David Southward

Born 1936. Cambridge technology entrepreneur.
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This life story of Cambridge technology entrepreneur David Southward was archived in 2021, with acknowledgement and thanks, from the Polymath Perspective website at www.polymathperspective.com and from the Archives IT website at www.archivesit.org.uk.

1. Introduction

David Southward.

This chapter was archived in 2021, with acknowledgement and thanks, from the Archives IT website at www.archivesit.org.uk.

David Southward was co-founder of Cambridge Consultants which is really the start of the Cambridge phenomenon in 1960 and then subsequently was technical director at Sinclair Research in the years from 1977-1986.

School days

David enjoyed his school days greatly, going first to The Old Hall preparatory school in Wellington and then on to Rugby. As well enjoying sport, David also enjoyed building and dismantling things; he, together with a friend, dismantled a radial engine in one of Rugby's storage sheds, he built hi-fi sets and radiograms, alongside model aeroplanes. He says: "I've always liked to find out how things worked and put them back together again." David was inspired by his chemistry and physics teachers.

Apprenticeship and university

In 1953, with the prospect of National Service, and having achieved seven O Levels and 3 A levels, David left school slightly early to go to the Ministry of Supply to undertake an apprenticeship scheme on offer there. He explains: "You spent a year at the bench filing your set of tools and learning how to use machines from lathes to mills, welding and so forth, and you were also studying at a local college. They also subsequently paid for your further education, which in my case was Cambridge." He met Tim Eiloart through the scheme, and they worked together at Woolwich Arsenal for the year.

During his year in Woolwich, David's enthusiasm for making things continued to grow as he explains: "I was still very keen on making things, and things that I had been making had progressed from model planes to a fourteen-foot speedboat, which I had built on the top floor of our Harley Street house. It was a major undertaking to remove it; I had to take all the doors off upstairs, wrap the boat up in, in carpets, lower it over the side of the house, in through a consulting room, and then out through the front door." The boat was used by the whole family on holidays in the South of France. He adds: "We used to water ski, at a time when nobody water skied. In fact, you couldn't buy water skis, that I was aware of, so I had to make all those too."

In 1955, David transferred to Trinity Hall College, Cambridge. He graduated in 1960 with a degree in natural sciences and chemical engineering.

After completing his apprenticeship and degree, David, on the advice of his father, spent a year in a chartered accountant's office in the City, studying accountancy. He did not enjoy it.

Cambridge Consultants

To escape his accountancy experience, David rang his friend Tim, who had also graduated by this point and was working for the Psychology Laboratory and had at the same time started the Cambridge Consultants as a technical translation service. Tim offered David a job at the Lab despite the fact that he had not authority to do so, inevitably, when his manager returned from holiday, both David and Tim decided to leave and start a workshop together. With financial help from their fathers, they founded Cambridge Consultants and the original translation work gradually petered out.

David says of the enterprise: "We formed the workshop, and we started taking on work from the Psychology Laboratory and other laboratories, and industries within Cambridge. We employed three or four instrument

makers, they were from the Cambridge Instrument Company, who had a very good apprenticeship scheme, so they were very skilled workers. But we were always looking for something to make our fortune as it were."

David describes one of the first jobs the company did was to create a machine to vibrate insect muscles, he explains: "It sounds a ridiculous thing, but, a professor at Oxford wanted to characterise the force characteristics of insect leg muscles, both under high pressure and at various frequencies. We built an enormous stainless steel machine. All the electronics for waggling the leg muscle up and down were valve controlled then. It was, quite an engineering feat just to make the electronics."

Everyone worked set hours a week but there was as always the search for that 'elusive money-spinning' idea. David says: "Newmarket Transistors, part of the Pye Group, used to give us transistors by the bucket-load, just to try and get them put into equipment. There was a lot of change to the way things were done, which was miniaturising electronics."

The company bursting out of its initial premises had funding from Robert Maxwell inter alia and built new premises at Bar Hill which were opened in 1968 by George Brown, Deputy Leader of the Labour Party,

In his twelve years with Cambridge Consultants, David says that one of the most memorable achievements was the design of a computer-controlled loom to produce multi coloured carpet. He explains: "That was a fun project. Carpets are conventionally produced very slowly if they are patterned – as with Axminster or Wilton carpets, or they are tufted which is rapid but limited to plain colours. The approach that I thought of was to bring all the colours of wool, eight colours typically, into one rotary head, and with a puff of air, to pull on one or other of these strands, to shear off the bit of wool that is puffed out, and then to transfer that pneumatically to a glue surface. This worked quite well."

The final project saw a yard wide machine built in conjunction with Durham Carpets, who were trying to move away from the conventional Wilton or Axminster approach. David continues: "The normal cheap carpets are tufted carpets, where if there's a pattern on it, it's just printed afterwards, and it's not very satisfactory. Axminster and Wilton processes are just very slow, because, they were dating back to the 1800s, so we were trying to look for a process that would be fast and computer linked."

By 1971 Cambridge Consultants was in financial difficulty. They had established an umbrella company; Aim Associates to try to protect the company from any shortcomings experienced by the numerous smaller companies under its wing, including; Cambridge Audio, AIM BioSciences, AIM Electronics, AIM Physical Sciences, DraftMaster systems, Durcam

Carpets, some of which were struggling financially. Eventually, the bank withdrew the company's overdraft facility and the company was sold to Arthur D Little, a Boston-based consulting company.

Lecson Audio

David left Cambridge Consultants in 1971 to form a top of the range hi fi company -Lecson Audio .. In 1974 it won a Design Council award for its amplifier.pany.

When Lecson Audio was subsequently taken over by a banker in the City, David moved to the Cambridge Instrument Company in Melbourn where he joined a team working on a machine to automatically analyse blood for Addenbrookes Hospital.

