a new empire. Like many small businessmen, Sinclair had taken the precaution of acquiring an off-the-shelf company, Ablesdeal Ltd, which was set up in September 1973. The object of this exercise was simply to have the capacity to start trading without experiencing the delays of formal incorporation. The first signs that Ablesdeal had ceased to be a precaution and was beginning to be considered as a serious option was when in February 1975 its name was changed to Westminster Mail Order Ltd and then again, in August of the same year, to Sinclair Instruments. It was under this last name that the fledgling Sinclair company launched the first of a range of products that would come to include the world's bestselling line of microcomputers.

The introduction of cheap home computers into the UK is popularly regarded as the single most important product of Clive Sinclair's innovative vision. However, a careful examination of the facts surrounding the launch of the ZX80, the forerunner of the incredibly successful ZX81 and the monumentally successful ZX Spectrum, reveals an unsung hero of the microcomputer industry.

Today, Ian Williamson is a highly paid executive with Leyland in Coventry, but back in the summer of 1977 he was one of the many electronics undergraduates whose talents were promoted and marketed by Cambridge Consultants. At the time Williamson first crossed paths with Clive Sinclair, the young electronics engineer was exhibiting all the symptoms of a die-hard enthusiast. Although his work with CCL centred around the solution of the day-to-day problems presented by the company's clients, Williamson could hardly fail but be influenced by the entrepreneurial environment in which he worked. Since he was in daily contact with men such as Clive Sinclair and Chris Curry, it would have been difficult for someone of Williamson's talents to escape the conclusion that there was money to be made from the new technologies. Furthermore, like any electronics

enthusiast of the day, Ian made it his business to keep abreast of developments in the States, and it was in the US hobbyist magazines that Williamson noted a market trend that so far remained unexploited in the UK. At the risk of sounding melodramatic, the implications of this modest observation would transform the face of consumer electronics in this country for the best part of a decade.

In 1977, the US electronics magazines were beginning to promote the earliest type of home computer kits. These products were primarily directed at the electronics enthusiasts who were bored with the construction of hi-fi-related products and equipment that simply promoted an incestuous exploration of the hobby itself (multimeters, oscilloscopes, etc.). Although calculator and digital-watch kits initially offered a way around this impasse, Williamson suspected that computer kits held the promise of an entirely new market. The intellectual challenge of a new technical practice, especially one like computing, which came with a built-in mystique, would almost certainly prove irresistible to even the most jaded obsessive.

Williamson had noted that garage entrepreneurs were importing US computer kits into Britain, but realized that relatively high prices ensured that the technology remained in the hands of institutions and the very well-heeled hobbyist. In 1977, simple kits offering an unknown quantity for around £200 were hardly likely to constitute an impulse buy. The young engineer decided that the key to transforming a specialist fetish into a product for the electronics enthusiast depended on whether or not anyone could bring the price of such kits to below the magic £100 mark.

In the early days of the home-computing industry, the progress of the technology took its lead from the world of hobbyist electronics. Developments and innovations tended to be passed on in a spirit of camaraderie from one enthusiast to another in an environment endearingly devoid of self-interest. It seems impossible to believe that such an era existed when one considers the atmosphere of tabloid paranoia and obsessive secrecy that currently surrounds today's microcomputer industry. But such was the climate during the hacker's heyday and, consciously or not, the early pioneers of the industry tended to adhere to the US micro guru Denis Allison's manifesto, 'Let's stand on each other's shoulders, not on

each other's toes...' This atmosphere of new-age idealism goes some way towards explaining why Ian Williamson took what, by today's standards, was the incredible step of delivering the fruits of his brainwave into the eager hands of Clive Sinclair and Chris Curry.

We should emphasize that Ian Williamson's project, although inspired, was hardly fuelled by a heartfelt desire to bring the wonders of technology to the masses. As we shall see, philanthropists were pretty thin on the ground in the Cambridge of the 1970s. In the summer of 1977, Williamson had already made up his mind to quit Cambridge Consultants Ltd, and had been offered a secure and lucrative post at Leyland Vehicles. In his spare time, he had developed the working design for a cheap microcomputer, or more accurately a microprocessor trainer, for which he saw a promising commercial future. The machine was created from an imaginative mutation of components found in a Sinclair calculator blended with a few others. However, for Williamson the project seemed like a case of bad timing, since the impending job with Leyland precluded the possibility of marketing the product himself. Williamson maintains that at the time the only way to make a success of a new-wave consumer electronics product was by setting up with one of the Cambridge cliques, impossible unless he decided to pass up his move to Coventry. In the event, he chose the safer of the two options and, given Sinclair Radionics' association with Cambridge Consultants and the origin of the prototype's components, it was natural that he should have taken his idea to Chris Curry and Clive Sinclair, as well as a couple of other Cambridge-based companies. Since everyone was aware that Radionics was sinking fast, it was also understandable that the veteran entrepreneurs should be approached by way of their new commercial identity, then known as Sinclair Instruments.

As we have seen, in the autumn of 1977 Sinclair was preoccupied with the battle between Radionics and the NEB, or rather between Clive and the short-sighted bureaucrats. Sinclair's endgame tactics included the formulation of corporate and commercial strategies that would ensure his personal survival after what by now he regarded as his inevitable departure. Certainly it was an open secret that Sinclair Instruments was to serve as a corporate 'lifeboat' for Sinclair and those loyal to his cause. Sinclair encouraged Chris Curry's departure from the corporate mire that was

Sinclair Radionics shortly after the NEB took control, and from this point on his trusty henchman was able to devote his full attention to the development of the new enterprise. Thus, although he never officially resigned from Radionics, the termination of relations between Curry and the company presumably became clear to the NEB when he borrowed some money and rented offices for the new company in King's Parade, Cambridge. John Pemberton remembers the new company as '*a hobby for Clive. Clive was operating it and Chris Curry was dealing with the problems of it.*' (Interview, 23 October 1985.)

It is important to remember that at this time one of the main bones of contention between Sinclair and his NEB partners centred around the latter's problems in marketing the Microvision. The miniature television, even in its early manifestations, can be regarded as one of a handful of products whose development and public acceptance were (and remained so until recently) critical to Sinclair's image of himself as an innovator, new-wave entrepreneur and hi-tech prophet. For Sinclair, the sole value of the shell that was Sinclair Instruments was as a money-spinner that would generate the R&D funding for the creation of the products that would confound his critics. In effect, Sinclair Instruments would continue the work of Radionics and its interim products were simply the means to a well-defined end. Avoiding the crippling burden of Radionics' debts and the galling position of being ultimately under the control of others was one reason why the new company became increasingly important for Sinclair. The other associated motivation for wanting to get Sinclair Instruments on the road is likely to have been the desire to get the first computer products that fell within the beloved consumer electronics ethos on to the market. Certainly the NEB-funded Radionics computer project was directed towards mainstream computing, of the Apple variety, rather than cut-price consumerism, although doubtless valuable to Sinclair in terms of the research and development knowledge it produced.

By the time Ian Williamson enters our story, Chris Curry had initiated the first Sinclair Instruments product, setting the company on its path towards a realization of Sinclair's vision. In retrospect, given the company's lofty aims, it's mildly depressing to record the form in which the new age was heralded. The beast in question was known as the Wrist Calculator and,

when it appeared, boasted a design that could charitably be described as an eyesore in black plastic. To be fair to John Pemberton, the moonlighting Radionics designer who must take responsibility for the appearance of this unfortunate creation, the calculator was rushed out at top speed and was probably the best that could be done with the components at hand. Sinclair Instruments was set up as a last-ditch sanctuary for a desperate team whose futures depended on their ability rapidly to generate a healthy cash flow from meagre resources. A return to the earlier user base of the mail-order hobbyist product, based on the Radionics calculator design experience, was in order.

Curiously, in spite of its aesthetic and technical shortcomings, the infamous Wrist Calculator fulfilled its role admirably. Incredible though it might seem today (an incredulity that one suspects must have been experienced at the time by the calculator's creators), more than 10,000 kits were ordered by masochistic hobbyists from all parts of the globe. Contemporary reviews of the kit suggest that its construction demanded much the same dedication required for the solution of a Rubik's Cube. It was extraordinarily tricky to assemble and, once completed, there was only a fair to middling chance of it working. John Pemberton recalled that it was designed to 'minimal tolerances', which meant that only if you were lucky enough to get a set of parts all of which were at or below the mean size of the prototype's components could you get it to fit within the case. So, against the odds, Sinclair Instruments had kicked off to a profitable start. By way of celebration, in July 1977 the company name was changed yet again, this time to Science of Cambridge.

It seems unlikely that anyone would have derived much of a sense of security from the knowledge that his or her livelihood depended on the earning power of a dodgy calculator. If the company was to have a future, its dependants were going to have to come up with reliable and innovative products. And, if the Wrist Calculator is anything to go by, in the early days of Science of Cambridge good ideas were pretty thin on the ground. A partial explanation for this paucity of creative drive is that the Sinclair team had come to rely on Clive to mastermind the direction of product development. At this time, although Sinclair's heart may have been with the new venture, his working day was devoted to keeping track of events at

Radionics as the company slipped from his control. Constantly on the defensive and increasingly forced to live with the consequences of other people's decisions (a situation he has repeatedly described as intolerable), Sinclair was hardly in any shape to fulfil his customary role as tireless innovator. Furthermore, a year of substantial state funding had encouraged him to think big when looking to the future, and the decidedly limited financial resources of Science of Cambridge would undoubtedly have cramped his creative style. In short, at a time when the new company desperately needed a breadwinning product, Sinclair's mind was still preoccupied with the dreams of the past and distracted by the corporate crises of a decidedly unpalatable present.

Away from the boardroom intrigues and Titanic spirit that marked Sinclair's final year at Radionics, Chris Curry was in a far better position to appraise the market and make the kind of decisions that would secure a viable future for Science of Cambridge. Thus, when Ian Williamson turned up on his doorstep with the idea of marketing a cut-price computer kit, Curry immediately saw a chance to jump ahead of the competition in the world of hobbyist electronics, while at the same time sticking with a market and a technology with which the company was familiar. Curry has always insisted that at the time Sinclair was totally uninterested in computers, and it was only his own commitment to the project that finally persuaded Clive to give Williamson the chance to put his theory into practice. As we saw in the last chapter, this seems unlikely, in the light of Sinclair's declared R&D objectives over at Radionics.

Whether Sinclair was behind the project or not, the fact of the matter is that soon after Williamson's demonstration of his initial creation, Curry was sufficiently impressed to provide the engineer with the necessary resources for the construction of a prototype suitable for production in terms of, surprisingly enough, defunct Radionics calculators. Williamson recalls:

You see, they wanted to do it on the cheap. They had a lot of redundant components from obsolete Oxfords and Cambridges [Radionics' calculator lines] and Curry wanted me to see if I could come up with the same sort of thing as my prototype using different components. (Telephone interview, 28 October 1985.)

Why it should be of any advantage to Science of Cambridge to use the same components that formed part of the defunct stock-in-trade of an entirely separate and state-owned company is not apparent. Perhaps Sinclair was going to bid for the crippled calculators from which recyclable parts could be extracted, in line with his old scavenger inclinations, or perhaps an unfortunate confusion had arisen concerning who was working on what, and for whom. Some light is perhaps shed on the state of affairs by Norman Hewett's comments when asked if Chris Curry had been engaged on Radionics work during his tenure:

While I was there, I occasionally had an emissary come up from the stores and places like that, saying Chris Curry is around again, at the stores, and wanted to take out so-and-so. I said, 'Who is this fellow?' and they'd say that he had worked for us. My response was, 'So what's he doing in our stores then? Tell him he's not welcome, and if he wants anything he must come to see me.' As far as I know, he certainly wasn't working for Sinclair Radionics Ltd, but whether he was quietly working with or for Clive and using Sinclair Radionics components I don't know. He wasn't in our stores for his health! Certainly Clive didn't give the impression that Curry was working for Sinclair Radionics - he had no comment about my chucking him out of the stores. (Interview, 16 October 1985.)

Component source and ownership aside, it's worth emphasizing that Williamson worked on the design of the kit in his own time, and that the computer was never intended as an item to be marketed by Cambridge Consultants. Indeed, as far as one can tell, Williamson's employers knew nothing of the project at the time; the idea was simply to make a little pin money out of the Cambridge scene before the move to Coventry. The engineer finally managed to cobble together a working prototype, and judging from its inventor's disarmingly modest description, it seems that the electronic equivalent of a silk purse somehow emerged from a heap of silicon junk whose equation to a sow's ear would constitute an insult to pigs: *'I made the original prototype based around a Sinclair Cambridge [calculator] that I bought in a shop somewhere.'* (Telephone interview, 28 October 1985.)

As we have seen, Williamson set about his R&D with low cost as one of the central considerations determining his design, which was further constrained by the decision to limit the choice of components (other than the microprocessor chip, and memory) to those which could be found in existing Sinclair Radionics products. One of the most impressive results of Williamson's labours was that he managed to create a computer that accepted hexadecimal input entered via a standard calculator keyboard. Without going into details, this involved basing the machine's software around octal notation, which, even today, the self-effacing Williamson concedes is an achievement of which he is proud.

In retrospect, it's tempting to conclude that ironically it was the chip choice that, despite the prototype's imaginative design and, even by today's standards, extremely clever software, explains why Ian Williamson's name is unlikely to crop up in any account of the early development of microcomputing in the UK. Like the American kits that provided Williamson with the original inspiration for his project, the enterprising engineer used what was known as a 'Scamp' chip (the National Semiconductor Microprocessor or National SC/MP) at the centre of his system. Designed and originally marketed in the States, this interesting little chip never really caught on with manufacturers on either side of the Atlantic. However, if we assess Williamson's choice of chip in the context of the era in which the product was being developed, the wisdom of opting for a Scamp-based design soon becomes apparent. For a start, the chip already had a proven track record as the centrepiece of comparable US products and by the standards of the day was unusually low-priced. In addition, the Scamp boasted an incredibly simple architecture for an 8-bit microprocessor of the 1970s, and thus for the novice was encouragingly easy to use and program. In short, and in the words of a contemporary assessment of the chip, '*For the homebrew enthusiast, the SC/MP is a good choice.*' (Byte, July 1978.)

It should be stressed that the machine Williamson demonstrated to Curry would appear incredibly primitive if placed alongside even the simplest of today's home computers. Readers familiar with the units by which a computer's memory is measured will be amused to learn that the commercial implementation of Williamson's idea proudly boasted 256

bytes of RAM (random-access memory)! For the uninitiated, suffice it to say that today's home micros specify memory size in units of just over 1000 bytes (K), and that no self-respecting hobbyist would even consider a product offering less than 49,152 bytes (48K) of memory.

Following the example of the designers of the US computer kits, Williamson deliberately restricted his machine's capabilities in an effort to keep down the price. It is quite clear that this early micro was never intended to be much more than an educational aid. Certainly Williamson's book about the machine emphasized its value as a tool for learning about the way microprocessors work, and never claimed that it offered a computing power that was of any practical use.

Chris Curry realized that if Science of Cambridge was to reap the advantages of launching a promising product into a virgin market, he was going to have to move fast. Williamson's prototype had already been seen by a number of other companies, and there was always the chance that someone else would have the guts to snap up a new idea. Curry and Sinclair agreed that it was time to formalize an agreement with Williamson. Sinclair arranged a hotel conference with the engineer and contractual conditions were discussed and agreed. Science of Cambridge would license Williamson's design, for which the company would pay a flat fee of £5000. The inventor would also receive royalty payments according to the number of units sold. Shortly after his meeting with Sinclair, Williamson received a contract detailing the licensing deal he had agreed at the meeting. This he signed and returned to the King's Parade offices. All that was required for the deal to be formalized was for Williamson to receive a copy of the contract bearing Sinclair's signature. It never arrived.

Williamson's project has been chronicled in detail in an attempt to clarify the circumstances in which his prototype was produced and to facilitate an informed assessment of subsequent developments. By now the reader should be able to appreciate that Williamson was essentially selling an idea whose commercial value was bolstered by the existence of a working design based around an American chip. The fact that the prototype made use of Sinclair components is almost irrelevant, apart from showing yet again Sinclair's recycling instincts and the fact that they were almost

certainly the cheapest available components. Considering the relationship that existed between the two companies, Williamson is hardly likely to have argued that it was of any benefit to Science of Cambridge that the production of his machine required the purchase of components that might possibly be held in quantity by Sinclair Radionics. He was selling an idea for a product whose economic and technical viability was confirmed by the prototypes he built and demonstrated. Clearly any company that decided to market Williamson's design would first take the precaution of costing each of the product's components, and at the same time shop around for cheaper alternatives. Obviously, if a selective substitution of components could reduce production costs, it would be acceptable for the manufacturer to request the designer to make any reasonable modifications required by the inclusion of the new components. Such situations are common enough to merit a standard clause in most licensing agreements.

Such considerations hardly seemed relevant in the case of Williamson's machine. There were only two elements of the hardware design whose replacement would effectively invalidate the brilliant software that established the uniqueness of Williamson's work. The first of these was the Scamp chip itself, which defined the machine's limitations and the way in which it could be programmed. The replacement of this chip would effectively mean the creation of an entirely different machine tailored to the idiosyncrasies of a new microprocessor. The second hardware feature on which the rest of the design depended was the inclusion of a standard calculator keyboard for the communication of hexadecimal input. As we have already mentioned, Williamson laboured over almost insurmountable problems in his determination to use an existing keyboard in his design. Ever conscious of production costs, he reasoned that a unique keyboard would require a unique production process. It would surely be cheaper to take advantage of an existing process that was churning out what could become a dual-purpose component. So a software design based around octal notation was eventually programmed on to the ROM (read-only memory) chips, which allowed hexadecimal instructions to be communicated via a standard Radionics calculator keyboard. Any decision to change the keyboard would mean the design of an entirely new input/output (I/O) program.

Williamson sat around waiting for the contract that was never sent. Finally, he received a phone call from an uncharacteristically edgy Curry. With a profusion of apologies, Christopher gallantly faced up to his responsibilities as the spokesperson for Science of Cambridge, and informed Williamson that the deal was off unless he was prepared to modify his original design. The engineer made it clear that he was prepared to consider any reasonable changes that Sinclair and Curry deemed necessary. It was explained that the calculator keyboard was to be replaced by one that made use of an economical membrane design, and that Williamson's I/O software would have to be modified accordingly. Williamson explained why such changes were impossible since they demolished the foundations on which the machine had been designed.

Science of Cambridge had changed its plans in the light of an offer from National Semiconductors (NS), the firm that manufactured the Scamp chip at the heart of Williamson's design. With a thoroughness to tempt tedium, we have established that because of the circumstances in which it was produced, Williamson's prototype made use of components that originated from a variety of sources but which, for the most part, were unexceptional enough to be replaceable when necessity demanded the application of a little creative substitution. When Curry approached National Semiconductors to negotiate the purchase of the first batch of Scamp chips, the Americans turned round and made the latent millionaire an offer he couldn't refuse. They offered to redesign the kit for the Brits free of charge. The idea was that the capabilities of Williamson's prototype would be realized in a product built exclusively from National Semiconductor chips.

Such a deal made obvious business sense to both parties. The Americans would be able to sell a product that would succeed only to the extent to which it was used - which in the case of the Scamp chip was hardly at all. In addition, although the primitive microprocessor had turned out to be a lost cause with the folks back home, there was a chance that it might catch on in Britain if adopted by high-profile whizzkids like the boys at Science of Cambridge. Finally, a redesigned product which made exclusive use of National Semiconductor components multiplied the original unit sales offered by the Williamson design by the number of components required in the NS design. All it would cost NS was the price of a new design.

The final National kit used the same processor, the same instruction set if you like, the same display and had the same memory size. Apart from that the hardware design was not similar because National tailored it to the products they had available. They already sold kits over here and in the US. You have to remember that my idea had been to make it as cheap as possible — right down to using a Cambridge [calculator] keyboard. (Ian Williamson, Interview, 29 October 1985.)

The attraction of the NS deal for Sinclair's company should be obvious. The logistics of manufacturing a product that requires components from a variety of sources are often unworkably complex. As the Sinclair team had learned from bitter experience, it needed only a single source to foul up and the entire production process could be brought to a standstill. Although delays in fulfilling orders were by now regarded as almost a defining quality of any Sinclair operation, any situation that diminished the risks of such difficulties would have been embraced with enthusiasm. It would clearly be easier to control the supply of components from a single source than attempt to plan production according to predictions concerning the reliability or otherwise of a large number of small suppliers. It would be reasonable to assume that the NS deal also provided Curry with an opportunity to negotiate a cut-price deal, since it could be argued that Science of Cambridge would be purchasing a large part of the American company's range in the kind of quantities that justified job-lot rates. Finally, Chris Curry has something of a reputation for his ability to bank the fruits of a competitor's weakness, and is unlikely to have pulled his punches when negotiating a deal that centred on a chip he knew National Semiconductors was desperate to promote in the UK.

As far as Science of Cambridge was concerned, the NS offer provided the company with an irresistible opportunity to make a fast and unusually respectable return on a relatively modest outlay. The only thing standing in the way of a straightforward deal was Ian Williamson. At this stage in the proceedings it would have been tempting to push to the back of the mind the fact that it was Williamson who had initiated the project and brought it to fruition.

From the security of life near the top of a national institution, Ian Williamson clearly feels that he can afford to be generous when looking back on his life in the Cambridge of the 1970s. These days he's sufficiently sanguine to be able to dismiss his experiences as a young inventor and aspiring entrepreneur as simply the first of many tough lessons that make up a commercial education. It's clear that Williamson has never regretted his decision to forsake the life of the inventor, which under the circumstances is hardly surprising.

Williamson insists that when Sinclair backed off from the deal they had agreed in favour of the NS option, his bitterness was primarily directed at the American company rather than the management of Science of Cambridge:

I was never particularly pissed off with Clive. If anything I think I was pissed off with National Semiconductors. You see, considering what NS were offering and the state of the company [Science of Cambridge] at the time, they [Sinclair/ Curry] were faced with an offer they couldn't really refuse. I was pissed off with NS for having the sense to offer Sinclair a design which only used components which could be ordered from one place. (Interview, 29 October 1985.)

In June 1978 Science of Cambridge launched a microcomputer kit based around the National SC/MP chip. The machine was marketed as the MK14, and the features it offered were identical to those of the prototype Ian Williamson had demonstrated to Chris Curry the previous summer. In the words of Williamson, the launch of the machine and the familiar post-natal depression that followed bore all the hallmarks of a 'typical Sinclair flop'. An inability to fulfil the first batch of orders inspired by the launch was, as usual, compounded by the effects of the extravagant advertising campaign by which it was preceded. Science of Cambridge had instructed National Semiconductors to produce a mere 2000 sets of components for the launch of the machine. It seems likely that this conservative launch stock was partly a reflection of the financial plight of the new company, and partly an indication of Sinclair's doubts about the potential of the home-computer market. In any case, the punters' donations flowed in to fill the corporate coffers, but little in the way of product flowed out of the company's doors.

In the age-old tradition of a Sinclair launch, supply immediately collapsed from the shock of attracting an encouraging level of public interest. Anyway, the first 2000 MK14 kits were no sooner packed than dispatched, after which eager customers were invited to kick their heels while the NS manufacturing machine was brought back to life, funded by the punters yet again.

In its short, sweet life as the UK's first cheap computer kit, the MK14 design was sold into between 10,000 and 15,000 homes. The rights of the manual Williamson had written for his machine were bought by Science of Cambridge and the book included as part of the MK14 package. It is clear that the company's principals were less than comfortable about Williamson's reward for his labours and enterprise, since Sinclair felt obliged to fork out the princely sum of £2000 for the right to use the engineer's documentation.

The unexpected success of the MK14 directly influenced product development at both Radionics and Science of Cambridge. At the former, it stimulated the development and design work on a more sophisticated home computer, a decision that, many years later, resulted in the appearance of the ill-fated NewBrain, and rather sooner, the ZX80. The Science of Cambridge followthrough was considerably more modest. The company churned out a small range of products that enabled the hobbyist to upgrade the basic MK14. There was the VDU Module (£33.75), which enabled sixteen lines of thirty-two characters to be displayed on a UHF television. To this was added the Cassette Interface Module (which allowed programmers to save programs to magnetic tape), the Prom Programmer, and a power supply to drive the expanded system.

According to the first editor of Personal Computer World magazine, Dave Tebbutt, the success of the M K14 was one of the major inspirations behind the decision to launch the UK's first home-computing magazine. It was undoubtedly also a contributory factor in Chris Curry setting up Acorn Computers some time in 1978, thus continuing the entrepreneurial splintering that his mentor Sinclair had taught him. Indeed the first Acorn product, the System 75, was remarkably akin to an enhanced MK14.

There was a more direct sense in which the MK14 hinted at the shape of things to come. The early hobbyist who cobbled together the complete MK14 system had before him the heart of the kit's legendary successor. The Scamp was ditched and replaced by the Z80 A chip; the easier BASIC language replaced hexadecimal numeric code and provided programmers with a less cumbersome method of communicating with their machines. But such factors aside, in every expanded MK14 the essentials of a ZX80 lurked, waiting to take the world by storm. Well, almost...

[5] THE ZX80: A NEW MEANS TO AN OLD END

One of the unshakeable tenets of microcomputing mythology insists that Sinclair's ZX80 computer kit established the parameters of price, computing capacity and marketing stance that shaped the entire first generation of home micros. There are many who regard this as a laudable achievement, while others, like respected computer journalist and author David Ahl, refuse to regard Sinclair's influence as a necessary good: *'Sinclair ZX80: with an unusable keyboard and a quirky BASIC, this machine discouraged millions of people from ever buying another computer'* (Personal Computer World, October 1985.)

Although none would dispute the machine's limitations, the ZX80's launch is nevertheless regarded as heralding a new era of consumer electronics. This is not to say that the Sinclair machine was by any means the first personal computer to be marketed in the UK. In 1979, a number of US products were providing the foundations for a growing number of retailers specializing in computing equipment. For example, Tandy's TRS-80 was on offer for just under £500, while bargain-hunters could pick up a Commodore PET for around £450. However, high prices ensured that the emphasis was on 'personal' rather than 'home' micros, and the majority of imports was aimed at the business and academic market.

As we have seen from the MK14 saga, Sinclair has never been particularly interested in the machines that made him a millionaire. Nevertheless, it is still easy to forget that it was only by default that computers - for many the quintessential emblem of new-age technology - became a part of Sinclair's vision of the future. As a result, one of the incidental problems plaguing any attempt to chronicle the development of the Sinclair companies is that the man himself assumes little more than a cameo role in the creation of the products with which he is popularly associated. One of the most consistent characteristics of Sir Clive's business career is that he has allowed his personal obsessions to determine corporate strategy, rather than making any serious attempt to address consumer demand. Norman Hewett's assessment of Sinclair's approach to his market during the Radionics era is equally applicable to subsequent developments at Sinclair Research:

Marketing-wise, the situation was quite extraordinary, in that I tried tactfully to inquire how we knew what the customers wanted, and who, indeed, the customers were supposed to be! This was greeted by a very marked lack of enthusiasm by Clive, who was quite convinced, and is to this day, that he alone knows what the customers want. And that what they will want is ingenious, and difficult to make, by definition. (Interview, 16 October 1985.)

Hewett's view of Sinclair's attitude to market demand is one of the few plausible explanations of Sinclair's obsessional preoccupation with commercially dubious projects such as the flat-screen television and the electric car. Although it's tempting to consider the cost of such an approach solely in terms of the millions sunk into fruitless research, at least as important is its disastrous effect on the formulation of strategic priorities for the companies. Because of Sinclair's lack of interest in home-computer products, in the post-Radionics era, there has been a tendency within his companies to neglect the sole area of the consumer electronics market in which he managed to establish a significant market lead.

Every profile of Clive Sinclair contains a reference to the man's determination and drive. In the spring of 1979, when Sinclair realized that it was only a matter of time before he and Radionics parted company, it is unlikely that Sinclair was particularly concerned about losing a company that he had built up from scratch. His companies are simply a means to an end, and in 1979 the goal in question was still the success and public acceptance of the miniature television, just as it had been when he first approached the NEB. The loss of Radionics simply amounted to a cessation of the funds required for the realization of his dream. Friends and commentators alike seem to agree that Sinclair has little interest in the acquisition of wealth for its own sake. PCW's Dave Tebbutt, a personal friend of Sir Clive, is adamant that while he will spend - and spend lavishly - if there's money around, wealth becomes an issue for Sinclair only when its absence inhibits the pursuit of his obsessions. Speculating on Sinclair's state of mind when faced with the spectre of commercial impotence following the loss of Radionics, Tebbutt is certain that such circumstances would merely have strengthened Sinclair's resolve. This view appears to be

supported by a description of the period immediately following Sinclair's departure from Radionics:

At this point Sinclair became profoundly calm. His irascibility vanished; he was, according to his mother, 'charm itself'. Nigel Searle recalls him musing, 'I really wonder whether I ought to be feeling as good as I do', and those who knew him were puzzled enough by his serenity to recall it afterwards as noteworthy ... After the collapse, Sinclair felt free to rebuild his success with exhilarating speed and single-mindedness. (Fortune, March 1982.)

This 'single-mindedness' had little to do with the need for personal financial security or the bolstering of self-respect in the aftermath of what many would regard as an era of significant failure. Instead, Sinclair's energies were devoted to generating the capital required to pursue the research uninterrupted by the shortsighted obstructions of the NEB.

In 1979, as in the years to follow, very little of Sinclair's attention was focused on the problems and potential of developing and exploiting the home-computer market. The products that were to determine his business strategy and hold his interest in the post-Radionics years were flat-screen televisions, electric cars and, later, wafer-scale chips and portable phones. However, when circumstances dictate, even the purest of visionaries must resign himself to the strictures of pragmatism - or, in this case, the realities of consumer demand. The limited but encouraging success of the M K14 suggested an untapped source of revenue that could be profitably mined without exhausting the decidedly limited resources of Science of Cambridge.

In short, the ZX80, Sinclair's response to the success of the MK14, was born of commercial necessity; that the machine spawned a range of home computers that revolutionized the consumer electronics industry must be regarded as the triumph of fortune over intent.

John Rowland, then with W. H. Smith, first met Sinclair in 1980 when exploring the viability of marketing the ZX80 through the high-street stores as part of the company's move into consumer electronics. Rowland is convinced that initially computers were intended to play only a supporting

role in Sinclair's plans for the new company: *'The company was set up to develop the flat-screen TV; the computers came almost by accident. They were just produced to fund the TV project'* (Interview, 18 October 1985). In an interview with the Sunday Times in April 1985, Sinclair himself acknowledges the irony of the genesis of the ZX range of computers, and confirms Rowland's impressions: *'We only got involved in computers in order to fund the rest of the business.'* An earlier interview with Martin Hayman reveals an ambivalence verging on indifference as far as computers are concerned:

I make computers because they are a good market, and they are interesting to design. I don't feel bad about making them or selling them for money or anything, there is a demand for them and they do no harm; but I don't think they are going to save the world. (Practical Computing, July 1982.)

Sinclair's opinion of the most successful products his companies have produced and his motivation for entering the market in the first place is significant only in the light of subsequent events. After all, there's no particular reason why any entrepreneur should be especially interested in the products he or she markets. However, Sinclair's inability to isolate his personal predilections from corporate strategy is axiomatic to an understanding of his business failures, as will become clear later.

Rodney Dale, in *The Sinclair Story*, conscientiously reiterates the received truths celebrating the ZX80 as a revolutionary concept in microcomputer design. He even suggests that Sinclair and Chris Curry parted company over Sinclair's determination to stick to his principles as an innovator. According to Dale, *'It was on the question of quality that Sinclair and Curry diverged.'* As the ZX story develops, it becomes increasingly difficult to imagine what Sinclair had in mind when addressing that 'question of quality'. Certainly Curry left Science of Cambridge in 1978 to set up his own company, Acorn Computers, and in 1979 launched the Acorn System 75. In contrast to the pioneering design concepts behind the ZX80, Dale feels safe dismissing the Acorn machine as *'little more than an M K14 with a proper keyboard'*.

Whatever the System 75's failings, in many respects Dale's description is equally applicable to an assessment of the ZX80's hardware. John Grant, the owner of Nine Tiles Information Handling Ltd, whose company was responsible for the machine's software, suggests that the only sense in which ZX80 hardware was an improvement on that of existing kits was that it was encased in injection-moulded plastic. When fully assembled the majority of kits, like the Nascom and indeed the M K14, were used with their boards exposed. In short, it is incorrect to think of ZX80 hardware as in any way innovative. According to Grant, even the much acclaimed television monitor circuitry can hardly be attributed to the imagination of Sinclair R&D. This cheap and imaginative solution to an old problem is strikingly similar to an electronics project in an American book called *The Video Cookbook*. It's worth stressing that although the ZX80's video circuitry is clever and undoubtedly innovative, it offered an economic rather than efficient solution to the problem. As a consequence, many ZX80 users who progressed to bigger and better machines were amazed to discover that a flickering display was a characteristic of the machine and not a fact of computing life.

It is not our intention to in any way detract from Sinclair's success in marketing the ZX range of computers. What is important is to be precise in our recognition of the components of that success. The ZX80 did not represent a development of existing technology, merely its competent application. Thus this particular product does nothing to support the popular image of Clive Sinclair the inventor. Indeed there is nothing in the development of the entire ZX range to suggest that he had even the slightest interest in performing such a role. When summing up Sinclair's technical role in the creation of the ZX80, John Grant recalls:

Clive didn't have a big involvement. He knew the kind of machine he wanted and the market he wanted to sell into. His interest was in checking around to find the cheapest components for the job. (Interview, 8 September 1985.)

Although the ZX80 reveals no evidence of technical innovation on the part of Sinclair or his R&D department, the machine's success is a testament to the company's remarkable marketing achievement. By tailoring the

computer's capabilities to what could be achieved using the cheapest components available, Sinclair was able significantly to undercut the competition. The low price tag offered a potential expansion of the market, but such an audience would have to be encouraged to sit up and take notice. So the unsightly innards of the ZX80 were hidden by white and blue plastic, and computing was promoted as a meal ticket to the future. The micro had begun its drift from the world of the hobbyist into the mainstream of consumer electronics. Seven years earlier, Radionics had helped perpetrate a similar shift in the market image of a commodity. With technology diminishing size and price, the promotions ensured that the calculator ceased to be a tool exclusive to the labs and came into use in business, ultimately descending into the hands of the student. Sinclair's packaging and advertising eased each transition, soothing consumer anxieties while opening new markets.

While technically insignificant, the ZX80 is important as the machine that formed a bridge between the demands of the hobbyist and the toys-of-technology ethos of consumer electronics. Certainly the second half of this assessment is shared by Sir Clive himself, who in 1982 explained:

When we introduced the personal computer, there was no doubt we would sell some in the hobbies market, but we also went out with advertising promotion to the man in the street, on the grounds that there would be a completely new market there. (Director, July 1982.)

By 'the man in the street' Sinclair presumably means the 'middle-class male professional' with a taste for technological chic. After all, just under £100 for an image accessory was beyond the pockets of the inhabitants of humbler streets. This is partially confirmed by subsequent surveys, which revealed that the first purchasers of the ZX80 were professional males aged 25 to 40.

The kit was launched at a computer fair in the first week of February, and it was priced £79.95 (plus a further £8.95 for the power supply). The 'ready-assembled' model was launched a month later, priced £99.95. John Rowland, who at the time was W. H. Smith's marketing development manager, recalls that the discrepancy between launch dates fed the rumours that the more expensive versions were simply customer-assembled kits

returned to Sinclair for repair. Whatever the truth behind such stories, their popular currency says much about the company's image even at this early stage in the game.

Before moving on to chronicle the development of the ZX80, a word should be said about the machine's price. At the launch, both versions of the computer were significantly cheaper than anything else on the market. However, the company's ability to smash, or rather circumvent, the £100 price barrier cannot be equated to its role in the fall of calculator prices a few years earlier. It was genuine advances in technology and design that facilitated the price cuts that established Radionics as a pioneer in the calculator market. It was Sinclair's manipulation of product image that was behind the company's early domination of the home-computer market.

In designing the ZX80 as a 'crossover' product between the hobbyist and consumer-electronics markets, Sinclair's promotional master stroke was to mutate the market image of a microcomputer until it described the low-cost machine he could profitably produce. When discussing Sinclair's initial brief to the hard- and software engineers who created the ZX line, it soon becomes clear that it was the price of components that established the limitations of application, not an informed assessment of the tasks to which a home computer might usefully be applied. This impression is confirmed by Steven Vickers when describing his work with John Grant on the development of the ZX81:

As far as Clive was concerned, it wasn't a question of what the machine ought to be able to do, but more what could be crammed into the machine given the component budget he'd set his mind on. The only firm brief for the '81 was that the '80's math package must be improved. (Interview with Steven Vickers, 23 July 1985.)

One of the most conspicuous economies incorporated into the design of the ZX80 was the 'touch-sensitive' or 'membrane' keypad. To avoid incurring the relatively high manufacturing costs associated with full-sized typewriter-style keyboards, the Sinclair machines made use of a top sheet of plastic, on which simulated keys were printed, the underside of which had a printed-on metallic circuit to contact a similar sheet underneath when pressed. The size and design of the membrane keypad made it an awkward

and unreliable means of entering data; since there was no 'feel' to the keys, and no sound when they were pressed, a great deal of care was required checking whether a keypress had registered. Furthermore, with sustained use many keypads ceased functioning altogether.

Although condemned by reviewers and users alike, savings in manufacturing costs ensured that the membrane design would become a consistent feature of the ZX range, modified but never abandoned. According to Tony Tebby, one of the QL's designers, the development of the Quantum Leap machine three years later saw an inexplicable decision to stick with the unpopular, non-standard design which was clung on to with a determination verging on perversity. Given that the QL was to be marketed as a business machine and should thus offer a quality keyboard suitable for wordprocessing, it seems incredible that the company should have abandoned alternatives in favour of an enhanced, but still membrane design. A number of Sinclair's R&D team have indicated that Sir Clive himself vetoed the use of standard keyboards, insisting that the membrane design was an intrinsic part of the image of a Sinclair computer. Whatever the reasons, apart from initial savings in manufacturing costs to Sinclair Research, the only group to benefit from this policy has been the peripheral manufacturers, who have provided a wide range of alternative keyboards.

Although the basic ZX80 was relatively cheap, the realities of such economy can be judged only in the light of the final cost of a halfway useful machine. One of the most significant weaknesses of the basic computer was that it arrived with only 1K of RAM - not nearly enough memory to enable owners to write serious programs. With this in mind, Sinclair developed and marketed memory expansion peripherals, which became available just after the launch of the kit. By mid-1980, Chris Curry had co-ordinated the launch of Acorn Computer's second product, the Acorn Atom microcomputer. The assembled version of the machine was priced £330 and equipped with 12 K of RAM. Now although at first glance the Sinclair product appears to offer a far better deal, such impressions are dispelled when the ZX80 is upgraded to meet the Atom's modest memory specifications. The costing is as follows:

1 assembled ZX80 (with 1K RAM) £99.95

1 power supply £8.95

1 1K memory chips @ £16.00 £176.00

4 memory boards @ £12.00 £48.00

total £332.90

Apart from offering a larger memory than the ZX80, the Atom also arrived with a full-sized keyboard, a floating-point maths package (as opposed to the integer-only capacity of the ZX80), a potential for colour graphics and sound capabilities. Thus although the ZX80 was notionally cheap, it was also only notionally a computer when one considers the capabilities of its rivals.

When compared with subsequent Sinclair development programmes, that of the ZX80 appears smooth, fast and relatively untroubled. However, it must be remembered that although work on the ZX80 started only in May 1979, the development of the Radionics computer that would become the NewBrain had been progressing since July 1978. Since the R&D work on both machines was carried out by much the same personnel, it's clear that the ZX80 programme benefited from a year of Radionics experience. The incestuousness of the two projects is highlighted by the fact that today few of the engineers involved seem capable of remembering who they were working for during this period.

In April 1979, Clive Sinclair arranged a meeting with John Grant of Nine Tiles to discuss the development of the successor to the MK14 kit. At that time, Grant was working on the software for the Radionics computer, and Sinclair made it clear that the new Science of Cambridge project would be shaped by many of the decisions defining the machine that would later become the NewBrain programme. The Radionics machine was designed around the Z80A microprocessor (as opposed to the MK14's SC/MP), and because of the development team's familiarity with the chip it was decided to use the Z80A in the Science of Cambridge machine. Grant recalls that Sinclair's brief to Nine Tiles was mainly concerned with ensuring that software development was tailored to the limitations imposed by the components he had selected. At all times the design of the ZX80 was driven

by the goal of producing a computer that broke the £100 barrier, yet still returned a comfortable profit. The product's capabilities were of secondary importance.

It's clear that Grant's involvement with the development of the ZX80 was not inspired by expectations of significant financial gain. The feeling at Nine Tiles was that the creation of a mass-market microcomputer was in itself an exciting project, and one with which the company was interested in being associated. Given that the estimated R&D costs for the entire ZX80 project are generally agreed to have just about reached the five-figure mark, Grant's cut of such a budget would have offered his company little more than pin money. Once again, it's worth emphasizing that a major percentage of the 'creative' design work on this new Sinclair product was not performed by the company itself, but contracted out and defined by an unusually nebulous brief.

