Computer Conservation Society

Aims and objectives

The Computer Conservation Society (CCS) is a co-operative venture between the British Computer Society and the Science Museum of London.

The CCS was constituted in September 1989 as a Specialist Group of the British Computer Society (BCS). It thus is covered by the Royal Charter and charitable status of the BCS.

The aims of the CCS are to

- ◇ Promote the conservation of historic computers
- ◇ Develop awareness of the importance of historic computers
- ◇ Encourage research on historic computers

Membership is open to anyone interested in computer conservation and the history of computing.

The CCS is funded and supported by a grant from the BCS, fees from corporate membership, donations, and by the free use of Science Museum facilities. Membership is free but some charges may be made for publications and attendance at seminars and conferences.

There are a number of active Working Parties on specific computer restorations and early computer technologies and software. Younger people are especially encouraged to take part in order to achieve skills transfer.

The corporate members who are supporting the Society are Bull HN Information Systems, Digital Equipment, ICL, Unisys and Vaughan Systems.

Resurrection

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Editorial

Nicholas Enticknap, Editor

There have been major developments at Bletchley Park. The Bletchley Park Trust has now secured the agreement of the Government to lease most of the Park at a peppercorn rent on a long lease. The Trust is now running guided tours every fortnight to allow the public to see the site that has been secret for so long, accompanied by an exhibition illustrating the activity that took place there during World War Two.

The Trust has also reached a separate agreement with British Telecom for a shorter lease on two of the buildings they own: negotiations are continuing with a view to securing a longer term arrangement. The short lease has allowed the Trust to develop plans for a temporary museum to be opened in July, while work continues on refurbishing the buildings that will be used for the permanent museum. Further details of these arrangements can be found in Society News.

Tony Sale's involvement with the Trust has reduced the time has has available for Society matters, and in particular the time he used to spend arranging seminars and conferences. Accordingly, the Society now needs a Meetings Secretary: anybody interested should contact Tony on 0234 822788.

The Society has now completed the transfer of most of its equipment to Blythe House in Olympia. The Elliott 401 and the Pegasus remain at the Science Museum, but the Elliott 803, the DEC systems and the S-100 working party's equipment is all now stored at the new location.

The move has meant there has been virtually no restoration activity in the south since the last issue. The North West Group in contrast is gradually accelerating in momentum. It has strengthened its steering committee by recruiting Frank Hooper and David Pearson; appointed a new secretary, William Gunn; and agreed a preliminary programme of meetings for the whole year: details can be found under Forthcoming Events. The Group's Pegasus restoration project started in January under the leadership of Charlie Portman.

Sadly, we have to report that the Group's original secretary, Liz Segal, died in January from the illness which forced her to give up the post. Liz was one of the principal driving forces in the Group, and will be sadly missed by her many friends in the Society as well as by the computing community at large.

Guest Editorial

Brian Oakley

The word *Resurrection* used to produce an image in my mind of a rather worm-eaten Lazarus rising from the grave. These days I look forward to *Resurrection* with rather the same anticipation as he must have looked forward to a bath.

I can't read the tape on the front cover as my contemporaries who were the real pioneers could. But to me the valve diagram looks suspiciously like the circuit for that 45 Mc/s IF box that was always known as the Pye strip. It was everywhere in the laboratories in the years after the war, probably because it was available as war surplus and so could be obtained even by the ever impecunious computer builders. By now the real pioneers will have recognised that I don't know much about early hardware either.

My pleasure in reading *Resurrection* can't stem from nostalgia as a user: my recollection is of frustrations due to frequent and endless down times, chronic shortages of store, and errors due to tape readers that rivalled Mr Patten's view of our children's spelling skills if taught by modern methods. It is a galling thought that the excellent optics on the Colossus gave the wartime pioneers a better reader than the commercial machines we had to use for at least a decade after Colossus had been put to bed.

I think my interest in *Resurrection* stems from the great set of characters who made up the early pioneers. There was that unsung genius, Philip Taylor at TRE, who could squeeze an instruction into less storage than anyone else: if he had been at Albuquerque in 1975 he would have won, hands down, the competition to write the loader routine for the Basic (very basic) compiler for the Altair that was taken by Bill Gates, beating even the redoubtable Paul Allen. Well, maybe Microsoft software is not that bad after all!