Sinclair Research

In 1977 David then moved to join Sinclair Research which had to been set up with to exploit an idea that Clive Sinclair had for a flat tube cathode ray tube and was a new company as opposed to Sinclair Radionics which produced calculators and hi fi . "The NRDC just about on board, and it was my job to work on this, and get the project off the ground; it was a tremendous job." David designed the flat cathode-ray tube which was produced by Timex when it went into full scale production. He also designed a Microdrive for Sinclair computers and the printer for the ZX81.

David says: "I enjoyed life a lot at Sinclair's. I think it was partly the change in working for a company where there was a prodigious turnover per employee. We were doing a million pounds per employee then; it was very successful."

Image Displays

In 1986, David moved to Harlow as Technical Director and co-founder of Image Displays. He explains: "I was following up this beautiful quality display that STC had been working on. It did have the defect that it required a high voltage drive, but it had a memory. I had always envisaged it to be something like the Kindle; I mean that was a different voltage technology that's been hugely successful. We started making demonstrators." Unfortunately, the project failed as David and his co-founders discovered that it was just too capital intensive to start an LCD manufacturing plant from scratch.

Lessons Learned

In 1989, David decided to set up his own consultancy which he ran for the next few years until retirement.

David says: “I think, we had a lot of people through our hands, very clever people. They have seen that, actually, it’s quite easy to set up and run your own business and I think that’s the way it’s been, it spawned.”

David says the lesson he learned from his experience was: “I should have insisted on a growth that was slower and more profitable, rather than go for expansion at the expense of profits.”

David says: “They always say it takes seven years to grow a business, and I think that’s probably true.

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5. Cambridge Consultants Today

The headquarters of Cambridge Consultants at the Cambridge Science Park.

Cambridge Consultants describes itself on its website in 2021 thus:

We started in 1960 to "put the brains of Cambridge University at the disposal of the problems of business and industry". In the last 60 years many high-tech enterprises can trace their roots back to Cambridge Consultants. We have created more than 20 successful spin-out ventures, including three of Cambridge's billion-dollar companies: Cambridge Silicon Radio (CSR), Domino Printing Science and Xaar.

Today we are a global team of engineers, scientists, designers and consultants helping some of the world's biggest brands and most ambitious start-ups to realise their technology-based aspirations.

We're a product and service development organisation that our clients employ to create breakthroughs in their markets.

Our combination of technical, commercial and market expertise yields market-leading solutions – creating returns for clients that are many times their investment.

The company explains that it undertakes over 500 projects each year, and has created more than 5,000 patents for its clients. It has more than 900 staff.

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2. Risky Business: Part 1

This and the following two chapters are a life story of Cambridge technology entrepreneur David Southward which was archived in 2021, with acknowledgement and thanks, from the Polymath Perspective website at www.polymathperspective.com.

In 1960, Cambridge University graduate, Tim Eiloart, set up a small technical consultancy business called Cambridge Consultants and invited his friend and fellow graduate, David Southward, to join him. It was the start of a fascinating career for David who, for the next 40 years, worked in and ran many of the UK's most influential technology companies. David tells the story of Cambridge Consultants and its associate companies, describes his later roles at Sinclair Radionics and Sinclair Research, and reveals some of the ups and downs he experienced working on innovative and cutting-edge technology projects.

A view of Enderby's Mill in St Ives, Cambridgeshire. Once the home to Cambridge Consultants and Sinclair Radionics. David founded the former company and worked for the latter. The original mill building is the tall one on the right

"Everybody sort of assumed that computers were going to sell and sell and sell," says David Southward, recalling the situation which led to the demise of Sinclair Research, "so all the companies and retailers were ordering them, and then everybody found that they had oversold! There wasn't the market there so the shops wanted to give them back and that caused cash flow problems."

Those cash flow problems eventually forced Clive Sinclair to sell his business to competing entrepreneur Alan Sugar, and soon afterwards many people who had been instrumental in the UK's technology boom of the early 1980s were looking for new employment opportunities.

David Southward was one of those temporarily out of a job, but it was not the first time he had experienced the slump of a business which relied on venture capital and large sales to survive.

A Scientific Mind

At university David studied natural sciences rather than engineering, yet a passion for building things, coupled with a stint making tools during his National Service, conspired to set him on a different career path.

"I always made things at school," he recalls. "I went through a phase of making aeroplanes – radio control ones, including the control. I also built radios and hi-fis and I even made a car shortly after school. It was one of these things with a space frame chassis. It had a Ford Consul engine, an MG Gearbox, a Woolsey rear axle and a fibreglass body, the last of which I bought for about £80 and fitted. It actually looked quite smart.

"I collected the bits over time. I bought a Ford 8 van initially as a source of parts; for its steering and the front axels, but subsequently fitted the rack and pinion steering from a Citroën Light 15 which I found in a scrap yard in Sweden. The car had a little bit of absolutely everything under the sun. I still had it when we first started Cambridge Consultants, and somebody remarked that it would go backwards almost as fast as it would go forwards!

"Although that was a long time ago, the car is still going strong. The space frame chassis was made by somebody called Butler and the son of the Butler family that made the thing subsequently bought the car and run it to this day. And a short while ago he invited me to a meeting where this car was actually the star of the show, which was rather surprising!

"I also made a 14-foot speed boat on the top floor of the London house my parents lived in. The most extraordinary thing about it was trying to get it out because it was made in a spare bedroom on the sixth floor, right at the very top of the house. I worked out that it would just go out if I took all the doors out upstairs. It did and I managed to get it out onto the flat roof. I wrapped it in carpets and then lowered it right the way down. My father was a doctor so it went in through various consulting rooms at the bottom of the house, then out through the front door. It was a work of art getting it out."