The month following Sinclair's initial meeting with Nine Tiles was particularly fraught for him, since in May 1979 the NEB announced its plans to sell off Radionics' television and calculator interests. While Sinclair was busy penning his resignation from Radionics, work started at Nine Tiles on the development of the ZX80 software. It has often been argued that the success of the early Sinclair machines played an important role in establishing BASIC as the resident computer language for the majority of home computers. In retrospect, this situation has been regretted by many in the industry, since it is generally agreed that BASIC is only moderately successful as a learning tool and positively obstructive to the development of serious programs. However, because BASIC had been selected as the Radionics computer's resident language and full documentation was readily to hand for the ANSI Minimal BASIC dialect, Sinclair instructed Nine Tiles to prepare a similar implementation for the Science of Cambridge machine. Grant remembers suggesting that a more flexible language such as Forth might offer more progressive facilities to the new programmer, but, since such an approach would have required a longer development programme, the possibility was never seriously considered.

Nine Tiles's work on the ZX80's software is generally hailed as a triumph of ingenuity over primitive resources. Given that Grant and his team had only 4K of ROM into which to squeeze the machine's operating system, editor and BASIC interpreter, the product of their labours set new standards for concise programming. Another unusual quality of the company's work was that it was completed more or less on time, an event almost without precedent in the world of R&D. The bulk of the ROM was written in the months of June and July, but the resultant code required 5K for its storage. Thus August 1979 was spent trimming the code to fit the ZX80's 4K ROM restrictions.

While the ZX80's software development can be chronicled in detail, a shroud of mystery hangs over the design of its hardware. Even at the time, Grant recalls a 'cloak-and-dagger' aura to everything associated with the machine's hardware. One possible version of the story is that Mike Wakefield, who at the time was working for Newbury to design the NewBrain's hardware, may have assisted Science of Cambridge. The hardware was not completed by the August deadline. Some participants suggest that Wakefield simply hadn't managed to design and build the circuits required, others that Newbury was threatening to cause trouble over his participation in the Sinclair project. All sources appear to agree that, by the end of August 1979, the ZX80's hardware had been handed over to the redoubtable Jim Westwood who, reliable as ever, finalized the work by the end of October.

The events of 1980 must have been extremely gratifying to Clive Sinclair. Having resigned from Radionics in July 1979, Sinclair took the £10,000 golden handshake offered by the NEB and concentrated all his efforts on carving out a future for his new enterprise. By August, still desperately short of working capital, he reluctantly parted with his vintage Rolls-Royce and sold his house. Undoubtedly, the autumn of 1979 must be regarded as one of many make-or-break points of Sinclair's career.

The launch of the ZX80 heralded a turning point in Sinclair's fortunes. In the eight months following the first appearance of the kit at the Wembley computer fair, Science of Cambridge sold 20,000 units into a virgin market. Having decided that in-house production had led to an overall inflexibility

at Radionics, with the ZX80 Sinclair initiated a policy of ‘subcontracting everything that could be subcontracted’. The early machines were put together by a small electronics company in St Ives, but before long production was shifted to the Timex factory in Dundee. This move to Scotland marked the beginning of what would become an important relationship between Sinclair and the American watch manufacturer, a cooperation that would prove more enduring than Sinclair’s commitment to home computers.

The contract between Timex and Science of Cambridge was the realization of a significant new strategy for Fred Olsen, the ‘Norwegian Howard Hughes’ and the tycoon behind the privately owned and intensely secretive Timex corporation. Myron Magnet, writing for Fortune magazine (8 March 1982), explained the problems facing the Connecticut-based company at the beginning of the 1980s:

Timex fell behind technologically as watches became digital in the seventies: unit sales stagnated, market share declined, and profits dwindled to virtually nothing by 1979. So Olsen has reason to diversify out of the mechanical watch business that has long been Timex’s mainspring.

The arrangement worked well for both companies. Although in 1980-81 the production of the Sinclair machines could hardly have generated enough revenue radically to improve the crisis at Timex, by 1982 the relationship between the two companies had reached the point where Sinclair technology was to be licensed by Timex and marketed under the watchmaker’s name in North America. Although the deal turned out to be a disaster for Olson’s company, Sinclair’s comments at the time underline the importance he placed on the link that was forged with the ZX80’s production:

I think that Timex will be making more money out of computers than watches within the next five years ... It will be a \$1-billion-a-year business for them and \$50-million-a-year for us. (ibid.)

The lack of resources at St Ives and the production delays incurred with the shift to the Timex plant in Dundee ensured that the public suffered the usual

delays associated with a Sinclair launch. As an early example of the type of complaint against Sinclair that would soon become a standard feature in the letters pages of the computing press, we'll take the case of D. J. Harper. Clearly the kind of hi-tech enthusiast the company should have been courting rather than ostracizing, the youthful Harper dispatched his cheque to Science of Cambridge in February 1980 and heard nothing for five months. Although Harper was unnaturally patient, Sinclair's announcement from the Las Vegas Consumer Electronics Show that Science of Cambridge were to market the ZX80 in the States proved too much to take. A copy of his plaintive letter was sent to Computing magazine:

Dear Mr Sinclair,

I was interested to see that you intend marketing the ZX80 in America. Perhaps before attempting to deliver to the States you could try delivering to Colchester, Essex, UK, a distance of 40 miles instead of 4000 ...

Aside from delivery problems, by the standards of subsequent Sinclair launches that of the ZX80 was relatively trouble-free. Primarily because of the relatively simple hardware design and the efforts of an unusually conscientious software team, the percentage of returns was the lowest of virtually any Sinclair product - official sources put the figure at around 1 per cent. By and large, the first purchasers of the ZX range seemed to have been satisfied with their investment in the new technology. There were occasional complaints about the keyboard, and everybody agreed that the ZX80, like its immediate successors, was prone to overheating. Author Tim Hartness, in nostalgic mood, recalls:

I'm not sure that programming will ever be like the 'old days'. It may sound silly, but I used to enjoy finding out about the ZX80 while I balanced a frozen milk carton precariously on top to cool it down! (Your Spectrum, May 1985.)

In September 1980, Science of Cambridge released a 16K RAM pack which enabled owners to significantly expand their machine's memory without the problems and expense of multiple chips and expansion boards. At £49.95 the RAM pack was considerably better value than the earlier expansion options, but unfortunately its decidedly clumsy design generated

a new variety of problem. Although the new peripheral simply plugged into the back of the ZX80, thus avoiding the tortuous and unstable construction required by the earlier option, the RAM pack was dangerously top-heavy and had a habit of falling out of its socket. As far as the user was concerned, this failure of design was disastrous, since hours of programming could be lost if the RAM pack chose the wrong moment to break loose. However, even in the infancy of the micro boom Sinclair's customers proved themselves to be both tolerant and resourceful. They resigned themselves to the inevitable, and solved the problem with unsightly gobs of Blu-Tack or chewing-gum.

Enjoying the advantages of little or no competition, consumer tolerance born of the pioneering spirit of the times and a general ignorance about what to expect from a computer, Sinclair's company was able to emerge unscathed and in profit despite the unnecessary delays and the thoughtless design of the ZX80. Such conditions prevailed, and protected Sinclair Research, up to and beyond the launch of the Spectrum. While initially enabling the company to consolidate its domination of the market - and at the same time encourage low standards within the home-computer industry as a whole - the enormous success of the ZX range encouraged Sinclair to believe that the company had a God-given right to treat its customers in a manner that would have spelt commercial suicide for a manufacturer in any other industry. Reflecting on the declining fortunes of the Sinclair empire, computer journalist David Ahl made the following prophecy about the logical consequences of such policies:

Sinclair products are highly innovative, interesting and cheesy. In the long run, the lack of quality and utility, and a cavalier approach to customers, will spell doom for the company. (Personal Computer World, October 1985.)

Although much of the early success with home computers must be attributed to the company's pricing policy, credit is also due to the advertising company that co-ordinated the ZX80 promotion. The Primary Contact agency was awarded the Radionics contract in 1971, and retained by each of the subsequent Sinclair corporations until March 1985. In the promotion of the ZX80, the company was faced with the problem of

needing to seduce an essentially schizophrenic market; precisely the type of campaign justifiably dreaded by advertising executives. It must be remembered that Sinclair was quite clear that for the ZX80 to succeed the machine would have to gain the support of the hobbyists, while at the same time appeal to a new market of computer illiterates.

The approach adopted by the Primary Contact promotions concentrated on hooking the neophytes, and relied on the obsessional curiosity of the hobbyist to take care of the communication of technical information to those who would understand it. It used flashy, full-colour displays to catch the eye of anyone turning a page, condensed its technical data into self-contained small print, and devoted the bulk of its copy to calming the anxieties of the masses. The idea was to lay the ghost of Big Brother and give birth to a New Image computing, one that you'd feel safe letting loose on the kids.

It is doubtful whether either Sinclair or the majority of his customers would ever admit it, but the benevolent presence of an avuncular boffin behind the early microcomputing products played a critical role in the defusion of the less seductive aspects of an intimidating technology. Although Guy Kewney, the Personal Computer World gossip columnist, is anxious to claim credit for the creation of the 'Uncle Clive' persona, it was Primary Contact that recognized the need to promote a 'human face' as the figurehead of a decidedly inhuman revolution in consumer electronics. Initially Sinclair was marketed as the maverick doyen of hi-tech, the lone entrepreneur with the vision to take on the Americans and the Japanese. The implication was that by supporting Sinclair the consumer was advancing the cause of British innovation in the face of the brute strength of foreign marketing might. David O'Reilly is one of the few journalists to have taken note of the personal emphasis of the early Sinclair campaigns:

By astute use of public relations, particularly playing up his image of a Briton taking on the world, Sinclair has become the best-known name in micros. (Microscope, October 1982.)

This shamelessly patriotic slant was complemented by a campaign that promoted the idea that computer literacy was no longer the intellectual bastion of an elite but the democratic right of the common man (if not yet

the common woman). One of the major triumphs of the early years of the home-computer industry is that its promotional campaigns managed to avoid questions as to why the common man should be remotely interested in the technology. The implication was that only a neo-Luddite would need to question the need to become acquainted with the world of the micro. The computer as a symbol of progress was as undeniable as the relationship between a Rolls-Royce and wealth.

As David O'Reilly notes, Primary Contact went 'single-mindedly for the user-friendly strategy'. One of the most successful slogans of the ZX80 campaign threatened 'Inside a day you'll be talking to it like an old friend'. Why you were talking to the machine at all and what the ZX80 was offering in return were questions best answered by experience. However, on one of the rare occasions Sir Clive was inspired to discuss the role of computers in society, he revealed an abstract yet refreshingly homely vision of computers which is satisfyingly reminiscent of Primary Contact's sloganizing:

'Another thing I'd like to do is make robots ...' he goes on, pooh-poohing the existing industrial kind. 'I mean the ones you can talk to and leave to look after granny. It's going to come.' (Computer Weekly, 23 August 1983.)

Chris Fawkes of Primary Contact was quite clear about the thrust of his company's campaign: 'We brought personal computers to the mass market by showing that you didn't have to be a whizzkid to use one' (Microscope, October 1982). Overnight, the creative imagination of Primary Contact had managed to elevate the 'use' of a computer to an application in its own right! Along with the 'common man', the all-purpose 'businessman' was particularly susceptible to the necessary good of computing. Absurd thought it might seem today, the glossy double-page spreads advertising the ZX80 suggested that the machine could play a role in 'managing a business'. In spite of the fact that the ZX80 could deal only in whole numbers and offered barely enough memory to deal with the financial consequences of its own acquisition, the fear of 'falling behind the times' would soon prove to be a far more compelling consideration than any concern about application. Although few knew or especially cared what they were going to do with it, the home computer would soon become an

essential acquisition for every businessman. Although in 1980 the industry's marketing machine was still in its infancy, the principles behind the early strategies pioneered by Primary Contact were to prove sound for years to come.

In recognition of the new thrust of the company, and with hopes of more of the same profitability to come, Clive renamed his company Sinclair Computers Ltd in November 1980...

[6] THE ZX81: BEGINNING OF THE BOOM

In March 1981 Sir Clive changed the name of his company from Sinclair Computers Ltd to Sinclair Research Ltd, and at the same time launched the successor to the ZX80. Like the earlier machine, the ZX81 was available both as a kit, at £49.95, and in a fully manufactured form at £69.95. Although eclipsed by the ZX Spectrum in the memories of both commentators and consumers, the ZX81 microcomputer is undoubtedly the most important product to emerge from the Sinclair stable. Tony Tebby, who was responsible for the QL's QDOS operating system, is full of praise for the machine:

Technologically, the ZX81 was something really quite special. It had a very small component count. It was a real computer, you could do calculations, it was programmable, you could do lots of things with it - it was in every way a real computer at a very low price. (Interview, 24 October 1985.)

While the ZX80 was a significant success, its role in the establishment and delineation of a new area of consumer electronics was, as we have noted, that of a bridge between the hobbyist and a broader-based, non-specialist market. Commercially speaking, in the months during which the ZX81 was being developed, there were two interest groups that had to be satisfied if the ZX80's successor was fully to exploit the new market. In many ways, it's unfortunate for Sinclair that he discovered one before the other.

The months following the launch of the ZX80 confirmed the wisdom of Sinclair's recognition of the microcomputer as a product capable of generating a significant return for a modest outlay. The promotion of the machine also enabled Primary Contact to provide its clients with the experience of developing a marketing stance that both informed the converted and preached to the leading edge of the consumer-electronics fetishists. Such experience was to play a major role in sustaining Sinclair's domination of the home-computer market in the years to come.

According to Dave Tebbutt of Personal Computer World, the arrival on the UK market of home computers like the Nascom, the UK 101 and Sinclair's

MK14 created an interest group that was large enough to justify the production of a specialist magazine. The sales of early issues of PCW vindicate such an assessment, although their tone and format have more in common with an electronics magazine supplement than the celebration of a newly accessible technology. The arrival and success of Sinclair's ZX80 offered the early computing magazines an opportunity significantly to expand their readership, but to do so required a subtle but critical shift in editorial policy. That the early issues of PCW resembled the magazines of the electronics hobbyist is both inevitable and an accurate reflection of the nature of the fascination of the early products for the people who bought them. The focus of interest in machines like the MK14 was hardware design and its potential, not the methods by which man could communicate with machines. The success of the ZX80 and the Acorn Atom precipitated a dilution of the technically solid but relentlessly dull hobbyist approach to computing, and forced the magazines to devote as much space to man-machine communication as to the minutiae of hardware design.

The computer kits that provided the focus for the early computer magazines could usually be controlled only with 'machine-language' programs, interminable sequences of hexadecimal numbers, which were the only form of communication from the user that the machine could understand and act on. Given that a 'hobbyist' is often a polite description of an obsessive, it's safe to assume that, far from throwing up their hands in despair, the owners of the early kits relished the challenge of struggling with the tedium and frustration of machine-code programming. However, computers and computer programming would become attractive to lesser mortals only if communication with the machines could be made simpler. One of the features of the ZX80 was that it could be programmed using a version of the Beginners All-purpose Symbolic Instruction Code - the BASIC computer language. This method of programming involves the use of instructions that are very similar to their English-language equivalents. As we mentioned in the last chapter, although today many experts question the value of BASIC as a learning language, its popularity among US hobbyists in the late 1970s made it a natural choice for Sinclair. As we saw in the case of the MK14, the development of microcomputers in the US was a major influence on the creation of the Sinclair line. Norman Hewett, the Radionics

MD, confirms that Sir Clive had his eye on the American computer markets as early as 1977:

[Clive] and I were both in Las Vegas in 1977 at the Electronics Fair. Apple was there, I think for the first or second time, and of course he spent most of his time going round looking at Apple and the other computer firms, with a view to doing the same thing himself. (Interview, 16 October 1985.)

The BASIC used in the ZX80 was essentially a partial implementation of ANSI Minimal BASIC. As its name suggests, even in a full implementation this dialect was of little use other than as a tool for learning the principles of programming, since it lacked many of the functions required for serious applications. Taking note of the criticisms of the ZX80 which appeared in the computer press, Sinclair set John Grant and his team to work on an upgrade of the machine's BASIC. That Sinclair had his priorities right, and Nine Tiles carried out their modifications with skill and imagination, is evident from the early reviews of the new machine:

The personal-computer industry may have greeted the launch of the Sinclair ZX80 dismissively, but it will have to take the ZX81 seriously. Not only does it eliminate many of the initial limitations of the ZX80 - the lack of such features as memory expansion, floating-point arithmetic and continuous screen display - but it is also 30 per cent cheaper. (Infomatics, 16 March 1981.)

That the new Sinclair product offered a massively improved version of BASIC and was considerably cheaper than the ZX80 was one of the shrewdest marketing decisions made by a Sinclair company. In an ecstatic bench test of the machine in *Personal Computer World* (April 1981), Dave Tebbutt drew the following conclusions:

He's done it again! Uncle Clive has come up with a lovely product which will have enormous appeal to people wanting to find out more about computers, but without it costing them an arm and a leg. The idea of producing a superior machine to the ZX80 and selling it for a lower price is wonderful. I'm full of admiration for the man. Most people would have upped the spec and held the price ... or even

increased it slightly. The product is clearly aimed at the home market and I'm sure it will do extremely well there, far better in fact than the ZX80. And that's rapidly becoming the biggest selling micro in the world!

It seems that as early as September 1979 Sinclair had sufficient confidence in the commercial potential of the ZX80 to set Jim Westwood to work on the hardware of its successor. One of the motivations behind the new development programme had its roots in Sinclair's determination to keep the component costs of his products to an absolute minimum. In the case of the ZX80, it was difficult to maximize profits by paring manufacturing costs since the machine's design made use of twenty-two relatively expensive 'off-the-shelf' chips. Westwood's brief was to come up with an improved hardware design for the ZX80 - one that, if nothing else, minimized the infamous screen flicker - and to do so quickly enough to give Sinclair the time to solve the problem of the high component count. According to Steven Vickers, Westwood worked miracles on his improvement of the video display, 'coming up with a technical dodge using non-maskable interrupts' to solve the flicker problems.

Once a working circuit for what would become the ZX81 was up and running, Sinclair was able to address himself to manufacturing economies. In this aspect of the micro's development process, Sinclair proved himself to be as successful as his hardware engineer. Recent commercial-chip innovations enabled Sinclair to go to electronics giant Ferranti with a view to incorporating a number of the ZX80's chips on a general-purpose chip known as an uncommitted logic array or ULA. The use of ULAs gives micro manufacturers the freedom to reprogram an existing chip according to their specific requirements, without going to the expense of developing a fully customized chip. A contemporary report summarizes the result of Sinclair's deal with Ferranti:

The secret... of the lower price and improved performance of the ZX81 over the ZX80 is a new bipolar chip designed by Sinclair and made for the company by Ferranti. The single integrated circuit concentrates 18 of the 21 chips of the ZX80, so that the ZX81 comes with only four chips... The new chip incorporates additional circuitry which

eliminates the need for the processor to drive the TV display, thus causing the screen to go blank whenever processing was being done. The ZX81 processes in two modes: normal, where the display is constantly on, and fast, where processing takes place at four times the speed but data is only displayed either at the completion of a program, when input data is awaited, or during a pause. (Infomatics, 16 March 1981.)

The enormous drop in the number of components used in the new machine and a significant fall in price earned Sinclair a justifiably favourable press when the ZX81 was launched. Although the machine's hidden hardware improvements were to be an important factor in the commercial success of the new machine, it was the improved BASIC that captured the attention of the industry and ultimately the consumer. The reason that the ZX81 was 'in every way a real computer' was that Nine Tiles programmers had managed to expand the ZX80 BASIC to incorporate most of the facilities required for practical programming and calculation purposes.

Steven Vickers joined Nine Tiles in January 1980, and learned that his first priority was to improve on the ZX80's mathematical capabilities. Sinclair realized that if his new machine was to be promoted as an educational tool for the home and the school, it must offer a broad range of trigonometric and floating-point functions. (The ZX80 could deal only with whole numbers.) Sinclair's brief to his contract programmers was to use the extra 4K of ROM offered by the ZX81's hardware to develop the machine's math pack and improve its input/output facilities.

The creation of the ZX80's software was essentially a one-man operation. It was written by John Grant, who developed the code in consultation with Sinclair Research. As far as the ZX81 was concerned, the work was a division of labour, with Steven Vickers undertaking the expansion of the BASIC, and Grant taking care of the software which handled the computer's hardware.

One of the most impressive features of the ZX81 is its editing capabilities, which make the alteration of existing program lines extremely straightforward. Given that the majority of owners of the ZX81 were newcomers to computing, the ability to correct errors simply and efficiently

was soon recognized as a major selling point. Another of Grant's bright ideas ensured that only a program line that made sense to the computer could be actually incorporated in a program. Most early micros notified the programmer of such an error only when a program was run, but all the ZX computers indicated any mistakes as soon as an attempt was made to enter the line into the machine. Once again, this thoughtful innovation was a godsend to neophyte programmers.

Most of the ZX81's software had been completed by the autumn of 1980. The rest of the year was devoted to tidying up the loose ends and writing the manual for the machine. For some reason, Steven Vickers's documentation, which introduced the ZX81 and its BASIC, received decidedly mediocre reviews in the computer press. This is somewhat surprising, since for the most part the manual offers an adequate overview of the machine and the essentials of BASIC programming, and is far superior to most of the documentation of the day. Certainly Vickers's text is a considerable improvement on the deficient one supplied with the ZX80 (which, incidentally, was written by Hugo Davenport, later to become Research's director of engineering). The most consistent gripes about the ZX81 manual appear to centre around Vickers's slightly eccentric prose, which in retrospect seems a small price to pay for an above-average introduction to computing. Since the provision of accurate and accessible documentation continues to be one of the most conspicuous shortcomings of the microcomputer industry, it's worth considering Max Phillips's view of Vickers's work in his 1983 reassessment of the ZX81:

The ZX81 manual is Steven Vickers's BASIC tutorial and, given the number of ZX81s and Spectrums sold, must now be one of the classic texts on BASIC. It does a reasonable job and sensibly provides lots for the reader to do. It's quite honest about the dear thing's shortcomings and provides hints and tips for ways round them... Best of all, the manual is complete and comprehensive. There's some fairly advanced and often undisclosed information in there. The beginner won't understand it for a long time but if he or she learns some more advanced ideas, the manual is ready for them. (What Micro?, April 1983.)

Given that Sinclair had made it clear that he would have the manual rewritten if the ZX81 proved a significant success, it is a credit to Nine Tiles that such improvements proved unnecessary in the light of Vickers's work. As far as John Grant is concerned, disputes over the ZX81 and Spectrum manuals are one of the main reasons why the software company no longer works for Research. According to Grant, Sinclair had personally suggested that royalties would be paid in respect of both manuals, which, given the vast quantities of machines sold, would have amounted to a tidy supplement to the software fees. In the event, the deal was never formalized, the royalties never materialized and the Spectrum was the last Sinclair project in which Nine Tiles participated. With something approaching grim satisfaction, John and Kate Grant point out that the QL was the first Sinclair computer to be developed entirely in-house, and the first to suffer from serious software failures.

Apart from the completion of the manual, the other major software task left to Nine Tiles was the code that handled output to the new Sinclair printer, which was due to be released at the same time as the computer. Once again finding inspiration in the States (which boasted a number of machines of similar design), Sinclair elected to produce a non-standard thermal printer for the ZX range. With many microcomputing systems, the cost of the printer can outstrip that of the computer itself. Part of the reason for this is that printers normally have to produce printout of a quality suitable for wordprocessing, which makes it impossible for manufacturers to come up with hardware retailing for much less than £250. However, as far as the ZX81 was concerned, the machine's quirky keyboard and restricted storage capabilities precluded any serious possibility of wordprocessing; the main reason that anyone would want to use a printer with it was simply to obtain readable program listings for reference purposes. The Sinclair ZX Printer used black paper with an aluminium coating and printed thirty-two characters to a line. The mechanics of the printing process were extremely simple. Two styluses were mounted on a belt that moved across the paper. A small electric charge was passed from the styluses, which burnt away the aluminium coating and allowed the black paper underneath to form the appropriate character. The design was crude but reasonably effective, and allowed Sinclair to bring the machine on to the market in November 1981 at the temptingly low price of £49.95. The printer was manufactured at the

trusty Timex plant in Dundee, with production kicking off at around 5000 units a month. Although the ZX Printer was far from robust (its output rapidly deteriorating with use), and used relatively expensive paper that never seemed to match the quality of the original roll supplied with the machine, an absence of economic alternatives ensured healthy sales.

In the final analysis, it was the ZX Printer that was behind an infamous error in the ZX81's software. Although time and the QL have diminished the significance of the 'square-root bug', it generated so much correspondence in the computer rags of the day that no history of the machine would be complete without a rendition of the saga. Today, his place in microcomputing history secure, Steve Vickers cheerfully cops the blame for the malfunctioning square-root function. We'll let a contemporary report in Datalink (21 September 1981) set the tone of the story:

Publicity building up around the fault in the Sinclair ZX81 is attracting the attention of users to the bug ... And to the fury of both Uncle Clive and the 300-odd people who bought the new machines at the PCW show, a whole new bunch of faulty machines has been released ... Sinclair told Datalink that up until the show, only 'around 300' people had complained of having faulty systems (they show the square root of 0.25 to be 1.3591409).

John Grant offers a plausible if not necessarily excusable explanation for the bug. As we have already established, Nine Tiles had completed most of the ZX81's software by the autumn of 1980. However, before the ROM could be finalized, Grant had to write the software to drive the printer, and Jim Westwood and the hardware boys at Research were proving slow in coming up with the goods. When prototypes finally turned up in October, it was discovered that the existing ROM required relatively dramatic restructuring to incorporate the printer code. Grant maintains that it was this process that was the root cause of Vickers's error.

The square-root saga would be little more than a Trivial Pursuit item for micro addicts were it not for the company's handling of the affair. Rather than rectify and apologize, Sinclair attempted to minimize and cover up. Once again, we'll let Datalink (ibid.) chronicle Sinclair's response to complaints:

'It really isn't true that we are deliberately supplying faulty machines in the hope that most users won't spot [the bug] ... There is a simple test which detects the fault, and Timex, our manufacturing subcontractor, normally test every machine before shipping it.'... He accepted that some customers were having difficulty getting replacements.

In spite of such assurances, it's difficult to accept that Sinclair Research made much of an effort to halt the shipping of faulty ROMs. The first documented account of the bug appeared in an issue of Datalink dated 17 February 1981. By December of that year, a quarter of a million ZX81s had been sold, and faulty machines were still being reported. It wasn't simply that the machines were malfunctioning, but that Sinclair Research was far from prompt in replacing returns. Such a situation, coupled with the fact that people were reportedly having to wait up to three months for the delivery of their machines, fuelled the growing suspicion that the company had very little interest in keeping the customer satisfied.

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At the beginning of this chapter, we noted that there were two external factors capable of significantly influencing the success of the ZX81. The first of these was high-street distribution and, fortunately for Clive, a key figure in one of the country's major chain stores was preoccupied with much the same product lines as Sinclair and his company. At the end of the 1960s, W. H. Smith & Son was suffering a crisis of identity. No longer everyone's favourite bookseller, the stores nevertheless retained a stuffy, almost stagnant market image which inhibited their capacity to diversify effectively. A more modern, up-market image was required, and in 1973 the company hired John Rowland as its marketing development manager. Rowland's brief was to investigate consumer electronics and see what elements of this growing market could be exploited in Smith's leap into the modern world.

Rowland's first move was to introduce audio and photographic products into the stores and, encouraged by the success of these new lines, he let Boots suffer the brunt of the fall in calculator prices before taking on the new generation of smaller, cheaper machines. It's worth stressing that

although the move into consumer electronics was both successful and necessary for the company, in the early days W. H. Smith found it difficult to adjust to the unstable prices and rapid obsolescence of the new products. In retrospect, however, this period must seem like the calm before the storm when one considers the chaotic price wars and unpredictable trends of the microcomputer boom that was to come.

Given the prohibitively high price of most personal computers at this time, it's not surprising that it was computing publications rather than hardware that provided W. H. Smith with its first taste of a promising new market. At the end of the 1970s, there were very few UK-based home-computer publications, and so the demands of a growing army of enthusiasts were satisfied by relatively high-priced US imports. In keeping with Smith's new image, Rowland felt it appropriate to create 'computer corners' in a number of key branches. At such sales points would be gathered magazines like *Personal Computer World*, *Byte*, *Dr Dobbs* and *Interface Age* along with the dozen or so home-computing books that were all the publishing industry had to offer enthusiasts in those days. The high point of these displays was the handful of Commodore PETs which generated colourful graphics to draw in the punters.

Smith's computer corners were something close to an overnight sensation, but the company still needed a hardware product if it was successfully to milk this untapped market. Rowland approached Sinclair Research with a view to conducting a marketing experiment with the ZX80. Sinclair recommended that the chainstore wait a few months and enter the world of microcomputers with the new, improved ZX81. Serious interest from a prestigious chain such as W. H. Smith was the break for which Sinclair's new company had been waiting. Although the ZX80 had been enormously successful, sales of the machine had peaked by the time Rowland made his approach and it was clear that the mail-order market would never be capable of generating sufficient revenue to fund the vehicle and television projects. In addition, by the 1980s Sinclair had become uncomfortable with the '*fly-by-night image*' (*Designer*, July 1982) of the mail-order manufacturer, and an association with a major retailer offered the opportunity to add a touch of stability and respectability to the corporate image.

Although by the end of 1980 Research had yet to produce a working prototype, Rowland was sufficiently impressed by the ZX81's specifications to bide his time and await the arrival of the new machine. In January 1981, Sinclair turned up in Rowland's office with a clay model 'shaped like a wedge of cheese', and a deal was signed which enabled W. H. Smith to retail the ZX81 '*on an exclusive basis for ... around six months - certainly up until Christmas 1981. After that [the company] would sell it on an exclusive basis for as long as it could sell all the machines [Sinclair Research] could produce.*' (Interview, 18 October 1985.)

To his credit, Rowland stuck his managerial neck out with the ZX81 and came up trumps. Although confident that the Sinclair machine was precisely the product for which the market was waiting, the dismal response from his major branches could hardly have been encouraging. Presented with the unprepossessing sight of a pre-production ZX81, sceptical buyers around the country suggested launch orders of around 10-15 units per branch. Had Rowland adhered to the unwritten edict of corporate convention, such an overwhelmingly negative reaction would have ensured that the microcomputer experiment was shelved. Fortunately for everyone concerned, he chose to discount his colleagues' caution and placed the ZX81 at the centre of a major microcomputing promotion.

Although the deal with W. H. Smith was agreed in January 1981 and the ZX81 launched in March, Sinclair wisely ensured that his company reaped healthy mail-order margins before turning the product loose on the high street. An apprehensive W. H. Smith didn't take delivery of its first microcomputers until the September. By this time, Timex had finally got into the swing of ZX81 assembly and the fulfilment delays of nine weeks reported in July had been whittled down to something approaching the twenty-eight days promised in the ads.

Over the next twelve months, Rowland's gamble was to generate a return that would justify his salary for the next decade. Negative feedback from the shopfloor was rapidly reversed by an overwhelmingly enthusiastic market response. In the year following the ZX81's appearance in the high street, W. H. Smith sold in excess of 350,000 machines and banked a net profit of around £10m (This figure assumes a ZX81 purchase price of

£69.95 and the 40 per cent retailer's discount quoted by W. H. Smith. It takes no account of additional revenue from ZX81 peripherals, software, books and magazines.) As far as the revamped bookstore chain was concerned, Sinclair products meant good business.

Unfortunately, every innovation has its price. Although the arrival of the Sinclair machine upped till counts in branches all over the country, on the shopfloor W. H. Smith staff found themselves totally unprepared for the kind of problems that arise when you mix with hi-tech merchandise. In an effort to instil sufficient worker confidence to neutralize the precocious demands of the hobbyist hordes, the company hastily initiated computer-consciousness training. Four hundred and fifty bemused employees were shown how to switch on a ZX81, load software and write a simple BASIC program. In the months that followed, these hapless individuals were lumbered with the mantle of 'computer expert' and suffered accordingly.

Cushioned by the distance that comes with executive privilege, Rowland is quite content to write off the shopfloor aggravation precipitated by Smith's microcomputing venture. He readily admits that the high number of faulty ZX81s returned initiated a company policy of ordering a third more Sinclair machines than were actually required for sale. Although Rowland maintained to us that 'quality control is always a problem with Sinclair products', as far as the ZX81 and the Spectrum were concerned, the profits more than compensated for the complaints.

In the interests of completeness (and as a trivial example of the domino theory in commercial life), it's worth recalling the transformation of a particularly dull consumer-electronics artefact into a microcomputing peripheral. For the majority of ZX users, magnetic tape was the only viable means of storing their software creations. Data storage not being a strong point of Sinclair machines, it soon became clear that only a certain kind of cassette recorder was equipped for the task. In an era of music centres and portable sound systems, it turned out that data storage on a ZX micro required a mono, low-fidelity 'shoebox' cassette player; the kind of machine that had disappeared from the market years before the appearance of the ZX81.

As Sinclair micros sold in their hundreds of thousands, an insatiable market developed for an extinct breed of cassette recorder. Sinclair Research has never devoted much energy to the peripheral support of its products, but there's no excuse for its failure to exploit the data-storage requirements of every single ZX owner. Rather than initiate the ambitious Microdrive development, the company could have anticipated consumer demand and reaped a substantial profit by simply adding its logo to an existing low-tech product. In the event, consumers suffered the frustration of a barren market until W. H. Smith was driven to satisfy demand with a product of their own. The company bought in devalued stock from the Far East, added the W. H. Smith brand and sold 100,000 'data recorders' in eighteen months.

One of the defining characteristics of fashion is that its manifestations can never be accurately captured by history. Origins, events and consequences can all be recorded, but no retrospective account can communicate the passion and urgency of a social fad. In short, the spirit and commercial potential of the micro mania that followed the launch of the ZX81 are effectively lost to memory. Nevertheless, when assessing a man whose real achievements have so often been smothered by hyperbole and misleading self-promotion, it is critical that Clive Sinclair and his products are recognized as the single most important elements in the technological and commercial environment that created the UK microcomputing boom of the early 1980s. The hobbyists who took computing out of the universities and into the home were (broadly speaking) bright social misfits in their late twenties who, a decade earlier, would have been building the ultimate hi-fi or searching for a way to better the theory of relativity. The consumers who made Sinclair a millionaire and micros an option for Christmas were predominantly schoolkids who lacked the coordination or the inclination to ride a skateboard but had the brains or determination to assimilate a new technical practice (or got a kick out of computer games).

The new investors in the latest flagship of consumer electronics fired and inspired an embryonic industry with the imagination and enthusiasm of adolescence. They were also the determining factor in its commercial durability as a mass-market phenomenon. Product development and market penetration undoubtedly benefited from their support, but businesses floundered and failed when they underestimated the technical sophistication

and healthy discrimination of a disturbingly uncompromising punter. Sinclair lost his grip on the microcomputer market when he chose to neglect the enthusiasts he understood and who had made him a household name.

One of the enduring impressions on meeting Clive Sinclair is endearingly anachronistic: the eternal electronics enthusiast who will never outgrow his passion for soldering-irons, transistors and a new gizmo. As we have seen, the success of the kits marketed by Radionics and the early Sinclair Research had little to do with the quality of the products, but quite a lot to do with the persuasive marketing of concepts that intrigued the electronics hobbyist or promised a window into the future. Sinclair's talent has always been his ability to identify such concepts and direct an R&D team towards their commercial realization.

With the success of the ZX81, Sinclair found himself in the role of avuncular guru for an entire generation of microcomputing enthusiasts. Sinclair the man would have identified with the obsessionism of a technological vanguard, but soon tired of a product range in which he had little interest or expertise. Sinclair the businessman should simply have noted the ardour of the obsession and profited from his company's reputation and market lead. After the launch of the ZX Spectrum, the ZX81's successor, Sinclair Research's domination of the home-computer market could have been secured by the design and promotion of products clinically tailored to a market sufficiently sophisticated to define its future demands with the precision of a blueprint.

As it turned out, Sinclair chose to become a victim of his own propaganda. Intimidated by the computing mystique, but intrigued by the frenzy the new craze inspired, the popular press had decided to tackle a commercial success it didn't understand by latching on to its leading light, and milking Sinclair's PR image as the working man's boffin for all it was worth. Never comfortable with half-measures, Fleet Street hyped up Primary Contact's promotional sketch of the innovatory entrepreneur until it described a genius to rival the greats of history. (The Sun promoted Sinclair as 'the most prodigious inventor since Leonardo'.) In the short term, this ostensibly positive press was good for business, but as far as Sinclair was concerned the consequences were disastrous. Never a shrinking violet at the best of

times, Clive was encouraged by the media promotion and development of his fantasy image to subscribe to his own mythologizing. It's clear that even before the launch of the Spectrum Sinclair had outgrown the role of microcomputer manufacturer and accepted the mantle of pioneering boffin leading Britain into a technological Utopia. His cavalier approach to customer relations is reminiscent of an imperial disdain for persistent petitioners. That Sinclair Research initially prospered in spite of its casual approach to consumer relations is simply a consequence of its effective monopoly of a section of the market in which demand frequently exceeded supply. John Rowland of W. H. Smith is convinced that the company's declining fortunes are directly attributable to a corporate arrogance born of its sustained period as a market leader.

By now it should be clear that weak or effectively non-existent management structures have been the root cause of the inconsistent performance of the Sinclair companies. The most conspicuous manifestation of this failing has been a squandering of valuable resources, and of all the resources that have been wasted none is more important than the goodwill and enthusiasm of the predominantly teenage market that supported the first wave of home computers.

Of the motive forces that drive Clive Sinclair, alongside genuine initiative, relentless personal ambition and commercial dogmatism runs a vein of good old-fashioned patriotism. Close friends insist that although both surprised and mildly embarrassed by the honour, Sinclair regards his knighthood as one of the crowning achievements of his life. Sinclair is not just a businessman, but a British Businessman expanding the frontiers of commerce in pursuit of the technological key to national prosperity. It is patriotism as much as commercial loss that inspires Sinclair's rage whenever the BBC saga is mentioned.

The BBC's decision to promote the popular application of microcomputers is the second external factor that influenced sales of the ZX81. Shortly after establishing the retail agreement with W. H. Smith, Sinclair received a call from former employee Chris Curry. The Acorn director had come across a story in one of the computing weeklies announcing that the BBC was planning a series outlining the principles, practice and application of

microcomputers. The series was to be produced by Paul Kriwaczek, who, having devoted a year to exploring the potential of the microcomputer boom, had very clear ideas about the form and function of his project. One of the series' defining principles was that the Corporation would produce software in support of its enterprise. Once this approach had been decided on, the selection of an appropriate hardware base soon became a pressing concern:

At the very beginning, all our advisers told us that it was absolutely necessary that an organization with the standing and public confidence of the BBC should enter the business of computer software, but software for what? (Your Computer, March 1982.)

The Beeb's 'advisers' in the microcomputing project were MUSE (Mini and Micro Users in Secondary Education), who made it clear to Kriwaczek that in-house hardware should define the software base for the project. According to the article Chris Curry had spotted, a subsidiary of the Corporation, BBC Enterprises, intended marketing the computer that would run the Corporation's software. To the chagrin of the Radionics exiles, it emerged that the Beeb had selected Newbury's NewBrain as the centrepiece for the series. The fruits of the microcomputer project Sinclair had initiated at Sinclair Radionics seemed poised to strike the hand of their creator. The substance of Curry's call was that he felt Acorn and Sinclair Research should join forces to resist the Beeb's decision to use the NewBrain as the basis of the series.

Since all other participants dismiss the saga as ancient history, we must rely on Sinclair's version of subsequent events. The Sinclair version of the story goes something like this. When Clive learned of the Beeb's decision to use the NewBrain exclusively throughout the series, he made it clear that he was opposed to any machine being so promoted by a state institution. On the basis of his phone call, Sinclair assumed that Chris Curry's objections were along much the same lines. In any event, from the Research corner letters were written, MPs lobbied and outrage expressed, but no one seemed to take much notice.

To cut a long story short, Newbury stunned both Sinclair and Curry by turning down the BBC's patronage. ('More no-brain than NewBrain,' quips

a still incredulous Sir Clive.) A few days later, Sinclair called the Acorn office only to be told that at that very moment Curry was at the BBC. It seems that Curry had been actively promoting the new Acorn product (codename 'Proton') as the NewBrain alternative. The Beeb checked out the specs and swallowed Curry's bait. Acorn was awarded the BBC contract. (After a series of delays, the BBC Micro was finally launched in January 1982 at £205 for the 16K version and £292 for the 32K machine.) In the Sinclair account of these events, much is made of the fact that John Coll of MUSE ultimately became part of the Acorn team. In reality, it seems unlikely that anyone working for MUSE would so blatantly compromise the integrity of both himself and his organization. More realistically, it seems entirely likely that in his determination to win the Beeb contract Curry embellished the Proton's potential. Assuming this to be the case, it would have been logical for Acorn to headhunt Coll in the hope that his expertise would guide the Proton towards the satisfaction of the Beeb's expectations.

Apart from severely bruising a friendship, the BBC saga also instilled in Sinclair a deep-rooted animosity for the Corporation. With more venom than accuracy, in a recent interview he described the affair as an example of 'disgraceful profiteering'. According to Sinclair, his company was never given a genuine opportunity to tender for the BBC contract. When, after repeated protests, the Corporation finally came up with the specifications of the machine they required, an infuriated Sinclair was confronted with the specs for the Acorn Proton. It seems that the BBC had made up its mind and nothing was going to change it.