When I joined TRE in 1950 the great radar pioneers had largely departed to establish radio astronomy and to staff physics, electrical engineering and in at least one case biology departments in the universities. TREAC was operating after a fashion, while MOSAIC was coming on stream at the Ministry of Supply, RRDE, round the back of the Malvern Hills, though the delay line stores were always difficult to stabilise. I think it was a young electrical engineer named John Fairclough at Ferranti who first developed the good engineering practice required to stabilise mercury delay lines.

I can't remember what TREAC used as a store, though it would be logical to expect that it was a Williams tube. For FC was still at Malvern then, and there was always a close collaboration with the Manchester University team, for several of them had learnt their considerable electronic skills working at TRE. The early air defence data handling systems were still being designed as a joint venture with the Post Office at Dollis Hill, following the pattern of the Bletchley Park collaboration.

Philip Woodward is the name that I will always associate with the programming of TREAC. After the autocode days one could use any language one liked at TRE, provided it was Algol. I think individuals at NPL were more involved with the MIT people in the development of Algol 60, but the TREAC compiler must have been one of the early ones just as TRE, or RRE as it was called by then, produced one of the very early Algol 70 compilers.

But by then the glorious simplicity of Algol had departed, at least in the eyes of Philip Woodward. He always maintained that the full syntax for the language could be written on two sides of paper, a claim that Philip substantiated by persuading HMSO to print it as an official Government publication. The booklet claims that the language was in regular use at TRE (in 1964), and that was absolutely true for Fortran was virtually unused at TRE, unless it be by those contractors' men who had been infected by "Big Blue".

The atmosphere of those days is well captured by the opening sentences of that Algol guide: "It is as difficult to write a manual on how to use a computer as to write one on how to compose music". It goes on "The pedagogue must take refuge in explaining the notion and hope that born programmers will emerge while others fall by the wayside". That is the unmistakeable voice of Philip Woodward who, for all his scholarly outlook, was as considerate of those of us who did not prove to be born with the appropriate skills as he was of his more erudite and ready pupils.

Incidentally, it was a common trick of the time to use computers to produce music. In the TRE mathematics department this was done without using frequency generators but by the more difficult approach of what might now be called digital synthesis. Many a journey on the train to London was occupied by programming music — largely Bach in my recollection.

After TREAC came SABINA, the Establishment's first transistorised computer, formally named by the circuit designer after the goddess who presides over the nearby River Severn, but always known by the less classically erudite staff as Sabrina after a well-known page 3 girl of the time.

The first computer from a commercial source to enter the establishment was probably the 802 that arrived from Elliotts in about 1956, for use in air defence research work. I do not think any other examples of this machine were ever produced. It was in some ways a more advanced machine than the much more famous 803, and various pioneers who subsequently became well-known figures in the industry, such as Iann Barron, cut their teeth on it.

Handling real time interrupts was a new problem, for until then the provision of digital computing had been the preserve of the Mathematics department who tended to give the impression to us practical merchants that they did not wish to know about the real world. But that situation would change radically as the fifties gave way to the sixties, when digital modules that could be assembled into primitive computers started to spread like a rash across the laboratories. By the end of the 1960s hardware from that upstart firm, DEC, and in particular the ubiquitous PDP-8, was everywhere, along with copious give-away manuals, making do-it-yourself computing a reality.

Looking back one can only regret that all that high quality effort that went into the design and building of the Malvern machines did not find — or even make any attempt to find — a commercial outlet. Yet perhaps the most telling mistake that we made in those early years was that it never seemed to enter any of our heads that TRE could have been an ideal source from which to spin off firms like the early DEC, rather than like IBM. Had the culture been different could a British Route 128, or even a Silicon Valley, have spread around the Malvern Hills? I suppose the answer is that it was too nice, too interesting a world as it was, to want to spoil it with making money.

Society News

Tony Sale, Secretary

Bletchley Park is now open every other weekend, starting from 9-10 April, from 10.30 am to 4.00 pm. The Bletchley Park Trust is offering guided tours and an exhibition for £2.00 (£1.25 concessions and children). The tours round the wartime buildings start on the hour and last about 90 minutes.