The ‘flat’ screen TV, which David worked on for Clive Sinclair

Supply or Service

After school David secured a place at Cambridge University to study natural sciences, however, at that time all young British men were unavoidably obliged to do a spell of National Service, either in the forces or a public service role of some prescription. David chose to do his Service before university, rather than after, and opted for a Ministry of Supply scheme.

“That is where I met Tim Eiloart who a lot of people will probably already have heard of,” explains David. “He was the actual founder of Cambridge Consultants. He and I met at this Ministry of Supply scheme where we were apprentices making a set of tools and learning how to use lathes, milling machines and things like that. The deal was that if you were successful they paid for your education. We did a year at the Woolwich Royal Arsenal factory, and then we both went on to Cambridge to study chemical engineering, although we still had to go back to the factories to work during the holidays.

“They were called the Royal Ordinance factories and were where they made TNT and all the ingredients that went into it. For example, they made all the acids; like concentrated nitric and concentrated sulphuric acid, so there was quite a lot of chemical engineering at the plant. And the factories were completely self-contained so if there was a war they had their own electricity supplies and everything.

“National Service was just about to end at that time, I think, so both of us just caught it, but we entered into the scheme with about 700 other people. Tim actually came top in this Civil Service exam and I think I was about fourth. It was very good training although it was incredibly boring for the first year, because we had to file our own set of tools. At least you learnt about how to use them properly! It was during that time that I was working on the car and the speed boat.

“Although Tim and I went to university at the same time he took a year out to go on a balloon trip from the Canaries, over the Atlantic to the West Indies. It was a project called the Small World and it was very celebrated in all the papers at the time. There were four of them: Tim and his father, Bushy, and two other chaps.

“So our ways split and I finished a year ahead of him. I then went into the city for a year, nominally at the behest of my father who thought that I should know something about accountancy! So I studied accountancy for that year after my four at Cambridge, but that absolutely wasn’t for me!

“Having done a little bit of accountancy so that I knew how to write books up and such things, I was casting around for a serious job, and Tim Eiloart, who was working at the experimental psychology laboratory in Cambridge by that time, said ‘Why not come up here? I can give you a job.’ So I came up to Cambridge, stayed with him, and worked for about a week at the job that he had offered me in the psychology laboratory, which turned out to be a non-job because, although I’d got a formal letter of appointment detailing holidays and all the rest of it, it hadn’t been agreed by his head of department. Tim was a pretty lowly creature and no way was he allowed to offer anybody a job. So that came to a halt pretty quickly!

“But that’s was when it transpired that there was actually quite a lot of work that the psychology laboratory, in particular, was putting out for local instrument makers, and, although we hadn’t any tools or machinery, we thought, ‘Why not give it a go?’”

69 Histon Road, Cambridge, where Cambridge Consultants had their first base

Cambridge Consultants

Tim had already registered Cambridge Consultants by the time he and David decided to work together, although at that stage the company didn't employ anybody full-time. The initial idea was to provide a technical consultancy service which sourced the expertise for a range of specialist jobs, but the plan soon changed, as David explains.

"The whole concept of Cambridge Consultants was that it could find a technical specialist for any particular scientific field and put them in touch with industry. For example, supposing somebody was studying cheese and wanted to read a Polish paper about cheese making. They would have to find a specialist who knew all the technical jargon involved in cheese making and who also knew Polish. It turned out to be quite a difficult thing to do and it wasn't a very satisfactory method of getting a company off the ground, really, and what we soon found was that we were actually doing the work ourselves.

"So what we did then, with a little bit of cash from both our parents, was set up a workshop at 69 Histon Road, at the back of a company called Polyhedron Printers, which was owned by a friend called Rodney Dale. We took on work making prototypes for the psychology laboratory and a lot of local industry; including commissions from parts of the Pye Group. Cambridge Prototypes is the name we traded under initially but that was under the wing of Cambridge Consultants.

“We had a little lathe and milling machine and hired a couple of really good instrument makers. In those days, Cambridge Instrument Company, who were famous for making the electron beam microscope, used to train instrument makers and ran a very good apprenticeship scheme, which, of course, nobody these days does. So we had a pool of labour in Cambridge that was extremely skilled and there were a lot of scientific instruments being made.

“At that stage Cambridge Consultants had one secretary on the top floor of 8 Jesus Lane in the centre of Cambridge and I had the workshop at Cambridge Prototypes. Then after about a year we started trading under Cambridge Consultants, Tim left the psychology laboratory and we expanded the premises at 69 Histon Road. It was about 1960 when I started, so that would have been 1961, I suppose.”

The work given to Cambridge Prototypes turned out to be varied, interesting and challenging. The company were called upon to make all sorts of esoteric pieces of equipment, often to help the university departments carry out very specific experimental research.

“It sounds a bit silly,” continues David, “but one of the biggest jobs we handled right at the beginning was making a piece of equipment to find out the characteristics of insect muscles – specifically bees. It was a vibrator to which you attached to the insect’s muscle and it vibrated it over a very accurate and precise distance at a set frequency. You then looked at the other end of the muscle to see the force that was generated.

This was done for a professor of zoology in Oxford, but what made it a bit difficult was that he wanted to measure it, not only in the normal atmosphere, but also in various other atmospheres; up to quite high pressures of about 1000PSI.

“The base plate for this thing was about two inches thick, 14 inches across and was made of stainless steel. This was because the vibration levels involved were extremely low and we didn’t want it to pick up the rumble from a passing truck, for example. It was a really solid piece of engineering and everything was stainless because it had to work in these varying atmospheres.

“We couldn’t make the pressure vessel itself so that was sub-contracted to another company. That looked almost like an oxygen cylinder with the top cut off, except it was larger in diameter.

“At that time we didn’t have any electronics expertise, so we used a friend of ours who was doing his PHD at the engineering labs. This was before transistors were in use so everything had to be done with valves and it was

a hell of a beast. I can't remember how much we were paid for it but probably about £3000.