Personalities aside, one of Sinclair's most vocal complaints about this affair has been that the BBC has never explained the reasoning behind its decision to adopt the Acorn product. It must be said that the Corporation's choice of micro can remain a mystery only for Sir Clive. In spite of the awesome sales of the ZX81's successor, few technical commentators would dispute the superiority of the Acorn machine over any of the ZX range. This said, no prototype of the Proton existed when the contract with Acorn was finalized, so it's a fair bet that the BBC was swayed by a comparison of Sinclair's militantly aberrant ZX81 with Acorn's ostensibly standard Atom. (To be fair, it should be noted that Curry's early machine resembled a

‘standard’ micro only to the uneducated eye. Although the Acorn computer boasted a ‘professional’ keyboard, Atom BASIC was actually one of the most aberrant implementations of the language to hit the streets.) As far as the Corporation was concerned, Curry was offering the world a professional keyboard, plans for standard disc-storage facilities and an admirably structured BASIC with advanced graphics potential. On the evidence of the ZX81, Sinclair was promoting a dubious membrane keyboard, the promise of untested, non-standard data storage in the shape of the Microdrives and a decidedly unstructured BASIC with no sign of graphics. So where was Acorn’s competition?

In the Corporation’s defence, it must be said that the BBC has always been perfectly clear about why it opted for the Acorn product rather than any development of the ZX81. In an interview given in March 1982, Paul Kriwaczek, producer of the Corporation’s Computer Programme, was explicit about his reservations when faced with the Sinclair alternative:

I would have been very reluctant for the BBC to sell something like the Sinclair [ZX81] because it is so limited. The Sinclair cannot be expanded; it is fundamentally a throwaway consumer product. Its usefulness is in learning about programming, but I do not believe that the future of computers lies in everyone learning to program in BASIC. (Your Computer, March 1982.)

In the event, Kriwaczek’s laudable, if stolid, series did little more than preach the wonders of computing to the converted. Nevertheless, as far as Acorn Computers were concerned, the BBC’s sanction facilitated a market penetration for the Proton that transcended the limitations of promotional resource. More importantly, however, the precise product definition outlined in the BBC/Acorn contract ensured the creation of an unusually sophisticated microcomputer. Certainly the BBC Micro’s facilities were considerably more advanced than the expectations of the average consumer. In short, Acorn’s contract with the BBC forced Curry’s company to create a product whose capabilities exceeded the demands of the market.

It should be stressed that price differentials ensured that Acorn’s success with the BBC Micro had little effect on the impact of either The ZX81 or its successor. Although 1982-4 was a period of gestural confrontation between

Sinclair and Curry, in the commercial arena their products complemented one another rather more than they competed. The significance of the BBC Micro is not that it offered an alternative to the ZX81 or the Spectrum but that it played a major role in establishing high standards for future developments in the market. Just as Sinclair used the ZX80 to redefine consumer expectations of a micro until they described the product he could profitably market, Acorn's machine upgraded the image of a home computer to the point where the effects of economies in Sinclair design became commercially unacceptable.

Curry's coup seems to have strengthened Sinclair's resolve more than it thwarted his ambitions. As his media image developed, Sinclair has increasingly resisted the mantle of technocrat in favour of the satisfying complete image of the renaissance man. A couple of months after Acorn's deal with the BBC, Sinclair comforted himself by turning one of his many non-technical predilections into a commercial venture. In June 1981, the Sinclair-Browne publishing company was formed. The aim of the venture was to subsidize and promote new writing of social significance, and an annual award was announced that would recognize the efforts of writers who satisfied the corporate ideal.

One of the inevitable consequences of the Acorn-BBC deal was that it gave Curry's company an advantage in the education market. In an effort to dilute the Acorn lead, Sinclair Research initiated an extensive promotion offering secondary schools a ZX81 and a 16K RAM memory pack at 46 per cent discount. Still ignorant about the implications of computing in general, and constrained by the limitations of their budgets, most local authorities chose to ignore Sinclair's generous offer.

Although the BBC affair was undoubtedly a galling setback for Sinclair, as far as his company was concerned it seemed that anything was possible. In October 1981 Sinclair Research signed a distribution deal with Mitsui, and over the next twelve months sold more computers in Japan than the combined efforts of the home-based competition. In December of the same year, computer giant ICL announced that it had signed a licensing deal with Sinclair's company. Sinclair BASIC and the yet-to-be-developed flat-screen

technology was to serve as the basis of ICL's 'One-Per-Desk' workstation project.

In two hectic years, Sinclair's hesitant and decidedly unconventional steps into the world of microcomputing had reaped the rewards of a virgin market. In March 1982, Sinclair Research announced profits of £8.55m on a turnover of £27.17m Sinclair awarded himself a bonus of £1m on top of his salary of £13,000. But Clive's public had little interest in the success of his company or of the rewards dished out to its founder. Like the man himself, it was primarily concerned with the Sinclair response to the Acorn challenge. The following extract from a Personal Computer World feature (December 1981) sets the scene:

Quite why Sinclair, with a proven record of producing cheap computers, didn't get the [BBC] contract ... will probably never be known ... Could Sinclair produce a BBC-compatible machine which would undersell the 'official' micro? Yes, he has the nous, the resources and the access to the necessary production capacity, together with an already established mail-order marketing set-up ... But whether he'll do it or not, he's not saying right now.

As we shall see, Sinclair had decided to capitalize on the success of his existing product, rather than challenge the Acorn machine on its own terms. By the time PCW published its speculations, the development of Sinclair's sequel to the ZX81 was essentially complete. The product in question was the ZX Spectrum.

[7] THE SPECTRUM OF SUCCESS

As we saw in the last chapter, the launch of the ZX81 initiated a computing fever which swept the country. Although to outsiders its arrival appeared as sudden and inexplicable as skateboards or breakdancing, micro mania was subtly different from the run-of-the-mill social fad. For a start, although the majority of enthusiasts fell into the mid-teen to early twenties age group, a significant number were of an age that generally manages to resist the lure of more ephemeral fashions. An unusual number of parents fell under the spell of the machines they bought for their children. A less positive (and rarely mentioned) characteristic of the boom was that its supporters were almost exclusively male.

Unlike most teen-dominated movements, it was difficult for the rest of the world to ignore or disapprove of the computing obsession. Partly because of its mystique and partly because of the support of the schools, there was a vague but compelling pressure to encourage an interest in computing. Although in the end most home microcomputers were exclusively applied to running arcade games, they were nevertheless regarded as inherently educational. Predictably, this misapprehension was milked for all it was worth by the manufacturers. Any parents without a micro in their home were made to feel that they were impeding their children's future employment prospects. Being shunned by the BBC may well have been a blow to Sinclair's pride, but more important was the loss of state sanction invaluable to the exploitation of the 'education' market.

While the ZX81 is undoubtedly the best microcomputing product to have been marketed by Sinclair Research, the ZX Spectrum is far and away the company's most significant commercial success. More than any other product it was responsible for establishing Sinclair's international reputation and his popular image in the UK as figurehead of the microcomputing revolution. Leaving long-term considerations to one side for a moment, it should be stressed that the Spectrum's launch was a beautifully orchestrated seduction of an already eager market. By December 1981, sales of the ZX81 had hit the 250,000 mark, providing Sinclair with easily the largest microcomputer user base in the world. The conspicuous

hordes of enthusiasts clustered around the Sinclair machine in W. H. Smith's, the elegiac tributes to the working man's boffin in the popular press, all contributed to persuading those without computers that the moment had come to move with the times. In an industry too young and confused to enjoy any meaningful traditions, veterans of the home-computer market awaited the new Sinclair machine with the anticipation of an annual festival. And Sinclair played his crowd like a master.

The phenomenal success of the ZX81 was a tough act to follow. Having given thousands of neophytes a taste for computing, Sinclair's next task was to ensure that they remained loyal to his product range. The new computerates were already hungry for the colour graphics of Atari, Commodore and Acorn; Clive knew he would have to come up with the goods at a price they could afford. For those who had yet to take the plunge, the company had to devise a marketing strategy that broadened the appeal of the new product.

As a first stage in his effort to expand the home-computer market, Sinclair devoted his attention to improving the appearance of his new product. In spite of attracting a Design Council award, the ZX81 wasn't much to look at. According to marketing development manager John Rowland, one of the biggest problems facing W. H. Smith when it started selling the ZX81 was that of display. How do you promote 'a lump of plastic shaped like a wedge of cheese' so that it looks as if it's worth seventy quid? The ZX81's design was still tethered to the hobbyist tradition and Sinclair was determined that the Spectrum would make the leap into the sleeker style of mainstream consumer electronics.

Rick Dickinson was Sinclair Research's resident industrial designer and was responsible for the internal and external appearance of all products since the ZX80. In an interview he explained the type of concerns that informed the Spectrum's design:

[The Spectrum] is a step up-market and I was really trying hard for a super-smart machine. It is not for quite the same amateur market ... We spent a great deal of time on [the keyboard]. It is the only interface between the user and the product and it has to be right. We were trying

also to cram on more information than anyone had ever done. I believe that form should follow function. (Sinclair User, August 1982.)

As far as newcomers to computing were concerned, Dickinson had done a great job. In spite of his form-should-follow-function maxim, the outward appearance of the Spectrum worked best as an abstraction. In the full-page colour adverts, the machine effortlessly looked the part of the consumer-electronics artefact. For those who didn't know one end of a computer from the other, the mysterious words and symbols in a multitude of colours were part and parcel of the micro mystique. For those who thought they knew one end of a computer from the other, the experience of defeat when faced with the Spectrum's keyboard was less compelling.

Like so much that was wrong with the Spectrum, its absurdly complex keyboard was the result of shortsighted economies in product development. The adoption of single-keystroke BASIC was a tolerable idiosyncrasy of the early products that became a serious liability as the range matured. As ZX BASIC was expanded, it became practically impossible to display every keyword and symbol clearly on an already cramped keyboard. This shortcoming was disastrous for the beginners for whom the machine was intended. Even the simplest operation became a major performance, as reviewers were quick to point out:

The BASIC is still programmed using the single-key technique which the ZX80 and ZX81 exploited but, and it is a big BUT, this has now got to the point where it is rather silly. Because there are so many functions crammed on to each key, generally five, there are now two levels of Shift. In fact, to type in some of the more commonly used BASIC commands takes more keypresses than there are letters in the command! (Computing Today, August 1982.)

Fortunately for Sinclair, suspense and anticipation blunted the critical faculties of the eager millions. As the April 1982 launch date drew close, editorials of the day took the tone of prayers to micro computing's high priest:

Let us hope firstly that Clive Sinclair does launch a ZX82 and secondly, that when he does it is not a replacement for the ZX81, as the

ZX81 was for the ZX80, but that he has carefully designed his new computer to fill the gaping hole between the ZX81 and the BBC Microcomputer. Then ZX81 users, and all the ZX81 support companies which have sprung up in the last year, will have something to look forward to. (Your Computer, March 1982.)

Amen! As far as the converted were concerned, Sinclair gave them the upgrade for which they were waiting. A colour computer with 16K or 48K of RAM at £125 and £175 respectively. Owners of more sophisticated micros could no longer sneer at the black and white blocks that passed for graphics on the ZX81. As far as first-time buyers were concerned, Sinclair could offer the first cogent reason for introducing a micro into the home. The inclusion of colour graphics allowed software houses to produce believable reproductions of the shoot-'em-up games found in the arcades. If you weren't interested in programming, then you could think of your Spectrum as a home entertainment centre. The explosion of games software that followed the Spectrum's launch was to be a critical factor in the massive expansion of the microcomputer market.

Unlike that of the ZX80 and ZX81, the development of the ZX Spectrum was not completed in a spirit of harmony and co-operation. From the outset, there were disagreements between Nine Tiles and its clients about how the project should be approached. According to Steven Vickers, 'Clive's strategy of getting [the Spectrum] out fast relied on making as few changes as possible to the ZX81.' The software for the ZX80 had been specifically designed for a machine with very little memory. The programmers felt that a structure intended for a 1K system was inappropriate for the processing requirements of a 16K or 48K Spectrum. With the ZX81, Sinclair had made it clear that little of the ZX80 code should be rewritten but that instead the expansion modules should simply be grafted on to the original base. The feeling at Nine Tiles was that although this approach was tolerable for the ZX81, such economies could be disastrous for the Spectrum. They believed that the resultant software would flounder because of the inadequacies of an inappropriate structure:

Certainly with the Spectrum we wanted to rewrite the code, but there wasn't the time and there definitely wasn't the resources. At every point

[in the development of the ZX range] Clive wanted the maximum new facilities for the minimum money. (Interview with John Grant, 8 September 1985.)

Thus, although the Spectrum boasted an impressive expansion of ZX BASIC, the new facilities were impaired by their inefficient implementation. In short, the execution of a Spectrum program was depressingly slow, as the following reviewer's comments emphasize:

The BASIC is slow, well, 'snail-like' would be a better description, and the standard Benchmark results are given in Table 1. The last test was done with a loop of 100 instead of 1000 as I thought that you might like to read the review before the Christmas holidays. (Computing Today, August 1982.)

Initially, the absence of competition and an inexperienced market meant that the Spectrum's deficiencies had little effect on its success. Had the machine been developed as an interim product, then its shortcomings would have been defensible. That Jan Jones was hired at the beginning of 1983 specifically to create a Spectrum Super BASIC suggests that Sinclair may have taken Grant's concerns to heart. That the Superspectrum was abandoned is a symptom of the complacency that lost Research its market lead as the competition hit back with superior products.

The stalwart Jim Westwood was conspicuously absent during the development of the Spectrum's hardware. The £5m flat-screen investment programme initiated at the beginning of 1981 had apparently brought the company no closer to getting a product on the market. In desperation, Westwood had been taken off the ZX range after the completion of the ZX81 and dispatched to rescue the television. Into Westwood's shoes stepped the admirably capable Richard Altwasser. That the Spectrum reached the market more or less on schedule is largely a result of the friendship that developed between Vickers and Altwasser, with the latter serving as a buffer between Nine Tiles and Sinclair Research. Having skimmed on the machine's software development, a decision seems to have been taken to be a little more generous with the hardware. A number of reviewers noted with satisfaction that, unlike earlier machines, the micro's clock circuitry and display were crystal controlled - a fact that contributed

to the reliability of the hardware. Others pointed to the tidy internal layout, for which credit must go to the cooperative labours of Dickinson and Altwasser.

The work on the Spectrum's software took the best part of a year to complete. Although the straight enhancements of ZX81 BASIC were relatively unproblematic, the development of the code that was to handle the various planned peripherals was impeded by the lack of working hardware. After six months shunting between Research and Ferranti, Altwasser finally managed to cobble together a prototype of the Spectrum itself, and by Christmas Vickers had completed the bulk of the software. From this point on the situation deteriorated.

The problems started in February 1982 with financial disagreements between Nine Tiles and Sinclair. The Grants insist that for years Sinclair had been suggesting the possibility of royalties on their work, and when it became clear that these were not going to materialize, they decided to put up their fees. For his part, Sinclair made it clear that the company's rates were over the top. In a product development impeded by bad feeling, the announcement by Vickers and Altwasser that they were departing to form their own company couldn't have come at a worse moment. (They went on to trade as Cantab, which was to produce the ill-fated Jupiter Ace, a computer featuring the Forth language.)

With Altwasser gone, for a while hardware development drifted along at Research with no one at the helm. In February, with the Spectrum's April launch looming and still no sign of completed peripherals, it was decided to produce the incomplete ROM for a limited release. Grant explains the theory behind the strategy:

The original idea was that Research were going to bring out the Spectrum with an unfinished ROM. They were going to make just a very few. They knew that before long ... they'd have the real ROM and anyone who bought add-ons for an early machine would be able to have an exchange ROM. Then it got to somewhere around May or June and they'd sold 75,000 machines, all with the old ROM. They came to the conclusion that the original idea just wasn't going to be viable. (Interview with John Grant, 8 September 1985.)

Grant resolved this potentially disastrous situation by coming up with the idea of a 'shadow' ROM that sat on the add-on card and took over from the Spectrum's ROM when the peripheral was called into use. This led to the absurd situation in which the Spectrum's software was still being developed more than three months after the machine's launch! In effect, the resident Spectrum ROM was to remain incomplete. Whereas the ROMs of the earlier ZX micros were crammed to the hilt, that of the Spectrum boasts 1300 free bytes, which had been reserved for the peripheral software.

Since the Spectrum was the last Sinclair product on which the company was to work, this seems an appropriate point to record the views of Nine Tiles on the Spectrum development. These are summed up in this extract from a letter to Sinclair:

During the last year, the project has been subject to abrupt changes in direction and considerable effort has been wasted. For instance, the way [the network] has been used has been changed several times in March and April of this year. Software was completed in April and we have not yet been told that there is any hardware on which to test it. We feel that there is a need for a more structured approach to the planning of the project with the hard- and software design's timescales being agreed beforehand by other members of the team. (Letter from John Grant to Clive Sinclair, 12 June 1982.)

Although it is easy to dismiss Grant's comments as the fruits of resentment, it should be remembered that Sinclair has levelled similar criticisms at the rest of the computer industry (see page 155). Given Sinclair's track record and the circumstances under which the Spectrum was developed, it is difficult to believe that Grant's complaints are entirely without foundation.

There's an ironic postscript to the Sinclair-Nine Tiles saga. After the split with Research visitors to Nine Tiles were puzzled by the sight of staff wistfully toying with calculations involving multiples of 2.5 million. The truth can now be told. It seems that at the end of 1984 Nigel Searle, then managing director of Sinclair Research, found himself grappling with a legal problem in the Far East. Pirate Spectrums were flooding the market and the company was constructing a case that would enable it to sue for breach of copyright. The only trouble was that no one seemed able to lay

hands on the document that established Sinclair's ownership of the Spectrum's software. With a growing sense of dread, it finally dawned on Searle and Sinclair that as far as anyone could tell the company didn't actually hold the software copyright! In the panic and bad feeling that marked the closing stages of the micro's development, no one had got around to asking Nine Tiles to sign over the appropriate pieces of paper. In theory, John Grant's company may well own the software copyright of the world's bestselling microcomputer, unit sales of which have now passed the 2.5 million mark. It seems that the company declined Sinclair's modest offer for the relevant documentation. After all, almost anything multiplied by 2.5 million comes to more than £5000, doesn't it? Anyway, the 1985 cash crisis interfered with the resolution of this potentially vexed issue, which was presumably sorted out in the course of the sale to Amstrad of Sinclair's intellectual property rights where they relate to computers in 1986.

Given the untidy conclusion to the development programme, it was hardly surprising that supply problems hit the Spectrum on an unprecedented scale. Following the standard pattern for a Sinclair launch, purchase was at first restricted to mail-order sales, but the company departed from its usual advertising strategy by initially confining its campaign to the pages of the computing publications. Nevertheless, demand was enormous and although the micro was officially launched in April 1982, it wasn't until June that the first machines began to trickle into the hands of the customers. Never prone to a sense of *deja vu*, Sinclair was once again reported to have been 'utterly astonished' by demand for his new product

By July, Sinclair Research was sitting on a backlog of 30,000 orders. Once production had got into full swing at Timex, Dundee, the manufacturer was pumping out 5000 units a week. Then, in mid-July, just as supply problems were in sight of being resolved, Timex shut down their entire plant for its three-week annual holiday. The backlog hit the 40,000 mark, and customers were told they could expect a wait of anything up to twelve weeks. With memories of ZX81 delays still fresh in their minds, the thousands who paid their money and then waited three months for delivery must have found it difficult to escape the suspicion that they were forward-financing Sinclair

production. There were dark rumblings of dissent in the computer journals and news of the crisis spread to the national papers.

Applying a Band-aid to the savaged jugular of his PR, in September Sinclair published an open letter in the computing press apologizing for the delays. He offered money back on demand to those who were fed up with waiting, and a £10 voucher towards printer or printer paper to those blessed with unnatural patience. However, as far as the Advertising Standards Authority (ASA) was concerned, it was a case of too little, too late. For all the good it did the customers, in October the organization upheld complaints against Spectrum ads (which promised '28-day delivery') and berated the company for the 'appalling delays' in fulfilling orders.

Given the backlog of orders for the Spectrum, it was clearly important to sustain ZX81 sales, particularly since it was the only Sinclair microcomputer making a showing in the retail outlets. Sinclair was convinced that, 'The ZX81 will continue to be ideal for the person who wants the lowest possible entry cost into computing.' To prove his point, at the Spectrum's launch he knocked down the price of the ZX81's RAM pack from £49.95 to £29.95, although the price of the ZX Printer was raised to £59.95. Far from cutting back on manufacture of the old machine, the company boldly announced that its ZX81 production target for the end of the year was 150,000 units per month. Despite the delays many first-time buyers chose to hold out for the Spectrum and there was a significant slump in sales of the ZX81. To counter this trend, Research signed up Prism Microproducts to wholesale the machine, extended high-street sales to include the Boots chain and cut the price of the ZX81 to £49.95.

In the frenzy and frustration of the months following the Spectrum's launch, Sinclair received solace and/or encouragement from an unexpected source. Caught by the wave of micro mania that was sweeping the country, the progressive forces of the Conservative government decided to step up their contribution to the hi-tech revolution. Fired by the success of the Micros for Secondary Schools campaign, the Department of Industry (DI) committed a further £9m with the intention of putting at least one computer in every primary school. Just as pre-production machines were being readied for the

reviewers, the Spectrum and ZX81 were tested by the DI to see if they qualified for a place in the programme.

In July 1982, Margaret Thatcher announced details of the scheme to the nation and revealed the products that had been deemed educationally sound - the Sinclair Spectrum 48K, the BBC Model B with disk interface and the Research Machines Link 480Z. With more than 27,000 institutions expected to take part in the scheme, Sinclair Research felt that there was cause for celebration. On hearing the news, a spokesman made it clear that the company believed it could knock the competition out of the running: *'We're very pleased about it. We hope that being the cheapest in the scheme, we will be able to outsell the other manufacturers.'* Ironically, although Sinclair has been extremely successful in getting his machines into institutions all over the world, the company managed to secure only a paltry 2 per cent of the UK education market. Among the reasons given by British teachers are that the Spectrum's size makes it too easy to steal and that the machine is simply too fragile to withstand the battering it could expect from hordes of pre-teens.

As the Spectrum looked set to secure Sinclair's dominance of the UK home-computer market, plans were already well advanced for the company's assault on the US. In July 1982, Timex launched the TS1000 in the States, so this seems an appropriate point at which to chronicle the relationship that developed between the two companies and outline their American ventures.

We saw in the last chapter how in 1981 Fred Olsen took the first steps in the rescue of his floundering Timex Corporation by diversifying into assembly and manufacture in the UK. Initially, Sinclair approached Olsen solely with a view to using Timex for the complex flat-screen production. The relatively straightforward ZX81 assembly could have been handled by any one of a number of alternative subcontractors. Desperate to develop the diversification strategy as quickly as possible, Timex persuaded Sinclair to let the Dundee plant handle the microcomputer assembly. By December, 50,000 units were rolling off the production line.

Since it affects later developments in the Sinclair story, it's worth mentioning that Timex's diversification programme also included

manufacturing contracts with IBM and Nimslo International. Between 1978 and 1981, Nimslo raised around £27m from British institutions for the development of a revolutionary 3D camera. Now, since Fred Olsen was a major shareholder in the company that controlled Nimslo, it made sense, to him at least, that production of the camera should be handled by Timex, Dundee. As it turned out, the Scottish plant failed to come up with the goods. The Nimslo camera was launched in the States in April 1982, with fewer than 60,000 cameras divided among 7000 dealers. Less than half of the production target of 200,000 units had been manufactured, and many of the completed cameras were reportedly substandard. The Nimslo contract was eventually turned over to the Japanese, which, as we shall see, was to have serious consequences for Sinclair's plans.

In January 1981, Sinclair had managed to put together a £5m investment package for flat-screen development. Sinclair's choice of Timex, Dundee, for the pre-production plant had turned out to be to the advantage of both companies. Government schemes to develop employment on Tayside facilitated a £2.6m grant to Sinclair Research from the DOI and the Scottish Enterprise Planning Department.

Although the manufacture of low-cost, miniature televisions has been a relentless obsession throughout Sinclair's career, the flat-screen project must be regarded as a new development on a path of consistent folly. The idea was initially offered for public consumption in the summer of 1979 while Sinclair was still with Radionics. One of the many problems of earlier Sinclair televisions was that their portability was seriously impaired by the size and weight of their tubes. The viability of the flat-screen solution occurred to Sinclair when he came across the 25-year-old research carried out by Professor Denis Gabor of Imperial College. The following extract from an Economist feature (21 February 1981) outlines the principles behind the technology Sinclair had decided on for the development of his flat screen:

A normal cathode-ray tube has electrons fired from the back. The Sinclair design has the electron gun firing its beam in from the side instead. Inside the set, the electron beam is then bent through a right-angle by an electrostatic field so as to strike a phosphor-coated screen

mounted on the inside of the set's backplate. The viewer thus sees the picture, not darkly through the thick phosphor screen (as in a conventional set), but directly through a clear glass window in the front of the set ... Not having to look at a piece of thick phosphor-coated glass makes the picture appear much brighter. So less power is needed - in fact, about five times less than in a conventional set.

In a further effort to minimize power consumption, Sinclair decided that his flat screen would be less wide than it was high. The television's picture was to be restored to normal shape by means of a Fresnel lens mounted in front of the screen.

Since the NEB had no interest in pursuing yet another of Sinclair's miniature visions, flat-screen development was deferred until revenue from the ZX80 provided funds for research. A team of engineers at St Ives worked on both the development of the flat-screen tube and the design of the automated production processes that would be used in its manufacture. By the time Sinclair announced that Timex had been awarded the flat-screen and ZX81 contracts, a prototype television was up and running for the consumption of a generally enthusiastic press. Ever optimistic, Sinclair confidently predicted an annual output of a million tubes a year, and an extra thousand jobs at Timex by 1985. In the event, production difficulties and industrial unrest ensured that the appearance of the Microvision would be delayed for more than two years.

In January 1982, Sinclair Research announced a licensing deal with Timex, allowing the former watch manufacturer to market Sinclair technology in the States. Although the success of the ZX81 and imminent Spectrum mania spelt phenomenal growth for Sinclair's company, Research was still far too small to make a sustained impact on the enormous American market. The deal with Olsen's floundering giant offered Sinclair a satisfyingly economic solution. Although Timex had very little to offer the States in terms of product, the company had maintained its network of 170,000 retail outlets, including the Sears, K-mart and Service Merchandise chains. On signing the licensing deal, Sinclair was able to tap into a vast distribution network without the enormous capital outlay such an operation would normally require. The terms of the arrangement were to prove extremely

profitable for Sinclair. Timex would pay a 5 per cent royalty on all Sinclair hardware sold in the US. In addition, Olsen had agreed to fork out a further 5 per cent on all Sinclair-originated software and 2.5 per cent on any software marketed by Timex but produced by companies other than Research.

Prior to signing the licensing deal, Sinclair's business in the States had been conducted almost exclusively on a mail-order basis. In spite of the limitations of such an approach, Research had done surprisingly well with the American hobbyists. Promoted by what Informatics magazine described as a 'cheeky' advertising campaign, Sinclair satisfied a gap in the US market that had yet to be addressed by home-based companies. By June 1981, Sinclair Research was shipping 18,000-20,000 ZX81s a month to the States, which in those days exceeded the combined unit sales of market leaders Tandy, Apple and Commodore. As a footnote to this impressive performance, a number of contemporary reports suggest that on arrival only one in three of the machines shipped actually worked.

In October 1981, Sinclair finalized a deal that proved to be the perfect promotional vehicle for the company and its products. American Express undertook to test market the ZX81 to its 9.5 million mail-order customers, who were offered the privilege of picking up the machine for \$150. In a statement from Sinclair's Boston office as empty as it was optimistic, a spokesman proclaimed, 'The demographics are right. Sinclair believes that American Express cardholders are representative of the kind of people who will want to buy his products, and American Express think the same.'

Latching on to Sinclair's self-promotion as the paradigm British eccentric, the American financial press generously heralded him as a maverick dark horse of the new technology. Having relished steady but profitable incursions into the US market by England's 'thin, unprepossessing inventor', those in the know anticipated a wealth of colourful copy when the Olsen deal was announced.

No one could suggest that at the beginning of the campaign the advance publicity failed to make the transition into an appropriate volume of dollars. When Timex announced the launch of the TS1000 in July 1982, the company adopted the standard promotional approach of establishing a toll-

free phone line to answer the queries of potential customers. No one could have predicted the 50,000 calls a week prompted by the campaign. It seems that many people dialled the Timex number simply to discuss their queries about microcomputing in general; nevertheless there were few at Timex inclined to scepticism over any promotion that at one point generated a staggering 5200 inquiries an hour.

By the time Olsen's company launched the TS1000 in the States, Sinclair had already creamed the lucrative hobbyist market via his adverts in the specialist magazines. According to market researchers Future Computing, Sinclair's company had sold 150,000 ZX81s into the US by the time the licensing deal with Timex was formalized. Under the terms of the agreement, even when the TS1000 became available in the States, Sinclair Research was still permitted to sell the ZX81 as a mail-order item until Timex sales reached an undisclosed volume.

Although the outward appearance of the ZX81 was modified for the US market, the TS1000 made precious few concessions to the demands of a transatlantic crossing. Nevertheless, in the five months following the launch, Timex sold more than 550,000 units into an enthusiastic market, earning in excess of \$1.2m in royalties for its British partners. It looked as if a solution had been found to the \$14m trading loss projected for Timex in 1982. Then the bubble burst. Timex's inexperience in the consumer-electronics market - let alone the home-computer market - took its toll. We'll let the Wall Street Journal (17 August 1983) take up the story:

Although [Timex] quickly sold thousands of computers in the heady days last fall [autumn 1982], early Timex Sinclair buyers faced an immediate disappointment. Almost all the programs written for the Timex computer required a \$50 memory unit. But Timex didn't supply that unit in great numbers until two or three months after it introduced the computer. Many new owners would take the computer home without software, plug it in and find it didn't do anything useful. 'It was a disaster,' says the computer buyer at a large discount store chain ... The model 1000 is also irritating to use. If it is jiggled when the memory unit is attached, the television screen hooked up to it sometimes goes blank. The keyboard, drawn on a piece of hard plastic,

doesn't have separate keys. The computer also can't produce color graphics or sound and isn't much good for playing games. Consumers who wanted to learn about computers were willing to ignore such shortcomings when the unit was the only one selling for less than \$100, but now sales have plummeted.

A partial explanation for the short-lived success of the Timex campaign centres on the conflicting demands of the embryonic home-computer markets in the U S and U K. When assessing the character of this particular commercial conjuncture, it is important to remember that prior to the Spectrum's launch the only real application for a Sinclair micro was as a learning tool for would-be BASIC or Z80 (machine-code) programmers. In the halcyon days when an inexperienced Sinclair confided to the American press that he'd rather be 'a pirate than a captain of industry', he was also tempted to pontificate on the failure of any single American company to dominate the fledgling US micro market:

Our competitors thought that consumers didn't want to learn programming. We [Sinclair Research] think they failed because of this and because of price. (Informatics, 29 June 1981.)

American market response to the TS1000 revealed that the competition was perfectly correct in its pessimistic assessment of the general public's interest in computer programming. Certainly there was a market for a learning machine among electronics hobbyists and students of computer science. This group would account for a substantial proportion of the 150,000 mail-order sales fulfilled by Sinclair Research prior to its licensing agreement with Timex. There was also an interest in programming among a minority of the affluent middle classes who, possibly intrigued by the technology littering their offices, considered the cost of a TS1000 a small price to pay to satisfy their curiosity. This group almost certainly made a healthy contribution to the 550,000 sales in six months that convinced Timex it was on to a winner.

Unfortunately, while the TS1000 was satisfying the demands of a studious minority, the competition was defining the role of the micro in the lives of the American people. According to the gospel of companies like Apple, Atari, Commodore and Texas Instruments, home computers were about

either business (including wordprocessing) or arcade games. Programming was the province of egg-head hobbyists or the professional. Why would any layman want to grapple with computer languages like BASIC when any game or application program could be had for the asking?

Although the US approach to microcomputer application eventually came to dominate the UK market, at the time the TS1000 began to flounder a significant proportion of Spectrum owners in Britain regarded their investment as an entree into the mysteries of programming. As a graphic illustration of this conflict in consumer demand, it is necessary only to examine the sluggish attempts by mass-market publishers to stumble aboard the microcomputing bandwagon. In the States, the only mass-market books that made money were those that simplified hard- or software manuals or offered listings of arcade games. By contrast, publishers in the UK supplemented revenue from listings books with high-level programming tutors, introductions to machine code and alternative user guides that demolished the limitations of design.

As far as Sinclair Research was concerned, Timex's launch of the TS 1000 had generated a significant return which surpassed its most optimistic projections. Given that the company had enough on its plate satisfying UK demand for the Spectrum, there was little incentive to embark on a comprehensive survey of market trends in the States.

The backlog of unsatisfied mail-order customers ensured that Sinclair was forced to hand over a significant proportion of Christmas trade to the competition. Although in November W. H. Smith finalized an exclusive retail deal for high-street distribution of the Spectrum, Sinclair Research could come up with only 3000 of the company's initial order of 6000 machines.

There can be little doubt that the early success of the TS1000 was largely attributable to the low price of the product coupled with the initial novelty value of a home computer as a consumer-electronics artefact. Within twelve months, the concerted promotions of home-based companies clarified the consumer's image and expectations of a computer, and in the process transformed Timex's commercial salvation into a dubious gimmick. Sales of the TS1000 took an irreparable nosedive when companies such as

Commodore and Texas Instruments slashed the prices of their down-market machines to below the \$100 mark. Unlike the TS1000, the decidedly limited TI/99A (Texas Instruments) and the VIC 20 (Commodore) boasted standard keyboards and generally gave the impression of being 'real' computers. Under pressure from the veterans of the US computer market the inexperienced Timex didn't stand a chance. The company dropped the price of the TS 1000 to around \$40, but no one seemed to notice.

As the Timex-Sinclair partnership stumbled towards a fall in the States, back in Dundee events struggled to keep pace with the trend. Having shifted Nimslo 3D-camera production to Japan, in January Fred Olsen announced 1900 redundancies at Timex's Scottish plant. Management maintained that the remaining 2300 jobs would be at risk unless the unions complied with the decision. Unsurprisingly, the Amalgamated Union of Engineering Workers (AUEW) was disinclined to suffer the dismissal of almost half the plant's workforce without a struggle. The threat of industrial action followed hot on the heels of the redundancy announcement.

The 'petulant' response of the AUEW could hardly have come at a worse time for Sinclair Research. Apart from the disruption to computer production that would result from any kind of a strike, there was a distinct danger that worker caprice would threaten the entire commercial viability of the flat-screen television project. Sinclair was well aware that Sony was on the verge of launching its Watchman product, and that unless he was careful Research would become an also-ran in the miniature-television market. With so much at stake, Sinclair made it clear in January that, unless the Timex workforce saw sense, the plant was in danger of losing both ZX81 and flat-screen production.

Although 1700 workers accepted voluntary redundancy pay-offs, the remaining 200 employees took the decision to fight for their right to work. The AUEW militants took control of the Dundee plant on 8 April, and their five-week sit-in disrupted all Timex production until the third week in May. Sony launched its Watchman in the first week of June, three months ahead of Sinclair's Microvision. 'Sick as a parrot,' is how Sinclair summed up his response to the Japanese invasion.

Sinclair made no attempt to hide his rage over the Timex dispute. He maintained that the strike had set back the Microvision launch by at least six weeks, and that each week's delay cost his company £1m in lost turnover. However, when the £79.95 television was finally launched in September 1983, Sinclair made it clear that unforeseen manufacturing problems were largely to blame for the delays. Certainly, the original launch date of autumn 1982 had been hopelessly unrealistic. By way of explanation for the delays, Sinclair told the Sunday Times (22 May 1983), *'You must put that down to our pure ignorance about the problems of setting up a totally new technology.'* A few months later, however, company policy seemed more inclined to forge virtue out of necessity:

'Unusually for us we're second in the field ... But we have learnt a lesson from calculators.' There, he explained, Sinclair products were first, but were overtaken by low-cost, mass-produced calculators from Japan which commanded the market. This time Sir Clive waited until a plant was ready for volume production. (Daily Telegraph, 17 September 1983.)

However, a little digging into the development of the manufacturing environment in which the flat-screen television was produced enables us to be slightly more precise about Sir Clive's problems. Before going into detail, it should be emphasized that Timex was by no means a natural choice as manufacturer for the project. The company had never built a television tube evacuation plant, and indeed had little or no experience of the technology. Since a number of UK companies had been developing such facilities for many decades - for example, Thorn-EMI and Ferranti - one can only assume that Sinclair's choice had more to do with the development grants associated with the Timex production than the expertise and capital equipment offered by the deal.

One of the laudable characteristics of Sinclair's approach to production has been that no manufacturing convention is sacred. Unfortunately, his companies' mode and motivation when bucking convention has always had more to do with corner-cutting economies than the exploration of the potential of genuine technical innovation (the new wafer-scale project being an honourable exception). The decision to create from scratch tube

production in Dundee precipitated a host of problems which eventually became so serious as to require the recruitment of a specialist to sort them out.

The conventional approach to tube production involves preliminary evacuation of each set of TV tubes by means of a roughing pump, and then completion of evacuation by a diffusion pump, backed up by another pump. Sinclair's cost-cutting tendency led them to reduce the number of pumps, swapping the pump action by means of high-speed switches between different sets of tubes. While fine and economical in concept, in practice the lubrication of the switches released methane, a light gas which it is difficult to evacuate. When you get methane inside a television tube it is not only harmful to the phosphors coated on the inside of the glass, but produces carbon deposits on the cathode when the stream of electrons is turned on to produce a picture, which degrades the picture quality.

Early televisions, produced when evacuation was a less-developed art, avoided such problems by using a bent electron gun, with a magnet to correct the electron beam. With such a system any undesirable positively charged particles get deposited harmlessly on the side of the electron gun. With this arrangement, Sinclair would not have experienced so many problems. However, magnets are expensive, and the flat-screen tube had been designed with a straight gun. The combination led to severe delays in achieving tubes of sufficient quality. Sinclair's tendency to pursue idiosyncratic solutions had once again led the company into difficulties.

Even when the new-look, one-per-person, flat-screen TV arrived, however, the initial publicity for this technological marvel failed to stir up the enthusiasm Clive no doubt expected.

Implicitly conceding defeat on the American retail market, Timex made a brave attempt to minimize the effects of its home-computer failure by signing a deal with a major US bank that wanted to give away TS1000s to new customers. The contract disposed of a couple of thousand machines, but did nothing to fade the writing on the wall. By August 1983, Timex-Sinclair finally got around to responding to complaints that the TS1000 had too little memory (RAM) to be of any practical use. The TS1500 was essentially an Americanized ZX81 with a built-in 16K RAM pack. Its

launch did little to overcome the growing conviction that Sinclair products were intrinsically unsuited to the demands of the US home-computer market.

The TS1500 was a belated and decidedly flabby response to Timex's rapid fall from grace. This definitively interim product was intended as a stop-gap between the TS1000 and the American version of the Spectrum (TS2000), but it was hardly worth the effort. By the time Timex got around to shipping the TS1500 in August 1983, Sinclair was promoting the Spectrum to a largely indifferent America. According to the Wall Street Journal (17 August 1983), even Nigel Searle, who was looking after the U S side of the company's business, had misgivings about the applicability of the TS2000 for the US market:

The Timex Sinclair 2000, an adaptation of Sinclair's ZX Spectrum computer, faces tough competition from the Commodore 64. Both sell for \$200, but the Commodore unit has a superior keyboard and much more available software. Even Nigel Searle, Sinclair's managing director, doubts the appeal of the model 2000. 'By the standards of six or nine months ago the 2000 would offer a hell of a lot,' he says. 'But now I don't know what the consumer's preference will be.'

According to the Wall Street Journal, it was unsaleable stocks of the TS 1000 that scuppered the Spectrum's chances in the States. By the time the TS2000 made an appearance, retailers in the US had come to regard the TS 1000 as a white elephant. No one wanted to know about its successors. The chainstores dropped the TS line, and Timex found itself out of its depth without the comfort of a distributive float. In the same month the TS2000 was offered to the American people, a senior vice-president at Timex inspired his sales force by proclaiming that, *'I don't think Timex can make it in computers.'*

Smothered by competition from slicker home-based machines with fortunes to promote them and substantial software bases to support them, the TS2000 disappeared without a trace. The last recorded sighting of a TS1000 was a \$10 gizmo at a supermarket checkout. Production of the TS line was discontinued in the summer of 1983, and Timex formally announced its withdrawal from the microcomputer market in February 1984. Vice-

president C. M. Jacobi was landed with the thankless task of composing the meaningless newspeak that purported to justify Timex's acknowledgement of defeat:

We believe that instability in the market will cause the value of inventories to decline, making it difficult to make a reasonable profit. Further, we are concerned that those conditions will strain trade relations between manufacturers and retailers, a relationship which the company values very highly. (New York Times, 22 February 1984.)