The exhibition shows the German use of cipher machines and the Polish and Allied attack on the intercepted cipher traffic. Also on show is a four rotor German naval Enigma machine and Lorenz and Siemens telegraphic cipher machines. Some original Colossus components are on view, together with some plans for the Colossus rebuild.

The Trust has now been offered a one year lease by British Telecom on two buildings — H Block and Faulkner House. This offers the possibility of creating a much larger initial museum provision before the permanent museum is ready. (That will be housed in D block, which requires substantial refurbishing.)

One wing of H Block has been set aside for a computer museum, and the CCS has been asked by the Trust to set this up ready for the official opening of the Park by royalty, which will be on 18 July 1994. The computer wing consists of a single large room mesuring 65 feet by 25 feet.

The Society has been promised an Elliott 803, and a Digico Micro 16 is available together with a Burroughs L5000. We will probably display various DEC machines and S100 bus computers, and some more modern PCs are also available to us. We would like also to be able to show the Williams tube storage system and the simulation of Pegasus.

Once the Trust has agreed lease terms with BT, working parties will be organised in the Park to put these CCS computer museum displays together. Anyone who is able to help should contact me on 0234 822788.

Determining the Age of a Pegasus

Chris Burton

Doubt has arisen as to the provenance of the Ferranti Pegasus owned by the Manchester Museum of Science and Industry, following a discussion with Dr Jenny Wetton, Curator of Science at the museum. Specifically, it had always been understood to be serial number 1, a very important machine, but recent indications were that it was more likely to be number 6, still important but not so evocative as the Portland Place system.

Careful examination of the machine has not revealed a serial number plate, and to my recollection such plates were not fitted. It occurred to me that an independent confirmation of the machine serial number might be possible using the serial numbers stamped on each plug-in package. This note outlines the procedure and is an invitation for further comment or experiment.

A Pegasus 1 has three logic cabinets containing altogether 597 packages of about 17 different types. Each package has a small aluminium plate rivetted to it, the plate stamped with the type number and a five-digit serial number. I think the commonest package type is the Twin Delay, type 01, of which there are 112 in a Pegasus 1. The basis of the proposed experiment is the expectation that, in a particular machine, the package serial numbers would be clustered together, representing the manufacture of successive batches of packages which were fed into the Pegasus assembly line. There are no records of the sizes, dates or any similar information regarding those batches, but it seems reasonable to assume that the serial numbers were allocated sequentially.

Other assumptions have to be made. Were the serial numbers a unique set, or was there a separate set for each package type? Did the set or sets start at 1, or at 100, or 1000, as is typical in manufacturing operations? Were serial numbers allocated at an early stage in manufacture and prior to scrapping of unusable packages? To what extent did the preventative maintenance philosophy of Pegasus, which involved regular cycling of spare packages through the machine, cause packages to move between machines, particularly where packages were returned to factory for repair? How many machines were being commissioned simultaneously in the factory, where manufactured package batches might be distributed over several machines?

These questions have been addressed in a simple way as follows. Looking at a few of the spare packages for the South Kensington Pegasus, the relatively recent type 6T packages have numbers around 1300, whereas the old established type 01s have numbers near 5000. So assume that each package type has its own set of numbers. No number has been seen less than 1100, so assume the numbers start at 1000. (This is rather cavalier, and would bear further examination).

It is believed that there was very little scrapping of packages in manufacture (they were re-worked until they were good) so assume that not many numbers were wasted. Lastly, assume that there was probably a good deal of diffusion and that over time the serial numbers would spread over many machines, but hopefully would still leave a residue of clustering.

The next step is to try to assess what groups of serial numbers might appear in a particular machine. Derek Milledge has a copy of a page of a sales document, undated but referring to Orion, Atlas and Argus, and so probably produced about 1963. It identifies each Pegasus by number, customer and delivery date. We assume the number represents a build number, although delivery dates are not necessarily strictly in number order. We are considering the first 25 machines which include both the Manchester and London machines. Delivery dates for these systems ranged from early 1956 to late 1960.

No doubt manufacturing and commissioning times varied, but assume that packages for early machines were made up to a year before delivery, and for later machines about three months before delivery. During these years, the same package types were also made for two Perseus machines. Packages were also used for Mercury drum units, for one Pluto machine, for test equipment and, I believe, for special equipment such as a cards-to-tape converter.