"That was one of the most ambitious things that we tackled back then. But there were all kinds of instruments that people wanted. For example, we made a wind tunnel for aphids! Aphids are steered by, or attracted to, various frequencies of light, so the idea was that you would shine polarised light of various frequencies on a pseudo sky – which was just a bit of cloth through which the air passed – and watch how the aphids took off.

"I can't remember too much about it but I just know that it was a thing of about a metre square in cross section. The airflow involved was very low but it had to be variable because you had to find out how hard the aphids were striving to get to the light that you were shining on the sky.

8 Jesus Lane, Cambridge.

"At that stage Cambridge Consultants had one secretary on the top floor of 8 Jesus Lane in the centre of Cambridge."

"Shortly after setting up with not much electronics expertise, we had some engineers join us. One was a chap called Peter Reiner, the other was Gordon Edge, and we made things like electronic petrol pumps for a garage forecourts, at a time when people hadn't got such things. You could put a pound in and you got a pounds worth of petrol out. We made those for Gilbarco, which is one of the petrol manufacturers. And we did a similar thing for a private individual who wanted to get an idea off of the ground.

“One of the typical things that we made, for example, was a TV audience measuring instruments for AGB. They were a big market research organisation – the sort of people who would tell you that 9 million people were watching East Enders, etcetera, etcetera.

“I can’t remember exactly how it worked but every time you changed the channel it could tell what you were watching so AGB installed these instruments in thousands of homes throughout the country and from that they could work out what the audience figures were likely to be.”

The Next Step

Tim and David were, by this stage, fully involved in the making of electro-mechanical instruments of one sort or another and, as it turned out, neither one would ever put their chemical engineering skills to any practical use for the benefit of Cambridge Consultants. Despite not making a great deal of money, they expanded the company rapidly so that it could tackle the diverse range of bespoke designs it was asked to complete, often deciding to create a new company trading within the Cambridge Consultants group to tackle the new line of work.

David admits that their motivation for expansion was at least partly fuelled by a desire to find that elusive big money-making venture.

“Making prototypes of various instruments is extremely difficult,” he explains, “because things always take longer and cost more. It was always next year that we were going to make a profit and we were always trying to be ‘cost plus’, but the client would always say, ‘No, I’ve got a finite amount of money, so I want a fixed price,’ as it were.

“When you are making prototypes of one thing or another there are always things you find out the hard way – a bit by trial and error – whereas if you are doing the same thing again and again it really is much easier. It was always a hassle and we didn’t actually make much money. We thought that what we needed were bread-and-butter products and were always looking for something to make our fortune.

“At the time we were also quite friendly with Clive Sinclair and could see that he was selling enormous numbers of things like that. Clive had bought some transistors and was looking for somebody to grade them into red spot and green spot transistors, which was into high gain and low gain. We had an engineer we weren’t entirely happy with, so he had a little room at the end of 69 Histon Road for a short spell where he was working for Clive.

“So it was always at the back of our minds that we’d expand and eventually, in 1968, we moved from Histon Road to quite a big building in Bar Hill. The premises were on the site that is now occupied Tesco. It was where I think the petrol pump station is now.”

“In the mean time we started expanding like anything and there were quite a lot of different companies within our umbrella. Gordon Edge was extremely good at electronics so we’d set up a company called AIM Electronics and even turned Cambridge Consultants into AIM Associates and made Cambridge Consultants one of a number of trading companies within the group. Another one of them was Cambridge Audio, which made hi-fi.

“Soon there was AIM Electronics, AIM Buyer Sciences and AIM Physical Sciences, the last of which made polarisers and other things. Once we had a manufacturing requirement, which was some time around 1969, we took over the Enderby’s Mill site at St Ives, and then all the manufacturing side of things happened at the mill.

“We rented the whole site which included the buildings, some sheds there that we filled with machine tools and the mill house itself. We also did a deal with Tim’s father, Bushy, who took over all the buildings on the river side and converted them, one-by-one, into flats. I can’t quite remember what the details were but originally we took over the whole site and split that fairly rapidly into the bits. The area adjacent to the bridge into St Ives was the bit Tim’s father looked after.

“We also had a long shed we called Dirkcam, which was where we were building an experimental weaving loom that I was involved with. It was to manufacture a patterned carpet at high speed, so that was put in there.” TF

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3. Risky Business: Part 2

In Part 1, David explained how his interest in making things resulted in the establishment of Cambridge Consultants. In Part 2, David describes how the company faired after moving to a site in St Ives, which they shared with Sinclair Radionics.

Enderby's Mill site, where Cambridge Consultants based many of their companies at the end of the 1960s.

"I'm not quite sure when Sinclair moved in to take over the mill," says David thinking back to the start of the 1970s, "but the mill building itself was derelict when we arrived. Everything was in a pretty awful state, but there was an enormous amount of space.

"Clive was building up Sinclair Radionics in the mill building and we were trying to produce amplifiers in some of the other outbuildings in the area near the Mill house."

At this time Clive Sinclair had no business interest in Cambridge Audio or Cambridge Consultants, even though his company was designing its own range of hi-fi equipment just a few yards away in the main mill building.

"He had his own audio amplifier which he called the System 2000," David recalls, "but we got extremely good write ups for the Cambridge Amplifier. Undeservedly good, really, because it was a pig of a design! I mean, it was exactly the opposite of Clive's. We had the name but we couldn't make them very easily, whereas Clive didn't have a name on that business at all then, but he could make them!

“I did a bit of product engineering on the Cambridge Audio amplifier and tried to get it made in a more up-to-date way, but there really wasn’t time to do too much and the whole group was basically pulled down by the working capital demands of the amplifier – at least that is what I reckon happened.