While in the States it would soon become a struggle to give away a Timex-Sinclair creation, in the UK Sinclair Research had established a market dominance that would be the envy of a multinational. Continuing production delays had inhibited Sinclair's effective exploitation of the 1982-3 Christmas market, but by the spring of 1983 supply finally fell into step with demand. In February, Sinclair contracted Prism to handle wholesale trade of the Spectrum, and extended his assault on the high street to include the Boots, John Menzies and Curry chains. At the beginning of the year, the Sinclair machine looked unstoppable. Clive had sold off 10% of his personal shareholding, which valued the company at around £136m, of which Clive Sinclair still owned 85 per cent. The company's triumphant computer division moved into spacious new offices in Willis Road, Cambridge, and in March Nigel Searle was appointed managing director of the Advance Products Division, which at this time meant that he was responsible for the development of any non-computing product. By the end of March, Sinclair Research had sold 200,000 Spectrums, and was announcing a £13.8m profit on a turnover of £54.53m A remarkable achievement for a new company which employed a staff of only 55.

Although 1983 will undoubtedly go down in history as the halcyon days of Sinclair Research, it would be remiss to pass over this period without reference to the occasional problem. For example, in March the company discovered that an entire shipment of Spectrum power-packs was faulty. It seems that 14,000 units were capable of flooring their owners with an electric shock. A massive recall operation was initiated in an attempt to replace the defectives before a hacker bit the dust. Fortunately, none of the Spectrum fraternity came to harm. As if to compensate Sinclair for an

unexpected headache, fate delivered him the Guardian's Young Businessman of the Year Award (at the age of 44).

Another hardware problem precipitated crisis and correspondence in the autumn. Minor chip-tampering prior to the release of the Issue 3 Spectrum proved to have radical consequences for the user. It seems that in August 1983 Research introduced a new chip into the machine's design which changed the entry point for the Spectrum's cassette-loaded programs. So what? Well, as a result of this minor change, a significant percentage of commercial software for the Spectrum simply wouldn't run on the Issue 3. Sinclair Research pointed the finger at the 'unprofessional programming practices' of the software houses. Software companies complained that Sinclair hadn't bothered to offer advance warning of the change. The computer press made a mountain out of a molehill, and offered untested suggestions as to how the Issue 3 problem could be circumvented. In the end, it seems the crisis simply disappeared of its own accord.

In May, Sinclair Research initiated a series of price cuts which are worthy of note simply because they exemplify an approach to marketing that has proved extremely effective for the company. At the height of the Spectrum's popularity, Sinclair reduced its price - £99.95 for 16K, £129.95 for 48K - and cut the prices of both the ZX81 and the ZX Printer to £39.95. The effect of this move was to secure and extend Sinclair's market lead and panic the competition. While most companies reduce prices when their products are in steep decline, Sinclair tends to discount shortly after sales have peaked. The advantage of his approach is that vacillating consumers are drawn into the fold while the product's promotion retains a commercial urgency, and the costings of the competition are thrown into utter disarray.

The year 1983 was the one in which Sinclair made his dreams come true. In June, Margaret Thatcher's 'favourite entrepreneur' was honoured with a knighthood. It seems that Sinclair was surprised and mildly embarrassed by the title, but in the context of the times the Prime Minister's decision was hardly controversial. For Thatcher's Conservatives, Sinclair symbolized the backbone of the nation and the country's hope for economic recovery. As the personification of individual enterprise and endeavour, his example was meant to demonstrate that from the accumulation of personal wealth could

spring employment and technological progress. The fallacy of this position would soon become as clear as the mounting unemployment figures.

Having recently emerged from a period in which his vision was curbed by the budgets of bureaucrats, Sinclair decided that his cash-rich company would never again suffer from constraints on its development resources. In May 1983 he announced that he had acquired the idyllic Milton Hall, situated in Milton village just outside Cambridge, at a cost of around £2m. The building was to become the company's MetaLab, a new kind of laboratory housing a brilliant team of researchers devoted to the pursuit of excellence in technological innovation. Sir Clive explained his plans for the centre in an interview with *The Times* (15 July 1983):

The MetaLab will bring together those parts of the company that might loosely be called 'blue-skies' research but are not really quite as blue skies as all that. It is the leading edge sort of work but also very much dedicated to a definite product - generally high-risk or very difficult work ... Freedom is the password. More freedom than researchers have been accustomed to ... In particular, [researchers] tend to be constrained in this country by their inability to purchase the goods they need. They have the odd business in Britain of employing a man at £20,000 or £30,000 a year who has to argue if he wants £100 worth of equipment. We will be employing people at very high salaries. They will be the crème de la crème, and if they think they want equipment they are going to have it.

Heading the centre would be two stalwarts from within Research, David Southward and Jim Westwood, and one 'known quantity' from outside the company in the shape of Richard Cutting. Before throwing in his lot with Sir Clive, Cutting had been managing director of Cambridge Consultants (since 1970), and was certainly well qualified to run a large research team. However, financial crisis was to hit the Sinclair empire before Sir Clive's dreams for the MetaLab could be realized, although before the storm clouds gathered he managed to transform Milton Hall into one of the best-equipped research centres in the private sector. Another positive effect of the MetaLab was that it attracted the leading members of what would become

Sinclair's 'wafer-scale' team, the significance of which we will examine in our penultimate chapter.

As we have seen with the earlier products in the ZX range, Sinclair's policy regarding the production of peripherals has been that such developments are best left to others. The company has felt disinclined to compete with the low profit margins tolerated by the garage entrepreneurs who emerged to support the Sinclair micros. The only exception to this rule was the Spectrum, which, from the start of its development, was always intended to be the central component of a complete microcomputer system. Unfortunately, as our account of the machine's software development has revealed, the design of the Spectrum's peripherals proved considerably more problematic than that of the machine itself.

In the months following its launch, one of the most frequently voiced complaints about the Spectrum was that it failed to provide users with an efficient method of storing data. Having written a program for the machine, the only way it could be saved for future use was with the aid of a cassette recorder and standard magnetic tape. Although cheap, the problem with cassette storage is that it is notoriously unreliable and impossibly slow. The most widely used alternative to cassettes is the floppy disc. Using a disc drive for the storage and retrieval of data is fast, efficient and reliable. It is also relatively expensive. A disc drive often costs more than the computer it serves.

At the Spectrum's launch, Sir Clive alerted his public to the fact that he was developing a new breed of fast-storage device, which he referred to as the ZX Microdrive. Since he offered no further details about the product, the world was driven to speculation. To the ever optimistic computer journalists, it seemed a fair bet that the man who smashed the price of the home computer was about to do the same for the disc drive.

Although the Microdrive was announced in April 1982, a number of Research employees seem to recall that work on the project was started around the time of the ZX81 development. What is not in question is that the solution to the design problems posed by the new product took considerably longer than anyone had anticipated. While David Southward ultimately assumed overall responsibility for the Microdrive, it seems only

fair to note that it was the tenacity and imagination of R&D staffer Ben Cheese that got the product to the market.

The Microdrive is more of an upmarket cassette recorder than it is a low-grade disc drive. Sinclair's little black box is used in conjunction with especially manufactured miniature cartridges that contain a loop of 200 inches of magnetic video tape on which 85K of data can be stored. Although considerably slower and less flexible than a disc system, the Microdrive can nevertheless load a 48K program in about 4 seconds. As far as Spectrum users were concerned, its arrival made cassette storage an instant anachronism.

Whatever the merits or otherwise of the Microdrive concept, the device should go down in the annals of microcomputing as a minor miracle of engineering. The important point to bear in mind is that, even under ideal conditions, such a crude approach to fast-access data storage simply shouldn't work. Given the speeds at which it travels, the cartridge tape ought to snap and the virtually standard audio heads miss more data signals than they catch. In the light of the crippling component economies constraining the design, Cheese's achievement should be regarded as a work of genius.

According to frontline sources, progress on the Microdrive suffered from a curiously oscillating development. Engineers at Sinclair Research would, for example, complete the analogue part of the design, only to discover that their solution required prohibitively high component costs to get the digital end working. So they were forced to go back and modify the analogue design, and the process would start all over again. After a while, the entire Microdrive development took on the character of an endless loop.

Sixteen months after Sir Clive's original announcement, Ben Cheese's final design was at last immortalized on yet another Ferranti chip. The device was launched in July 1983 and retailed at £49.95. (One of the hidden drawbacks of the product was the high cost of cartridges, which initially sold at £4.95 each. In time, the tapes were reduced to the more realistic price of £1.95.) Given the incredible problems Cheese had overcome in the course of a gruelling three-year development, MD Nigel Searle's explanation of the Microdrive's delay sounds a touch churlish:

The delay on the Microdrives has been the result of mechanical difficulties we had not foreseen. These have now been solved along with an improvement in the performance of the drives. They are now much more reliable than we had hoped to achieve ... The designers would like to go on and on making improvements. But a line has now been drawn.' (Microscope, 24 March 1983.)

In some respects, the launch of the Microdrive seemed to suggest that Sinclair Research was beginning to learn from its mistakes. The company made no attempt to pretend that initially the device would be produced in sufficient quantities to satisfy demand:

Sinclair's long-awaited Microdrive will not go on 'general release' even when it is eventually launched later in the year. Instead, only 5000 Microdrives will be made available to the original mail-order purchasers of the Spectrum ... Sinclair managing director Nigel Searle said this measure was being taken to 'reward' original Spectrum customers who suffered long delays as Sinclair struggled to meet demand. However Searle agreed that the exclusivity of the launch would also enable Sinclair to test demand for the Microdrives and gear production accordingly, (ibid.)

Although there was general disappointment that Sinclair had not attempted to come up with a cheap solution to industry-standard disc drives, the overall critical response to the Microdrives was positive:

In some ways [the Microdrive] could be more important than the Spectrum itself. That has done well because it is so cheap, not because it is technically special. The Microdrives on the other hand are very different to anything on the market and could start a whole new trend with other companies copying them. Let's all hope so. (What Micro?, October 1983.)

Curiously enough, none of the initial spate of reviews predicted the most likely reaction from the software houses to a device using a non-standard medium like the Microdrive's cartridges. Indeed, some of the reviews anticipated that the software houses were likely to back Sir Clive all the way:

Sinclair seems to have done it again. The Microdrive should have a major impact on the Spectrum software market, not only for games but for sophisticated personal/business software like spreadsheets or database applications. (Personal Computer News, 4 August 1983.)

As it turned out, the majority of software producers decided that by the time the Microdrive was launched the Spectrum was coming to the end of its commercial life. This, coupled with the high unit price of the cartridges, ensured that very little software was retailed for the Microdrive. In the final analysis, however, although the Microdrive was hardly a revolution in data storage, it was a massive improvement on cassette recorders.

Spectrum owners who thought they were getting their hands on a Microdrive for a mere £49.95 were dismayed to discover that you couldn't simply plug the device into the computer, but required an additional interface. The Interface I was released at the same time as the Microdrive and, as long as you bought the pair as a set, cost an extra £29.95 (or £49.95 as a separate item). Unlike the precarious RAM packs for the ZX81, the design of the new interface was professional and stable. It simply plugged into the back of the Spectrum and was secured by a couple of screws to the computer's underside. Apart from controlling the Microdrives, the Interface I facilitated two other functions. The device offered 'standard' RS232 facilities, which allowed Spectrum users access to a wide range of printers and modems. It also offered a simple 'local area network' option, which essentially means that up to 64 Spectrums can be connected together, communicate at relatively high speeds and share Microdrives and printers. The Interface I was praised by users and reviewers alike, and was generally considered to be a well-designed and efficient addition to the Spectrum's hardware.

The ugly sister of the Spectrum peripherals was released in September 1983 with little in the way of fanfare and to about as much interest. The Interface II was designed to allow users of the machine to use joysticks and ROM software cartridges. The device disappeared without a trace within twelve months. The reason for such a riot of indifference was that independent peripherals producers had been selling joystick interfaces almost since the day the Spectrum was released, and that the Interface II allowed the use

only of 'switch-type' (rather than potentiometer) joysticks. Owners rightly decided that the ROM-cartridges simply weren't likely to be produced by a sufficient number of software houses to make the device worth their investment. Furthermore, at a cost of £19.95 the cartridges offered software at three or four times the price of a tape. So why bother? And very few did.

Before moving on to discuss the next major Sinclair product development, it seems sensible to depart from our chronological sequence to record the company's efforts to extend the commercial life of its most popular product in the face of increasingly sophisticated competition. As we have seen, the long-term appeal of the Spectrum was significantly constrained by the economies imposed on its development. Although the machine's sluggish software and dubious hardware were no impediment to success as long as the machine stood alone in the market, the first sight of organized competition forced Sinclair to rely on the cheapness of the machine to provide the main thrust of his promotional strategy.

For an interim development that sought to exploit the paucity of product in a hungry market the Spectrum's quick-'n'-dirty development was both appropriate and necessary. Had the company followed through with its original plans and completed the development of a medium-price advanced colour micro, there was a good chance that such a Super Spectrum would have replicated its forerunner's success and ensured domination of a new section of the market. Ironically, it was the Spectrum's apparently unstoppable success that convinced Sir Clive that the creation of a SuperSpectrum was unnecessary. In spite of its relatively advanced stage of development, the project was abandoned.

By the middle of 1984, the Spectrum was looking tired; Sinclair Research had no product to satisfy a growing section of the market, and the only indication of the company's future in microcomputing came in the shape of the multiply flawed QL (see next chapter). At this stage, the full-scale development of an appropriate product seemed out of the question. In June 1984, the company pondered its options and concluded that the lightning development of a stop-gap product seemed to offer the simplest, most economic solution to its dilemma. The result of these deliberations was eventually marketed as the Spectrum+.

Once one has explained why the Spectrum+ was produced, it's difficult to know what else to say about the machine. Rumours of a Spectrum upgrade began to circulate in September 1984 and, encouraged by the company's elaborate denials of such a development, the computer press made a meal of building on its own speculations. To everyone's surprise, the Spectrum+ was never actually launched, but simply became available in October, priced at £179.95. The machine's sudden appearance infuriated the chain-stores, since most had already stocked up for Christmas with standard Spectrums. However, a presumably forewarned W. H. Smith was able to take advantage of its privileged position as the leading Sinclair stockist by making the most of seasonal sales of the new product.

The reality of the Spectrum+ caused its own problems for reviewers who had got so much mileage out of speculation. How much could you say about a standard Spectrum 48K with a new keyboard? Most writers opted to be out front about their disappointment. The general consensus seemed to be that the machine looked like a sawn-off QL, and that considering the price rise the minimal improvements simply were not good enough:

Sinclair Research could have taken a bit more time and effort to produce a machine it's worth upgrading to. Of course Sinclair Research couldn't do a very enhanced Spectrum (say, with CP/M ability) as the product would more than likely knock spots off the QL. So what we get instead is a rather limp marketing ploy and a return to old Spectrum prices. And while I'm on this tack, you'll notice that the idea of a 16K colour computer for under £100 has been quietly dismissed. (Your Spectrum, December 1984.)

It was not as if the consumer was being presented with a choice between the old and new machine, since in an interview in Your Spectrum (December 1984) Nigel Searle inadvertently let slip that the company intended phasing out the standard Spectrum. To add insult to injury, the new packaging for the computer seemed to owe more to economy than any real attempt to improve an old product. A number of reviewers noted that the keys of the so-called 'professional keyboard' tended to fall off, and with the passing of time the Spectrum+ track record regarding quality control was less than

impressive. Statements from major retailers such as Boots seemed to indicate that the putative upgrade was more trouble than it was worth:

Return levels for the Spectrum+ are still high, according to a Boots spokesman. 'It seems to take one person to sell a computer and three to deal with the complaints. The acceptable returns level is 5 to 6 per cent. Returns are running at four or five times that amount and 90 per cent of those faults are genuine.' (Sinclair User, September 1985.)

Far from breathing new life into an old product, the release of the Spectrum+ seems to have drawn attention to the weaknesses of the old machine and reinforced suspicions about the low standards of quality control at Sinclair Research.

In view of its limitations, it's hardly surprising that the Spectrum+ turned out to be the answer to no one's problems. Faced with rising debts, enormous stocks of out-dated product, and little in the way of revenue to finance developments for the future, in June 1985 Sir Clive opened negotiations with Robert Maxwell in an effort to raise some capital. When 'Cap'n Bob's' rescue package fell apart, Sinclair finally put his name to a deal with Dixons that had been pending for some while. The chainstore gained an enormous volume of Sinclair stock, and Sir Clive a much-needed £10m of revenue.

If things weren't exactly looking up for Sinclair Research, at least the situation wasn't getting any worse. However, it seems that one of the drawbacks of the deal with Dixons was that it meant that Sinclair could not release any kind of new Spectrum upgrade until 1986. The effect of this clause was that Research was unable to take full advantage of another deal that it had recently finalized with Investronica, the company's Spanish distributor. While the Spectrum was on its way out in the UK, sales of the old warhorse were going from strength to strength over in Spain, although overall the micro-market was considerably less developed than in Britain, and Research product faced little in the way of competition. Presumably mindful of the consequences of Sir Clive's complacency about the product's position in the UK, Investronica decided to plough back some of its profits into the development of a genuine Spectrum upgrade.

The Spectrum 128K is everything the Spectrum+ should have been. With its enlarged memory capacity, a new sound chip, significantly improved keyboard with numeric keypad and RS232 and video output facilities, the machine looked distinctly competitive at around £175. Far too competitive as far as Dixons was concerned. Sinclair Research made it clear that only after stocks of the Spectrum+ had been significantly reduced would the Spanish development be launched on the UK market.

The UK version of the 128K Spectrum arrived in February 1986, priced at £179.95. It lacked the numeric keypad of the Spanish model, this being an extra £19.95 accessory for the unfortunate British enthusiast. Criticized for its lack of a joystick port, and lacking also the new software to take advantage of the extra memory, it aroused little enthusiasm. As an upgrade it offered better sound (played through the television loudspeaker) and the annoying 'dot crawl' on the display was cured. It enabled a VDU monitor to be connected and incorporated a non-standard RS232 communications port. All this was a welcome improvement on a dated machine, but it was launched at the wrong time of the year for new sales and provided no compelling reasons for the existing Spectrum user to upgrade and manifestly failed to revitalize the Sinclair image, as either innovator or provider of cheap machines.

Having tidied up the tail end of the Spectrum story, we must now return to the events of 1983 and chronicle the extraordinary saga of Sinclair's abortive attempt to make a killing in the business market.

However, before we forget - as did most of the population - a few words on the fate of the flat-screen pocket TV are in order. Apart from those gadgeteers who couldn't resist a new toy, most people didn't feel the need for such a life-style accessory. The sales curve remained as flat as the screen. The reasons for this are adequately summarized by W. H. Smith's John Rowland, normally a firm supporter of Clive's products:

I think you have to be perfectly clear about the distinction between a gizmo and a market. I say its a gizmo ... the constraints of a 2-inch screen and its limitations on sensitivity I think makes it a gizmo. I don't think it has the functionality you need for a TV. I mean, you need to see

the picture, and you need to hear the sound, and you need it to work!
(Interview, 18 October 1985.)

[8] THE QUANTUM LEAP: TO WHERE?

The massive success of the ZX81 and the Spectrum had given Sinclair Research the top sellers in a rapidly expanding market. The rewards for such success, allied to Sir Clive's cost-cutting expertise and the massive percentage mark-up that mail-order sales provide, are apparent in the profit figures, the year ending March 1983 producing profits of nearly £14m on a turnover of just over £54m March 1984 showed a lower percentage profit, reflecting the Micro-vision costs and retail merchandising, with the increased turnover of £77m providing only the same profit. However, in anyone's terms this was good business. Rothschild and Sons placed 10 per cent of the company equity with a group of financial institutions in January of 1983 for a price of £13.6m at the same time, it was announced that the company would seek a share placement, either on the unlisted securities market or on the Stock Exchange, some time in 1984.

As well as rewarding himself with a £1m bonus on top of his salary for the year ending March 1982 (he needed the money for his £400,000 Knightsbridge mansion), Sinclair had now cashed in some of his corporate chips, at what in hindsight looks like a very well-chosen point. The notional value of £136m that this gave Sinclair Research was not a realistic assessment, based as it was on a rapidly saturating market in the UK. The rise of Sinclair as a household name had gone together with the micro mania that had produced the highest percentage of homes with micros in the world. In 1982 over 500,000 home computers were sold in the UK, 220,000 of them ZX81s, and 75,000 of them Spectrums. While the 1983 market was estimated at 600,000 machines, sustainable growth in the computer market would require new products. While Sinclair, secure in his visionary zeal, undoubtedly believed that the latest version of the pocket television would sell 'zillions', despite the decidedly lukewarm reception previous incarnations had met with, few shared his faith in this as the replacement cash generator for Sinclair Research.

Sinclair had defined the new wonder product that would keep the computers rolling off the lines, and the contortions of his team as they struggled to flesh out the contours of his vision are the main focus of this chapter.

Although it owed little to any activity on the part of Sinclair himself, it owed much to the legacy of his hand-picked team as they followed in the master's footsteps.

The supposed Quantum Leap in computing power after which the Sinclair QL was named apparently had more to do with the chaos of quantum unpredictability than the orderly behaviour of large numbers of particles. The QL - 'sheer professional power in the special Sinclair style' as the glossy brochure had it - was 'launched' in January of 1984. Expectations in the computer press were high, with persistent rumours about the 'ZX83' having been circulating more or less since the Spectrum appeared. When it finally arrived, having become the 'ZX84' in the meantime, the assembled hacks were informed of its manifold virtues by the recently knighted Sir Clive, and MD Nigel Searle, dazzled by pre-programmed displays on the monitors, prevented from playing with the bolted-down QL, but allowed to book review machines. Searle, with that intriguing blend of Mensa mental might and ingénue honesty we have come to expect, delivered the firm managerial policy: 'When we introduced the Spectrum we didn't know what we'd do next... and now we've launched the QL, we don't know what direction the machine will take us.'

The cream of the technical press then staggered out into the winter sunlight, having plied themselves with free sparkling wine, clutching the glossy blurbs, press releases and a copy of the Super BASIC manual firmly stamped provisional on every page. They then informed their eager readers in no uncertain terms that a new age had dawned for British computer power, and that Sinclair had done it again. The general tone in the computer press was much as Practical Computing (March 1984) had it:

Each of Sinclair's new machines has been more amazing than the one before, but this time he has really excelled himself. The QL fully deserves the initials, which stand for Quantum Leap, it is so far ahead of everything else at the same price.

Most reports didn't strike the realistic notes and qualifications that Practical's previewer stuck in, though:

On past performance, the QL should be well made, but there will be supply problems due to demand. There will also be bugs, and some features of the QL will turn out to have unforeseen and possibly unwanted consequences.

... Four software packages are supplied with the QL ... Extravagant claims have been made for these packages: 'They outperform the software for all existing micros.' On demonstration they looked fast, attractive and user-friendly - but then, it would be a poor demonstration if they did not.

Sir Clive himself said the QL was:

Sinclair's most important contribution to personal computing since breaking the £100 barrier with the ZX80. It should set new industry standards for value, performance, quality and user-friendliness. (Financial Times, 13 January 1984.)

Orders flooded in for this new wonder micro, but when nothing trickled out it became apparent over the next few months that what had been done was to set new industry standards for launching a machine prematurely. It is an all too frequent occurrence in the industry to announce new machines before completion, but only Sinclair Research follows the mail-order merchandising policy such that both legally and ethically, the announcement should imply that a new product will actually be available. The theory is, as Sinclair expressed it in an interview with Martin Hayman back in 1982:

'Professionalism is very important. We have very professional people and we do everything on time, to very tight schedules and with a great deal of commitment. We just are not amateur...'

Did he include in the amateur category the common practice of 'kite-flying' - announcing a product with a stupendous specification for delivery 'next month'?

'Yes, there is far too much of that and it is very silly. It mucks up the marketplace at the time but it rebounds on the company eventually ... If

we announce a product now, it is because it is ready for production.'
(*Practical Computing, July 1982.*)

Quite apart from the fact that he was talking about the Spectrum at the time, and guilty of terminological inaccuracy in respect of that product, the vaunted 'professionalism' of Sinclair Research would seem to have taken a turn for the worse in the intervening years.

The astonishing thing is that at the time the QL was launched there did not exist a complete working prototype of the machine. (Astonishing, that is, unless one has followed the Sinclair story thus far, and hence might predict the culmination of the Sinclair Research style at just such a nadir.) Note that this is not a case of 'vapourware', as the trade calls software announced before writing the code is finished, nor yet a case where the hardware design was finished, albeit not geared up to production, nor even a bug-ridden machine. It was simply the announcement of a machine, for delivery in '28 days', of which a complete working example had never been seen, even within Sinclair Research's labs! When the QL did finally arrive, it turned out to have many of the faults new machines tend to have, and not a few unique ones, but by then the initial tide of enthusiasm had long ebbed, leaving the QL a long crawl back to the littoral of profitability.

The reasons for this deplorable debacle - the attempted marketing of a machine so far from completion, but still with the ludicrous promise of delivery within a month - are buried within the attitudes and management of Sinclair Research. When Sir Clive sold off 10 per cent of Sinclair Research, one of the conditions imposed by the financial institutions that bought the shares was that a proper board of directors should run the company. Several Sinclair staff members found themselves now directors - for example, Jim Westwood, after some twenty years of faithful service to Sinclair's concepts. This condition did not suit Sir Clive, as ever resistant to any control of his activities, and he moved out of the Willis Road premises two weeks after the enhanced board was formed. From this point on he took no part in the day-to-day running of the company and the QL project apart from attending directors' meetings. Sir Clive was pursuing another obsession, electric vehicles, into which he sank a large part of the funds he derived from the share sale. This tale will be told later.

It fell to the directors, under MD Nigel Searle, to follow through on realizing the ZX83 design concept, eventually to become the QL. The original design, much as presented in various leaks to the computer press in mid-1983, was for a portable, battery-powered machine with the famous flat-screen display, using twin microdrives for storage, and incorporating a modem for communication via the telephone system. Following the lead provided by the conceptual, if not financial, success of the Osborne 1 and subsequent 'portables' it was to have a 'bundled' package of business software - spreadsheet, wordprocessor, database and communications. The flat screen and Microdrives offered good size and weight savings over the first generation of such machines, which with standard disc drives and built-in monitor screens were sewing-machine-sized computers for which the trade coined the term 'luggables'. The ZX83 was to take Sinclair Research up-market, into a proven market for serious business computers, and away from entry-level computers and the games syndrome. The concept was Sir Clive's, although the execution was not. As Steven Vickers observed:

One of the things he has always wanted to produce is a business machine - or he's always wanted to put his machines across as business machines - even the ZX81. (Interview, 24 September 1985.)

As far as the abstract idea was concerned, it was fine, and constituted effectively a portable and telephoneless version of the ICL One-Per-Desk workstation machine, or OPD, also known as the British Telecom Merlin Tonto. This was supposed to emerge from the collaboration deal that Sinclair made with his old friend Robb Wilmot (from whom he bought chips when Wilmot was at Texas Instruments before moving to ICL as MD) in December 1981. ICL did indeed bring out the OPD in February 1985, but it owed little to the Sinclair effort in its final form. However, the deal with ICL presumably marks the genesis of the concept. Unfortunately the prenatal development process within Sinclair was flawed, producing a malformed offspring.

The ICL deal presumably sounded good to Wilmot, since ICL was to put up something in the region of £1m for development and give Sinclair royalties on top. It must certainly have sounded good to Sir Clive, offering the

chance of funding a large part of Sinclair's R&D on the new project, with no overlap in the markets for the two versions. At the time ICL was doing quite well with software for the ZX81, and the concept was fine, but one can't help suspecting that it was another case of Sir Clive's renowned powers of persuasion. As Norman Hewett said:

The trouble with a guy like that is that he can get away with things because he can hoodwink by his presentation, earnestness and technical forcefulness, his apparent mastery of his subject... It's entirely people talking. There's no product yet, by definition. They're backing the man, as they cheerfully say. (Interview, 16 October 1985.)

The Sinclair Research labs at the time could probably show a 2-inch flat-screen display of some kind, and a guy named Ben Cheese who was working on the Microdrives (as he had been for a year), but for the rest ICL was putting up a lot of hard cash on faith. As it turned out, it was unwarranted. The first signs of disquiet in ICL may well have appeared when Sinclair Research failed to tell the company when it decided to change the main processing chip from the good old Z80 of the Spectrum. The delay in informing ICL would not have mattered much if they had not, in the three months or so that the news took to travel from Cambridge, bought in Z80 development kits in order to start work on their own bits of the project!

The new machine, it was decided in late 1982, would now be based around the Motorola 68008 microprocessor chip. This was decided on not because of any of the inherent virtues such as power, speed or flexibility on which chip choice is normally based, but because of its perceived virtues as a market ploy and its attractiveness as a futuristic hip chip in 1982. Getting away from the ageing Z80 workhorse chip was presumably seen as necessary to presenting the image of pushing forward the frontiers of technology or some such marketable rationale.

The complex innards of processor chips are not of interest to our story, but a few comments are probably in order to illustrate this particular theme. Data in a computer is all numbers, and is transferred as on/off voltage patterns along 'buses', parallel sets of conductors.

Think of it as a road with a certain number of lanes, and you can see that the more lanes, the more traffic (in this case, data) can be handled. All old-style chips used 8-lane highways (an 8-bit bus), both inside the chip and to pass data in and out. The 68000 family of chips uses 32-bit buses internally, but different sizes of bus to communicate with the rest of the computer. The 68008 has an 8-bit bus, the 68000 a 16-bit bus. Other considerations aside, it is apparent that all data coming in and out of a 68008 will have to be chopped up into smaller pieces for transmission, and take longer, than would be the case with a 68000 chip. The performance penalty is serious, so much so that no other manufacturer used the 68008 in a micro.

When first chosen the 68008 was admittedly much cheaper than the full-specification 68000. By 1985 it was only a few dollars cheaper. If the project had been controlled by the ever-cost-conscious Sir Clive, the savings might have made some sense. In the event, in terms of both design and component costs, the difference is minimal. Choosing a limited chip rather than the full-specification 68000 version (now used by the Apple Macintosh, the Atari 520ST and other modern machines) is an example of Sinclair Research's incapacity to get it right when it matters. It ended up paying more or less the same price for a processor that does less, more slowly, than the correct choice. In any case, the price differences were a matter of a few dollars, and not of major significance to production costs. However the QL saga illustrates the capacity of Sinclair Research to make not only single wrong choices and assessments, but a whole sequence of them.

When the R&D effort started in earnest, there were, to put it mildly, problems. There was no project director, and Nigel Searle was effectively running the show. Sinclair's explanation for his own non-involvement in the development process centres around Searle's sensibilities as an MD:

The reason behind that was because Nigel Searle was managing director at the time, and he really wanted a free hand, you know, he was very concerned not to have me breathing down his neck. (Interview, 6 November 1985.)

The notional concept, at the beginning of 1983, was, as we saw, for a portable battery-powered computer with built-in modem, twin Microdrives,

the flat-screen display and business software. Those facilities which constituted whatever claims the machine had to represent technological advance got dropped one by one. First the battery-driven capability went, since although the Microdrives could easily run on batteries, the DRAM (dynamic memory) chips necessary would drain too much power. Then the flat-screen display was dropped, itself a blow to any lingering portability concepts. In the light of the performance of both earlier (calculators) and later (C5) battery-powered Sinclair products, one should perhaps be grateful.

The continual promise of the flat-screen display deserves a comment. When the QL development started, it was not in production. During the first half of 1983 the production problems were solved, or at least ameliorated to the point where the televisions could start rolling off the lines. Since the 2-inch flat-screen display of the Microvision has resisted all attempts to increase its size (the only reason the Microvision is viewable is a combination of electronic fixes for the beam path and a thick plastic lens), making a larger version for use on a computer was a closed pathway. A larger display would produce a more distorted image, beyond optical correction. Successful attempts were apparently made to produce a projected image from the small flat screen, one version using a mirror producing a real image hanging in space - a nice idea but a non-starter as far as engineering it for production went. ICL was reportedly none too pleased that the visibly innovative bit of its machine was unproduceable, but presumably consoled itself with the other promised features. ICL could get by with a black and white display (the OPD being dubbed by some ICL wit 'Work Station Zebra'), since this was all they wanted, but whether the concept of the QL screen involved colour is not known. If it did, then Sir Clive was being more ludicrously optimistic than ever in his assessment of Sinclair Research's capabilities, however much he could depend on the inventive engineering skills of Jim Westwood, already tried and tested in pursuit of Sinclair's television visions over decades. Derek Holley's comments, made in the context of the conventional tube of the first pocket television, are perhaps even more appropriate to the flat screen:

His argument was that once you developed the 2-inch screen and got it running it would be easy to scale upwards, a typical non-engineering

approach to it. You take something and double the size of it, he thinks it's easy, but it isn't. In fact, it's as hard to double the size as it is to halve it. (Interview, 13 November 1985.)

So the downgraded ZX83 project lurched along in what one source called the 'disorganized shambles' that was Sinclair Research at the time. The absence of a project leader, a board acting divisively and throwing up conflicting views masquerading as decisions, and the lack of co-ordination all compounded each other, and combined with the absence of Sinclair from the R&D scene to produce a fiasco. Whatever Sir Clive's competence or lack of it in other respects, his capacity to provide drive to an R&D team's efforts are not in question, nor is his decisiveness. His lack of direct interaction with the project, which however uninteresting to him personally was vital to his own company, cannot be explained solely by his interest in Sinclair Vehicles. Since he attended various of the board and steering committee meetings, and since the QL was the major project, the progress of the machine should have been both of concern to Sir Clive personally, and the subject of report. Whether because of over-optimism, personal and departmental strife between the directors, fear of showing incompetence and triggering Sir Clive's infamous temper, or whatever other influences were at work in the boardroom cabals, the true situation appears to have been concealed from him. He certainly seems to have known little of the QL's problems until it was too late for him to resist the pressures driving the company to launch the machine prematurely. Not that our readers will by now think that Sir Clive is averse to premature launches, or overly concerned with the problems of production, only that he has a history of at least producing a prototype of some kind before launching a new idea on the world. His comments to us, if accurate, show that even this charitable view is incorrect:

I knew what was being done. If I'd felt that it was very wrong I'd have said so pretty firmly, so I can't say I got it right, I didn't. (Interview, 6 November 1985.)

As development work proceeded on the separate sections of the machine - the Microdrives, the main-board hardware, the software, the case and keyboard, all the concern of separate groups - it became apparent that all

was not going as it should. Part of the trouble was that it was an all-new machine, with the necessary need for well-organized development that that implies, rather than a development of a prior model, as with the ZX80-ZX81-Spectrum series. The plans were also based on an inflated view of Sinclair Research's capabilities, ensuring that time and effort would be wasted in trying to produce features then abandoned, such as the flat screen. Over-optimism in respect of flat-screen displays can be laid firmly at the door of Sir Clive, who first announced in 1980 that the ZX80 would be linked to a flat-screen display', and additional pressure must have come from the ICL agreement, which specified the flat screen as part of the deal.

Other aborted lines of research wasted more time, changed the specifications and delayed the project. Even David Karlin, the designer of the main QL board and hardware, in a staunch display of Sinclair PR hyperbole in *Personal Computer World* while the customers were still waiting for sight of the QL, had to admit that 'there was a spec, but this was modified almost every day'. His comment that 'it was the machine I wanted to build, although it went through various permutations en route' makes one wonder about his criteria, if they were not based on simple pragmatism, since they were still trying to get bits working when he made the comments (around March of 1984). As our story of the Sinclair team's travails continues, the inaccuracy of his comments about this period will become apparent:

Karlin says that the development of the QL was almost trouble-free. In fact, the most difficult problem the team encountered was how to assemble the case! (Personal Computer World, April 1984.)

The PR style of bland and placatory statements delivered straight-faced by Sinclair personnel intent on retaining a veneer of 'professionalism' and credibility seems to be absorbed by association with Sir Clive, or else is a factor in his choice of employees. Whatever his PR utility, David Karlin was valuable as someone who knew the microchip manufacturing scene well from his days at Fairchild Semiconductors running a production line. Because of his insider's knowledge of the industry, it fell to him to replace the absent Sir Clive in the role of cost-cutting component purchaser. Unfortunately, this role diverted effort from the work on what was his first

major piece of electronics design. The tendency of Sir Clive to recruit talented people and place them on tasks new to them, on the grounds that they are then not cluttered with old ideas, may give them an interesting challenge, but also increases the likelihood of inefficiency in the ways they go about the job.

For those unaware of the normal progression of microcomputer hardware design, you start with schematics, essentially a paper design. Any standard chips, such as the 68008, can be considered as 'black boxes' where the innards don't need to concern you overmuch, since the chip specification will tell you what comes out for a particular set of inputs and conditions. The design work, after these chips are chosen, proceeds to a definition of the logical circuits necessary to control and manipulate the system. Some portions of these circuits can utilize standard off-the-shelf chips, others will be incorporated in custom-designed chips. Usual practice is then to build TTL (transistor-transistor logic) prototypes of the custom chips, and then of the full machine, using the lego blocks of electronics design, simple chips forming logical elements, to replace the symbols of the schematic. This gives you the capability to test out the correct operation of the circuits and their interactions, and revise as necessary before commissioning custom chips. The next stage is the design of the printed circuit board on which the chips, plus sockets, resistors, and all the other discrete components are mounted, and which provides the interconnecting 'wires' as metallic tracks laid down on the insulating board material. Prototypes can then be built with the custom chips, and they can be tested. Several reiterations of complex chips will be necessary for various reasons - logical errors and the like.

This is a fairly well-established development process, and originally must have been plotted out on a timescale by Sinclair Research despite the statement in Rodney Dale's account that:

It was part of the Nigel Searle management technique never to prepare any sort of schedule showing who was going to do what and by when. Such an approach, he averred, leads people to take more time than they should. (The Sinclair Story, p. 136.)

If this was the case, it would have made for unusually vague ‘management’. Apparently Nigel Searle, at least towards the end of the project, was engaged in not only defining timescales for particular activities, but manipulating them rather arbitrarily. Tony Tebby, working on system design and software, recalls the process:

For instance, I was asked how long it would take to do the Microdrive software, and said four weeks’ actual working time once the work started. That went down in the minutes as ‘The Microdrive software would be complete within two weeks.’ First, the period was halved, and then it was changed from actual to elapsed time, by Nigel Searle. When the minutes went to everyone else, [and] in two weeks I haven’t done the Microdrive software because I’m doing something else, everyone who gets [the minutes] says I’m falling down on my job ... I think he thought he could make things run faster by generating external pressure. (Interview, 14 October 1984.)

Slippage in the timescale and the design flaws resulted from a combination of factors. Shortage of technical staff, forced and unforced changes in the design, problems with the technology, lack of management decisiveness allied with the divisiveness of tactics such as the above, all emerge from the story. As pressure to complete the work was exerted by management the problems got worse, with mutual recriminations the order of the day at the steering committee meetings.

Grandiose ideas of what could be achieved by as small a group as the Sinclair R&D team, however talented individually, led to the contemplation of an additional computer project in 1982. Sinclair Research was going not only to produce an all-new machine, the ZX83/QL, aimed at the business market, but it was also going to recycle bits of the hardware into a new machine for the Spectrum market. Although the Interface I and Interface II were still not ready, despite the efforts of Martin Brennan and Ben Cheese (Brennan had originally joined to do artificial intelligence work, but technical staff were so thin on the ground that he ended up doing logic design for the interfaces), plans were in hand for a 68008-based SuperSpectrum. This would have all the add-ons incorporated: ROM cartridge, joystick ports, microdrives, serial interface and network. A faster

processor and more memory, plus a new BASIC, would give the loyal Spectrum freaks a machine to upgrade to, it was hoped, since the QL was supposed, in both price and concept, to avoid this area. Jan Jones was recruited to do the new BASIC, and the project started, including an enhanced keyboard design, which replaced the soggy rubber keypads of the Spectrum with hard plastic for a firmer feel. Then, at the end of 1982, the project was dropped, because the hardware design load was already overstressing the capacity of the limited technical team. The Spectrum market was also holding up well, and the Interfaces would give it a boost when they finally appeared, so there was no immediate need for a new hobbyist machine.

The ZX83 design process outlined above never got much of a chance to proceed smoothly. The delays in the design of the Spectrum Interfaces held up the development of the upgraded microdrives for the QL. Having finalized the actual tape-cartridge design, Dave Southward, Sinclair Research's technical director, had to try to gain faster data transfer and capacity by modifying the drive mechanisms and electronics. Sir Clive is inclined to blame delays on this aspect of the design:

The problems centred principally on the microdrives, which worked a treat in the Spectrum version, but in the QL were re-engineered in what looked like subtle and fairly minor ways, but in fact turned out to have a lot of problems. (Interview, 6 November 1985.)

Since portability had vanished, there was no longer any particular need for the low power consumption of the microdrives, and not as much cost benefit as might be imagined. Standard 3-inch floppy-disc drives bought in from Japan would be nearly as cheap, and have both faster performance and higher storage capacity. There was no likelihood that Sinclair would take this route, however, since it had succeeded in producing an 'innovative', if inefficient and idiosyncratic, storage device, and would proceed with the design despite good arguments to the contrary. Of course there was little else that was distinctive about the machine, and ICL presumably wanted some innovative Sinclair technology in exchange for its investment.