Of these, the most significant is Perseus which used about 360 type 01 packages, equivalent to three Pegasi. We will assume that at any time, an additional 10% had been used as spares for sites, and a further 5% for test equipment and wastage.

Given all these assumptions, then we can calculate the expected package type 01 serial numbers for the South Kensington Pegasus, machine number 25.

24 Pegasus @ 112	2688
2 Perseus @ 360	720
Pluto etc (guess)	50
	3458
Spares @ 10%	346
	3804
Test and waste @ 5%	190
TOTAL	3994

Thus serial numbers for machine number 25 would cluster around 5050 (assuming serial numbers start at 1000).

To check whether these calculations and assumptions were valid, the serial numbers of all 112 type 01s in the first three cabinets of the South Kensington machine were noted, with the result given in the following chart.

The correspondence with the predicted result is striking, but the many guesses and assumptions must mean that luck has played a part. The secondary cluster near 4300 is interesting, and may represent a manufactured batch split between more than one machine. This could occur if the machines were built and commissioned in phases (I can't remember whether they were). Equally, the cluster could be the primary cluster, meaning that package serial numbers started at 1, not 1000.

On the basis of this encouraging result, it is possible to do similar calculations and predict a serial number distribution for the Manchester Pegasus. The result is likely to be fuzzier due to the longer time since the machine was built, and early machines probably suffered more "messing about" at manufacturing time than later machines. However, for the same package type, it seems reasonable to expect machine number 1 to yield a peak at serial numbers 1100 to 1200, or for machine number 6 at serial numbers 1800 to 1900.

I anxiously await a communique from the north-western front!

Chris Burton has been a member of the Society's Pegasus Working Party from the outset, and is currently its acting chairman. He is also chairman of the Elliott 401 Working Party.

Internet address

Readers of *Resurrection* who wish to contact the author of this article, Chris Burton, can do so via Internet electronic mail. His Internet address is: chris@envex.demon.co.uk

Memories of the Pilot Ace

Ted Newman

I had just about completed my PhD when the war came along. In wartime people tell you to go to certain places, and I was sent to a small firm that dealt with communication receivers with very low noise. Then I was recruited by AD Blumlein, who got me making complicated radar equipment — things like H2S and various other special equipment, all requiring very fast circuitry. Then in September 1947 I joined NPL.

I want first to say a bit about how this came to happen. Turing had been doing a lot of work on designs for a computer, and people were thinking of various ways of making it. But the question of who was to make it remained. It so happened that Dr Smith-Rose, who was Superintendent of Radio Division, was for a very short time acting director of NPL as well. In that capacity he decided that NPL should make the machine itself, and set up a team to do it.

Dr HA Thomas was put in charge of the Ace project, and given a group of 12 people. That team did very good work, but the trouble was that although they were expert in radio they weren't really expert in very fast circuits. In due course Dr Thomas recruited me from EMI to take on the circuit work. I'd known David Clayden for a very long time and so I thought I'd recruit him as well.

By the time I got there, Thomas had set up a very good laboratory. He'd got hold of lots of valves of the kinds that might well be useful, and in fact they were useful. Getting valves in those days was no easy matter, but he arranged to get everything that was needed. Another thing: we needed quite a lot of test equipment and Thomas had got all that organised too. I thought he'd made a very impressive place to work in. I say that because a lot of people have derided him a great deal, and I don't think it was fair.

The next thing I want to discuss is why Turing designed the sort of machine he did. It so happened that by accident I got to know Turing early on: by the time I came arrived at NPL in 1947 he was still working for the Laboratory, but he wasn't very often there.

One of things that had been arranged was for Dollis Hill to make delay lines. By the time I got there that contract had been broken, but Turing was quite interested in looking at them, and he turned up a couple of times just after I arrived. I found out that he was a marathon runner, and I was too. So we ran to Dollis Hill to look at the delay lines, and while we were doing it we had a chat about this and that. So just during those two runs (after all it takes quite a long time to run to Dollis Hill and back) I learnt a lot about what he believed was the right thing to do.

Turing knew perfectly well what the job was he had to do, which was to manufacture or design a machine that would do the complicated sort of mathematics that had to be done in the Mathematics Division of NPL. But he had all sorts of interesting things that he liked to do: for example he was really quite obsessed with knowing how the human brain worked and the possible correspondence with what he was doing on computers.