“Cambridge Audio was just part of the AIM Associates group, and the idea of separating companies into stand-a-lone entities was so that if one fell down it didn’t pull the others with it, but in reality it didn’t work like that because there was so much intercompany trading and everything was cross-guaranteed. It got terribly complicated.

“Anyway, in the end – in 1971 this was – we were about breaking even but the bank said enough is enough and they demanded the overdraught be shut down. The loan was paid back within a couple of weeks, or something like that, but it caused the whole group to go into receivership and the audio business was sold off to a chap called Colin Hammond. The AIM Electronics business went off to somebody else and Cambridge Consultants were taken over by Arthur D. Little.

“I should mention that before the bank demanded their money back and we shut down, Clive did chip in some money and become chairman of the group, and took an active interest in it, but it was too little, too late, as it were.”

A New Start

When the company broke apart in 1971, Tim and David went their separate ways. Tim eventually became interested in Green politics, while David continued involving himself with product development and production. His first post-Cambridge Consultants venture was, in some ways, an attempt to realize some of the ambitions he had had for Cambridge Audio, and was born out of an association with an aspiring designer.

“We went into receivership so everything was sort of sold off and I formed a company called Lecson Audio which, in 1974, got one of the design council awards,” David explains. “That was what I was doing for about three years, I think, and it was, again, very top-of-the-range high-fi equipment.

“I knew a chap called Bob Stuart who had previously entered a Cambridge Consultants quiz organised for Cambridge Audio. It was a technical quiz at an exhibition we used to have at Olympia and this chap, Bob Stuart, won hands down. So he got his free Cambridge Audio amplifier and that’s how we met up.

“When the receiver was appointed and I was looking around for things to do, I got in contact with Bob. He had always said that he wanted to design

a better amplifier but he was working for Marconi, or someone like that, at the time. We also knew a chap called John Greenbank who was then working for the Gramophone classical music magazine, so they both joined me in this new venture, Lecson Audio, which had premises on Burrell Road in St Ives.

“We were financed by a local builder, and that went fine until his market – the building business – suddenly collapsed and he wanted to withdraw his money from the company. It was when credit rates suddenly increased. He had been building up a portfolio and he’d got assets and liabilities and the two were sort of balancing. It was fine when things were stable but as soon as the interest rates went up he was in trouble. I decided I had to get out of Lecson Audio but Bob kept going by getting funds from a city banker who was looking for a placing.

“So that sort of continued. Then Bob and a chap called Allen Boothroyd, who had worked on the design of the Lecson amplifier, went on to build the company Boothroyd Stuart who have a very big place in Huntingdon called Meridian Audio. And if you want to spend £20,000 on a pair of speakers, well, they are the people! Personally I think it is daylight robbery.”

Cambridge Instrument Company

David’s next move was to join an established company where the risk of things going belly up must have seemed much lower. The company in question was called, Metals Research, although while David was there it merged with Cambridge Instrument Company, which was similarly well-established in its field.

“The work was done down at Melbourne, but Metals Research, which was the driving force, was originally in King’s Street, Cambridge, amongst a whole rabbit warren of offices. They made equipment to look at the crystal structure of metals and tell you the number of inclusions, the size of the crystals and things like that.

“In general, you sectioned your steel and then put it under the microscope, which scanned the picture telling you the grain size, etcetera. And they built a very successful business out of this.

“Metals Research was actually owned by the Cole Brothers. E.K. Cole was, I think, the father of it all and he was behind the EKCO radios. Anyway, they took over Cambridge Instrument Company which had been struggling. The merger was being pushed by Wedgewood Benn and one of the government departments.

“Cambridge Instruments made electron beam micro fabrication equipment which you would use to write the whole circuit of a silicon wafer, so it had to work to incredible levels of accuracy. Cambridge Instruments were the

first to produce the electron microscope and they continued to make instruments like that, selling for £50,000 or so. But they only made a few of each kind and it was a real nightmare because each one involved so many different parts. If, for example, you were using 14 BA screws – absurdly small screws – which you did for some of these things, you might only use a few of them, but you might also use the same tiny screw in another very expensive instrument, so just handling the stock for these things was extremely complex.

"Everything had a special purpose and was made with phenomenal accuracy. All the columns had to be aligned to fractions of a thou, so it was difficult.

"When I joined Metals Research/Cambridge Instruments I was working on a blood analysis machine which was being was done in conjunction with Addenbrooke's Hospital in Cambridge. The concept was you took a sample of someone's blood and it would tell you the red cell count, the white cell count, and it would also tell you the different kinds of white cells too. Of course this was done electronically, but the equipment also had to make the slides. What we were doing was separating the white cells from the red cells, making a slide, putting it under the microscope and the software had to decipher what was what, because a lot of these white cells – basophils, neutrophil and so on – almost grade from one end of the scale to the other. Two people would not agree what some of the cells actually were.

"I wasn't involved in any software; I was just making the equipment. So the equipment was fed with a little file of blood, it shook it up, sampled it, separated the white cells, made the slides, put the cover slip on, put it under the microscope and then printed out the results! It was a big, complicated and expensive beast, and there were a lot of engineers working on it; it wasn't just me.

"I also had a spell working on trying to find the errors in the electron beam micro fabrication equipment. That was enormous fun because the electron beam would only scan a very, very small area. It was like a cathode ray tube, only you were writing over something like half a millimetre square. It had to be able to scan a five inch wafer so to do that all these little half-a-millimetre squares had to link together with no errors and no overlaps. If there was a track that was a few microns wide, for example, it had to carry straight on from one to another, as it were.

"It also had stages. There was the optical stage which came from the States: that was a Hewlett Packard thing which had laser interferometers and was capable of measuring to a fraction of a wavelength of light. It was ridiculous!