The need to stick with the Sinclair approach is also apparent in the keyboard for the QL. This revised membrane design, although a distinct

improvement over previous Sinclair designs, is not the 'professional keyboard' it pretends to be. It was assessed as the better of two designs produced for the QL but, symptomatically, the sample keyboards produced by a Japanese company to Sinclair's requirements, of typewriter standard, were not included in the assessment. The obsessive Sinclair Research mentality says, apparently, that it has to look like a Sinclair design even if it doesn't work as well as it might. Again, there is no significant cost saving that acts as a justification. We were informed that the sample keyboards costed out at the same price as the Sinclair design chosen! The movement of the yen might have altered this by a pound or so, but most purchasers of a 'business' computer would probably happily have paid such a surcharge for something their secretary could type on.

It's unlikely that any decisions could have been made to go against the Sinclair style, since the management couldn't even manage to decide which of the sample printers offered by manufacturers they should choose. (The QL has a serial printer interface, rather than the industry standard parallel interface.) Since the sample printers were available in 1983, it is somewhat peculiar that only in late 1985 was one announced. One explanation for the lack is of course that a useful business system must have a printer. Since cheapness would be a selling point, reminding the potential purchaser that another large investment would be required would be counter-productive.

The same argument went for the VDU monitor that is essential for extended use. Again, there was a very good argument for Sinclair to provide a monitor, because the QL system drives an international standard display, which will not work effectively with some of the British monitors available. Marketing-wise, to trumpet a price breakthrough of £400 for a business system, and then admit that you needed a printer (about £250) and a colour monitor (about the same) to put it to use might remind potential purchasers that they were looking at a total cost of nearer £1000. At £400, the QL could be made to look like a bargain, but at £1000 there were other options the customer might look at. This train of thought, or incapacity to commit to a competitive assessment - however you look at it - led to two decisions, or rather one non-decision and a fudge. The first was not to provide a monitor, which was one less commercial task, and the second was the addition of an output suitable for a domestic television. Again, this was retrogressive in

terms of the original concept, but comforting in the sense of reverting to Sinclair style — all previous machines had only plugged into televisions. The fact that the display wraps off the corners of a lot of television screens and produces flicker was discounted in favour of increasing the market; the specifications changed again, and another job was added to the design task.

Back to the hardware that was supposed to use the peripherals. The heart of the design was the custom gate array. At the point when the TTL prototypes should have been built, the design process had slipped so far that the electronic design for them was not completed. Since the turnaround time on a custom chip was only three weeks (and about £10,000), the decision was to go straight for the custom chip, and then incorporate this in a prototype, cutting out the TTL version. Predictably, the chips had problems, and with mounting pressure it appears that as soon as one problem had been identified and corrected the modification was incorporated in another reiteration of the chip. Another three weeks, in the course of which more flaws would come to light, and the process would then be repeated.

Two consequences are apparent from this illusorily time-saving approach. The first is that the integrated modem that David Karlin was to produce, as part of one of the chips, was never designed. Another feature vanishes from the vision. The second was the incorporation in the design of what the ad people turned into a virtue, an Intel 8049 microprocessor chip. This ‘second processor’, says the blurb, ‘controls the keyboard, generates the sound, and acts as an RS232 receiver. None of the power of the 68008 processor is wasted on these functions.’ Well, yes, but a lot of the potential processing power of the 8049 is wasted on doing three minor jobs, none of them very well. It wasn’t supposed to be there at all, since the functions were supposed to be performed by another custom chip.

This was a sensible choice, as an initial design decision, because it would replace the three standard chips that could do the job, be cheaper, and simplify the circuit. Unfortunately, they didn’t have time to design this, so the 8049 was pressed into service. The beeping noises it makes are more variable than the Spectrum’s, but just as useless. It handles the keyboard encoding, but this could as easily be done in software, and it handles RS232 serial communications (signals in and out of the machine) in a peculiarly

inefficient way, operating one channel but multiplexing two channels into this. The result is various problems with the RS232 facilities, one being that both serial ports provided can be set only to the same speed of transmission. If there was a cost saving there might be some argument for it, but since the 8049 is more expensive than the custom chip, and less efficient than three dedicated chips (together not significantly more expensive), it gives a measure of the confusion of the design process. It is not as if the 8049 merely dropped into the position reserved for the custom chip, either, since it didn't have enough pins (connections) and additional custom-chip work was required to overcome this problem.

In the light of this catalogue of circuit changes, Sir Clive's explanation of design problems as due to lack of control over the engineers rings a little hollow:

The project started off in a totally different fashion, and then diverged from what I originally wanted because the engineers who worked on it wanted something very different. Engineers always do, they want something that they would like, and you've either got to pull them back, or you've got to persuade them, or you've got to switch engineers. In this case, they weren't having to persuade me, really, they were persuading Nigel, and he bought the package. (Interview, 6 November 1985.)

What the engineers wanted was not a better machine, but more time, better co-ordination, a consistent specification and things like that. Given the way the QL turned out, to blame the engineers for a common trait of their profession, the quest for excellence, is perverse. The engineers were in fact doing their best, but if you can't put all the bits together to test them you are bound to have problems with the overall system.

Since the interactions are supposed to be controlled by the software, the writers of the operating system also have problems. It is quite feasible to write the bulk of the software from the specification of the hardware and its interrelationship, but revisions in the design must be reflected in changes to at least the lower level of software, that directly controlling chips and other devices. The operating system (OS) was commissioned from a software company called GST. It worked from the low-level OS drivers produced by

Tony Tebby, and in contrast to the modest fees paid to Nine Tiles, GST was to have done fairly well out of their involvement. In addition to time and material payments that ran into six figures, GST was to receive a royalty. Tony Tebby, inside Sinclair Research, was also developing an operating system 'as a backup'.

Psion, a software company that had done very well out of games software for home micros, had forged links with Sinclair Research on earlier software ventures. When Sinclair put the word out in early 1983 that a suite of business programs was needed, Psion had already started to develop just such a package of integrated software for IBM micros and other MS-DOS machines. It put its proposals in and they were accepted. Since all the development work was done on a VAX minicomputer system the lack of hardware didn't matter so much in the first place. It would later be customized to the QL operating system. The only hardware available in mid-1983 was mock-ups of the main board, minus microdrives, serial ports and the like. Somewhat later some hand-built versions were produced, with a single Microdrive, and the serial ports, but since the Microdrive couldn't be used in conjunction with the serial port, and the logical faults were still there, their appearance, although better than nothing, could not have given anybody a sense of rampant progress. We now leave the QL saga for a moment to consider another development taking place around this time.

There were persistent rumours that out of the Far East would emerge a cheap (£50 or so) colour computer as the Orient moved into the market. Responding to this potential challenge to the Spectrum's pre-eminence, the Low Cost Colour Computer (LC3) project was started. The hardware was virtually a one-man project for Martin Brennan, who designed and produced it in a matter of a month as a TTL prototype. With a Z80 chip, and designed to use ROM software cartridges, and with data storage on battery-backed RAM packs, it was a nice concept. Steve Berry produced an operating system, complete with the full overlapping 'windows' that the QL doesn't possess. (True windowing, as on the Macintosh, allows a separate screen portion to overlay whatever was originally there, and then be removed, while preserving the contents of the original screen.) This cheap and powerful machine, with superior display handling to that of the QL,

was one of the topics discussed at a planning meeting in November 1983 held, for some reason, in the Lake District.

Sir Clive, the technical members of the board, and various members of the technical staff forgathered. The LC3 project was chopped, on the grounds that the competition had not appeared, and there was no reason to introduce a cheaper computer unilaterally, especially with the lower absolute profit margins it would produce. So much for cheap computing for the masses! Further development of the LC3 would be costly, and the view was being sustained at this time that the QL was almost ready for production. The capacity for self-delusion that this implies is explicable only in terms of a lack of communication. While Nigel Searle puts it like this:

We are a very bureaucratic company and don't spend a lot of time in formal communication, written or otherwise. (Quoted in International Management, November 1984.)

The technical staff found themselves wondering why, in a fairly small company, communication was worse than that found in the major companies they had worked for. When Searle decided to go for a QL launch date, the stresses became acute. Again, the implication was that the engineers were a problem:

At some point in a project that has been going on for 18 months, you have to put a stake in the ground and say you are launching the product on such and such a date. If you wait for the guys who are working on the product to tell you when it will be finished, you will wait for ever, (ibid.)

Waiting until there's a working prototype, however, would seem to be sensible. The decision to go for a launch was imposed rather than negotiated, just as Searle implies, but ill-advised. Tony Tebby recalled the state of affairs:

Communications were deliberately distorted. If I talked to marketing, they would describe to me a product I'd never heard of. They said, 'Well, give us the finished product in a couple of weeks' time and we'll review our position.' I said, 'But it's not going to be working for six

months!’ They say, ‘But we’re starting the ad campaign in two weeks’ time, placing the ads.’ (Interview, 14 October 1985.)

The case design was frozen, which didn’t allow time for the design of the ‘feet’ to prop up the case to a good typing angle to be completed. The resulting bodge occasioned comment from reviewers:

If you do a lot of typing you might find the keyboard lies a bit flat. To overcome this, Sinclair has supplied three funny little plastic feet which are supposed to fit into rubber pads under the keyboard. I found that these fell out regularly and in the end I dispensed with them and got used to a new typing position. (Personal Computer World, June 1984.)

Another reviewer suggested you also dispense with the feet, but rest this ‘professional’ micro on a book! Another result of freezing the case design meant that positions of sockets for external connections were also frozen, and the PCB (printed circuit board) tracks had to lead, however inefficiently, to those locations. Rick Dickinson, the case designer, and John Williams, the draughtsman, or the others involved (effectively everybody) can’t be blamed or even disparaged for any of these problems. The lack of co-ordination and communication, and the pressure for an unrealistic launch date must bear the blame. The last prevarication and specification change indulged in by the management of the time illustrates the point.

At launch date minus a few weeks, the stance was still that there would not be an inbuilt version of BASIC on the QL, in line with the decision to go for a ‘business’, rather than a hobbyist, machine. The only set of instructions provided in ROM memory, apart from the QDOS operating system, would be a ‘bootstrap’ BASIC with no instructions other than those needed to enable the Psion software packages to be loaded and run. Jan Jones had been recruited for, and had started writing, an advanced and structured BASIC for the proposed, but now dropped, SuperSpectrum. When the Super Spectrum project got the chop, she continued to develop the BASIC in her own time, while working on other QL software for Sinclair. Since there was most of a 68008-based advanced form of BASIC in existence on the premises, the temptation was to use it. No Sinclair machine since the MK14 had been provided without an inbuilt BASIC, and

the computer freak/hobbyist market made much use of BASIC (when they weren't playing games), as was attested by the continuing popularity of BASIC program listings in the magazines. To commit to the business computer market and have no product for the mass of loyal Sinclair enthusiasts to upgrade to must have produced a distinct and disconcerting feeling of going out on a limb. The Sinclair success with computers was based on a certain type of machine: ones that had BASIC built in, could be plugged into a television, powered up, and be ready to go. To move into a new area of the computing arena, even at the bottom end of such a market, would require both an impeccable machine and a great deal of confidence in the product and the market. This latter would appear to have been lacking, while as yet the machine could hardly be said to have emerged as an operational reality.

It is only such considerations that can explain the gradual watering down of the QL concept in certain respects. Adding a television outlet was as much a response to this as the fact that Sinclair Research hadn't produced a monitor to go with the QL, or arranged an OEM deal with someone who manufactured a monitor. The late decision to hedge the bets yet again and include a BASIC was not only a failure of nerve in the concept, but productive of more problems.

The operating system had been allocated two sockets on the board, each for a 16K ROM chip, into which the operating system and the 'bootstrap' loader for the Psion programs had to fit. The operating system commissioned from GST was not finished (the designers realistically couldn't do much to finalize it until there was some definitive hardware) and in any case the OS was designed to occupy most of the 32K available. QDOS was more compact, and more complete, but with the unfinished Superb ASIC needing some 22K, there was no way in which the OS plus the BASIC would fit within 32K. Tony Tebby, on learning of the launch, promptly handed in his notice, to take effect as soon as working machines had been produced, on the grounds that the launch was misleading to the consumer:

There was never any possibility of launching a machine of which there was not a working prototype ... [the launch] was ... commercially

foolish, and brought no benefits. (Interview, 14 October 1985.)

The QL manual handed out at the launch was a stop-gap construct leaning heavily on the Psion package's documentation, since at least the user's actions and their consequences could be described with some accuracy, even if they were not yet converted so that they actually worked on the QL. The SuperBASIC section of the manual was a confabulation of existing facilities, hoped-for additions and some straightforwardly inventive writing.

At this point, we arrive at the launch date. There are two views as to why the launch was allowed to go ahead so prematurely. One has it that the launch was designed to upstage the Apple Macintosh computer. As the Macintosh would predictably be a more expensive machine, and would not be competing directly with the QL, this explanation makes little sense as a marketing decision. Given that the Macintosh is, however, noticeably more innovative, flexible and user-friendly, as well as faster, than the QL, the need to get in ahead on the media attention may have played a part. Far more likely is the suggestion made by, among others, Guy Kewney in *Personal Computer World* that it was a desire to get some funds in before the end of the financial year (March 1984), to enhance the sales figures for the potential shareholders who would be invited to invest in British innovation on the basis of this year's figures. Given the investment costs of the flat-screen television production line, and the continuing problems that prevented even the fairly sluggish demand for the £100 Microvisions being satisfied, plus cessation of the high-profit mail-order market for computers and the Spectrum price cuts, this would seem as good an explanation as any. Christmas sales were not as great as had been hoped, and Sinclair was holding £7m of stocks at the end of the year - none of it in QLs!

As up to 500 orders for the QL poured in each day, there was certainly no hesitation in cashing cheques, despite an absence of product. Indeed, it must have been clear that there was no hope of shipping before the end of the financial year in March, let alone honouring the '28 days delivery' promise. That this was not only apparent, but recognized as a fact within Sinclair, is confirmed by Tony Tebby:

I discovered they were going to launch it about one week before Christmas. However, in the press release I was shown the day before

the launch, it estimated delivery as 'end April'. The press release that went out had 'end February' - a stroke of total idiocy. They said the ads said 28 days delivery, so the press release couldn't say different. But, I said, it's totally untrue, we don't even have a complete working prototype! (ibid.)

Whether the over-optimistic promises to the public were rooted in the desire to help the faltering cash flow or not, this was the result. The cash figures for the year end were a massive £8.5m, and apparently included the £5.5m 'trust fund' set up by Sinclair (after the end of the financial year) to hold the mail-orderers' money when the flak started to fly in the press. However useful in accounting terms, the publicity subsequent to the initial euphoria of the 'launch' was uniformly negative.

The lack of euphoria within Sinclair Research itself can be illustrated by a story that subsequently emerged. Your Spectrum magazine, in its December 1984 issue, asked Nigel Searle what he would like as a Christmas present:

What I'd really like to have is the name of the person who sabotaged my chair at the QL launch. Sitting in my cushioned chair waiting for Clive to finish his introduction so that I could kick off the proceedings I became aware that the chair was absolutely soaked. Someone had filled the cushions with a few gallons of water, so that it looked perfectly all right before you sat in it, but as soon as you did - well, need I say more? When I stood up to make my speech I had rivers of water pouring down my legs.

The world and the press waited in vain for QLs while the Sinclair team battled with 'finalizing' SuperBASIC and QDOS, getting the Microdrive interface working, and solving the logic errors in the custom chips, all while notionally gearing up for production. Inquiring journalists, anxious for review machines, were told that delays were caused by 'development problems'. This was at least more honest than the letters sent out to all who had placed orders in response to the full-colour ad campaign in the Sunday supplements, which blamed the delays on the fact that, 'The demand for the QL has been phenomenal from the day we launched it.'

This non sequitur posing as a ‘reason’ for not having produced a single QL was backed up by the offer of a ‘free gift’ for those who waited patiently while their money accrued interest for Sinclair Research. So those patient souls who didn’t demand their money back would receive a free RS232 cable. Normally priced at £9.95, it was repriced, as an added virtue, for the hopeful customers at £14.95 to increase their ardour. The complaints went to the ASA, and Sinclair itself changed the ads to say that delivery ‘may take longer than 28 days’.

The computer press, especially those having to fill QL supplements with notional reviews, rumours, speculative comparisons with other machines and details of the 68008 chip, was starting to complain. Dave Tebbutt, a friend of Sir Clive and a Mensa member among other things, got hold of one of the first working models, some time in April, and produced a positive review in Personal Computer World, despite the unfinished BASIC and QDOS. The less-privileged journalists were shipped off in the Sinclair Research black Mercedes to use four machines on show. The results were not what Sinclair had hoped from this PR exercise. Firstly, the fact that more than 32K of ROM was needed for the BASIC and operating system meant that hanging out of the back of the QLs was what came to be known as the ‘kludge’ - an extra 16K of storage sticking out of the ROM cartridge socket. Other aspects of the machine also proved disappointing:

The bad news is that QDOS and the bundled software’s current implementation is what one of Sinclair’s engineers described as ‘flakey’. Even basic operations like retrieving specific bytes from microdrives brought the system down. Several of the bugs thrown up in the session seemed new to Sinclair, and were noted with bemused interest. (Practical Computing, June 1984.)

In April, the first ‘production’ models (complete with kludge) were shipped to customers. Estimates of the numbers varied from 89 (curiously precise) to 1000, but were probably closer to the low figure. This enabled Sinclair to declare that it had started shipping machines. The press got the long-awaited review machines shortly after. Their gratitude at finally having something about which to churn out words at NUJ rates muted the criticisms somewhat, but the reception the QL got could still best be

described as mixed. The keyboard, the most obvious part of the machine, was criticized by many:

The keyboard is not what it's cracked up to be and don't let anyone tell you otherwise ... The worst factor of all is the key action itself: squashy. Anyone using the wordprocessor will have very tired fingers and wrists after a day's keying in. There is no springback on the keys and they have to be depressed a considerable distance to function. (Electronics and Computing Monthly, June 1984.)

The keyboard also belies the QL's image as a business machine.

The keytops are expensive, classy items, but underneath there's the same old membrane, and we found them unpleasant and difficult to use. (Personal Computer News, 26 May 1984.)

Others were less scathing:

Sinclair are pushing it to describe the keyboard as of 'professional quality'. It's certainly adequate for programming and so on but doesn't compare with something like the BBC. (QL User, July 1984.)

Some reviewers even liked it, but it's worth commenting that reviewers don't have to do wordprocessing for a day at a time, as would a dedicated business user. Nobody of course rated it as highly as Sir Clive, since nobody else would feel driven to defend a dubious 'innovation' as obsessively:

The mechanism inside the keyboard is an immense investment in tooling and is a very precise system ... We are very proud of the keyboard. (Personal Computer News, 16 June 1984.)

Emphasizing the investment in, rather than the utility of, a keyboard, especially since a better one could have been bought in, seems to miss the point. However, there were more cogent criticisms of the first 'production' QLs. To avoid the tedium of repetitive quotes, we'll illustrate them by a summary that appeared in *Your Computer* in July 1984:

Those criticisms covered all aspects of the QL: it was slow, had an unfriendly editor, the microdrives were prone to lose files and data, there was no documentation other than for the Psion packages, the network would not allow integration of Spectrums, the RS232 interface had bugs in it, Microdrive files on a well-used cartridge would take an age to load, the keyboard felt a bit clattery with a sticking enter key, and so on.

The 'and so on' covers a multitude of computerish sins. We should perhaps note criticisms of the Psion wordprocessing package as being excruciatingly slow to rewrite the screen and of the microdrives as being very slow. All the above criticisms refer to version 'FB' of the QL BASIC software. (There was a whole sequence of them, issued and unissued, all identified by two-letter names. Rumour had it that these referred to the programmer's initials, but in fact the first two were named after cab drivers' initials, and subsequent ones after girls who worked at Sinclair Research.) The same reviewer went on to say that the newer (AH) version of the ROMs '*is Sinclair's answer to most of the problems, but it does not present a cure for all the QL's troubles, and cannot make any difference to the hardware faults*'.

Subsequently, this 'final' version was replaced by 'JM', and then by 'JS' in production models. Sinclair got rid of the unsightly 'kludge' hanging out the back around version 'AH' by putting 32K EPROMs in one of the sockets inside the machine.

Actually, the hardware was going through some hard revision processes as well. By the time the 'AH' software arrived they were on issue 7 of the main board layout! There were firstly some relatively simple problems to resolve, such as the fact that the early machines had the high-frequency PAL television oscillator circuit right next to the head amplifier of Microdrive 1, effectively ensuring that this Microdrive was inoperative and you had to use Microdrive 2. There were interactional problems that appeared in the early machines, such as the fact that the act of turning on a Microdrive altered voltages in the circuit, and it started to oscillate. The result looked like a signal coming off the Microdrive head amplifier, as it stopped when the motor stopped, but was in fact garbage. This was solved

by soldering a capacitor across the head amplifier. Gradual improvements were made - rerouting power-supply tracks, modifying the custom chips - and the machine improved over time. Some problems, such as the fact that QLs were supposed to be able to communicate over the network with Spectrums, could be solved just by ceasing to claim that it was possible.

ICL, waiting to get the core of the OPD machine out of Sinclair (having given up on the original specification), was given early QLs. ICL ended up using only the display-control chip, microdrives and the Microdrive-control chips. Even with this low return on its investment, it had problems. It didn't get that much co-operation from Sinclair, either, it would appear. Tony Tebby by this time had left Sinclair Research, his work on producing working machines done and honour satisfied. He was however still involved in QL work, and recalls a meeting with ICL personnel. He takes up the story at the inclusion of the capacitor across the Microdrive amplifier:

I said, 'It stops the head amp oscillating.' They said, 'Sinclair says it improves the signal-to-noise ratio.' Well, it does, in the sense that you got signal out of the thing, rather than noise. Without the capacitor, on a substantial proportion of machines, you got nothing but noise. .. Anyway, we went through either eleven or seventeen problems, all of which were caused because known faults in the hardware had been insufficiently notified to ICL. (Interview, 14 October 1985.)

ICL, wanting to press Sinclair's innovative technology to use in the OPD, found that its supposed partner was not coming clean:

There was a hardware fault such that you had to go into Microdrive mode to write to a Microdrive, but you also had to disable the RS232 in total, otherwise you wrote to the Microdrive at the RS232 baud rate. You had to disable, not only disconnect, the RS232. ICL were understandably a little annoyed at all this. At this time I was in a Portakabin in the grounds of Milton Hall. ICL sent a very annoyed letter to Sinclair Research [saying] that under the terms of their contract they were supposed to be notified of changes. They had been notified of some changes but had not been informed of other errors in the hardware, (ibid.)

Tebby's desire to help ICL did not have particularly happy consequences. When his input to the contractual partnership was revealed:

I was literally thrown off [the Milton Hall] site. They were furious. I got a letter from Nigel Searle about it, and I got an apology from Clive when I sent the letter from Searle to him and told him what had happened. At that stage he was so far removed he didn't know what people were doing in his name, (ibid.)

However, ICL's need to sort the hardware was fed back into the ongoing development of the QL as it assisted in identifying and rectifying problems.

The fact that meanwhile people were paying good money for these interim development machines (you could get upgrades, but only by returning your 'business' machine to Sinclair, a process that took at least three weeks) was brazened out by Sinclair with a bold face. Interviewed in Personal Computer News (26 May 1984), Sir Clive said:

The whole point about the software was that it wasn't final, and it wasn't final in the sense that it was crashable. No new computer with new software is ever totally free of bugs ... in a sense, by shipping the machines out to customers early, we are getting them to find those bugs for us, but we are not making any pretence that we are doing otherwise.

It was not mentioned in the adverts, however! Nigel Searle took a firmer view, as befits a managing director rather than a visionary looking for excuses:

How could it happen that British industry's blue-eyed company could foul up so badly? Managing Director Nigel Searle explains that Sinclair felt customers would rather have a provisional machine than no machine ... (ibid.)

Well, maybe, but they should perhaps have been asked. The final words on the machine as it appeared in the early versions can come from the launch issue of QL User magazine. Despite the whole rationale being the wonder

of the QL, by July 1984 the journalists couldn't keep realism out of their text:

At the moment it's hard to be enthusiastic about a product that was pre-announced and is suffering from a rush into production and premature placing into the hands of customers. The most obvious reaction is that only dedicated hobbyists and enthusiasts are going to buy the machine. If the QL is to have any part in business computing it needs to be sorted out very quickly. And that's something of a shame because the design is a step forward (though hardly a Quantum Leap) for micros. The reality is a machine that needs a lot of work, and Sinclair Research is looking distinctly as though it made a mistake. (Max Philips.)

The marketing of the QL has been shoddy, and the treatment of customers and press alike inadequate for the seriousness with which Sinclair Research would like us to take its new product. However, I'm convinced that the machine is going to be good, and this opinion is not so much fashioned from what Sinclair is saying, but is based on the dedicated user base out there that has backed up and developed previous Sinclair machines into something worth having. Clearly there have been technical problems with this one ... Still, it's lucky the company didn't invent the typewriter — if it had I'd probably be carving this in stone. (Roger Mumford.)

The hope that a dedicated (and magazine-buying) user base would arise, as it had for the ZX81 and Spectrum, in order to make the QL worthwhile would seem to show an early recognition that the machine had missed the business market. Ironically, one of the few surviving businesslike bits of the QL was that it had not included a cassette port, thus depriving software houses of their cheapest means of distributing their wares. Instead, they had to use the expensive Microdrive cartridges, available only from Sinclair, which took the QL out of the cheap games arena. The 'serious' software that did appear - other languages, programmers' utilities and the like - was all again for the hobbyist market. Sinclair Research hadn't managed to crawl, let alone leap, into a new market after all.

The QLs that were produced did get better, in terms of hardware and software, over the period to the end of 1984, when they were up to version 14 of the hardware. By July 1984, with machines actually being shipped in visible and kludge less quantity Sinclair was attempting to persuade everybody that the problems were over. Production was claimed to be 2000 a week, with 28-day delivery possible by September, and Searle predicted 250,000 QL sales in 1984. David Karlin was wheeled out to practise his PR:

On the tricky subject of software bugs Karlin told us, 'Of course silly and convoluted things will crash the machine - if you get the answer wrong through a complicated expression, then this is not significant ... no BASIC ever written is perfect - within that we are perfect.' (Your Spectrum, August 1984.)

Improved Psion software was announced to be in preparation, but didn't arrive until February 1985. The £4m advertising campaign in the autumn of 1984, which used television for the first time (Sir Clive in a long scarf doing a leap over rival machines), didn't help much. This promotion was intended to support the retail availability of the QL and the flat screen, as well as the Spectrum.

Unfortunately there appeared to be some quality-control problems on the QLs:

The manager of the local branch of Dixons told me that out of 1000 machines delivered to their warehouse, only 190 worked properly. Further rumbles from Spectrum distributors seem to indicate similar troubles - with one hapless dealer spending a whole morning with six QLs and six sets of Psion software trying to find a combination that allowed all the Psion wares to be loaded. (Your Spectrum, December 1984.)

Christmas 1984 was a declining market for computers. Sinclair maintained its market share, with the ageing original Spectrum supported by freebie software, and repackaged Interface I, Microdrive and software deals, and the cosmetically upgraded Spectrum+. But it was a bad year all round. Poor sales of the QL weren't helping, and all was not rosy on the financial front. Having reached Christmas 1984, however, we now need to backtrack to the

project that had been absorbing a lot of Sir Clive's energy and cash while the QL development debacle had been proceeding.

[9] THE MACHINE STOPPED

The C5 saga chronicles the most depressing failure of a Sinclair vision. Anticipated for decades and developed over many years, Sir Clive's electric-powered dream came and went in ten short months. If tragedy comes in threes as the old wives maintain, then the ill-fated trike must be added to the flat screen and QL to complete Sir Clive's trinity of disasters. Like the television, the idea of producing some kind of electric vehicle had been a constant preoccupation for Sinclair since the beginning of his commercial career. It's ironic that both projects were destined to suffer much the same ignominious fate.

Although electric-vehicle research was begun in earnest only at Sinclair Research, company records suggest that in the early seventies Chris Curry half-heartedly tinkered with the embryonic development of the project for Radionics. Even at this stage it seems the research was active rather than theoretical, since Norman Hewett recalls spotting an early prototype rotting away in the depths of the St Ives Mill, although he stresses that the NEB never had any interest in the product. Indeed, even among Clive's most loyal supporters one senses the desire to disown the fruits of this particular vision. Everyone is at pains to emphasize that the electric vehicle has always been Sinclair's personal dream rather than any kind of corporate endeavour. Uncharacteristically, Sinclair seems to have bowed to this consensus of doubt, and development of the C5 was postponed until it could be backed by his own burgeoning fortune.

Although Sinclair has always promoted the C5 as a 'completely new concept in personal transportation', a cursory examination of developments in the motor industry reveals that such claims cannot be supported by history. While the earliest development of a crude battery-powered car can be traced to Thomas Davenport's decidedly limited prototypes of 1834, it wasn't until the beginning of this century that commercial research and development began in earnest.

According to *The Complete Book of Electric Vehicles*, Shacket's definitive history of the subject, 35 per cent of the vehicles sold in 1900 were powered by electricity. The market peaked in 1912 when almost 34,000 electric cars

were registered. This figure takes into account only vehicles used as 'personal transportation'. (At this time, there was an even greater number of commercial electric vehicles on the streets - i.e. trucks, vans, taxis, etc.) However, as petrol-powered technology advanced by leaps and bounds, electric-powered vehicles sank into a decline, their progress inhibited by the failure of science to make any significant advances in battery technology.

A century of evidence reveals that Britain, more than any other industrial power, has intermittently taken the principle of electric-powered transportation seriously enough to commit resources to investigating its technical and commercial viability. As a consequence, in the year Sinclair's modest contribution was revealed to the world, this country could boast 30,000 electric-powered vehicles in commercial use (27,000 of which were milkfloats), while similar developments in the domestic market still awaited significant technical innovations.

At the beginning of the 1970s, all the major political parties recognized that there were votes to be gained from a gestural support of a broad spectrum of 'ecological issues'. To this end, correspondingly gestural grants suddenly became available to companies that could cobble together proposals demonstrating the pursuit of 'ecologically sound' goals. The compelling combination of an ideological fad and a crisis in oil ensured that alternatives to the internal combustion engine were, once again, an acceptable subject for corporate speculation. But only just. In the event, between 1971 and 1980 the state invested less than £6m in researching non-pollutant forms of transport. Almost half of the total allocation ended up in the hands of the already heavily subsidized Lucas Aerospace. (To date, the only tangible product of the Lucas investment is the decidedly uninnovatory van used for company deliveries.) The remaining subsidies were wisely passed on to companies researching methods of providing a reliable power source for electric vehicles, an unsolved problem that continues to constrain the commercial viability of such products.

Early in 1980, Sinclair was beginning to feel that he'd finally laid the spectre of the NEB and was once again at the helm of his own operation. The recently launched ZX80 looked set for success, and the development of its successor was well under way. While in lesser mortals such a period

might prompt a sense of cautious optimism, the new decade found Sinclair in an expansive frame of mind. The time seemed ripe to re-evaluate the electric vehicle concept. To this end, Radionics veteran Tony Rogers was hired on a consultancy basis. It's worth stressing that at this time Research was just beginning to grapple with the supply and demand problems precipitated by the success of the ZX80. If any form of corporate plan existed, it would almost certainly have been concerned with exploiting the company's tangible success in a new line of consumer electronics. There were neither the people nor the financial resources to encourage dreams of ambitious diversification. Unless you were Clive Sinclair! Under the circumstances, it seems certain that while the rest of the company concerned itself with the demands of the early home-micro enthusiasts, only Sinclair himself felt confident enough about the future to indulge in one of his obsessions.

To be fair, there is no reason to suspect that in the early days the vehicle development would have consumed much in the way of time or money. The project was more of a diversion than a fully fledged research programme. Rogers had a full-time job running the Exeter Academy, and considered his work for Sinclair as something akin to a challenging hobby. According to corporate biographer Rodney Dale, Sinclair's brief to Rogers was sufficiently loose to encourage inspired tinkering rather than a path of rigorous research:

[Rogers was contracted to] perform and present a preliminary investigation into a personal electric vehicle. The vehicle is assumed to carry one person (with a possible second person only by squeezing), and is seen as a replacement for a moped and limited to urban use with a top speed of 30 mph. (The Sinclair Story, p. 152.)

It seems fair to assume that at the time Tony Rogers was churning out early prototypes of the vehicle, Sinclair was perfectly sincere in his desire to create a revolutionary form of personal transport. As a man for whom public acclaim invariably takes precedence over monetary gain, he would have relished the prospect of going down in history as the inventor who took carbon-dioxide pollution out of the twentieth century. An authentic realization of Sinclair's transportation revolution would have offered social

salvation and commercial success. Furthermore, his stubborn dedication to the television project demonstrates that neither time nor escalating research costs would be regarded as significant obstacles to product realization. In the event, the stolid but relentless progress of Clive the visionary was distracted by legislative developments that awakened the reflex opportunism of Clive the entrepreneur.

The motivation for accelerating the vehicle development programme came in March 1980, when the government abolished motor tax for all types of electric transport. Overnight, Sinclair's vision started to look like a viable marketing proposition. Over the next eighteen months, Rogers pushed ahead with the development of the body design and motor, but according to his biographer Sinclair took the decision to make do with existing battery technology:

Part of the ground-up approach was not to spend... enormous amounts trying to develop a more efficient battery, but to make use of the models already available. Sinclair's very sound reasoning was that a successful electric vehicle would provide the necessary push to battery manufacturers to pursue their own developments in the fullness of time: for him to sponsor this work would be a misplacement of funds, (ibid., p. 154.)

As we have noted, the creation of a reliable power source for electric vehicles is one of the major obstacles impeding their commercial development. The bottom-line quandary that continues to plague battery-technology development centres around petrol's privileged relationship with energy. Petrol is valuable because of its massive energy density. Or to put the battery researcher's problem into perspective, a kilogram of petrol offers an energy potential of 13,000 watt-hours; the lead-acid equivalent holds a miserable 50 watt-hours of energy. For the moment there appears to be no contest.

The decision to leave the thorny problems of battery research to others effectively turned the vehicle project into little more than a marketing exercise. By opting to base his design around existing power supplies, Sinclair avoided addressing problems the solutions to which demanded genuine technical innovation. Having abandoned any pretence of

technological advance, the only unanswered questions facing Sinclair concerned public demand and economies of production. Could the public be persuaded that it needed a three-wheeled electric moped that came on like an invalid car? Could such a product be manufactured cheaply enough to be commercially viable?

By the beginning of 1983, the development of the Sinclair vehicle had reached the point where serious investment was required if the product was ever to reach the marketplace. However, corporate support was conspicuous in its absence. The phenomenal success of the ZX81 had finally enabled a Sinclair company to make its presence felt in the high street; there was every indication that the Spectrum's imminent launch would ensure a domination of the home-computer market for the foreseeable future. Company and consumer had developed a clear sense of corporate identity; it was an image that centred on low-cost home computers, and had absolutely nothing to do with electric trikes.

Even Sinclair couldn't remain oblivious to his colleagues' mounting anxiety as they watched their mentor's challenging diversion rapidly move towards a production-line reality. Although on a one-to-one basis Sinclair could be chillingly convincing about the project's potential, the collective doubt of a normally uncritically supportive staff persuaded him that there was no point risking corporate stability unnecessarily. As we have seen, in January 1983 Sinclair solved his problem by selling off a small percentage of his personal holdings in the company. At a time when the value of Sinclair Research shares were at their peak, this little deal provided him with cash-in-hand to the tune around £12m. March saw the incorporation of a new company, Sinclair Vehicles, whose activities would be financed by an initial investment of £8.6m of the revenue from the share sale. Although we were unable to trace any record of money changing hands following the transfer of vehicle development to Sinclair Vehicles, there can be little doubt that the move would have been greeted with relief by the doubting hordes at Research. From now on the parent company could continue to consolidate its success in splendid isolation, securely insulated from the economic consequences of a shaky vision.

In March 1983, Sinclair managed to persuade ex-DeLorean henchman Barrie Wills to take care of the day-to-day running of Sinclair Vehicles. Although the new managing director soon discovered that he was overlord of a company without a product, rumours of further legislative modifications boded well for the future. The company learned that 'electrically assisted pedal cycles' were to be singled out for special treatment under the law. Although owners of such machines would be constrained by a 15 mph speed limit, they would also be exempt from insurance, road tax and a driving licence. Sinclair's vehicle design was modified accordingly.

Making use of his industry contacts, Wills ended up placing the contract for the final stages of the C5's development with Lotus. Work on the project was finalized towards the end of 1983, and the new few months were devoted to refining the vehicle's bodywork, a task that was tackled by industrial designer Guy Desbarats. As far as the C5's battery and motor were concerned, most of the development had been commissioned out of house. The bulk of the modifications to the battery had been accomplished by the combined efforts of Sinclair Vehicles and Oldham. Since Sinclair had decided that innovations in power-supply technology should be funded by battery manufacturers, one of the most critical elements of any electric-vehicle design was conspicuously neglected. The C5's power supply is essentially a bog-standard (albeit lightweight) lead-acid battery. Sinclair claims that suitable modifications were incorporated into the design to compensate for the effects of repeated draining and recharging, but subsequent developments cast doubts on the adequacy of this work. The vehicle's motor was manufactured in Italy by Polymotor, a subsidiary of Philips. Sinclair's press release went to some lengths to point out that the Italian company had developed motors for 'gyros, torpedoes and fast-response actuators'. What it didn't explain was that the C5's motor belonged to the less glamorous end of the Polymotor range. Sinclair's 'revolution in personal transportation' would be driven by a modified washing-machine motor.

With product development close to completion, Sinclair turned his attention to finding a production plant for his vehicle. For a while he negotiated with DeLorean's liquidators in an effort to buy the fallen tycoon's sophisticated

Northern Ireland plant. After a year of talks, the plan was finally scrapped. In the meantime, the company's twenty-five staff had found a home for themselves in the Science Park, right next door to Warwick University where much of the early vehicle research was completed.

As a veteran of the development-grant circus, it comes as no surprise that Sinclair had his manufacturing problem solved by the Welsh Development Agency (WDA). Acting on behalf of Sinclair Vehicles, the agency persuaded Hoover that the company's Merthyr Tydfil plant could painlessly adapt its production line to handle the demands of electric-trike manufacture. It seems certain that both the WDA and Hoover allowed themselves to be seduced by Sinclair's wildly optimistic production projections of 200,000-500,000 units per year. For the Agency, the project offered the promise of jobs in an area crippled by unemployment; for Hoover, the contract offered a significant revenue on a high output and the prospect of more work in the future as the vehicle range expanded. As the project's principal subcontractor, Hoover would be responsible for the bulk of C5 manufacture, with only the bodywork assembly commissioned elsewhere. (Because of the specialized equipment required, the C5's pair of polypropylene injection mouldings became the responsibility of Linpac. According to the C5's technical specifications, the vehicle's body was the largest ever mass-produced polypropylene assembly.)

By now, Sinclair's improbable coup with home computers had made his name synonymous with individual enterprise and national advance. However dubious the vehicle project looked on paper, with Clive Sinclair behind it there were few bold enough to commit their doubts to print. An unusually restrained Economist feature (25 June 1983) offers a taste of the pervasive mood of journalistic caution:

'If it was anyone but Sinclair,' said one competitor, 'we'd say he was bonkers.' But can a man who has made a fortune out of calculators and computers, and could double it on flat-screen televisions, be that crazy?

As far as the Welsh workforce and management were concerned, times were hard and there was very little incentive to look a gift horse in the mouth, however questionable its pedigree. The contract was considered

important enough for Hoover to allocate a section of the Merthyr Tydfil plant exclusively for the production of the Sinclair vehicle. In addition, the company invested £100,000 in a customized production line for the project. By the end of 1984, the first batch of C5s trundled out and began their ill-fated quest for a non-existent market.

From a distance, the C5 resembles a giant plastic clog. In spite of the vast amounts of time and effort that went into the vehicle's external design, at first glance its most memorable characteristic is its size. The C5 is small. Small, vulnerable and curiously provisional. When confronted with a C5, one's thoughts invariably turn to morbid meditations on juggernauts. With overall dimensions of 5 feet 9 inches by 2 feet 5 inches by 2 feet 7 inches, there was little chance that the C5 would make an instant impression in traffic. In the critical onslaught that followed the launch, the majority of commentators voiced anxieties concerning the wisdom of driving such a diminutive form of transport in anything approaching heavy traffic:

In fact, I would not want to drive a C5 in any traffic at all. My head was on a level with the top of a juggernaut's tyres, the exhaust fumes blasted into my face. Even with the minuscule front and rear lights on, I could not feel confident that a lorry driver so high above the ground would see me. Small wonder that one of the accessories listed in the C5 brochure is a high and bright-red reflecting mast, said by the Royal Society for the Prevention of Accidents to be a 'must'. (Daily Telegraph, 11 January 1985.).

There were many who maintained that the 'Hi-Vis Mast' should have been included as a standard feature.

Before moving on to the C5's launch and its aftermath, it's worth mentioning that Sinclair was not alone in his faith in the electric-powered option. Ignored by all but the specialist press, two companies were busily completing the development of three more electric vehicles, all of which were targeted for a 1985 launch. It should be stressed that none of the neglected trio posed a threat to Sinclair's plans, since all were directed way up market with price tags to match their ambitions. However, in spite of being considerably more expensive than the Sinclair creation, none of the C5's competitors boasted much in the way of technological advances. Like

Sinclair, both the companies concerned had opted to design around the limitations of existing technology.