Turing thought that the machine should be made very simple, and at the same time should make everything possible that could be done. His particular purpose was to permit the writing of programs that modify programs, not in the simple way now common but rather in the way that people think. That sort of thing is possible: it hasn't been done yet but I have no doubt that Turing's machine in principle, if one could find out the best way to program it, would have done what he wanted.

The thing that really matters is that it was a simple machine; it didn't have a great many functions, pretty well the minimum number. This was the machine that Thomas was told to make. The actual Pilot ACE that was developed from it afterwards was a good bit more complicated. I still think that Turing was right and it should have been a very simple machine, but it didn't turn out like that.

In a way the Pilot Ace was a parallel machine. I haven't mentioned (and not many people have mentioned) the multiplier. This was arranged to be absolutely synchronous so it would fit in all right, but it was also arranged that all the normal functions could still go on while the multiplier was being used. Of course there were some difficult problems about the timimg to get it right.

Also when we used the drum we were doing the same sort of thing, because it was still synchronised. The drum would make all its data transfers while the other work was going on. So really it was a parallel machine in a certain sense, and I think that was important and I don't think any of the other machines at that time were doing that sort of parallel work.

Eventually, about a year and a bit later, Morley Colebrook took over from Thomas. Morley decided he wasn't interested in circuitry or anything like that, he wanted to manage. So he gave me a team of 10 people to look after the electronics. Then in due course we joined up with the mathematics people, who had a group of four people under Jim Wilkinson.

There is an argument that the maths team and the electronics group ought to have joined up earlier. I'm not sure about that because I think the first part of the work we were doing was dealing with a lot of circuits. After they were developed we taught them all to the maths people, who I might say were an extremely bright lot, and knew exactly how to use these circuits in about five minutes flat.

Finally I want to talk about office arithmetic. When I was an undergraduate, I thought that people shouldn't have to do all that easy office arithmetic: they like to do better things than that. Then the time came when the Treasury O&M decided they wanted to find out what was happening on computers. So they got Bowden and a lot of senior academics to work out what ought to be the future of the machines. At that time no machine had been completed, though several were being built.

As they wanted to know about the down to earth electronic stuff I was asked to join their meeting. Because of what I'd done I thought I ought to write a paper about the importance of office arithmetic, and in it I said I thought there would be a great many computers once you got round to doing business sort of work.

At that time the academics thought this was a lot of nonsense. They said two or three machines is the most you should ever have; and office arithmetic — that's absolutely stupid. I think it was Mr Dunkley, who was at that time in charge of Treasury O&M, who disagreed. Over a number of years I got brought over to various places, the National Insurance people at Newcastle and various other people, and Dunkley kept asking about how things might go.

One of the things that happened fairly early on was the 1951 census, where there was a lot of legislation that they found very difficult to handle. Dunkley was very worried about this, and there were a lot of other problems too. Some work was done in cleaning up the census data, and there were a number of other jobs that were done at NPL for the Treasury.

Eventually Dunkley arranged that they should actually get down to doing something about commercial arithmetic. I can't quite remember the date, but in due course we had a training course where all the departments sent an executive officer to come over and learn to program the Ace machine. Quite soon pretty well every department we were dealing with started setting up groups themselves to do office arithmetic. So I think, to a large degree, the Ace Pilot Model helped to get office arithmetic started up.

This article is based on a paper presented at the Society's all day NPL/English Electric seminar held at the Science Museum on 20 May 1993. Sadly, Ted Newman has since died, as recorded in Resurrection *issue 8. The editor acknowledges with gratitude the assistance of George Davis in editing the transcript of Newman's talk.*

New contact point

Readers wishing to contact the Secretary are reminded that he is now running the secretariat from his home, and can no longer be contacted at the Science Museum.

The new secretarial telephone number is 0234 822788. Letters should be addressed to Tony Sale, Secretary, Computer Conservation Society, 15 Northampton Road, Bromham, Beds MK43 8QB.

Russian computing: back from Siberia

Doron Swade

During the Cold War scientific collaboration between the West and the Eastern-bloc countries was officially prohibited. With the recent collapse of state communism as the official ideology of the former Soviet Union the West now has unprecedented access to centres of excellence and to the communities of scientists and engineers that people them.