“I spent a spell trying to sort out the errors that the machine made. For that we had to look at what the errors actually were and then deduce where they came from. What you found was that if anything warmed up, even by five degrees or something like that, it would make an enormous difference. You could actually calculate the expansion of things and tie everything back.

“I can’t remember too much about it now but I do recall that we got this equipment, which was for one of the big American companies called Rockwell, so that it was working really well, but when it was taken for packing it was dropped, so it was back to square one, practically!”

Metals Research were based at 91 Kings Street, in what David describes as “a whole rabbit warren of offices.” The address is now a shop, as seen on the right.

Tube Time

While David was working first on his Lecson project and later for Cambridge Instruments, Clive Sinclair’s Sinclair Radionics had begun to phase out its hi-fi business and was enjoying the success of its pocket calculators. The digital ‘black watch’ was still a few years off, as was the ZX80 home computer, but the TV1A pocket television, which Sinclair had prototyped way back in 1966, was in production. The television’s costs were detrimental to the company, causing it to make a loss, and not even the lower-cost, plastic-cased TV1B and variants, the TV1C and TV1D, could rescue matters. Things were so bad that the National Enterprise Board, known as the NEB, stepped in to save the company, offering a massive injection of capital on the condition that it also took partial control of the business.

Undaunted, Sinclair still planned to take his pocket television concept a stage further, this time replacing the Telefunken tube with a bespoke ‘flat’ tube, which required the cathode beam to bend at a right angle.

To help take the state-of-the-art tube from the prototype stage into production, Clive approached David, asking him if he would join the team.

“It was during my spell at Cambridge Instruments,” recalls David, “when Clive said ‘Look, I’ve got this flat tube and I need a million of them a year.’ So he encouraged me to join Sinclair Radionics to work on its production. I had an office on the top floor of the mill that I shared with CRT consultant Tony Krause. That was some time around 1975, or something like that – I’m not entirely sure. But Clive told me he had got backing for the tube from the National Research Development Council and the National Enterprise Board, but actually it was when the whole place was falling apart! There were the most furious arguments going on because the NRDC and NEB thought that Clive was conning them. Having just joined I was absolutely appalled by this, and, of course, there wasn’t a flat tube!

“The thing that I saw on the top floor of the mill that first made me think that it was possible was somebody else’s tube; specifically an AEG Telefunken CRT, built inside a round tube and arranged so that it looked as though what Clive was proposing – which was to bend the beam at a right angle – did actually work. I’m not sure when amongst all of this the company bust up actually occurred, but when it did Clive had to leave the mill and go to King’s Parade in Cambridge, taking with him Jim Westwood, Brian Flint and a few others. I stayed behind to look after the making the prototype tube.” TF

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4. Risky Business: Part 3

In part 2 David explained how Cambridge Consultants fell into receivership, causing him to start up a hi-fi design business, before joining a precision instruments company. In Part 3 David talks about his development work on the innovative ‘flat’ cathode ray tube for Sinclair’s TV80 pocket television, and describe some of the interesting projects he has worked on since the Sinclair empire collapsed in the late 1980s.

The FTV1, otherwise known as the TV80

At his new base in Cambridge’s King’s Parade, Clive Sinclair focussed almost all his efforts on the production of the Sinclair ZX80 home computer, which would eventually lead to the ZX81 and the hugely successful Spectrum. In the mean time, back at the Enderby’s Mill site in St Ives, David and a few other engineers were left working on ways to mass manufacture a flat television tube for the TV1B pocket television’s successor. Since the NRDC (National Research Development Council) and NEB (National Enterprise Board) had split the old company into pieces so that they could sell off the profitable parts and recoup a little of their investments, the budget for developing the flat tube was low, resulting in very slow progress.

“I was working with a chap called Robin Colclough who was a physicist,” David recalls. “He was definitely a tube man and a very clever bloke, but after a while he got a bit nervous that Sinclair Radionics had gone, that Clive’s company was down to about 10 people and the tube was a long, long way from production. So Robin left the project and it was down to me to work on setting up a production line to mass produce these tubes.

“At this point we were working on the prototype in a shed at the mill site that we called the Dircam. It was the first building on the left when you entered the site, on the other side of the mill house from what we called The Chapel. That was the boiler house for the big chimney, which Bushy eventually pulled down.

“Looking back I can see that before there was any capital input from Clive’s computer business, everything was paid for by the NRDC, who were, strictly speaking, only meant to be paying for half of the costs!

King’s Parade as it is today. At the start of the 1980s, Sinclair and his team were based on the upper floors of Number 6

“Clive was based completely in King’s Parade and I’m not sure exactly what he was doing. We didn’t have a flat tube at that stage so I’m not quite clear if they were working on the electronics for the television or whether it was just the ZX80. But when the computer side eventually started generating a lot of money it became relatively easy to progress the tube.

“We needed equipment to, for example, vacuum-form soda glass – which is ordinary window glass – into the right shape. When I joined we had nothing that looked as though it could be made at all. The problem was that if you mould different kinds of glass, the thermal expansions of the materials don’t match and so they are difficult to seal together without them cracking. They had made a pressed-glass enclosure when I arrived but they hadn’t managed to seal it properly. That was when I said ‘Look, let’s try and vacuum-form soda glass.’ For that we were just taking an ordinary sheet of glass, heating it up to the appropriate temperature and then applying a vacuum to draw it down onto the mould that we had made.”

Bending the Tube

Given that there were no other pocket televisions on the market using flat screens, and Telefunken – providers of the TV1B’s tube – didn’t make anything similar, David and his colleagues had to use trial and error to find the best way to produce their tube parts. As history now reveals, Sony were working on their Watchman flat CRT pocket television at the same time, but the team in St Ives had no information as to how the Japanese technology giants were solving the problem.