The electric-powered Whisper is an unremarkable-looking hatchback. Designed and marketed by a Dutch company called Whisper Electric Cars, the vehicle costs around £4000 and was launched in August 1985. At a cruising speed of 30 mph, the Whisper travels 50 miles before requiring a recharge. The other company involved in electric-vehicle development is the all-British HIL Electric. Like the Whisper, both the QT pick-up van and the U36 bubble car boast exteriors based around standard motor industry designs. To date (July 1986) none of these electric alternatives can be said to have made much of an impression on the market.

The launch of the C5 electric vehicle was expensive, glossy and mildly embarrassing. Like the majority of products from the Sinclair stable, the C5 was initially announced as being sold on an exclusively mail-order basis. However, this didn't mean that Sir Clive planned a low-profile launch for his new baby. According to official statistics, Sinclair Vehicles sank £3m into a three-month Primary Contact promotion. The campaign included television slots and colour-supplement spreads and seemed to be directed at anyone who would listen:

Targeted broadly at the family audience, Sinclair believes that the C5 will appeal equally to the younger generation ... and to adults for activities such as urban commuting, shopping and getting to the railway station. (Sinclair Vehicles, press release, 10 January 1985.)

At first glance, the extravagant brochure promoting the new product appeared to offer the customary hallmarks of a standard Sinclair hype. However, behind the high-gloss pics lurked an undercurrent of desperation. Rather than promote the C5 as the future of urban transportation, the static tableaux of businessmen, housewives and their indispensable C5s served to accentuate the redundancy of the product. Apart from anything else, it was quite obvious that none of the featured models would be seen dead driving the contraption they were attempting to market. The accompanying text was slightly more convincing. Adopting a shamelessly heroic stance, it portrayed Sir Clive as a technologically enhanced David, fearlessly taming the giants of urban chaos:

Sinclair's reputation is built on cutting giants down to size, turning impersonal tyrants into personal servants. Sinclair took a desktop calculator and put it in your pocket ... took the big-business computer and tucked it into your living room ... took the television set and made it smaller than a paperback. Now, with the C5, Sinclair Vehicles puts personal, private transportation back where it belongs - in the hands of the individual. ('Sinclair C5 - A New Power in Personal Transport'.)

Extending a familiar theme of Sinclair promotions to something close to breaking point, the blurb struggled to imply that the purchase of a C5 spelt liberation from the multinationals and a blow for the humanization of the urban landscape. To their credit, there are moments when the admen came perilously close to making a turkey look like a dove. But for once reality defeated commercial intent. In spite of the first-class photography and expensive design, the C5 still looked like an exiled pedal car from the children's section of a mail-order catalogue. In spite of the blue-print style diagrams, Sir Clive's dream machine manifested all the hi-tech innovation one would expect from a three-wheeled electric moped wrapped in injection-moulded polypropylene. In spite of the brochure's depiction of a blue-sky suburbia exclusively populated by electric trikes and their drivers, readers continued to speculate on the carnage resulting from C5-omnibus interaction.

The official launch of the C5 at Alexandra Palace was an unqualified disaster. Ever unpredictable, Sir Clive had astounded his public by launching his open-topped, low-performance trike in the middle of winter. The first (and last) product from Sinclair Vehicles was unveiled on 10 January 1985 and priced at £399. In his opening speech, Sir Clive confirmed suspicions that, rather than make any serious attempt at technological advance, Sinclair Vehicles had chosen to rush out the C5 in the hope of capitalizing on the new electric-vehicle legislation. In any event, the reality that was the C5 fell well short of the promise of Sir Clive's vision, and at times his obligatory launch euphoria sounded dangerously apologetic:

I'm going to start in a rather unusual fashion by telling you what we're not announcing today ... we're not announcing a conventional car. Sinclair Vehicles is dedicated to the development and production of a full range of electric cars, but today we have an electric vehicle, the first stage on the road to an electric car. (The Sinclair Story, p. 164.)

Although desperate hacks did their best to evoke the shock-horror vision of packs of 14-year-olds terrorizing the neighbourhood in their customized C5s, it was clear that the launch offered little mileage for the tabloids. For the rest of the press, close encounters with the trike provided the long-awaited opportunity to voice doubts about the commercial viability of Sinclair's vehicle project. Appallingly negligent organization at the launch did much to ensure that journalists' negative preconceptions were soon confirmed by experience. It turned out that for one reason or another a large number of the demonstration machines simply didn't work! What possible excuse can there be for inviting the press to assess the reliability of your product and then providing them with defective machines? A little ahead of schedule, Sir Clive's new company took on the commercial scars that are the hallmark of a depressingly enduring Sinclair tradition.

Critical evaluation arrived in three main waves, and little of it did anything to encourage sales. Even before the official launch the trike was under attack from the British Safety Council (BSC). It seems that on the 6 January 1985 the Council's James Tye accepted Sir Clive's invitation to test-drive the new product at Vehicle's Science Park headquarters. After due consideration, the vociferous Mr Tye made it clear that he didn't like what he saw. He was particularly concerned about the prospective mobilization of unlicensed, uninsured 14-year-olds; teenagers and C5s was not a combination the Council relished. Two days before the launch, the BSC issued a decidedly negative report on the trike, which was dispatched to its 32,000 members. The following day, Sir Clive announced his intention to sue both the BSC and Tye for their 'defamatory remarks' about his project. Although nothing came of the threat, Sinclair remains bitter about Tye's opposition to the C5 and the amount of media attention given over to the BSC's views:

The C5 got a very bad press. There's an outfit called the British Safety Council who sound like a government agency but... go round bad-mouthing other people's products, as far as I can make out... The interesting thing was that the ROSPA [Royal Society for the Prevention of Accidents], who are the real authorities on safety, thought the C5 was absolutely super. They were very supportive because they thought it was a great improvement on the bicycle and motorbikes, so were very keen to see it succeed. But the press, of course, listened to the vocal James [Tye]. (Interview, 6 November 1985.)

In the wake of the fateful launch, intrepid motoring and technology correspondents filed their anecdotes and voiced their doubts. All in all the critical response was firmly negative. The following extract is fairly representative of the general tone of the next-day impressions:

The instructions were quite simple: sit in, switch on and go. And go the Sinclair C5 vehicle ... certainly did. For seven minutes. Then the first battery ran flat. Fortunately, I was not stuck in the middle of a city rush-hour nor on an isolated country road ... I pedalled the C5 back to the service point (my legs are still aching even though the slopes were gentle) and the spare battery was connected ... But nothing could compensate for the sheer feeling of vulnerability in spite of Sinclair's claim that it is far safer than anything on two wheels. The electrically powered car might be the personal transport of the future, but if the C5 is anything to go by, then that day has not yet dawned. (Daily Telegraph, 11 January 1985.)

Overall, the gentlemen of the press seemed to suspect that the C5's hardware simply wasn't up to the task of realizing the manufacturer's already rather limited performance claims with any measure of reliability:

The 250 watt electric motor which drives one of the back wheels proved incapable of powering the C5 up even the gentlest slopes without using pedal power. The tricycle soon started making a plaintive 'peep, peep' noise, signalling that the engine had overheated ... The C5 is compromised by the need to sneak in under the quaintly named Electrically Assisted Pedal Cycle Regulations 1983. This lays down a maximum power of 250 watts for the engine which gives the

C5 a top speed of 15 mph on the level - less than most cyclists would manage. (Your Computer, February 1985.)

If the newspapers cast doubts about the viability of the Sinclair enterprise, then the measured assessments of the C5 by consumer and motoring agencies must take the credit for planting the kiss of death. For example, the Automobile Association (AA) was in no doubt that many of Sinclair Vehicles' claims for the C5 were contradicted by the results of the Association's own tests.

The first of Sinclair's claims to be called into question was the 'up to 20 miles' range (determined by the life of the battery) referred to in the advertising campaigns:

Tests on the AA's normal suburban fuel-evaluation course gave a 'typical' range of ten miles, about half that claimed by the makers. On a cold day, in poor conditions, the battery ran flat after 6.5 miles. (Daily Telegraph, 2 May 1985.)

Confirming Your Computer's suspicion that the C5's motor simply wasn't powerful enough to drive the vehicle under anything but the most favourable conditions, the Association recorded a maximum running speed of 12.5 mph (against the 15 mph claimed by Sinclair). The AA's report had this to say about the C5's running costs:

...for the C5 over a year would work out at £19.17 on off-peak electricity or £21.77 at standard rates, allowing partly for eventual battery replacement. This compared with £19.25 for a £390 Honda PX50 moped, against which it was compared. The moped had a maximum range of 150 miles on a tankful of fuel, with an average consumption of 170 mpg and a maximum speed of more than 30 mph. (ibid.)

In consideration of the C5's overall performance, the Association drew the following conclusions:

The C5 looks more comfortable and convenient than it really is — older cyclists looking for less pedal effort will be disappointed by the

agility its layout demands. Although it is delightfully quiet, performance, range and comfort do not compare with the better mopeds and costs are much closer than one might think when one allows for the inevitable battery replacement, (ibid.)

At the top of a sizeable list calling into question the C5's stability and general roadworthiness, the AA, like virtually everyone who came into contact with the machine, expressed concern about the visibility of C5 drivers at large. Once again it was suggested that the 'Hi-Vis Mast' be incorporated as a standard feature. No one at Sinclair Vehicles seemed particularly keen to respond to the AA report:

A spokesman for Sinclair Vehicles said, 'It would seem fruitless to argue in any detail with an organization like the AA, but on the question of running costs compared with a moped, they are not comparing like with like.' (ibid.)

If the results of the AA's test amplified public doubts about the C5, the review of the vehicle in the consumer magazine Which? effectively dug a grave for the project. Since the Which? report (June 1985) is essentially an amalgamation of most of the criticisms of the C5 that we have already noted, we'll simply list some of the survey's somewhat cryptic summary as an indication of the areas of concern:

How far? A lot less than claimed.

How fast? Hard to keep up with traffic.

Handling and braking? Adequate.

How safe? Not very good.

How manoeuvrable? Disappointing.

How secure? Too easy to steal.

How reliable? Not promising.

Our verdict: of limited use in its present form; poor value for money.

But enough from the professionals who get paid to complain. How was the real world responding to the arrival of the C5? In the light of the initial mail-order-only policy, the only place that Joe Public was likely to come across a C5 was in the local electricity showrooms which displayed the vehicle for a couple of months after the launch. With such limited exposure, it's unlikely that the C5's launch was noticed by many outside the sizeable but hardly representative network of Sinclair supporters.

In the absence of reliable statistics, it's difficult to assess the initial response to the mail-order promotion. Four weeks after the launch the company was celebrating the sale of a modest 1000 units (remember, Hoover were geared up to produce 200,000 C5s in the first year), and one month later Barrie Wills was claiming that there were 5000 C5s on the road. In addition, Sinclair Vehicles had doubled its sales staff and was struggling to process around 200,000 information requests about the C5. So all was well. Or was it? Was there anything to be concluded from the discreet announcement that plans for an expansion of the vehicle production line had been temporarily 'postponed'?

In February 1985, a reporter from The Times succeeded where we failed by unearthing some of the early buyers of Sir Clive's transportation revolution. How did it feel to be the first on your block to own a C5? Take 48-year-old businessman Roger Wilding:

Most of us hope that electric vehicles will take over one day because they are cheaper, quieter and pollution-free. Sinclair seemed to be taking a big step towards achieving this and I felt it was important to support him. However, I thought the C5 would be more sophisticated and, although the design is very clever and it performs surprisingly well, the technology is not very innovative. I'm a little disappointed and am thinking of selling.' (5 February 1985.)

Or disabled pensioner Dick German:

'I was very excited when it first arrived, but the first time I tried it out it would just not go up a hill and I had to come home. I then got my stepson to have a go and he didn't get much further, so I have sent it back.' (ibid.)

Apparently unaffected by the portents of impending doom, Sir Clive felt inspired to announce a new product. Scattering investment projections of around the £100m mark, he anticipated that by 1990 Sinclair Vehicles would be marketing the C15, an electric powered four-seater car capable of speeds of up to 80 mph. Dismissing the possibility of using a combination of electric and petrol/diesel power, he explained that his design would be based around innovations in battery technology. One suspects that Sir Clive's compelling dreams were relying on the principles of innovation as an act of will. Certainly he offered no indication of the kind of approach he would employ in his solution of one of the century's most elusive technological problems. However, he was clear about the shape of the new vehicle and the kind of wheels he might use:

The car has a futuristic design with an elongated 'tear-drop' shape, a lightweight body made of self-coloured polypropylene and a single, possibly 'roller' type rear wheel. (The Times, 3 February 1985.)

Back in the real world, by March 1985 it was clear that Sinclair and Wills were becoming anxious about the public's sluggish response to an extremely expensive promotion. There was a serious danger that the C5 would be lost in a sea of indifference. Sir Clive's inspired solution to the problem was to hire teams of unemployed teenagers to ride C5s around the capital promoting public awareness of the product. The campaign was later extended to Birmingham and Leeds. The experiment got the C5 noticed, but there's little evidence that it boosted sales. From 1 March, the C5 started to be sold in the high street through the Woolworth and Comet chainstores, with the latter buying in a launch stock of 1600 units. Nine months later, both companies were stuck with the bulk of their original orders, and slashed the C5's price by 65 per cent in an effort to move the product.

To make a bad situation worse, Sinclair had received numerous complaints that the C5's performance was impaired by the plastic moulding attached to the gearbox. The decision was taken to halt production for three weeks so that the problem could be sorted out. The 100 Hoover workers concerned with C5 production were shifted to replacing the plastic moulding on the vehicles currently in stock.

From this point on, it was downhill all the way for the C5. As the least of his problems, the Advertising Standards Authority surfaced in April to announce that it would uphold complaints that called into question launch promotion claims for the C5. It seems that the Authority considered the most contentious claim to be that the trike was 'far safer than anything on two wheels'. It's certainly true that there was absolutely no evidence to support the assertion. In the same month, production recommenced in Merthyr Tydfil, but demand for the C5 had ground to a virtual standstill so it was hardly worth the effort. Production was cut by 95 per cent and Hoover churned out a mere 100 C5s a week.

When in May the project's production controller was made redundant, Sinclair was forced to confess that, at 6000, unsold stocks were twice previously disclosed levels. In a desperate bid to drum up business, Sir Clive announced his intention to 'seek export markets, particularly in Holland'. A few days later, the Dutch National Transport Service ruled that the C5 was not suitable for Dutch roads in its present form. According to the NTS, the C5's braking system needed to be improved, more reflectors were required and the 'Hi-Vis Mast' would have to become a standard fixture. Much the same requirements were demanded by most of the ten countries in which Sir Clive intended launching the C5, so he had no choice but to comply.

As we have seen, throughout 1985 Sinclair Research was mirroring Vehicle's disastrous trajectory, and by June the company was looking to Robert Maxwell to bail it out. During this period, negotiations with Maxwell along with the search for alternative solutions to the Research crisis meant that the computer company claimed both Sir Clive's time and his attention. Apart from his half-heartedly exploring the export potential for the C5 in the States and the Far East (approaching primarily leisure resort chains and hiring outfits), it seemed that any decision concerning the fate of Sinclair Vehicles would have to await the resolution of more pressing concerns. Then it was leaked that the company was up for sale and that Sir Clive was already talking with prospective clients. It seems that Sinclair had decided to rid himself of a millstone that required more attention than he had time on his hands.

It was presumably news of the sale and the frustration of being pushed to the back of Sir Clive's concerns that prompted Hoover to draw up a writ announcing its intention to sue him personally to the tune of £1.5m. By the second week in July when Hoover made its surprise move, Sir Clive's plans to sell Sinclair Vehicles had collapsed when he turned down an offer of £2.7m for the company. In what was presumably an attempt to spur him into action, Hoover was pressing for the full £1,525,000 in respect of C5 production from November 1984 to date, and an additional £32,720 interest. In the end, the company never served its writ. Temporarily pacified by personal guarantees from Sir Clive, Hoover was seduced into accepting negotiation. The company even agreed to set ten of its workers to the modification of C5 stock for sale in Europe. However, by the second week in August Hoover decided that it had demonstrated more than enough restraint, and publicly announced that it was stopping all work on the C5:

We have run out of several key parts and do not wish to plan for any further inventories until our differences with Sir Clive are resolved. (Guardian, 13 August 1985.)

Out in the high street, Sir Clive's declining fortunes were reflected in the fall in shelf value of his companies' products. Stores discounted Sinclair goods in the hope of pruning stock before the seemingly inevitable liquidation turned it into throwaway sale fodder. In some of the larger stores, a C5 along with a complete set of accessories could be picked up for £139.99!

On 15 October 1985, Sir Clive finally got around to making the announcement everyone had been expecting. Sinclair Vehicles had officially been placed in the hands of the receiver on Friday, 12 October. It fell to London accountants Begpie, Pickering and Co. to untangle the £700,000 worth of debts owed to 110 suppliers. In the month before the receivers were appointed Sinclair Vehicles was renamed TPD Limited. On the date the receivership of TPD was announced, it was also stated that Sinclair Vehicle Sales Limited held the C5 stock and according to the Guardian was involved in continuing research. The message appeared to be that in seizing the receivership option, Sir Clive had secured vehicle development rather than throwing it to the wolves of the City:

The company [TPD Ltd] said yesterday that research on two new electric cars was well ahead. Sir Clive had been advised to call in the receivers 'to ensure the future of the electric vehicle venture and its research activities'. (Guardian, 15 October 1985.)

There seems little point in speculating about how the original Sinclair Vehicle debt to Hoover of £1.5m failed to make the transition to TPD's accounting. Hoover refuses to comment on the affair, and Sinclair simply confirms rather coyly that the 'issue has been resolved'. Although Hoover is presumably satisfied by whatever settlement finally resolved its problems with Sinclair, one doubts whether the same can be said of the vehicle's production-line workers.

When TPD finally crawled into voluntary liquidation on 4 November 1985, there was an opportunity to assess the cost of Sir Clive's ten-month support of a loss leader. At the shareholders' meeting at which he announced his decision to liquidate, it was revealed that in addition to Sinclair's original investment of £8.6m (of the £12m earned from his sale of Research shares), he had also pumped in a further £5.9m of his own capital. This second age of Sir Clive's investment was passed to the company in the form of a loan secured by debenture. In other words, although the original investment was gone for good, the £5.9m would be recovered.

According to the results of the shareholders' meeting, there were 4500 unsold C5s in TPD's hands as the company was liquidated, and the company's total deficit appeared to be around £6.4m. So what has Sir Clive's £8.6m loss bought him in the way of experience? Well, although he could hardly be described as eating humble pie, the arrival of the liquidator invariably inspires gestures of penance, which in Sinclair's case amounted to the recognition of undeniable errors of judgement. He certainly conceded that there is no room for a partially developed electric vehicle like the C5, and today insists that future developments will tackle the fundamental problems of battery innovation. By rushing ahead half-cocked in an effort to exploit a loophole in EEC regulations, Sinclair has set himself the additional hurdle of repairing his tattered credibility before he can even begin to consider marketing related products. According to the Financial Times, Sir Clive has also come round to the position where he might admit

that it would have been more prudent to launch his open-topped trike in the spring rather than the winter!

Under more favourable circumstances, the C5 debacle would have been of little consequence. A rich man's folly. However, alongside the failures of both the QL and the flat screen and coupled with the crisis at Research, the conspicuous collapse of Sinclair Vehicles did much to confirm institutional suspicions that Sir Clive was a bad risk. What could be worse at a time when Sinclair needed investment more urgently than at any other period in his commercial life?

One might have hoped that with the failure of both the flat-screen television and the C5, Sir Clive would have finally driven his long-term obsessions from his system. Not a chance! When we interviewed him the day after the TPD liquidation announcement, Sinclair was bullish in his determination to press on with vehicle development. Presumably building on research now in the hands of Sinclair Vehicles (Sales), Sir Clive intends a return to the pursuit of his original vision. In some shape or form, finance permitting we can expect the arrival of an enclosed two-seater C5 marketed as the C10, and a deluxe, four-seater 'teardrop-on-rollers', otherwise known as the C15.

One can only pray that Sir Clive will shelve his plans to develop a personal, vertical-take-off aircraft!

[10] SWEET SURRENDER

Having followed the C5 saga from initiation to liquidation, we can now turn our attention back to events on the computer front at the end of 1985. In fact, our theme should start with Nigel Searle's definitive statements about the proposed 1985 share placement, made in *Computing* in May 1984, after good profits (aided by QL mail-order monies) of £14m pre-tax on a turnover of £77m

I hope I'm not speaking out of turn, but I don't believe there is any change in our originally announced intentions ... Apart from Clive and the people who bought shares from him, I don't know of anybody in a position to decide to go public before then. And anyway, don't you have to have five years of results before you can? We were founded in 1979.

This 'cautious denial' contrasted with persistent rumours that the company was short of capital after the television investments and was looking for an autumn launch. Searle's firm grasp of the requirements for share placement may have been correct, except he got the year wrong - Sinclair Instruments (as Research then was) launched the wrist calculator in 1977. More cogently, the company was certainly in a strong enough position, with 38 per cent of the UK computer market, to survive both the seasonal summer slump in computer sales and the QL tooling and production costs. And, of course, the flat-screen television might, now that its production levels were building up, help the cash flow. Without the QL problems, and the high-profile publicity surrounding them, a share placement could have gone ahead in 1984, on the basis of the previous year's good figures, and might have then valued the company as high as £300m, depending on the value placed on the various MetaLab projects. Still, there was no reason to suppose an adjournment would affect the position too much.

All must have seemed well to Sir Clive as he busied himself with the C5 and various MetaLab projects. A measure of his feeling that the sunrise industry of consumer computers would serve to fund further projects is to be found in his desire to go public at all, given that he is on record as saying that it was a bad thing to be a public company in Britain. However, the

share placement finally planned for March 1985 turned out to be a false dawn.

The writing was on the wall in 1984. Dragon Data, the maker of a machine that had made a significant showing in home-computer sales, went into liquidation, and Amstrad moved into the computing arena with an impeccable machine, packaged innovatively complete with monitor (choice of monochrome or colour) and with an in-built cassette deck. With this unitary approach, established outlets, good quality control and a degree of professionalism markedly absent from the Sinclair stable, it rapidly became a bestseller. This marked a significant shift in the market, as the Amstrad integrated approach was applied to computing. The swift follow-up of a disc drive, using the ageing but functional CP/M operating system (which precisely because of its venerability offered large amounts of software), exemplifies the contrast between the Sinclair style of innovation at any cost - dubious keyboards and slow Microdrives - and a good implementation of well-understood technology at intensely competitive prices. Jumping ahead a little, the Amstrad PCW8256, marketed as a wordprocessor, but in fact a full CP/M machine complete with monitor and printer, elicited this comment from the reviewer:

It is often said that whereas Sinclair is driven by technology, Amstrad is driven by the market. Nowhere is this better illustrated than this machine compared to the QL. The new technology of the QL is totally outshone by the price/performance value of a good old Z80 with production costs taken to the bone. (Personal Computer World, October 1985.)

Amstrad won at least 10 per cent of the market in 1984. This didn't affect Spectrum sales much, but in the run-up to Christmas the retailers over-ordered, to avoid the shortages of the previous year. Although Sinclair claimed to have shipped 300,000 Spectrums in the last quarter of the year, a lot of them were still sitting on the shelves in the New Year. The seasonality of computer sales has always been a problem for cash flow, with the pre-Christmas sales in Britain of some 100,000 computers (of all makes) a week declining drastically in January, and falling to a low of 7000 a week in

midsummer. No orders came in to Sinclair post-Christmas, as the overstocks were slowly cleared in the sluggish spring trade.

A price war started in the high street, and Sinclair cut the Spectrum+ price to £129.95, having creamed off what could be made from pretending it was anything different from the standard 48K Spectrum, which was now dropped. This did not endear Sinclair Research to those retailers still holding stocks at the old price. No Spectrum orders came in during January or February to help the cash flow, and the QL was hardly in the running, pre- and post-Christmas. The old problem, quality control, had not gone away, either. Far too many of the machines sold in the Christmas season would come back from the retailers as faulty.

To help the QL software situation, and promote the use of the Spectrum microdrives, the cartridge price was dropped to £1.95, from the £4.95 it had been since the ZX Microdrive launch. This at last reduced the cartridges to a price competitive with that of floppy discs, and the offer of discounts for quantity purchase and free duplication to software houses made it a viable proposition for software to be distributed in Microdrive format. The expense of cartridge purchase and the difficulties of duplication had prevented Spectrum software being sold on anything other than cassette tapes, but since the 'business'-oriented QL didn't have a cassette facility this was an overdue step for Sinclair to take if it was serious about the QL. It was also a statement of faith that the design problems had been sorted out, and mass-duplicated cartridges now had a good chance of working with any production QL, which had not been the case in earlier days.

If, finally, the QL looked like a workable machine, it was not before time. On Sinclair's figures only 60,000 QLs were sold in the twelve months after the first production models went out to customers, and many in the industry thought this likely to be a gross overestimate. The QL was 'relaunched' in January with a showing of thirty-three software packages and seventeen peripherals 'available or projected'. Heavy advertising was planned in the press, but some embarrassment was caused when OEL, the developers of the communications equipment Sinclair had chosen, and promoted heavily, went into receivership.

Mounting problems in the micro industry were highlighted by the collapse of Prism, a distributor of Sinclair machines, and the obviously troubled Oric Products. When February came round, Acorn computers, with the flagship BBC machine still at £400 and the Electron uncompetitive at £199, having lost out in the Christmas period, were revealed to be in deep trouble. The essentially one-product company had placed its sunrise-industry shares on the Unlisted Securities Market in late 1983, had seen a brief midday glory in 1984 when the shares touched 193p, but the investors became uneasy, and the shares fell steadily, slumping from around 100p to just over 50p in the last three months of 1984. When the shares hit 44p the directors of Acorn sacked bankers Lazards and brokers Cazenove, then resigned. By the time the news broke, Acorn's shares were at 23p, and were suspended at 28p on 7 February. The sun had set on a hi-tech high-flyer. Olivetti eventually staged a rescue bid, only to have to repeat the rescue and increase its stake to 79 per cent six months later.

Unsurprisingly, Sinclair Research aborted its proposed market flotation twenty-four hours after the initial Acorn collapse. This had been proposed for March or April, any possibility of going public the year before having been fouled up by the QL catastrophe. Michael Richardson of Rothschilds, after commenting that Sir Clive was 'enormously relaxed' about the postponement, went on to say:

Even if Sinclair had produced the most brilliant figures and marvellous sales, we would still be reluctant to put them into the market in the face of the Acorn problems. (Quoted in the Financial Times, 8 February 1985.)

The further information that the investors, who were sitting on 10 per cent of Sinclair Research equity, had no objection to the postponement was unsurprising. From projected values of £300m placed on the company in mid-1984, expectations had been rapidly revised downwards, despite the statements from Sinclair that trading profits for the nine months to December were above those for the same period last year. Within Sinclair Research, the situation must have looked a little disconcerting. QL production was halted, just as the ICL One-Per-Desk was finally launched. The workstation went on to do very well, transmuted into the British

Telecom Tonto and earning ICL enough to compensate for the fact that it had to pay royalties to Sinclair on all machines sold.

Something clearly needed to be done within Sinclair. The investors, actual and potential, were worried about Sir Clive's reputation as a businessman and manager and probably, with the C5 scenario running concurrently, his marketing and inventive capabilities. Searle had not done a very good job of providing an alternative figure who could be seen to be reliably in command. Additionally, Sir Clive's response, on past performance, to problems is (as we have seen) to blame them on others. Despite Sir Clive's statement to us that Searle *'just didn't want to do the job any more'* (interview, 6 November 1985) it seems likely that he was shunted sideways. The form that this took was a restructuring of Sinclair Research, in which Searle was effectively packed off back to the States (where he'd been head of the Sinclair US subsidiary before Timex took over the marketing of the computers). The company was restructured into two divisions. One, the Television and Communications Division, was headed by a new face, Bill Jeffrey, brought in from Mars Electronics to see what could be done about the flagging flat-screen television. Dave Chatten, the production director, took on a new role as MD of the Computers Division. Hugo Davenport, who had been with Cambridge Consultants before moving to Solatron-Schlumberger, returned to Cambridge to fill the new position of director of engineering.

Searle headed across the Atlantic to the Boston office to launch the QL and the flat -screen television in the States, as well as what must have been a Sir Clive product, an FM wristwatch radio, which was exhibited at the Las Vegas Consumer Electronics Show in January. Sir Clive told us that, although the company had tooled up production of this modern marvel, it didn't go ahead with it. Either it fell foul of the financial straits we are currently describing, or saner product strategies prevailed. Whatever the reason, one can only be grateful. Only Sir Clive's obsessiveness could revive a 20-year-old dream and think the world was waiting for it - technological infantilism as it might be termed, or a 'brainstorm' as the Guardian (19 December 1985) put it. Presumably it was to be launched in the States because the Americans wouldn't recall the matchbox radio and 'Transrista' strap of Radionics days, and might find it 'innovative'.

Whatever the reasons, Searle was absolved from the unenviable task of marketing this particular novelty item. Putting a brave face on it, Searle talked to QL User about his 'important strategic move' to the States:

In sheer numbers, we could be successful with much lower numbers than Atari. We'll have a very low-overhead operation, and of course the company doesn't stand or fall by how we do in America ... We have a big commitment to the US market; the very fact that I'm going shows that. (QL User, June 1985.)

Well, maybe. The institutional shareholders asked for, and got, a meeting in March, only the second since they had bought the shares. As the Observer (21 April 1985) commented:

With only 10 per cent of the shares they have little means of influencing the founder, Sir Clive Sinclair, who controls the rest. Indeed the great inventor has shown little interest in their views.

That, as our readers are by now aware, he has never shown much regard for anyone's views was presumably cold comfort. Not only would the attitude and confidence of the institutions affect any share placement for Sinclair Research, but the more businesslike of Sir Clive's associates must have prevailed on him to pay some attention in this case, especially since Robb Wilmot, now part-time head of ICL, had recently joined the board as a non-executive director to assist in raising the £50m finance for a wafer-scale chip company (of which more later).

The institutions were informed that unaudited figures for the nine months to December showed a turnover of £89m generating profits of £7.9m, but with stocks totalling a massive £34m. Even taking the figures at face value (given subsequent results, it seems likely that no allowance was made for either returns or marking down the value of Spectrum machines at this point) it was not comforting news. The shares, if you could find a buyer, were marked down to £10, from their purchase price of £34.

The lack of confidence had validity. There were obvious, if loose, analogies with the Radionics problems. Speedy growth and large profits in a boom period had not been capitalized on by firm management. Instead of a

commitment to spreading the product base as widely as possible into peripherals and software, increasing efficiency and quality, and progressing steadily by sound marketing, Sir Clive's compulsions had won out again. There was a miniature television on the market again, and it was making as little impact as the first. There was even another massive American Express order for the televisions supposed to be in the offing, as reported by Sir Clive in April. Even the ageing Spectrum, supported by a software base rather than intrinsic virtues, was under threat as a money-spinner. The QL could be seen as a Black Watch equivalent - innovative, ill-executed and too late to the market. The stock levels were massive, cash flow negative, quality control low, and borrowing high. When asked why problems would seem to have appeared in Sinclair Research similar to those of Radionics, Derek Holley replied:

Well, because he ended up with the same people he worked with here [at Radionics], quite honestly. When you look at the set-up before the more recent sort-out, they were all people who worked here, all people that were of the same ilk, and all people who were responsible, in a small way, for what happened [with Radionics] in the first place. So you were just moving the problem from one place to another. (Interview, 13 November 1985.)

We will reach the 'sort-out' in due course. Despite Uncle Clive appearing in his long scarf on television leaping over rival machines, attempts to persuade the French to use the Spectrum in schools, and a plethora of optimistic PR, the emergence of the facts that the overdraft was £5m, and that Thorn-EMI and Timex (owed some £10m between them) had agreed to extend two months' credit made apparent that some drastic action was required.

Sinclair Research finally announced in May that 'following a series of Press reports' it was 'seeking to raise £10m to £15m from industrial or other sources, in order to fund long-term growth and restructuring plans', and would seek a new chief executive to replace Sir Clive. Nobody leapt forward to hand over the cash, quite understandably. Research under Sir Clive's leadership had managed to strap itself into an untenable high-stocks,

high-debt situation while keeping its position as the main supplier to a fairly volatile but large market.

Timex, for one, lost patience and decided to cut some losses. It offered 65,000 Spectrums, at a large discount, to Zeta Marketing for disposal overseas at a price around £16 less than Sinclair's export trade prices. Thorn-EMI remained more sanguine, or perhaps it didn't have the Spectrums to sell. It rejected any options to take equity, but was prepared to be flexible in planning debt renegotiation.

Once again, Sir Clive was at the head of a company that, as the Guardian had it when reporting the fact that the Bank of England, no less, was to be involved in the search for a saviour:

... is regarded as far too visible and too important a symbol of the country's new industries to be allowed to fail or be rushed into receivership. (8 June 1985.)

Shades of Radionics again! This time, however, a rescue would have to be forthcoming from adventurous venture capitalists, since the NEB had been dismembered. Why the Bank of England should bother with a fairly minor company's problems is explained in the next paragraph:

Informed sources also say that the Prime Minister, whose government knighted Sir Clive for his services to British technology two years ago, is taking a close interest in the company's fate, as are 'a number of other important bodies', including the Department of Trade and Industry, (ibid.)

The Emperor of British entrepreneurialism was in danger of being found naked again, so the loyal subscribers to the myth rallied round to:

explore ways of continuing the lines of bank credit beyond purely commercial limits, to stand in the last resort between the company and receivership, and to see whether the loans can be restructured, rather than repaid, or converted into equity, so that the company can continue trading, (ibid.)

What price market forces when the fate of a favourite entrepreneur is at stake? Sir Clive's adeptness at provoking a reputation for invention and innovation was standing him in good stead. As Norman Hewett commented about a previous incarnation of the phenomenon:

There is the fact that there is a groundswell in the UK that Sinclair is a pioneering, innovative British company, and they come out with some bright new things, and they sometimes have 'problems' with them, and they don't always work as they should at the time, but it's a British firm, and we must bear with them, and not be too critical. (Interview, 16 October 1985.)

That this notion, accurately delineated by someone who suffered its effects, is dubious at best is a theme we have been concerned to put over. However, the myth produced its own White Knight in the robust and patriotic form of Robert Maxwell. In a 'World Exclusive' the Mirror (17 June 1985) trumpeted 'Maxwell Saves Sinclair'. The 'dramatic £12m rescue bid' was put together after a long talk, and Mr Maxwell said:

I was glad to have been able to help in the survival of Sinclair Research, one of Britain's great national assets. I look forward to working with Sir Clive, a man of brilliant inventive genius.

The actual deal, as ensconced in the heads of agreement, effectively placed this great British asset under the ultimate control of the Lichtenstein holding company that owns Pergamon Press, a subsidiary of which was Hollis Bros & ESA. Hollis would take a majority control for a nominal price, and then subscribe the majority of the new shares, offered on the basis of three £1 shares for each existing share. This would raise around £12m, giving Sir Clive around 8 per cent, leaving 17 per cent of the shares to be subscribed elsewhere, preferentially to the existing institutional shareholders. Research had been devalued to £16m in one fell swoop.

Sir Clive was to become 'life president', cease to be a director and instead become a consultant to the company for an undisclosed fee. Maxwell would become the non-executive chairman, and a new MD would be appointed. Everyone seemed happy about the deal. The Sinclair line was:

I am not the sort of person to run an established business. I am good during the early up-rush, then it needs other hands. I am very glad to find Bob Maxwell. I have known Bob Maxwell for a long, long time, fifteen years in fact, and he is the ideal guy to run a big business, but not just an ordinary sort of business. I do not mind a bit. I do not feel hurt by not being in control. I am not moved by avarice... I am not management type; I am an inventor. I am awful at managing established businesses. (Quoted in The Times, 18 June 1985.)

Even Downing Street was pleased:

The Government has been aware that these talks have been going on and welcomes any move to put the Sinclair business on a firm footing (Daily Mirror, 17 June 1985.)

Despite this apparent accord there were inconsistencies. In the negotiations, Sir Clive had been playing down some of the research that had been going on, especially the wafer-scale project, as he was not sharing the pleasure Maxwell found in the prospect of the two patriots working together. He was going to leave, and he wanted some of the research and development to go with him. In the event the wafer-scale project, which Sir Clive would have liked to utilize as his lifeboat from this particular sinking ship, had to be brought in as a potential earner in order to get Maxwell to confirm the deal, according to the head of the project, Malcolm Wilkinson. The same day the rescue deal was announced, so also was the success of the wafer-scale team in producing working 500K memory chips on a single wafer.

Maxwell thought the agreement stopped Sir Clive from sloping off because of a *'five-year agreement which precludes him from doing anything for anybody elsewhere'* (quoted in the Financial Times, June 1985). Sir Clive was quite clear that it didn't stop him doing something for himself:

I was not going to remain with the company ... would have left and started another business ... Fifth generation. Part of the deal was that that project would leave with me. (Interview, 6 November 1985.)

He was also quite clear that making the agreement was not a matter of choosing an acceptable partner, but taking the only offer:

I signed it because I thought there was no choice. I regretted it in some respects because it was a loss of independence, but I signed it because we'd seemed to run out of time. I don't think it was true that we'd run out of time, actually to the extent people thought, but that's what we were told, (ibid.)

Maxwell lost no time in getting to grips with the situation, his first action being to set his own accountants to work to scrutinize the figures that the Sinclair accountants had produced for the last year's trading. The crucial question was the valuation to be placed on the high stock levels. According to *Microscope* (11 July 1985) Maxwell also called in all cheque books, locked them in the safe, and issued instructions that they were to be used only with his authority.

The next questions were the choice of a new chief executive and some income. The latter hinged around a potential deal with the Dixons retail chain, with whom Bill Jeffrey had had some success with the televisions, and who, if the terms were right, would consider a huge order. The former seems to have been a bit of a saga. The candidate suggested by a Sinclair board member was seriously considered, but finally rejected by both Sir Clive and Maxwell, which enabled Sir Clive to put Bill Jeffrey forward. Accepted by Maxwell, there was now a new chief, who could set about putting the house in order. Apart from reports that Robert Maxwell wanted to sell Sinclair computers to the Eastern Bloc, all was quiet until 10 August, when the news broke that Maxwell had aborted the deal.

Maxwell's comments on the decision were particularly vapid:

We are sad that it was not possible to conclude the deal, but it just did not gell. There is no doubt in our minds, however, that Sinclair computers are a fine product appreciated by millions. (Financial Times, 10 August 1985.)

Hollis Bros was more direct:

After advice by merchant bankers Hill Samuel, the board decided that on the basis of information available to it, it could not recommend the acquisition to shareholders, (ibid.)

We can with confidence take this to mean that it didn't think it was going to make any money on the deal. Sinclair Research put a brave face on it, announcing that Dixons was buying 160,000 Spectrums, QLs and flat-screen televisions over the next three months in a deal worth £10m, for an aggressive sales drive. Declaring that no rescue was now needed, Sir Clive was quoted as saying:

We no longer need rescuing. Three other people expressed interest in investing money in Sinclair Research before Mr Maxwell made his offer. We will now go back and talk to them. (Observer, 11 August 1985.)

As well as expressing optimism elsewhere because sales of the QL in the States were increasing 'drastically' (cynics might point out that from zero, any increase is bound to be dramatic), Sir Clive also suggested that the institutional investors might be interested in putting up more money:

They have not been fully briefed on the company's position. I need to do that very soon. I believe if they knew what we had achieved lately they would be interested in buying more shares. (ibid.)

Sir Clive offered us no further information on the Maxwell pull-out when we interviewed him on 6 November 1985:

I quite honestly don't know. He gave no reasons, really. It was looking as if it might be dubious for quite a while. He didn't like the Dixons deal, he didn't want us to do it... I think, or suspect, that the reason he didn't like it was that the company wasn't in a strong negotiating position on it... I think he may have thought he'd bitten off more than he could chew perhaps.

He did however confirm that the ride into the Maxwell stable would not have gone ahead smoothly:

Having thought about it since, I think it would have been pretty difficult. The people who worked in the company were very worried about it, and that's not a good start... I think he did find with Sinclair Research that he'd have a meeting and say, 'Well, this is what I said'

and our people would say 'No, that's not what you said' and he's not used to that... he wouldn't have understood the business, so I don't know what would have happened.

Despite Sir Clive's caginess, it became quite clear what had happened. The Dixons deal had saved the company from immediate liquidation, and an agreement with Terry Blood Distribution was set up to allow the same terms to other retailers, gaining another £4.5m of fairly certain cash flow. The cost was in halving the value of the QL stocks, since the retail price had been cut from £399 to £199.

The picture from the accounts, when they finally surfaced for public scrutiny, was unpromising, as apparently Hollis Bros had felt it to be, and formed the background to some hectic activity in the third week of August, when Research met with its major creditors. Jeffrey persuaded the creditors that his proposed reorganization would place Sir Clive firmly into his role as R&D supremo and chairman, and back this up with a firm management structure. They agreed to support Sinclair Research until the peak Christmas sales Period was over.