Perhaps the best solution would have been to ask Telefunken, or some other well-established tube manufacturer, to develop the component on behalf of Sinclair Radionics at their own factory, but Sinclair was determined to try to cut costs by refining the process in-house. “Clive was always raving about the tube he’d used before as being rather over-engineered and quite expensive and it was also the wrong aspect ratio to view,” explains David. “But like all things to do with manufacturing, every factor of 10 in terms of output is significantly challenging because you need to use a different method. We had to develop the processes in the Dircam shed at the mill site, and that included the vacuum deposition of the screen, designing the equipment to manufacture the cathodes, and finding a method of aligning all the electrodes and plates that make up a tube.

“The way we did it was to hold all the plates in a jig. They have all got little tags on them, so you introduce a hot glass bar on each side and plunge the tags into the glass, and that holds everything in exactly the right position. So we had heaters that melted the glass for this purpose. Of course, none of the assembly is in the vacuum at that point – you assemble the whole innards of the tube as one unit while it is outside.”

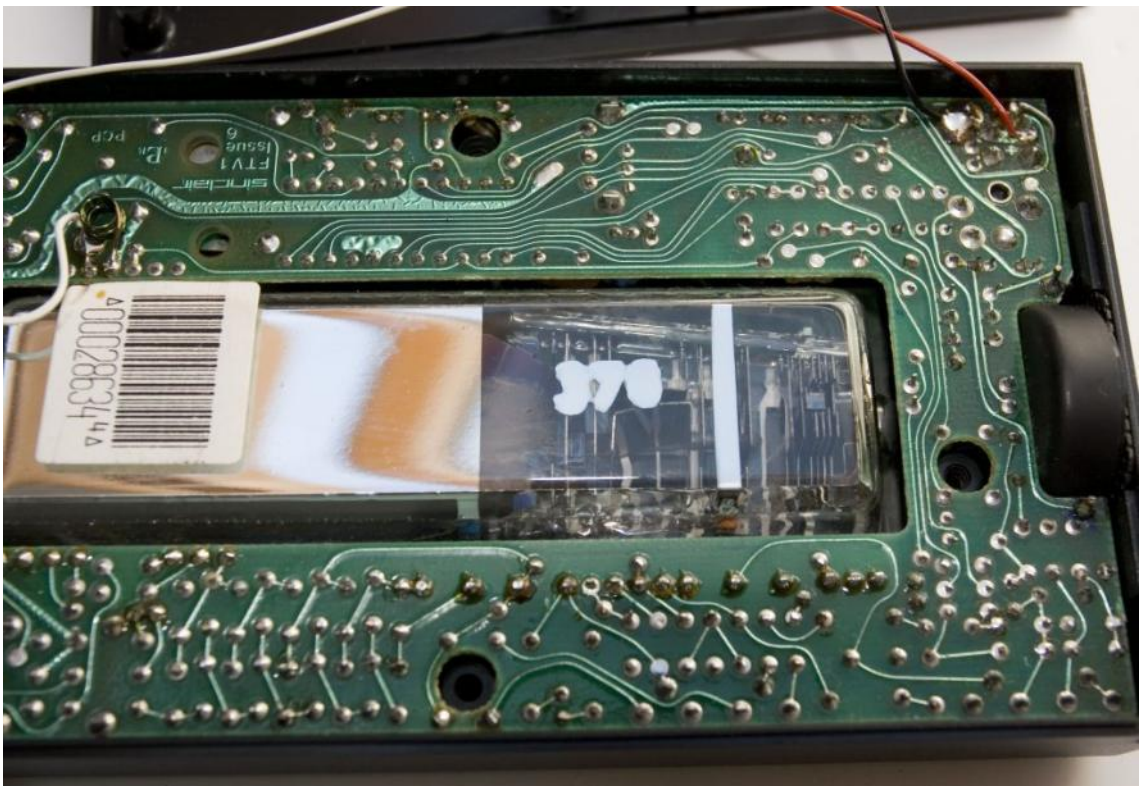
One of the biggest challenges David and his team faced was making sure the tube did not use too much power, which would drain the battery rather quickly. As Rick Dickinson explained in his interview with Polymath Perspective, Sinclair wanted the television to use an extremely slim-line battery, which Polaroid made to power their instant cameras. It was

therefore imperative that the design of the tube was compatible with the battery specification.

”In order to get the electrons to be emitted from a conventional cathode ray tube,” explains David, “you have to heat the cathode up to about 800 degrees, or something like that, but if you are using battery power you can’t afford to use a significant amount of power because it will drain the battery very quickly. You just have to have a very low power tube, but the heaters in a lot of conventional old-fashioned power valves are rated at something like five Watts. Well, that would be absurd because the battery would be flat in no time.

“The way we conserved power was to use 16 microns thick tungsten wire – which is just over half a thou in diameter – and have quite a long length of it. I suppose it was about one centimetre long. In the middle it got up to the right temperature but it stayed cold at the edges where it was attached to an electrode at one end and a tensioning spring at the other.

“The wire had to be coated in a special mixture of oxides because tungsten wire won’t emit on its own, so we added a ceramic coating made of something like barium and strontium oxide, and when we heated those substances they would emit.



The finished tube, seen from the back

“We had to place that 16 micron wire exactly in the middle of the five thou grid hole that monitored the beam. The tolerances were ridiculously low and it was a challenge to work with such very fine wire.

“So we had to develop equipment to coat the wire, strip it to exactly the right length and then attach it at each end. For that we started with quite a long bit of wire which was located on two Vs to ensure that it was the right height and the right distance away from everything. This half a thou wire had to be located right in the middle of the five thou hole and we had to weld the tungsten at both ends, one to a fixed electrode, the other to a spring so that the wire was under tension.

“And, at the same time, we had to develop a means of doing all of this at the rate of one tube a minute, or something like that. We also had to develop all the machinery to make it as well because there was nothing you could buy off the shelf. That was the case with all the equipment, really.”

Better Never than Late?

Although the early working prototypes for the flat-screen television had been demonstrated some time around 1978, the TV80, as it was eventually called, didn’t make it onto the high street until 1983. Unfortunately for Sinclair, while those five years were passing the market had moved on. Sony managed to launch the first of their Watchman portable flat-screen televisions in 1982, just beating Sinclair to it, although the Watchman’s European launch didn’t happen for another couple of years. More significantly, Casio introduced the first portable LCD television in the spring of 1983, and only a year later Epson released the ET-10 colour portable, putting an end to the flat screen tube dream and signalling the start of a new era or technology.

“The company only made 300,000 tubes because Sinclair wasn’t really able to sell them,” confirms David. “I can’t remember being particularly conscious of Sony’s product because I think we were probably at a lower price, and Clive was always absolutely convinced he was going to outsell everybody, but it was at a time when LCDs were just about to come in, so the technology was just too late, really.

“But we did set up a pretty big plant to make the tube at the Timex Electronics factory in Dundee, which probably cost £5,000,000, so it was a big operation and the computers funded all the equipment that we had to buy, right the way through.

“Clive moved into Willis Road after King’s Parade, right behind where the post office used to be in Mill Road, but I was at the mill in St Ives until he set up offices at Milton Hall. I moved there then and that’s when we basically shut up shop at St Ives completely.”

“I still worked on different gadgets for Clive, including printers, Microdrives and things like that. I was doing that until Clive decided that

he'd sell to Alan Sugar, and when Sugar took over all of the computer business Milton was effectively shut down."

Ever optimistic, David didn't let the demise of Sinclair Research dampen his enthusiasm for business, and was soon looking to start up a fresh venture with a new partner.

"At the time I was told my services were no longer needed at Sinclair Research I was talking to a chap who worked for STC in Harlow," recalls David, "and we began trying to get a business off the ground making liquid crystal displays of a particular kind. This was a memory LCD and, in a way, it was like the Kindle devices you get now. The idea was that you put your pattern in and it remained like that for evermore. STC had developed this technology and they were looking to exploit it, so this STC chap and I got some backing from the city and set up Image Displays Ltd. This was probably around 1985.

Fitting the tube, circuit, speaker, controls and battery in the small case was a challenge

"I remember I was driving up and down the A11 to Harlow all the time because we had a clean room within the STC Harlow complex. It was a very expensive room where you had to wear special clothing, just like those where they make silicone chips. The air was filtered because we were trying to make an LCD with a resolution equivalent to a fax, which is 200 lines per inch, and when you are trying to pattern glass at 200 lines per inch it is quite difficult. You have to ensure there are no dust particles or

anything anywhere and that's why you have to wear a special suit and mask. It's a bit of a nightmare.

"We had to have a special chip made and I got it so we were directly mounting them on the glass all the way around the edge of the display. That worked quite nicely but it was really quite a difficult thing to fund because, even though we were starting with £250,000, you have to spend at quite a high rate in order to be able to demonstrate prototypes and get interested people involved. And when you do that you tend to run out of money very quickly. So in the end that business was sold to a Norwegian company and I'm sure it has folded by now."

Working from Home

After the disappointment of not being able to carry on with the LCD project, David decided to take a different approach to his working altogether, and began freelancing from his home in Cambridgeshire.

"I did that when I realised that things had got to the stage where there was really good computer-aided design," he explains. "I used a thing called Power CAD and worked for people like Clive Sinclair and Jim Westwood. The company Jim was working for made a rival to the BSkyB Satellite aerial and I did the mouldings and things for that.

"I continued working freelance until I retired about 10 years ago. That setup was very nice and easy really. There was no stress and you have no overheads to speak of. And I was always pretty busy.

"One of the very first clients I had was someone who had once approached Cambridge Consultants. He had originally wanted us to design check weighing equipment for Mars and people like that, where you weigh the products as they go through on the conveyor belt. When that particular fellow returned, I worked on a series of CCTV products for him, this time using very much better optical systems, including some where the lenses were eight or 10 inches in diameter and cost an absolute fortune; but you could look at things five miles away!

"The army used it for spying on what people were doing and the chap was also working for various prisons in Northern Ireland and things like that, always with much better optical systems than the conventional street monitor."

The back of the TV80

Computer Days

Today, Cambridge Consultants is still a thriving business, as are many other technology companies based in the Cambridge region, which owe a debt of gratitude to the businesses set up in the 1960s by David Southward and Tim Eiloart. Long since retired, David is in a position to look back at his career and objectively observe its many ups and downs. Reflecting on technology and manufacturing in general, David sees the evolution of the computer as the one development which has resulted in the biggest change.

“Everything now is driven by a computer,” he says. “It has magicked the way. You can print in 3D and you can machine every known metal with water jets or lasers. It has just completely transformed the place really. I suppose the high capital cost of equipment has actually taken over from the extreme accuracy of workers. When we had instrument workers in the past they were capable of doing very fine work, but now that is not really necessary because you get it accurate with ‘numerically controlled’ equipment, and that’s much cheaper overall. So it has transformed things. I wish I’d had a computer at the start of my life because it does make life so much better.”

It is understandable that David sees computers in such a positive light, given that they offer relatively easy solutions to certain design and production problems which he struggled with in the past, but when it is

suggested to him that perhaps designers today don't get the chance enjoy experiencing the process of making things, he admits that that is an issue.

"Well, I suppose people are removed from understanding the properties of things. People have changed a lot. Now nobody services their car or knows how to change a wheel really. At least my children don't, which is a great scandal!

"I have a Ferrari in my barn which I had in the same state that it is for the last 30 years or something ridiculous. I always said that when I'm retired I was going to rebuild it but now I've retired I have no wish whatsoever to get my hands dirty!" TF