With the affairs as of March 1985 showing that writing stocks down to 'net realizable value' cost £17m, and debts of £34m due within the year, the company's future looked extremely bleak. At a time when Sinclair Research desperately needed a new and exciting product, all it had to look forward to was Christmas. While the corporate crisis was sufficiently pronounced to preclude any dangerous optimism, Dixons' significant investment in Sinclair products gave Sir Clive a much needed straw to clutch at as he grappled with the demons of a potential liquidation. While in most respects the odds seemed stacked against him, Sinclair could at least be certain that a corner of the high street would be rooting for him for the duration of the festive season. This said, the fruits of the Dixons deal were already spoken for, and the only real hope was that the chain store's promotion would spark off renewed interest in Sinclair products in other sections of the market.

In the event, the vested interests of the high street ensured that Sinclair products were promoted to good effect. During this brief but critical period, chainstore support coupled with developments in the export market (in the shape of the Spectrum 128) enabled the company to boost sales and win an

encouraging chunk of the market. But it was a case of too little, too late. The slight increase in sales failed to make much of an impression on the crippling mountain of debts that daily threatened to turn terminal. Nevertheless, the response to the Dixons promotion was encouraging, and as early as November 1985 Sinclair was claiming that the chain was already reordering stock items depleted by an early burst of Christmas enthusiasm.

In February 1986, against all odds, Sir Clive Sinclair was still in a position to inspire caution in those anxious to herald his demise. Thanks to the hard sell in the chainstores, when he emerged to face his public at the beginning of a new year, Sir Clive was able to confirm that his company's products still accounted for 40 per cent of the home-computer market. With the cool calculation of a brinkmanship veteran, he made every effort to encourage the impression that the tide was about to turn for his ailing flagship. Any attempts to question such an impression would, with luck, be smothered by the mess of real and simulated corporate activity that was regularly leaked to the press at this time. There was the Pandora portable micro, the cellular 'under-£100' telephone, and the wafer-scale breakthrough. The deadwood was cut away somewhat by selling off worldwide marketing, sales and distribution rights for the flat screen pocket TV to Timex in January. The price went down to £79 at the same time. Furthermore, now that the company was freed from the constraints of the Dixons deal, Sinclair Research was able to promote the UK launch of the Spectrum 128 on 13 February 1986. Although it's unlikely that anyone expected the Spanish machine to cause much of a stir on the home market, its arrival was presumably intended to encourage the impression of a going concern with a developing product range. In bleak contrast to the anticipation and excitement surrounding earlier launches, the arrival of the Spectrum 128 passed unnoticed by all save the fanzines and trade press. No one wanted to know, especially since the price, at £179.99 for a machine without a joystick port and lacking the Spanish version's separate numeric and cursor keypad, brought it close to the QL price.

Nevertheless Christmas sales were presumably faintly promising, and the launch of the Spectrum 128 provided a welcome distraction for the increasingly apprehensive workforce at Sinclair Research. However, in spite of his bullish PR stance, it seems unlikely that under the circumstances

Sir Clive could have fostered many illusions about corporate stability. If the history of Radionics is anything to go by, it seems likely that while part of Sinclair would have doggedly refused to concede defeat, Clive the Survivor would have coldly used any respite to consolidate resources and plot his renaissance. As we shall see, in the end it was the survivor who won the day (but not without a fair amount of prodding from the creditors).

Although we should be wary about drawing glib parallels between the histories of Sinclair Radionics and Research, such a comparison became irresistible when, in March 1986, Sir Clive announced the sale of his Kensington town house. After all, back in 1979 it was the sale of his house and 'collector's Rolls' that provided Sinclair with the finance for the embryonic Sinclair Research. However, although the portents were there for all to see, they didn't offer any hint of the sensational circumstances under which this critical chapter of the Sinclair story would be resolved. On March 1986, Sir Clive stunned the trade by announcing that he had sold his existing computer business to his arch rival – Amstrad! For many years Amstrad was essentially a one-man show, and the company logo takes its letters from his name and forte - Alan Michael Sugar Trading. From the moment Amstrad made its move on the microcomputer market, Sir Clive seemed to take the new competition to heart, and a bitter rivalry developed. Products apart, the personalities involved were built for conflict. In many respects, Sugar is the consumer electronics maverick Sinclair has spent so much of his career trying to be. The difference between the two men is that while Sugar has always been content to see himself as simply a well-honed marketer, Sinclair's marketing nous has often been impeded by his scientific and intellectual pretensions. While both are dominant figureheads for their respective companies, it's only Sir Clive who wants to be thought of as an inventor.

In contrast to most of the early market leaders in home computing - e.g. Commodore, Apple, Acorn, Oric, etc. - Amstrad didn't start out selling micros. The company was formed in 1965 and for a while struggled to make ends meet as a one-man enterprise. In the early days, Sugar made his money selling car aerials from the back of a van. In 1968, Amstrad launched into the low-cost hi-fi market, and over the next decade developed a range of music systems that consistently undercut the opposition. By

1980, Sugar had an acknowledged brand name in the chainstores, and a solid place in the high-street electronics market. When the company went public in 1980 it was valued at around £8m Today, Amstrad claims a 35 per cent share of the UK hi-fi market.

By the end of 1983, Acorn and Sinclair Research had loosely defined the bottom end of the UK home-computer market, while independent software and peripheral development illuminated additional consumer demands and the shape of things to come. While at this time the market could hardly have been described as stable, Sugar clearly considered it sufficiently well delineated to mount his own challenge. In 1984, manufacturers of low-cost home computers were legion, but it is unlikely that the volume of competition would have bothered Sugar. After all, there were an awful lot of hi-fi manufacturers around in the 1970s, but they didn't prevent Amstrad from making its mark. Sugar's gung-ho catchphrase, constantly hurled at Amstrad's notoriously effective sales force, maintains that the company's secret is that it 'has the right product, at the right price, at the right time.' However, perhaps the key to Sugar's success is that while he has confidence in his products, unlike Sir Clive they don't for him represent any kind of emotional commitment. Although it went against the grain as far as the hardcore hobbyists were concerned, Amstrad made it clear from the outset that if their computers didn't reap an acceptable return fast enough, the range would quite simply be dropped. In addition, Sugar publicly acknowledged that he had no interest in initiating developments to advance the technology of microcomputing. His objective was simply to create a product that would satisfy the market he had identified, and he demonstrated that such a machine could be designed around existing technology. Maggie Brown had this to say about Alan Sugar's style in an article contrasting the fates of Sinclair Research and Amstrad:

Sugar would never have pioneered a chancy new market as Sir Clive did brilliantly in 1980 when the first Spectrums hit the colour magazines. Yet Sugar showed his opportunistic style when he subsequently shifted Amstrad, the hi-fi company he has turned into a £521m hot property, into the established home-computer niche two years ago ... He did it with such professional ruthlessness that Sinclair

and his newer QL computer were outpaced, overtaken, and then beaten at their own game. (Guardian, 8 April 1986.)

The first Amstrad micro - essentially aimed at up-market hobbyists - soon proved itself worthy of Sugar's sales maxim. By the end of 1985, the company had intelligently developed its range, and the success of the Amstrad PCW8256 computer, cleverly marketed as a dedicated wordprocessor, consolidated the company's position in the increasingly professional microcomputer market. In the spring of 1985, Amstrad shares could be had for 74p apiece; a year later, the price had soared to £4.77. The company's growth was a wonder to the City, which by this time had written off microcomputers and microcomputer companies as the loss leaders of the 1980s. In the first six months of its financial year ending 31 December 1985, Amstrad was reporting that it had tripled its half-yearly profits to £27.5m. By now the company was valued at around £521m and Alan Sugar was a very rich man. In spite of having sold off millions of shares, Sugar still owned a personal stake in Amstrad worth a cool £263m.

Amstrad computers had not merely paid their way, but had the cash to expand with a vengeance. In the current context, the most important aspect of Amstrad's computer development was the international distribution network whose expansion efficiently cushioned the company from the potentially fatal fluctuations of national markets. In addition, Amstrad's decision to sell cheap, simple but attractive business machines, as well as the initial hobbyist products, ensured that the company wasn't relying solely on the Christmas computer market to generate sales.

The press conference at which the Amstrad-Sinclair deal was announced was jointly chaired by Alan Sugar and Sir Clive, although circumstances dictated that it was the former who took charge of the proceedings. Most of the national press reports of the event make reference to Sir Clive's 'brave face' under humiliating circumstances. However, while at times he was clearly unsettled by what he would have regarded as a public proclamation of failure, he was obviously relieved that a particularly frustrating era had finally drawn to a close. As he told a television reporter, 'We should have done it a damned sight earlier.' Apart from the financial considerations, Sir

Clive finally conceded that he'd lost all interest in the current Sinclair Research range.

The Amstrad-Sinclair deal cost Sugar's company £5m in cash and on the face of it was a sensible option for both parties. On the Amstrad side, the company stated in its press release that it had bought 'worldwide rights to sell and manufacture all existing and future Sinclair computers and computer products, together with the Sinclair brandname'. It also acquired 'intellectual property rights' in the existing products. Sugar summed up his immediate plans for the Sinclair machines:

[Sinclair] recently turned down an offer from an unnamed investor for a 30 per cent stake [in Sinclair Research] which would have enabled him to stay in the home-computer business because he was much more interested in pursuing new developments. (Financial Times, 8 April 1986.)

We're really going to do a very good job on the overseas and export markets, which we've already done with our own computers. We have agents throughout the world, we have subsidiaries throughout the world. We have a ready outlet for the product, and we will establish it very firmly in the European and South East Asian markets. (Newsnight, BBC2, 7 April 1986.)

At the stroke of a pen, Sugar was able to swallow the competition and dominate the home market (although at the time the deal had yet to be cleared by the Office of Fair Trading) while at the same time profiting from the substantial export demand for Sinclair products that Research had never been in a position efficiently to exploit. Interestingly, it was Dixons who, by suggesting the deal to Sugar, had once again saved Sinclair from being overwhelmed by his creditors. With the acquisition of the Sinclair products, Amstrad could now claim 60 per cent of the UK home-computer market (40 per cent Sinclair, 20 per cent Amstrad products).

With this significant expansion of the product range (which now embraced virtually every section of the home-computer market), Sugar added that little bit extra to his salesman's clout on the international market - just as Amstrad was preparing to wargame its assault on the States. As far as the

UK was concerned, Sugar made it clear that he was essentially looking at the Sinclair machines as low-cost entertainment items, for Christmas. He announced that he would be scrapping the QL altogether, and planned to 'simplify' the Spectrums, with modifications designed to make the machines easier to use.

The only negative moment in the proceedings came when it was discovered that following the announcement of the deal with Sinclair, the value of Amstrad shares had fallen by 14p. (It was impossible, though, to make realistic assessments of cause and effect with the stock market rocked by unstable oil prices.) All in all, the financial world seemed to think that Sugar had bought himself a bargain. A spokesman for Simon and Coates, the stockbrokers, offered the following projection:

From our calculations, [the Amstrad-Sinclair deal] should be worth £35-40m in sales to Amstrad over the next year. [Sugar] should look to make between £5.5m and £6.5m in profit. So it's going to more than pay for itself in the next year. (Channel 4 News, 7 April 1986.)

From Sir Clive's point of view, the Amstrad offer effectively put a floundering enterprise out of its misery, while avoiding the conclusive humiliation of liquidation:

We pioneered the market. Now we've handed it over to the people who are experts in international marketing. It gets us out of a business we were not doing very well in, and allows us to continue in interests we do well in. We chose the Amstrad deal because it was a better deal. We sold off the traditional business. (Quoted in the Guardian, 8 April 1986.)

Clive announced that with the conclusion of the Amstrad deal Sinclair Research was able to settle with all its creditors and continue to develop its current projects. Although a number of conflicting figures have been bandied about, the consensus suggests that at the conclusion of the agreement, Sinclair's liabilities stood at £15m (£8m to the banks, £7m to other creditors). Surprisingly, Amstrad placed no constraints on Sinclair's development of new microcomputer products, although reports indicated that Research would be obliged to offer the company first option on

distribution. Sinclair has since denied this, saying that it applies only to products incorporating the technology and intellectual property of the existing machines - so that he has a free hand on any brand-new micro. It is certain, however, that he is prohibited from using the Sinclair brandname on any computer product.

Sir Clive indicated that the deal would mean redundancies in the marketing and distribution departments of Sinclair Research, but implied that the remainder of the company would, he hoped, be unaffected. In the event, more than 90 per cent of the managerial and technical staff found themselves out of a job within a few months. Looking at the overall effects of the deal, it seems likely that the manufacture of Sinclair products will ultimately be moved out of the UK, with resultant job losses at Timex, AB Electronics and Thorn. Most of Amstrad's manufacturing is based in South Korea, and Sugar seems far from convinced that any UK company would be able to compete with his current subcontractors in terms of either price or quality. In the course of the press conference, Sugar described the current standard of Sinclair products as 'atrocious' (Guardian, 7 April 1986), and suggested that the company's UK subcontractors were at least partially responsible for the unreliability of the machines (Financial Times, 7 April 1986).

As to remaining stocks of Sinclair products, Sugar explained that he would buy up all remaining Sinclair products, and market the goods through Amstrad's distribution. He also agreed to pay for existing orders of computers, which were expected to run out by July 1986. All in all, on top of the initial £5m, Sugar agreed to pay out an additional £11m to Sinclair Research and its subcontractors.

In outlining his decision to throw in the towel, Sir Clive confessed that his company lacked the expertise to market and distribute effectively in a developed home-computer market:

We got to the point really where the home-computer business became flat, from a technical point of view, and we always recognized at Sinclair Research when we established it that when it gets to that point we ought to sell out. We don't have the expertise that Alan has - and may be other companies have - in mass marketing worldwide. There's

no room nowadays for a company that can't work on a world basis - as I'm sure Alan's business does - and that takes a great deal of expertise which, frankly, we don't possess. (Channel 4 News, 7 April 1986.)

Although the events of 1984-6 cast doubts on Sinclair's claim that he had planned such a withdrawal from the outset, there's no disputing his assessment that towards the end Sinclair Research was out of its depth in the home-computer market. Falling back on his standard response to such situations, Sir Clive was anxious to present the universally acceptable image of the simple inventor who still hasn't quite got the hang of business matters. Once again there was much talk about a return to the lab, that mythical environment in Sir Clive has consistently claimed he feels most at home. Sinclair's telecommunication and wafer-scale projects required significant investment if they were to make it to the market. Two new companies were to be formed to run the projects, and the same month that the Amstrad deal was announced, Sir Clive said he was well on the way to finalizing a brace of financial packages aimed at realizing his ambitions for the future (and providing working capital for the present). The first product planned by the Winchester-based telecom team was a low-cost Cellnet-style telephone, with production cautiously planned for the middle to end of 1987. If all goes well, it seems that Sir Clive's mentor, Fred Olsen, will bring in Timex to join forces with the Sinclair Research offshoot. The former watch manufacturer is rumoured to be buying up to 75 per cent holding in the ambitious but potentially very profitable enterprise. It seems likely that in addition to providing backing for the project's development, Timex will also undertake at least a percentage of the product's manufacture.

Sir Clive's second financial package appears to have been finalized by the time the Amstrad deal was announced. Following months of negotiation, shortly after Christmas 1985 Barclays agreed to back the wafer-scale development in the form of non-interest-bearing equity stock and a bank loan. The wafer project had long been close to Sinclair's heart, and the deal with Barclays must have come as a great relief, since for a while it looked as if Research would be forced to give up controlling interest in the project in order to come up with the necessary backing. Anamartic Ltd (the name is one of Clive's neo-classicist coinings - it means 'without fault') was

launched on 7 July with ‘a memory device for business computers at final prototype stage and scheduled for introduction in early 1987’. With Clive taking a low-profile stance as a non-executive director, it announced it was seeking £6m to bring the product to market.

As far as Sinclair himself was concerned, the immediate effect of all these deals was finally to liberate him from the mire of debts that had plagued him for so long. By the beginning of April 1986, Sir Clive was in a position to reimburse Sinclair Research’s major creditors and announce with understandable relief that ‘the organization was free of borrowings’ for the first time for years. Although for obvious reasons, it was the Amstrad deal that hit the headlines, time may well prove the wafer and telecom projects to be far more significant landmarks in Sir Clive’s erratic career. Certainly these are the products that will determine whether there is a future for all or any of the Sinclair companies, although Sir Clive himself has indicated that he is unlikely to play any part in running the enterprises.

While the objectives of the cellular phone project are presumably self-evident, Research’s work on wafer-scale integration is less easily grasped (which is one of the reasons the company found it so difficult to raise the necessary backing). Given that if the researchers get it right, their work is certain to revolutionize the international microelectronics industry, it seems worthwhile devoting the remainder of this chapter to an explanation of what a wafer is and why it’s so important.

Wafer-scale technology came into Sinclair’s life on 3 July 1983, when Ivor Catt responded to the advert in the Observer in which Sir Clive announced that he was seeking personnel for his revolutionary MetaLab. In terms of the new centre’s stated objectives, Catt was made to measure. A maverick computer theorist with too much integrity and experience to be tethered to the short-term commercial objectives of an intensely conservative industry, Catt was anathema to the multinationals. For twenty years he had developed the theoretical foundations for a revolution in the semiconductor industry, and for twenty years his ideas had been rejected as unworkable. When Sinclair made it clear that he was interested in Catt’s proposals, the disillusioned engineer saw his chance to show the computing mafia the error of its ways.

By the time Catt had made his bid for the MetaLab, an abortive attempt at wafer-scale integration had become almost a rite of passage for the multinationals of the industry. Everyone who was anyone had had a stab at it. Both TI and ITT had floundered in spectacular style, but it was Gene Amdahl's bid for the super-computer-via-wafer-scale that proved to be the kiss of death for research as far as investors were concerned. Before going into detail about the Amdahl disaster, let's race through a schematic overview of what the technology is all about.

Ivor Carr first applied his mind to the problem of wafer-scale integration when he identified a significant wastage in the semiconductor manufacturing process:

I noticed that the silicon wafer was a hundredth of the cost of the total system so why not use that cheap commodity to build the system on the wafer instead of sawing it up to form separate circuits (Infomatics, August 1984.)

In other words, one of the most conspicuous weaknesses of semiconductor manufacture is the manner in which it has elected to deal with rejects. Chips are produced on 4- or 5-inch wafers of silicon, which are then chopped up in order to separate the working chips from a large number of rejects. The consequence of this process is that the working chips must then be mounted, wired and packaged in plastic before being assembled on to a printed circuit board (PCB). The wafer-scale concept seeks to do away with this costly and cumbersome second-stage development process.

The essence of the wafer-scale alternative is that the entire wafer is preserved (including the reject chips), and designed and tested in such a way as to obviate the need for a PCB. The process requires not the creation of a wafer containing perfect chips, but a method of testing and rejecting that results eventually in a sequence of working chips to be built up on the wafer. Faulty chips are rejected by electronic logic built into the wafer rather than by cutting the wafer apart.

A variety of approaches have been developed in an attempt to realize such a process, but the Catt solution can be summarized as follows. One of a number of possible entry points is selected on the wafer, and the first chip in

the sequence is tested. An off-wafer tester feeds random data to the chip, and if the appropriate data is returned to the tester the first chip is considered to be sound. The next stage in the process requires the tester to instruct the working chip to open a link with one of four adjacent chips. Data is once again sent to the second chip via the original working chip, and if the appropriate data is returned then the second chip is considered sound. If the second chip fails to return the appropriate data, then the last working chip is instructed to open a link with one of its three remaining adjacent chips, and the test sequence is repeated. In this way, a spiral of working chips is established, in the end creating a one-dimensional array of chips that function as what is known as a 'shift register'.

Now you don't have to know anything about one-dimensional arrays or shift registers to get an intimation of the beauty of such a process. What wafer-scale integration achieves is a fully functioning component from a chunk of silicon that is riddled with nonfunctioning segments. The inherent economies of the process lie in the fact that the rejects can remain in place and that the working chips are formed in a working configuration that doesn't need to be reassembled on to a separate PCB.

As far as investors in the US were concerned, Gene Amdahl was the golden boy of the sunrise industries. Having made his name as one of IBM's foremost hardware designers, Amdahl had moved on to set up his own company, Trilogy, whose success in marketing IBM plug-compatible machinery had given 'Big Blue' serious cause for concern in the mid-1970s. Riding a tidal wave of success, in the early 1980s Amdahl announced his plans to design a new generation of supercomputers built around designs incorporating the as yet unconquered wafer-scale integration techniques. Everyone wants to back a winner, and Trilogy found no shortage of willing investors. US heavyweights Sperry and Digital Equipment came up with backing, as did the Bull corporation of France. At conservative estimates, more than \$240m were pumped into Amdahl's viable project.

By the middle of 1983, the American company was announcing positive results. The wafers it was producing were claimed to run more than 30 per cent faster than equivalent chips, and there were intimations that Amdahl

had found a solution to the overheating problems associated with such circuitry. However, the reality of the situation emerged in March 1984. The supercomputer programme fell behind schedule for the second time and rumours began to circulate that the company's wafer-based product would turn out to be only slightly faster than IBM's best. By May 1984, Trilogy announced that completion of its revolutionary new product had slipped a further twelve months, and in June the company conceded defeat and scrapped the entire project. The only party with cause to gloat over Amdahl's failure was IBM, who in the 1960s had decided that wafer scale was too difficult and costly a development to be a proposition.

In light of the experience of Amdahl, IBM, and Texas Instruments, Catt's optimism seemed unfounded and his association with Sinclair Research insignificant. However, as far as Catt was concerned, the opposition's failure to realize wafer scale was no more surprising than would be the failure of the wheel without the concept of the circle. According to Catt, Amdahl's inability to bring wafer scale to fruition was a result of a failure to recognize the advantages of the technology his company was attempting to develop. Axiomatic to the Catt approach is the exploitation of the reduction in interconnections facilitated by wafer-scale integration. It's generally believed that in the latter stages of its development, an Amdahl mega chip boasted an astounding 1200 pins packed on to its 2-inch length. As a consequence of the testing process outlined above, Catt's wafer chip requires only two pins, since communication with the component is necessarily confined to the first chip in the spiral. Equally, entire wafers are rejected only if each one of the first chips at all the possible entry points reveals a fault.

The uniformly negative evidence seemed to suggest that the only hope for wafer-scale integration lay in the creation of fault-free wafers, the production of which, according to Gene Amdahl, will take more than a century to perfect. Unless, of course, one attached any significance to the theories of a crank like Ivor Catt...

To his credit, Sir Clive didn't dismiss Catt as a crank, but identified with the inventor's dedication to a project that had been rejected by the industry's establishment for two decades. Sinclair's support for Catt's vision is

multiply determined. In the first instance, having been shunned and scorned for his perennial devotion to electric vehicles and pocket television, Sinclair would have recognized and valorized the drive of a kindred spirit. Less emotively, Sir Clive's consuming interest in developments that reduce production costs by limiting the component count would have stimulated his interest in Catt's theories. (It's no coincidence that the ZX81 was the first product to take advantage of Ferranti's revolutionary development of ULA technology.) Finally, the logic and simplicity of Catt's theories are so seductive that only the vested interests and hidebound conservatism of the multinationals could find reason to deny their experimental implementation.

It should be stressed that while the computer industry shunned Catt's theories, over the years the inventor's approach to wafer-scale development has found support from both the state and the academic world. The NRDC funded research that enabled Catt to develop his concepts to the stage where he was able to patent its implications, and at Middlesex Polytechnic Dr Malcolm Wilkinson headed a team that explored the practical implementation of wafer-scale integration a la Catt. Over the years, the combined assault on the industry by Catt and Wilkinson should have generated a positive response, but in the event ICL, GEC, Plessey and STC all turned down the project.

While Ivor Catt eked out a living for himself as a lecturer at Watford College, Wilkinson managed to persuade Burroughs to take him on as head of a team investigating wafer-scale's potential. The team's research reached the stage where the theoretical basis of the project was demonstrable, but further resources were required to examine the commercial viability of the process. Wilkinson's group had produced a working wafer when the project fell foul of company politics:

The Burroughs wafer was very much a test structure. Exactly the time the wafer project was being viewed at Burroughs, very major structural changes were taking place in the company. There were a lot of people at intermediate levels who were very sensitive to these changes and thus not prepared to take risks or champion risky technical problems or projects. And at that time the wafer was considered to be fairly high risk, particularly since a lot of people who

were coming into Burroughs were from IBM and were quite hostile to wafers. (Interview with Malcolm Wilkinson, 15 December 1985.)

In September 1983, Sinclair and Catt had a series of meetings at which the implications of wafer-scale development were discussed at length. As a result of these discussions, Sir Clive bought the rights to Catt's patents, and took him on as a consultant. In February 1984, Malcolm Wilkinson left Burroughs for Sinclair Research and was soon joined by three others from his original team. The wafer-scale programme soon became the centrepiece of MetaLab research. In its heyday it boasted twelve full-time members headhunted from Plessey, Texas Instruments, STL and GEC.

By March 1985, the wafer team had made sufficient progress to convince Sir Clive that the fruits of its endeavour might well constitute the foundations on which Sinclair Research could re-establish its position as a market leader. The problem was, wafer-scale development took the company into the new area of component manufacture in which it had no track record and for which it required significant investment. To drum up financial support for his new endeavour, Sir Clive recruited the expertise and clout of old friend and ICL chairman Robb Wilmot.

Wilmot's original brief was to seek out £50m worth of investment for the creation of a wafer-scale production plant. As far as the financial press was concerned, Wilmot's arrival ensured that attaining the venture capital was merely a formality. In the event, the financial crisis culminating in the abortive Maxwell rescue chronicled above proved too much even for the ICL chairman. As far as the City was concerned, the combination of a Sinclair product and semiconductor technology amounted to a less than tempting package. However, although Wilmot severed his relationship with Sinclair Research in September 1985 without finalizing the investment package required for the wafer-scale plant, it seems that his contribution to the project was far from negligible. According to Wilkinson, it was Wilmot who recognized the potential of the wafer-scale development:

I think that there's a lot of money to be made out of the wafer project, perhaps a lot more than Clive originally envisaged. I think it was Wilmot who eventually showed that the potential of all this is much larger than its effects on Sinclair Research. We could end up with a

large semiconductor plant servicing a much larger range of the marketplace than Sinclair Research could handle ... Clive had simply looked at the wafer concept and considered how it would impact Sinclair products. I think what Wilmot did was to take the marketplace in general and ask how wafer scale would impact mainframes, telecommunications and military systems. (Interview, 15 December 1985).

While the announcement was lost in the collapse of the Maxwell rescue, the most compelling motivation for investment in the new Sinclair venture is that Wilkinson's team has succeeded where the multinationals have failed. In May 1985, the group was poised to go ahead with the production of a half-megabyte wafer-scale memory for the QL. Then a slump in the memory market meant that standard RAM was being sold for less than cost price, and the Sinclair product was no longer economically viable.

At the beginning of 1986, Sinclair's wafer-scale enterprise still appeared to be the company's most promising hope for the future. Negotiations initiated by Wilmot seemed close to fruition, although at the time it seemed unlikely that Sinclair Research was in any position to achieve a controlling interest in any such enterprise. The situation was further complicated by the fact that Catt's patents were in the hands of Barclays, part of the security covering the overdraft that was keeping Sir Clive's company afloat. So although salvation appeared to be at hand, it was still possible that the company might flounder at the final hurdle. Malcolm Wilkinson put the situation into perspective:

It's difficult in the context of Sinclair Research today to see how they can realize the benefits of the resource [wafer scale] quickly enough. They really need a product for this Christmas [1985], and the wafer is a long-term development, (ibid.)

Now that Sugar has removed the financial drain and distractions of the troubled parent company, and Barclays Bank has come up with the necessary funds to kickstart Anamartic, it's up to Wilkinson and his team to prove that they really can take the world by storm. One thing's for certain: the rewards that would accompany a successful realization of the product would make Sinclair Research's heyday look like a depression. And as a

significant shareholder in the company, clearly Sir Clive must have in mind precisely the kind of renaissance that success with wafer scale would bring.

[11] EXERCISE IN STYLE

For more than a decade, droves of optimistic journalists have probed Sir Clive in the hope that in an epigram of quotable copy the key to his success and survival will be revealed. Fortunately, whatever the current state of his corporate fortunes, Sinclair is never coy about spelling out the unique strengths, innovative business practices and revolutionary products that he sees as the foundations of his contribution to an industrial and technological renaissance. It is the promise of a new dawn that invariably occupies centre stage whenever Sir Clive is persuaded to expound on the course and inspiration of his endeavour:

We should face a Golden Age as fully intelligent machines appear, bringing immense new wealth. In the decades following the 1990s individual wealth could rival that of a Roman emperor. We will see, if war can be avoided, the most Golden Age man has ever known. (Futures, BBC TV, 7 October 1982.)

Implicit in such dicta is the revelation that fame and fortune have simply graced an avatar with the good sense to capitalize on the implications of his own visions.

When describing his interventions in the mostly stolid and unimaginative mire that is Western consumerism, Sir Clive regularly adopts the mantle of a new age prophet; a visionary intent on bringing the fruits of technology to the impoverished and endearingly ignorant masses:

The artificially intelligent machine will make an enormous difference. We'll be able to have in the home a machine that performs many of the functions of the professionals we go to today - doctor, teacher or lawyer ... There'll be robots to go out to the Third World with real intelligence and endless patience to educate vast numbers of people. Full employment will return in the 1990s - if we don't get a Marxist government or something. We'll have highly automated factories employing very few. People will work more in the service industries. (Woman's Own, May 1985.)

Be it a matchbox radio or an electronic trike he's announcing, Sinclair has always presented himself as a man who conjures the dreams of the future from an imaginative development of contemporary technology. From the careful cultivation of his own image as the boffin of the people, to the promotion of the MetaLab as a hotbed of applied intellect smashing through the frontiers of consumable technology, Sinclair has shown himself to be a subtle and tireless manipulator of popular archetypes. In tracing the development of the Sinclair companies and the progress of their founder, it is difficult to escape the conclusion that one is chronicling the gradual perfection of a sophisticated and profoundly marketable icon whose benign image implicitly bestows credibility on the products with which it is associated. Of course, there's nothing new about developing a warm and dependable front for the company you're promoting, and if this can be personified by an instantly recognizable and avuncular caricature, so much the better.

Clive Sinclair has always devoted a great deal of attention to the refinement of a commercial image. In the early days of his career, such efforts were concentrated on the manner in which his products and companies were presented to the outside world. Up until recently, however, the emphasis had shifted to the development of his own image, which, by an unusually effective process of osmosis, communicated hi-tech credibility and a promise for the future to the products offered by his company. The importance of the Sinclair image is explained by Andy Knott of Kinnear, the PR company that handled the Research account until recently:

[Clive] also contributes the personality that is viewed from the outside, and actually that is very valuable. When people go in to buy a Sinclair product it's almost as if they're buying it from a friend - you know, my uncle made this ... (Interview, 22 October 1985.)

The resilience of Sinclair's public persona is exemplified by the market response to the launch of the QL, the long-awaited successor to the Spectrum and Sinclair's first attempt to reap the rich rewards of the business market. As we have seen, both the machine and its launch were essentially a disaster, and in the years that followed the machine's launch, Research was forced to incorporate seventeen sets of design modifications

in an effort to rectify the multitude of faults. With Alan Sugar's decision to exclude the machine from the Amstrad distribution line, the QL will, let us hope, take a well-deserved dive into oblivion. The following report, published well over a year after the launch of the machine, summarized the effects of the QL's failure:

Sir Clive Sinclair has confirmed that production of his QL micro computer has been suspended for two months. He refused to say when production is likely to start up again or how many QLs are stockpiled ... Mike Whitaker of brokers Simon and Coates commented: 'I think Sinclair is still trading at a monthly loss; the company's older Spectrum computer has passed its peak and the QL has failed to take off.' (Guardian, April 1985.)

That Sinclair Research had taken money from the faithful and then dumped an unfinished product into their laps was never denied by the company. Indeed, when discussing the QL's hard- and software failings, Sir Clive seemed to suggest that the initial purchasers of a new Sinclair product were actually taking part in some kind of communal R&D exercise. The QL's market performance can be regarded as a fair indication of the public's reaction to such a stance. But how can we account for the failures that have punctuated Sinclair's career? How can you explain something like the QL? It can't be put down to ignorance. More than two years before the appearance of the machine, Sinclair made it clear that he was aware of the consequences of a QL-style launch in his response to Martin Hayman's questions about companies who announce and market products prematurely:

Yes, there is far too much of that about [the premature announcement of products] and it is very silly. It mucks up the marketplace at the time but it rebounds on the company eventually. They [the competition] are talking about products that are further and further away. If we announce a product now, it is because it is ready for production. (Practical Computing, July 1982.)

So Sir Clive is not unaware of the consequences of running a business the way he has run Sinclair Research. Was he aware of the wealth of consumer loyalty that was squandered with the QL's launch? The measure of that

loyalty can be gathered from a review of the public's initial reaction to the QL circus. In spite of the lack of a visible product, out-of-pocket customers actively struggled to swallow the company's excuses and even came up with some of their own. Of course, it wasn't the micro they'd never seen to which they were committed, but the man everyone believed to be behind it - Uncle Clive. Naturally, as the truth about the QL leaked out, so public opinion gradually turned against the company and, to a lesser extent, its founder. Yet how can that initial loyalty be accounted for? Why did so many people seem to have almost an emotional investment in Sinclair's success? The fact is, they wanted to believe in him. Despite the volume of dissatisfaction surrounding the distribution, sales and servicing of the Spectrum, and the fact that these symptoms of apparent contempt for the consumer were replicated with a vengeance with the launch of the QL, both the public and the trade press initially greeted the arrival of the new machine with a benevolence verging on collective blindness. For example, journalists on Personal Computer News managed to carry out a four-page 'Pre-Test' (4 February 1984) on the new Sinclair machine, undeterred by the fact that the QL in question didn't actually work:

It is impossible not to be carried away by the QL. Unless it proves to have very serious faults or drawbacks when in use we can safely nominate it as Machine of the Year for 1984. Sir Clive has identified the demand to launch another mass-market computer where volume sales can keep down cost and low cost can assure volume sales.

Coven the fact that no complete working prototype existed at the launch of the machine (see p. 174), the sense of a mass delusion reminiscent of the Emperor's new clothes becomes irresistible when reading reports of the event:

Each of Sinclair's new machines has been more amazing than the one before, but this time he has really excelled himself. The QL fully deserves the initials, which stand for Quantum Leap, it is so far ahead of everything else at the same price ... That at least was my impression at the launch of the QL, where all the demonstrations were run using real machines, said to be 'pilot production models'. On past performance, the QL should be well made but there will probably be

supply problems due to demand. There will also be bugs, and some features of the QL will turn out to have unforeseen and possibly unwanted consequences. But even so, the Research QL is too powerful a machine for anyone to ignore - and that includes professional and educational as well as home micro users. (Jack Schofield, Practical Computing, March 1984.)

At the end of a review heavy with reservations tempered by praise, Schofield concludes:

If the QL is reliable, delivered in quantity and lives up to its promise, it should do very well indeed, providing competition even for the IBM.

In other words, if the Emperor is wearing clothes, then they are beautiful! The tortuous deliberations of the apologists find their ultimate expression in the launch issue of QL User (July 1984). Nigel Cross makes one suspect that a quantum leap has something to do with bending over backwards:

Much as I'm a born cynic, sceptic and a member of the 'I'll believe it when I see it' school, now that I've actually seen it - both in pre- and initial production form - I actually tend to believe it. Admittedly I haven't seen the final production version, but that's largely irrelevant. It's still a 'good thing' and it can only get better. Of course it's not perfect - but how many new products are?

While market and media support for Sir Clive would gradually fall away over the next year or so, it is a measure of the potency of the Sinclair image that, even after the QL, his company could continue to sell related products into a contracting market and even consolidate its position as market leader. In the fickle world of the computer press there appears to have been an almost desperate desire to see the new Sinclair creation succeed. It's almost as if the industry's commentators had come to regard the success of Sinclair Research as inexorably linked to their own credibility as the spokespersons of the micro age. Although it may seem fanciful today, there are many journalists who are prepared to admit that at the time the success or failure of Clive Sinclair, the universally acknowledged figurehead of the sunrise industries, seemed pivotal to the value and status of their own work.

This curious state of affairs will undoubtedly prove of little more than passing interest to anyone attempting to unravel the semiotics of an era littered with garbled and ephemeral signifiers. However, from our point of view, Sinclair's preoccupation with personal and corporate image offers a partial explanation for some of his most spectacular successes, as well as providing significant insights into the roots of his failures. It would be simplistic to conclude that Sir Clive is merely the victim of his own propaganda, although there is certainly an element of truth in such a view. A more productive line of thought starts from the premiss that the Sinclair advertising campaigns and PR stance initiated a dialectical process that detrimentally influenced both the company and the market.

From the outset, the creation of a strong market image was a high priority for any Sinclair enterprise. Even in the days when he was mailing amplifier kits from a friend's flat in Islington, the young Clive Sinclair was determined not to be lost in the crowd. The electronics magazines of the early 1960s were packed with hundreds of uniformly uninspiring adverts offering a thousand arcane gadgets to the enthusiast. Like Sinclair, most of the young hopefuls touting their wares were electronics hardliners, garage entrepreneurs struggling to make a business out of a hobby. Like most enthusiasts, they were convinced that their products would sell themselves and that there was little point in preaching to the converted. Thus the description, specifications, price and origin of the products were invariably crammed into a 2-inch square of advertising copy, invisible to all but the tireless obsessive. Such anonymity was never to plague a Sinclair creation. One of the hallmarks of Sir Clive's business style has been to take a cottage industry and make it roar like a multinational:

In those days ... everybody was taking tiny ads. Even if they had a lot of products, they would take a lot of tiny ads. Some took a page of them. I decided to take a half-page for just one product. It worked like a treat, and people thought I was running a much bigger business than I was. (Tycoons, p. 158.)

By April 1966, when he had moved his mail-order operation to Newmarket Road in Cambridge, the stature of Sinclair Radionics was further enhanced by an invitation to clients to mail their orders to a decidedly semi-detached

‘Sinclair House’, a promotional ploy that was dropped a month later, presumably as a consequence of bewilderment at the GPO. However, in spite of occasionally missing the mark, it’s clear that as a salesman Sinclair had discovered his true vocation. In the context of the competition, his early Radionics promotions were indisputably imaginative, if a little eccentric. The deb cheerfully fingering a matchbox radio can be regarded as an innocent anticipation of today’s more offensive campaigns, adding a taste of glamour unheard of in the gritty world of electronics in the 1960s. On the other hand, Sinclair’s use of Jane, ‘the well-loved dog of the Beckingham family’, in the promotion of the same product reveals an unexpected flair for the surreal. It seems unlikely that Sinclair’s snap of a labrador with a Micro-6 plugged into its ear did much for the radio’s sales.

Up until recently, apart from the Radionics scientific instrument line the Sinclair product range has remained determinedly within the confines of the consumer-electronics market. Thus, although the products were promoted with the promise of the new technology, their development was an exercise in style rather than a commercial scientific endeavour. From the earliest Radionics kits through to the C5, it was an impression of technological progress that was communicated by the design of the products. Like many companies marketing consumer electronics, Sinclair quickly learned that application must always take second place to concept and style.

Throughout the history of Sinclair products we have seen how the starting point for the development engineers was always defined in terms of size and appearance. In one of the most vivid descriptions of the man offered by an associate, Alfred Marks emphasizes Sir Clive’s preoccupation with style:

A very elegant fellow is Clive. He always had a panache, a sang-froid, a sort of devil-may-care attitude, but a man of some considerable instinct in taste. (Interview, 25 September 1985.)

Just as they were to provide him with a source of inspiration in the creation of future products, the American electronics magazines seemed to have served as a model for Sinclair’s early promotional campaigns. Unlike the competition, Sinclair Radionics made extensive use of testimonials from satisfied customers who extolled the virtues of life in a Sinclair world. Even at this early stage in his career, Sinclair was promoting a world in which a

new technology was capable of sweeping the consumer into a future enriched by the gadgets of convenience. Nowhere in his advertisements was there any attempt to explain why miniaturization was a necessary good. According to Alfred Marks, it was simply one of his stylistic obsessions:

One of the things that has always dominated Clive's thinking is smallness. I have another client who has the same approach, but everything he does is perfect, (ibid.)

Years after the products had disappeared from the market, Sinclair confessed that the miniaturization issue was really nothing but a marketing device:

To miniaturize some things might be inelegant, but it is certainly inelegant to make things larger than they functionally need to be , assuming there is not some other benefit in making them larger. Once or twice we have made things deliberately small, like the radio kit. That was just a gimmick, to make it exciting for people to build so that they could say it was the tiniest radio in the world. (Practical Computing, July 1982.)

Gimmicks or not, the implication was that without a matchbox radio, or an electronic calculator or a micro the doubting consumer would somehow remain trapped in the past while the rest of the world moved on into a glowing technological future. In the late 1960s and early 1970s, such propaganda for the new age had little impact on the real world, since the manifestos were exclusively consumed by electronics enthusiasts who hardly needed convincing. Later, when Sinclair Research came to market the first generation of home computers, the effective divorce of a product from its application became a critical marketing strategy on which the development of the industry depended. It was essential that the consumer was convinced that the quality of a family's future depended on the introduction of a computer into the home. Questions concerning the machine's use were not to be allowed to stand in the way of its purchase.

There is no single explanation for the initial success of the home-computer industry or of Clive Sinclair's role as one of its earliest and most privileged beneficiaries. However, there can be little doubt that for a while Sinclair

Research's association with the dependable image of Cambridge academia did much to promote the impression that personal computers were somehow a gift from Science (with a capital S) to the masses. While it can be argued that Sinclair helped take computers out of the stuffy world of the university and bring them into the home, it may equally be said that he used the musty kudos of Cambridge to help him establish the credentials of the project in the first place. We must be careful not to make too much of what was simply a subtle exploitation of a generalized faith in all things academic. Contrary to prevalent marketing philosophy, the consumer is not unfailingly gullible and is unlikely to conclude that a Cambridge product is necessarily stamped with the seal of scientific approval. Nevertheless, no one who has shown himself to be as concerned with personal and corporate image as Clive Sinclair could have resisted squeezing every drop of credibility-by-proxy from his relationship with the city and its halls of learning. As William Kay says of Sinclair's move to Cambridge, *'It gave his business an academic gloss which did not harm to credibility, either then or later'*. (Tycoons, pp. 158-9.)

In short, Sinclair certainly took advantage of the fact that a company selling scientific instruments out of Cambridge looked considerably better than would an identical outfit operating from almost anywhere else in the country. 'Science of Balham' hardly fills the heart with confidence. On the other hand, it would be shortsighted to regard a desire for academic proximity as simply a calculated and perfectly legitimate marketing ploy. From the very early days, all the Sinclair companies relied extensively on external expertise for the development of new products. Now, as in 1961 when Sinclair first met Tim Eiloart, the founder of Cambridge Consultants Ltd, the city offers a wealth of freelance talent seeking to turn a respectable education into a quick buck.

The large number of graduates and undergraduates, who over the years have played a significant role in the creation of Sinclair products, can be regarded as the most obvious symptom of Clive Sinclair's style of product development. Broadly speaking, it is clear that Sinclair applies a double standard when determining the level of R&D expenditure to be pumped into a project. As we have seen from John Grant's account of the early development of the ZX range, when creating what Clive regards as bread-

and-butter products like the instruments, calculators and computers, he is dedicated to doing things on the cheap, often to the extent that the finished product fails to maximize its market potential. Even the prestigious MetaLab accounted for only a tiny percentage of Research's total expenditure:

We spend very little on R&D as a percentage of revenue ... The people resource represents, in my terms, not very much. The biggest investment you're going to make in a project is the start-up production figure - maybe a million pounds for the first few batches - and the advertising, which certainly dwarfs the R&D spending. (Interview with Hugo Davenport, Director of Engineering, 22 October 1985.)

However, as far as Sir Clive's obsessions are concerned - for example, developments such as the flat-screen television, the electric car and a wafer-scale chip - he is generous to the point of folly. By now it should be clear that there is little to suggest that the millions of Pounds sunk into the television and the C5 could ever have resulted in Products that had any hope of generating a sensible return on the investment. But where his pet projects are concerned, Sir Clive has a tendency to allow his heart to rule his head, and certainly will not allow fiscal considerations to stand in the way of his vision.

As a general rule, Sinclair feels more comfortable contracting out production and development than handling it in-house. Indeed, it seems that one of the worst stages of his career was the period from 1977 to 1979 when staff levels at Sinclair Radionics reached their peak. In 1977 the company employed around 350 people at a time when it was producing its calculators and the Microvision, and most employees were involved in production-line assembly. Sinclair has always maintained that it was these large numbers of workers that limited the company's capacity to respond with sufficient speed to the collapse of the calculator market, and that the blame for such corporate inflexibility rested with his NEB partners. In retrospect, Sinclair regarded this turning point for his corporate style as a salutary lesson. In an interview with Fortune magazine (8 March 1982) he confessed, *'In a way... I owe a lot to the NEB inadvertently, because you know so much more the second time around; you can avoid the mistakes.'*

And as his interviewer, Myron Magnet, points out later in the article, ‘The chief lesson [Sinclair] learned is to keep his company as miniature as the machines he makes ...’

The small-is-beautiful principle is one that Sinclair adopted and voiced from the time he and Radionics parted company. Apart from arguing the dangers of a lack of flexibility, which he maintained to be inherent in employing a large workforce, in the early days of Sinclair Research Clive was suitably deprecating about his failures as a manager: ‘I’ve learned... to keep the organization small, because I’m not a great organizer of people, and so I find it best to subcontract everything that can be subcontracted’ (ibid.). This confessional stance is replicated three years later when Sinclair spoke to Guy Kewney the day after the announcement of Maxwell’s ‘rescue’ of Sinclair Research. Once again he voices his distaste for employing and administering large numbers of people, but this time reveals a curiously Victorian impression of the role of management:

I’ve never kidded anybody that I wanted to run a large company ... I hate having to boss people around, I hate having to deal with people running in saying, ‘Oh, what shall we do, there’s trouble at till, t’winders are all falling over’, and bringing you their troubles. (Microscope, 27 June 1985.)

Although there can be little doubt that the horrors of administration and worker-management interaction are a contributory factor to the formulation of Sinclair’s subcontracting policies, the appeal of a relatively small corporate wage bill can hardly be deemed a minor consideration. This said, when circumstances have dictated the acquisition of a sizeable workforce, the Sinclair management has shown itself surprisingly adept in the exploitation of local conditions. The peak workforce of 1977 was employed on the production lines at Enderby’s Mill at St Ives. Although conditions of employment could hardly be compared to those of the sweatshop, this definitively rural labour environment offered Sinclair a return on capital that must have been the envy of employers in the rest of the country. Sinclair transports shunted local women from villages in a 15-mile radius. Quite where such workers fit in Sir Clive’s vision of a society benefiting from the rewards of the new technology (let alone a ‘Golden Age’) is not

clear. Nevertheless, the level of wages, coupled with incredibly low rents, points to the Radionics crisis as having its roots in growing R&D expenditure, a contracting market and a disdain for 'bread-and-butter' products rather than the 'liability' of a large workforce.

When complaining about the demands of life as a manager, Sir Clive invariably eulogizes the joys of frontline work in the lab. Although such statements do much to reinforce the popular image of Sinclair the boffin, there is no evidence that except in the very early days of Radionics he has played any significant part in the technicalities of product design or the day-to-day running of the research labs. Steven Vickers, who worked on the development of the first three of the ZX range of computers, maintains that Sinclair has a clear market image for a product, and intervenes in the development process only when results deviate from his original idea:

Clive would sort of stay aloof for a long time, and then suddenly he'd see something that didn't fit in with his ideas of how things should be marketed and suddenly crash down like a ton of bricks and then go away again ... He knows more about hardware than software, but it's difficult to know just how much he knows about hardware. He knows what's cheap to make. (Interview, 23 July 1985.)

So while it's clear that he undoubtedly feels more at home with his R&D teams than with management or production groups, it is difficult to know to what extent Sir Clive believes in the role of distracted boffin. Certainly public and media are comfortable to think of him in this role, and the persona was invaluable when Sinclair was still in the business of selling computers.

Many of Sinclair's failings as a businessman are attributed to his lack of interest in money per se, and his dedication to his role as inventor over the grubby considerations of the accumulation of wealth. David Tebbutt, long-time friend of Sir Clive, is convinced that for Sinclair monetary gain is considerably less important than designing for the future and the realization of his visions. Tebbutt concedes, however, that it's very rare for personal financial stability to become a source of anxiety for Sir Clive. These days, having removed the home-computer burden from his shoulders and sorted out the backing for his two pet projects, Sir Clive seems more than happy to

slip into the role of the man of science lost in the distressingly fiscal considerations of the commercial world. At the same time, he goes to some lengths to make it clear that the concerns of the visionary are necessarily of more moment than the mundane machinations of management:

I'm dedicated to being an inventor ... Some people are dedicated journalists, some are dedicated managers. But managing is no job for amateurs, and I don't enjoy it. In the lab you're all working together, but when you're managing, you're constantly distracted by people bringing you little problems which you have to sort out for them. (Microscope, 27 June 1985.)

Throughout his career, Sinclair has poured scorn on his abilities as a manager, and the history of his companies does nothing to reinforce the suspicion that a successive failure to consolidate the rewards of success has much to do with the absence of an effective management team. This said, it is not enough to attribute such shortcomings to circumstance. Indeed, there is a wealth of evidence to suggest that, while apparently recognizing his own weaknesses in the administration and planning of his companies, in practice Sir Clive is disinclined to pass over the reins to anyone else. This view is shared by former Radionics MD Norman Hewett, who had this to say about Sinclair's repeated claims that he lacks the ability to manage:

That's what he says, but he doesn't believe it really. He would tend to attribute problems to others not doing their jobs. (Interview, 16 October 1985.)

In autumn 1985, when Sinclair Research's management structures were being firmed up, and the company was frantically courting the City for backing, spokesmen for the company were suddenly anxious to point out that Sir Clive's managerial qualities had been much maligned. At worst, he was presented as a man who is quickly bored by the responsibilities of administration, and it was made clear that his confessions of inadequacy were merely the natural modesty of the renaissance man:

There is no point in Clive making every decision. Ninety-nine per cent of them are decisions which just bore him. He's not going to worry about detailed nitty-gritty production schedules ... So that the reason

that he's been encouraged to develop the management structure is so that he's freed to look at the things which interest him most ... The crucial thing is how many guys can one man manage directly. That's the whole pivotal point. Up until that point you don't need a [management] structure from the operational point of view, because that one man has the capacity to do it. Clive is quite remarkable - he can handle an awful lot of people by comparison with most. I would set the average limit at seven ... People can go on managing more people than they should do for quite extended Periods of time, but I would say that [Clive can directly manage] well over twenty people, which is quite staggering, and it might be higher than that. (Interview with Hugo Davenport, 22 October 1985.)

At a time when the company was desperately scouring the City for a saviour, Sir Clive's position on management had become a serious embarrassment for Kinnear, Sinclair's PR company. The approach it adopted to deal with the problem was to play on the consensus view that historically the sunrise industries have always been strong on ideas and weak on management, and that, in comparison with other companies, Sinclair's approach to management has been relatively enlightened. Andy Knott offered a taste of this strategy in action:

Commodore was a \$1 billion company by the time Tramiel acknowledged that he could no longer manage it from his back pocket. Clive's actually done a lot more in terms of implementing management structures than Tramiel ever did. That company [Commodore] actually circulated around him completely, and if you wanted any decision on anything at all you stopped Tramiel as he walked around the building. (Interview, 22 October 1985.)

However bored he may be by the day-to-day chores of administration, the evidence of the preceding chapters should have made it abundantly clear that Clive seems temperamentally incapable of passing control of his companies to less reluctant management. In a recent interview he spoke about the collapse of the computer division. One suspects that his comments offer insights into his true feelings about his own management capabilities along with a deep-rooted mistrust of the abilities of others:

When I was running Sinclair Research it was extremely profitable, but about two years ago I handed over to someone else because then the company was expanding. During that time it wasn't profitable. That's why I'm reversing it and taking over running Sinclair Research myself again. It will work. (Sunday Express, 8 June 1986.)

Despite Sir Clive's distaste for delegating managerial control, at various points in his career a commercial necessity has been elevated to an obligatory requirement enforced by the whip hand of the financial institutions. In his search for someone who will take ultimate responsibility for his companies' commercial performance and deal with the 'little problems' of the employees, it's difficult to escape the conclusion that Sinclair allows impossible expectations to govern his assessment of anyone attempting to fill such a role. It is not enough that such a person should enforce corporate strategy according to the dictates of current market trends and the capacity of the company to satisfy or anticipate such trends. Instead, Sir Clive seems to believe that such a conservative approach should be abandoned according to the dictates of his innovative vision. The problems of explaining such an approach to any but the most enlightened board is apparent in a description of the Sinclair method from long-time friend and associate Nigel Searle:

'The Sinclair phenomenon', says Searle, with a vividness beyond logic, 'is to enter those races that are worth winning but that no one else even knew were going on.' (Fortune, 8 March 1982.)

In his rendition of the NEB saga, Rodney Dale chronicles the problems facing Sinclair in his search for an acceptable managing director:

The need to find a managing director was of paramount importance. No one knew better than Sinclair the difficulty of finding someone to play managing director to his chairman ... One or two rare individuals were found, though none of them lasted very long - and not just because of personality clashes; they just weren't rare enough. (The Sinclair Story, p. 80.)

Norman Hewett, the man who was eventually lumbered with the job of 'playing' managing director to Sinclair's chairman, suggests that Sir Clive's

inability to work effectively within a management structure has its roots in a refusal to acknowledge the authority of any opinions other than his own. Hewett has this to say about Sir Clive's interaction with the NEB-owned Radionics board:

He wouldn't mind an exchange of views, but no way would he like it if they presumed to say that their view should prevail. He'd say, 'Who started this company? Who developed the products? Whose brain did it come from?' So what does the board do? (Interview, 16 October 1985.)

As we have noted elsewhere, one of the most important qualities revealed in Sir Clive's dealings with his workforce is the loyalty he inspires among his technical staff. Hewett explains:

He's the sort of guy who has the gift of the gab with technical people, and he can infuse them with technical interest in what he's asking. Either the money isn't discussed, or it's waffled - the 'I'll see you all right' sort of thing, (ibid.)

That Sinclair should enjoy the company of his technical staff and recognize that their inspiration and organization is one of his strengths is obviously an important asset. However, from a management point of view such a bias can prove disruptive when the effects of an affinity prove divisive. Once again, Norman Hewett noted the adverse effects of Sir Clive's personal predilections on the effective management of Sinclair Radionics:

He's not interested in production, really. I think he thinks that people who deal with production and selling are rather lower orders compared to the people who devise the ingenious device itself. Which I can understand in a way, but perhaps he shouldn't make it so clear sometimes, (ibid.)

Sinclair, probably quite correctly, has always regarded his design engineers as the most valuable asset his companies possess. Within hi-tech industries the frontline R&D staffers tend to form themselves into an elite clique within the company, but when such an arrangement is essentially formalized by the chairman, it is inevitable that there will be problems of

communication and motivation within the company as a whole. As we have seen from the QL saga, these problems were accentuated within Sinclair Research by a board that was split in almost as many directions as there were members.

Throughout the history of Sinclair Research, Sir Clive's managerial strategy has been to isolate the individual project groups within the organization, establishing control by offering himself as the sole link with the outside world. This eccentric and somewhat despotic mode of management was fine during the boom years, but was hardly likely to have had an encouraging effect on the sources of investment that were courted when the company fell on hard times. Malcolm Wilkinson, head of the wafer-scale project, describes the state of the company prior to Bill Jeffrey's reorganization in the autumn of 1985:

Up until six months ago [i.e. July 1985], Sinclair Research had very little [management] structure. It was run on an informal basis, very much with Clive as the catalyst. Things that were relevant from one group were communicated to another through him. We felt that we understood the potential of our project for the other products and although we had a limited interaction with other groups, we relied on Clive to recognize what was needed in other areas of the company. Obviously, the company is going through structural changes at the moment, which are formalizing the relationships between the different groups. This makes the company more traditional - there's a more visible structure. (Interview, 15 December 1985.)

Although the changes Wilkinson refers to could be dismissed as cosmetic, there's no doubt that Jeffrey's restructuring enabled Sinclair Research to present a more substantial corporate image to outsiders. The management moves were clearly a central component of the business plan, which had been prepared for potential investors and creditors, and may well have tipped the balance in the negotiations that secured financing for the wafer-scale and telecom projects. So even before Alan Sugar made his dramatic intervention, Sinclair Research had managed to accomplish a corporate facelift that convincingly demonstrated that it still meant business.

One of the most conspicuous effects of the management reshuffle was that it shifted the focus of the company away from Sir Clive. Although still valuable as a figurehead, investors were no longer being asked to put their money behind Sinclair, but into a solid organization whose future lay in the technical assets its research teams had developed. For possibly the first time in its history, if there was to be a future for Sinclair Enterprises it would be determined by the commercial viability of its products rather than the charm of its chairman. But it was not to be. The arrival of the Amstrad rescue package robbed the world of the chance to see how a Sinclair company would fare under a well-structured and rigorous management. And whether Clive was actually capable of sitting back and watching passively from the wings.

In certain respects spring 1986 saw Sir Clive in better shape than he had been for years. With his corporate debts behind him and financing secured for future products, he could consider himself fortunate if less affluent. With the home-computer business out of the way, Sinclair Research was once again the kind of small-but-plucky business environment in which Sir Clive has consistently thrived and prospered. Although it may seem difficult to believe, Sinclair finally appears to have responded to his own misgivings about his managerial abilities, and seems determined to delegate the administration of the telecom and wafer-scale projects. Time alone will tell. Although his personal plans are vague, he has expressed an interest in developing a consultancy division within Sinclair Research, which would '*work as an ideas centre, a sort of private think-tank for corporate clients*' (Guardian, 8 April 1986).

Reading between the lines, it seems likely that Sir Clive will be content to coast for a while, at least until the wafer-scale division is in a position to shake the world - or not, depending on the results of their endeavours. Whether he likes it or not, Sinclair may well find himself in a position where there's little else for him to do but find himself a lab and get down to some intensive innovating. While the press predictably dubbed the sale of the computer division the end of an era, it seems unlikely that 1986 will go down in history as anything more than a brief coda in the turbulent development of the Sinclair saga.

APPENDIX - A SINCLAIR CHRONOLOGY

Since our text of necessity does not follow a strict chronological sequence, we provide here a selective overview of Sir Clive's career, plus some related events from the computing world.

1940 Clive Marles Sinclair born to George William Carter Sinclair and Thora Edith Ella Sinclair

1957 Leaves St George's College, Weybridge

Employed by Practical Wireless as journalist

1958 Becomes editor of Bernards Publishers Ltd

1959 Authors Practical Transistor Receivers

Becomes member of Mensa

1961 Leaves Bernards Publishers and goes freelance

Sinclair Radionics formed 25 July 1961

Joins Instrument World staff

1962 Marries Ann Trevor-Briscoe

December: Sinclair micro-amplifier ads appear at 28/6d, serviced from 69 Histon Rd, Cambridge

1963 Authors British Semiconductor Survey

April: Sinclair Slimline pocket medium wave radio kit appears at 49/6d

September: Jim Westwood joins Radionics

December: Sinclair micro-injector signal generator appears at 27/6d kit, 32/6d built

1964 January: TR5 pre-amp/0.5 watt amp appears at 59/6d built

April: Radionics moves to Duncan Terrace, Islington

August: Radionics move to Comberton, Cambridge

Announces supply delays now a thing of the past

September: Micro-6 matchbox-sized radio appears at 59/6d kit, 'Transrista' strap for wearing on wrist, 7/6d T R750 0.75 watt power amp appears at 39/6d kit, 45/- built

December: Sinclair X-10 pulse width modulation '10 watts' amplifier designed by Cambridge Consultants Ltd appears at £5.19.6d kit, £6.19.6d built, power supply £2.14.0

1965 June: X-20 '20 watts' amplifier appears at £7.19.6d kit, £9.19.6d built, power supply £4.19.6d.

December: Micro FM pocket radio appears at £5.19.6d kit

1966 January: Z12 12 watt amplifier/pre-amp appears at 89/6d built

April: Radionics moves to Newmarket Rd, Cambridge

Clive moves house to Cambridge. Chris Curry joins Radionics

May: PZ3 power supply unit appears, 79/6d built

September: Stereo 25 'De-luxe' pre-amp and control unit at £9.19.6d built

October: Microvision pocket TV receiver demonstrated at Radio and TV Exhibition. Announced as 'available early 1967 at a cost of 49 guineas'

1967 February: Sinclair Micromatic - the 'world's smallest radio' – appears at 59/6d kit, 79/6d built

April: Micromatic kit becomes available in new 'See for yourself' sealed polystyrene kit pack at no extra cost

May: Sinclair Radionics turnover £100,000

October: Q14 loudspeaker available at £6.19.6d.

December: Micromatic dropped in price to 49/6d kit, 59/6d built

1968 April: Neoteric 60 amplifier launched but abandoned

October: System 2000 35-watt amplifier (29 guineas), FM tuner (25 guineas), plug-in stereo decoder (4 guineas) and loudspeaker (12 guineas) launched. Available from dealers

1969 June: IC-10 integrated circuit amplifier announced but unavailable

December: Stereo 60 pre-amp and control unit, at £9.19.6, and Z30 25-watt amplifier, at 89/6d, appear

1970 June: Z50 amplifier added to Project 60 range at 109/6d

November: Stereo FM tuner at £25 and Q16 speakers added to Project 60 range

December: Active Filter unit added to Project 60 range at £5.19.6d.

1971 February: Radionics operation moves to Enderby's Mill, London Rd, St Ives, Huntingdonshire

May: Sinclair Radionics profits £85,000 on turnover of £563,000

June: IC12 integrated circuit amplifier announced at £2.98

[November: Intel launch 4004 four-bit microprocessor chip on to market]

1972 May: Sinclair Radionics profits £97,000 on turnover of £761,000

June: Executive calculator launched at £79.95, wins Design Centre Award. Appoints Primary Contact as ad agency October: Q30 speaker launched

[April: Intel 8008 eight-bit microprocessor chip appears]

1973 May: Sinclair Radionics generates a turnover of £1.8m

August: Sinclair Cambridge calculator introduced at £29.95 exc. VAT built, £24.95 kit

September: Ableseal Ltd registered

November: Executive Memory calculator launched at £24.95 exc. VAT

December: Project 80 revamp of Project 60 modules launched with advice on building it into your furniture included

1974 February: \$1.5m of Executive calculators sold to Japan

April: Sinclair Scientific calculator launched at £19.95 exc. VAT built, £14.95 kit DM1 multimeter launched but unavailable

May: Sinclair Radionics profits £240,000 on turnover of £4m

June: System 4000 hi-fi system launched

November: Clive presented with Institute of Marketing award DM1 multimeter kit dropped to £24.95. Sinclair Radionics Inc., USA founded with Nigel Searle as President

[April: Intel 8080 chip launched, unit cost \$360]

1975 February: Ablesdeal Ltd becomes Westminster Mail Order Ltd. DM2 digital multimeter launched at £59 exc. VAT

March: Oxford range of calculators launched: '100', £12.95; '200', £19.95; '300', £29.95, exc. VAT

April: Sinclair Radionics wins Queen's Award to Industry Sinclair Radionics profits £45,000 on turnover of £6.3m August: Cambridge Scientific Programmable (Mk 1) calculator launched at £29.95 exc. VAT Westminster Mail Order Ltd becomes Sinclair Instruments Ltd

November: Black Watch announced

[January: Altair 8800 kit computer appears in Popular Electronics in USA at \$395. Used Intel 8080 chip, had 256 bytes of memory] [September: Intel 6502 chip appears at \$25, MITS 4K and 8K BASICs appear, KIM-1 micro appears at \$245]

1976 January: Black Watch available with 'totally in-house designed chip' at £17.95 kit

March: Black Watch kit dropped to £14.95

April: Sinclair Radionics loss £355,000 on turnover of £5.6m Black Watch available built at £24.95

July: Black Watch adverts cease to appear

August: National Enterprise Board inject £650,000 capital for 43 per cent stake in Sinclair Radionics

October: NRDC agree to £1m input into flat-screen TV

[April: Apple Computer Inc. formed]

[June: Zilog Z80 microprocessor chip launched]

1977 January: Microvision T VIA pocket TV launched at £225, production 200 a month

February: Cambridge Scientific Programmable (Mk 2) launched at £17.22 with program library at £4.95

Sinclair Instruments Ltd launch wristwatch calculator at £9.95 kit

April: Sovereign calculator in 'brushed chrome' wins Design Centre Award.

Sinclair Radionics loss £820,000 in previous twelve months

July: NEB inject further £1.65m to take 73 per cent equity in Sinclair Radionics, and extend loan facility of £1m

Norman Hewett appointed MD of Radionics on behalf of NEB

Sinclair Instruments Ltd becomes Science of Cambridge Ltd

Clive and Hewett visit Las Vegas electronics show

October: Enterprise calculator launched at £9.95

November: Microquartz car clock produced for retail at £12.95

December: Sinclair Radionics loss £1.29m in previous eight months

[April: Apple II (4KR AM,\$1298) and Commodore PET (4K RAM, monitor, \$595) computers appear]

[August: TRS-80 Model 1, 4K RAM, 4K ROM BASIC, monitor, \$599, appears]

1978 Design work starts on Clive Sinclair's first micro: the machine that later became the NewBrain

February: President desktop calculator launched

April: Microvision wins Design Centre Award

June: Science of Cambridge Ltd launch MK14 microcomputer kit at £39.95 exc. VAT

July: Norman Hewett leaves Radionics.

Science of Cambridge offer VDU module (£33.75), cassette interface (£7.25) and PROM programming card (£11.85) for MK14

Enterprise Programmable launched at £25

September: Michael Pye appointed MD of Radionics

November: Simplified UK version of Microvision TV1B launched at £99.95

December: Sinclair Radionics loss £1.98m on £6.39m turnover. Total NEB investment £4.45m, plus trading losses

[June: Exidy Sorcerer, 8K RAM, 12K ROM, \$895, appears]

1979 March: Sinclair PFM 200 frequency meter launched at £49.80

April: Science of Cambridge commission ZX80 version of BASIC

May: NEB announces plans to sell off calculator and TV interests of Sinclair Radionics

Acorn launch System 1 microcomputer kit at £65 plus VAT

July: Clive Sinclair resigns from Sinclair Radionics with £10,000 golden handshake

August: Binatone buys stock and rights to Microvision and Enterprise calculators for £1m +

September: NEB shift instruments division into Sinclair Electronics

December: NEB loss totals £7.8m on Radionics operation

1980 January: Sinclair Electronics becomes Thandar Electronics Ltd, and Sinclair Radionics ceases to exist

February: Sinclair ZX80 launched at £79.95 for kit. Built versions available March for £99.95. Power supplies £8.95. Memory expansions from 1K (£28.00) to 15K (£276.00) available

Acorn add 8K memory kit (£95 +VAT) and VDU colour card (£88 + VAT) to System 1

March: Science of Cambridge profit £131,000 on turnover of £640,000.

Work starts on 8K BASIC upgrade

June: Acorn launch Atom (full keyboard, 2K RAM, 8K ROM BASIC) for £120 kit, £150 assembled, plus VAT

September: New 8K ROM for ZX80 with extended BASIC announced at £19.95

November: Science of Cambridge Ltd becomes Sinclair Computers Ltd.

New ROM for ZX80 withdrawn. Clive appointed Chairman of British Mensa

1981 February: £5m, four-year capital investment in flat-screen TV production announced by Sinclair for Timex plant includes £2.6m grants from DOI and SEPD.

First production models to be Microvision 2700, priced 'about £50' and 'expected summer 1982'.

Clive announces ZX80 will be linked to flat-screen TV 'some time next year'

March: ZX80 ads announce 16K RAM pack memory add-on and claim 'over 20,000' sold.

Sinclair Computers Ltd becomes Sinclair Research Ltd.

Clive denies ZX range will use flat-screen TV.

ZX81 launched at £69.95 built, £49.95 kit. 16K RAM pack £49.95.

ZX80 discontinued after sales of some 50,000 units.

Printer announced for June.

Sinclair Research pretax profits £818,000 on turnover of £4.6m Clive receives £242,000 in past year.

ZX81 square root bug discovered

April: Despite Clive's assurances, users still finding faults in RAM packs.

BBC choose Acorn to develop their machine from Proton development

May: Sinclair offer secondary schools the opportunity to purchase one ZX81 and RAM pack at 46 per cent discount '4- or 5-inch flat screen will be incorporated into ZX81,' says Clive

June: Sinclair Browne Ltd publishing company formed

July: ZX81 delivery delays of up to nine weeks reported

September: W. H. Smith start retail sales of ZX81. ZX Printer launched at £49.95

October: ZX81 sales exceed 100,000.

Mitsui take ZX81 for sale in Japan American Express test-market mail order ZX81s

December: ZX81 sales exceed 250,000 with monthly production of 50,000. Faulty ROMs still being shipped.

ICL announces plans to use Sinclair BASIC and flat-tube TV for 'One-Per-Desk' terminal/telephone workstation

1982 January: Acorn announce BBC Micro at £205 (16K R AM), £292 (32K)

February: Timex are licensed to manufacture and market Sinclair products in USA

March: Sinclair Research profits of £8.55m on turnover of £27.17m, including £383,000 government grants for flat scree. Clive receives £1m 'bonus' on top of £13,000 salary for past year. Employees' total salary £400,000.

ZX81 discounted to \$53 by some retailers in US. BBC Micro repriced to £299 and £399 for 16K and 32K respectively

April: ZX Spectrum launched at £125 for 16K R AM, £175 for 48K, upgrade £60, 'for delivery in two weeks' ZX81 RAM pack reduced to £29.95. ZX Printer price increased to £59.95. Microdrive announced at £50, RS232 unit at £20

June: First Spectrum deliveries reported

July: Spectrums start to roll off production lines after initial ULA chip problems resolved.

Spectrum approved for use in secondary schools under government support scheme.

Annual three-week holiday at Timex halts Spectrum production.

Timex launch TS1000 (ZX81 version) in US

August: ZX81 price cut to £49.95. Boots start retail sales of ZX81, Prism Microproducts to start wholesaling ZX81s

September: Sinclair throws in free printer and LOGO language program with every Spectrum bought under government's 'Micros in Primaries' scheme

Currys and John Menzies start retail sales of ZX81

October: ZX81 sales exceed 500,000 worldwide.

Sinclair claims adverts for Dragon computers used Spectrum details in misleading fashion.

ASA upholds complaints against Spectrum ads on grounds of 'appalling delays' in delivery

BBC delivery backlog cleared

November: Oric 1 launched at £99.95 (16K) and £169.95 (48K)

W. H. Smith's agree to take Spectrum on retail basis, order 6,000 but 'only 300 turned up'

December: Spectrum order backlog still three months.

Sinclair confirms new computer under development, to incorporate 'flat screen' and 'dual microfloppies'.

Sony launch Watchman pocket TV in US and Japan

1983 January: Spectrum launched at Las Vegas Consumer Electronics Show.

Sinclair threatens to stop production Timex Dundee plant if strike over redundancies takes place.

N. M. Rothschild & Son place 400,000 shares (10 per cent of equity) of Sinclair Research at £34 each with financial institutions, valuing the company at £136m Clive now owns 85 per cent, gains £13.6m as result of sale

Oric computers become available. Jupiter Ace appears at £80, running Forth language

February: Boots, John Menzies and Currys start retail sales of Spectrum, Prism starts wholesaling

First Sinclair Prize for Fiction won by Death is Part of the Process by Hilda Bernstein

Computer division of Sinclair moves to Willis Rd, Cambridge

March: Sinclair Research profits of £13.8m on £54.53m turnover, including £1.1m flat TV grants. Clive's salary £82,000. Spectrum sales 200,000. Searle heads Computer Division, and is MD. Clive heads Advance Products Division. Employs fifty-five staff, but claims creation of 'more than 2000' jobs.

14,000 Spectrum faulty power packs recalled.

Clive wins 'Young Businessman of the Year Award' from Guardian

April: Timex/Sinclair 2000 announced in the States, with 2040 printer. TS1000 sales 600,000 to date

Sinclair drops plans for Prestel/teletext adaptor (promised at Spectrum launch)

May: Price cuts: Spectrum dropped to £99.95 (16K), £129.95 (48K), ZX Printer price cut to £39.95, ZX81 to £39.95

Kempston launch Centronics standard printer interface (£45) and joystick interface (£25) for Spectrum.

Micronet 800 launch Prestel/teletext adaptor for Spectrum

16K to 48K upgrade (£60) becomes available one year after promised.

Plans for Spectrum Modem scrapped on grounds of lack of profit margins.

Microdrive launch announced for end of May, and 'ZX84 to be a portable' says Searle.

Richard Cutting recruited to head 'MetaLab' research centre.

Sony launch Watchman in UK at £250

June: Clive Sinclair knighted

July: ZX Interface I and Microdrives launched. Interface £29.95 with Microdrive(s), £49.95 without, Microdrives £49.95 each, cartridges £4.95 each - supply is rationed by Sinclair

Milton Hall, bought for £2m, becomes the home of MetaLab

ZX81 shipments 'in excess of 30,000' a month but W. H. Smith cut back machine and software purchases owing to lack of demand

Timex announce TS1500 upgrade of TS1000 with 16K memory at \$80, and TS2000 version of Spectrum at \$150 (16K) and \$200 (48 K)

Commodore and Texas Instruments cut prices on their machines BBC Micro (£400) unit sales top those of Spectrum in last three months

Issue 3 of Spectrum board, with redesigned ULA, is shipped, not compatible with some software for earlier issues August: Acorn launch Electron at £199

September: Sinclair flat-screen pocket TV launched at £79.95. Uses Polaroid battery packs at £3.30 each

Interface II joystick and ROM cartridge add-on for Spectrum launched at £19.95

Prism produce Spectrum Modem at £99.95

Sinclair claims Issue 3 board problems due to 'unprofessional practices' by software houses

October: Clive allocates £400,000 for 'deluxe Knightsbridge dwelling' construction from £1m 'bonus' from Sinclair Research for year ending March 1982. Y/E March **1983** took merely his salary of £82,000

December: Flat-screen TV price increased to £99.95

£50,000 ad campaign started for TV, W. H. Smith's order 7000 for Xmas, 'only 300' turn up

1984 January: Sinclair QL computer launched

February: Timex discontinue computer production in US

March: Sinclair Research profits £14.28m on turnover of £77.69m, including £309,000 government grants

April: Amstrad launch CPC464 at £200 with monochrome monitor, £300 with colour monitor. Oric Atmos 48K launched at £170

Microdrives and Interface I go on retail sale

May: First reported delivery of a QL to mail order customer - returned within a week

ASA upholds complaints on QL advertising delivery claims, and Spectrum Chess program advertising

Sinclair Vehicles moves to University of Warwick Science Park. Barry Wills is MD

June: Sinclair announce Interface 1 ROM to be changed

July: QL production reported to be '2000 a week'.

Corrected versions of User Guide due in August. Expects 250,000 QLs to be sold by end 1985

Improved Psion software promised for 'later in the year'

AB Electronics (South Wales) and Samsung Electronics (Korea) appointed as Spectrum assemblers.

Projected 200,000 a month production of Spectrums by end 1984, 50,000 a month for QL, 20,000 a month for pocket TV

August: Spectrum LOGO language launched by Sinclair at £39.00
September: QL and flat-screen TV go into retail outlets. QL 'now in large volume production'

October: Spectrum+ (48K Spectrum with new keyboard/box) released at £179.95

November: ICL's 'One-Per-Desk' workstation launched, using Sinclair Microdrives and SuperBASIC

Sinclair predicts record sales of 400,000 Spectrums in fourth quarter. 175,000 Spectrums to be shipped in December

Spectrum shipments reach 2m units £4m ad campaign starts

1985 10 January: C5 electric tricycle launched at £399

16 January: Sinclair shows FM wristwatch radio at Las Vegas Consumer Electronics Show in US

20 January: Spectrum+ price dropped to £129.95, 48K Spectrum discontinued. Upgrade of Spectrum to Spectrum+ offered for £30 (kit £20)

30 January: Microdrive cartridge price dropped to £1.99 as cartridge sales reach 750,000. Free duplication and bulk carriage purchase offered to software houses to boost QL software February: QL production suspended

ICL launch 'One-Per-Desk' workstation with microdrives, version of Superb ASIC, Psion packages

6 February: Acorn shares suspended

7 February: Sinclair aborts stock market flotation

9 February: Sinclair Vehicles reports 5,000 orders for C5 20 February.

Sinclair Research restructures into TV and Communications Division (headed by Bill Jeffrey, brought in from Mars Electronics) and Computer Division (headed by Davis Chatten, ex-Sinclair Production Director). Hugo Davenport appointed Engineering Director (ex-Solatron-Schlumberger) Nigel Searle transfers to head U S operation for QL, FM wristwatch radio and pocket TV mail order

Sinclair holds overseas distributors conference, displaying thirty- three software packages and seventeen peripherals available or projected for the QL

22 February: Improved Version 2.0 Psion software for the QL announced, to be shipped with new QLs. Free upgrades provided to QLUB members

March: Production faults on C5 halt production for three weeks

Unemployed teenagers hired to drive C5s around London, Manchester, Birmingham and Leeds

12 March: Plans to form and seek funding for separate company for wafer-scale chips under Robb Wilmot are announced by Clive. Wilmot appointed a director of Sinclair Research Institutions holding 10 per cent shares told profits to December £7.9m on £89m turnover, stocks held £34m

25 March: Intensive TV and press marketing campaign for QL starts.

Sinclair states it 'intends' to sell 200,000 QLs this year

April: Figures (not released until November) show pre-tax loss of £18m on turnover of £102m. £22m written off for decrease in stock value and bad debts

14 April: Dutch ban C5

16 April: Spanish language QL launched

25 April: ASA upholds complaints on unsubstantiated claims in C5 adverts in draft report

Hoover cut C5 workforce from 100 to 12 and production from 1000 a week to 100

May: Several London retailers discount QL prices in stores

Amstrad launch CPC664 with disc drive and monitor. Monochrome £339, colour £449 Hoover make C5 production controller redundant 2 May: Tandata buys QCOM modem from bankrupt OEL

14 May: French language QL launched

28 May: Sinclair confirms it is seeking £10m-15m to 'fund long-term growth and restructuring' and a new chief executive to replace Clive in this role, denies Clive intends to relinquish his position as chairman, and counters reports of weak computer market by stating they shipped 300,000 Spectrums in pre-Xmas period

2 June: Sinclair Vehicles confirms it is looking to sell company. 'About 9000' C5s sold

6 June: Timex sell Spectrums directly to Zeta Services to reduce debts owed by Sinclair Research

17 June: Maxwell announces rescue bid for Sinclair Research, which has £15m debts. Deal to leave Clive with 8 per cent, chairmanship and consultancy

Sinclair announces wafer-scale integration process proven viable for commercial production, to be used in 500K memory add-on for QL

22 June: Amstrad launch CPC6128 machine with CP/M, disc, monitor, 128K RAM at £299 monochrome, £399 colour

July: Timex lay off 400 workers from Spectrum assembly line, but continue flat-screen production

Boots say Spectrum+ returns running at 20-30 per cent

13 July: Hoover issue writ against Clive for £1.5m due for work done on C5, but it is not served

17 July: ASA uphold four out of five complaints on misleading C5 adverts

9 August: Maxwell aborts Sinclair Research takeover

Dixons take 160,000 computers and flat-screen TVs for £10m

13 August: Hoover stops C5 production

24 August: QL price cut from £399 to £199.95

September: Sinclair Vehicles renamed as TPD Ltd

Comet cuts C5 price to £189, including accessories

Amstrad launch PCW8256 machine with CP/M, disc drive, monitor, printer and 256K RAM for £459

19 September: Digital Research confirms talks taking place with Sinclair over GEM operating system for QL

23 September: Spectrum 128K version unveiled at Barcelona Computer Fair, result of joint venture with Investronica and Sinclair Research

14 October: Receivers called in to TPD Ltd (ex-Sinclair Vehicles Ltd). Only 4500 C5s sold in total

17 October: 'Pandora' '68000-based' portable scheduled for April 1986, at £300

25 October: 'Enigma' leaked to Your Computer, May 1986, 3.5-inch discs, mouse, monitor, printer and Psion packages for '£500- 1000'. 'Pandora' will be Spectrum (Z80 chip) based 'Personal Communicator' £99 portable cell net phone leaked to press

6 November: TPD Ltd (ex-Sinclair Vehicles) goes into voluntary liquidation with debts of £6.4m.

Sinclair Vehicles (Sales) Ltd to continue electric car projects

1986 6 February: Timex take over worldwide marketing and distribution of flat-screen pocket TV, with price cut to £79.95

13 February: Spectrum 128K launched in UK. New sound chip, video output, improved BASIC editor, full keyboard input, nonstandard RS232 port, keypad interface and no 'dot crawl', with 128K memory for £179.95. Numeric keypad available separately for £19.95. Disc drive promised. Clive says ' "Pandora" could just be a CP/M machine'

13 March: Amstrad announce PCW8512 machine, with twin disc drives, 512K memory, monitor, printer, for £573.85

April: C5s go on sale in the USA, at \$595 complete, \$395 kit

6 April: Amstrad pays £5m for all rights to existing Sinclair computer products, and commits £1m for outstanding orders and work in progress. Sinclair Research becomes research and consultancy, two separate subsidiaries to be formed, one with Timex holding 75 per cent for portable

phone project, one with Barclays Bank funding for wafer-scale development

7 July: Anamartic Ltd launched. Seeks to raise £6m to produce wafer-scale memory device for production early 1987

Ian Adamson was born in Yorkshire in 1950 and gained some education at Salford and Middle East technical universities and at Salford Technical College. He then worked as labourer, machinist, roadie, salesman and house painter - interspersed with periods in Europe, Asia and Africa - before becoming a book importer and distributor. The design of laboratories, libraries and educational facilities for the Third World led to collaboration on his first computer book. He is now a freelance author and literary agent. His hobbies are metaphysics, music and magick indoors; sailing outside when he gets the chance. His previous books include The Century Computer Programming Course (co-author), the Oric Atmos Manual and the Oric Companion.

Richard Kennedy has had a varied and chequered career. Shop assistant, rock musician, amateur chemist, investigative journalist and writer, Mr Kennedy was bitten by the computer bug over seven years ago and has been writing about the consequences ever since. Previous publications include major contributions to The Century Computer Course, the Oric Atmos Manual, the Complete Commodore 64 and the Electron Companion. He currently resides in the radioactive shadow of London's Telecom Tower. He has no hobbies.

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