The newly lowered ideological guard was one factor favouring a visit to our new and tentative allies in a Western-styled market economy. The determining stimulus was a range of extraordinary tales told by the growing trickle of Westerners returning from the former Soviet Union.

There were tales of Russian-designed machines built into DEC consoles that outperformed their Western equivalents by several orders of magnitude — Volkswagens with V8 engines; tales of ternary logic computers for which there was no Western counterpart (MIR); and finally, a tale of a winking monster — a Cold War supercomputer — that occupied an entire floor. It was rumoured to have thousands of flashing console lights, was operated in near darkness in the heart of Siberia, and was said to be the last working version of the legendary Besm-6 supercomputer.

The prospect of verifying travellers' tales of this kind was irresistible. I went to Russia to forage for historic computers for acquisition by the Science Museum, profoundly intrigued by these apocryphal yarns.

In preparation for what was to be my first trip to the former Soviet Union I read what I could find on Russian computers. The literature search was both baffling and revealing. In British computer culture names such as Edsac, Elliott, Pegasus, Deuce, ACE, and LEO have rich resonances for their designers, technicians and users.

I found that Russian computer culture has its own tribal icons — Ural, Mesm, MIR, Riad, Nairi, Strela, Besm, Elbrus — acronymic tags as rich in shared history and personal associations to the Soviet computer community as our acronymic mantras are to us. Yet these machines are practically unknown to Western historians of computing and barely feature in the historical canon.

A second striking feature of the literature search was how little public domain material has been published in English. A large part of what little there is has its origins in the US military. This material, written for the most part during the Cold War years, goes to extraordinary lengths to establish the 'backwardness' of Russian computer hardware. A central feature of the propaganda war was the issue of technological supremacy.

The triumphalist spirit in which Russian 'backwardness' is trumpeted appears to us now insensitive and even brutal. The trouble taken to convince ourselves of our own supremacy cannot be seen outside the context of threat and insecurity of the Cold War. The challenge to modern computer history is to evaluate the extent to which Cold War historiography is propagandist.

In the West, Russian programmers command respect and even awe. One reason advanced for the excellence of Soviet software is that the originality of their algorithms and the efficiency of their code was an enforced compensatory response to inferior hardware.

Others advanced more ominous reasons. Developments in science and technology that offered any prospect of practical application were appropriated and controlled by the state, and abstraction into theory was posited as a refuge from centralised control. The more abstract and theoretical the research the less manifest was its practical value and the greater the immunity from unwelcome controls.

The major strategic conflict in the development of Soviet hardware centred on the choice between 'make and take', ie. whether to maintain indigenous independent Soviet design, or whether to copy from the West. The tension came to a head in the late Sixties. The temptation to bypass long and costly hardware development cycles by copying Western hardware won the day. Sergei Lebedyev (1902-1974), an influential protagonist of independent development, was defeated by the copyist lobby. From then on Russian machines adopted Western architectures.

Hardware based predominantly on IBM, Burroughs and DEC machines was cloned, reverse engineered, pirated and sometimes even directly purchased. But the time-lag involved in cloning or reverse engineering proved to be an unforeseen handicap, and the performance gap in the hardware platforms apparently widened. The period of particular interest to the history of computing is the period of indigenous development starting in the late 1940s and which predates the era of cloning.

If the early Soviet computers, particularly the Mesm (1951/2), the M-20 (1958/9) and the Besm series (1953-1967), developed during the isolationist years of the Cold War, are similar in architecture and performance to Western contemporary machines, then this either says something significant about the uniqueness of the solutions, or that the official prohibition against technological exchange was not as complete as is publicly perceived. On the other hand, if Soviet machines are significantly different, then the Soviet computing community is something of a lost tribe. Either way the history of computing now faces a challenging new chapter.

In this abbreviated account I propose to omit discussion of particular machines, their development (technical and political), and the figures responsible for their design and production. (I am happy to provide sources for anyone interested.) Instead I propose to add to the growing corpus of travellers' tales that I found deeply revealing about Soviet computing culture.

Dima, a bearded fiercely gentle Muscovite, is Principal Programmer at the Institute of Physics, Russian Academy of Science, Moscow, and he took us to visit his Institute. As Principal Programmer, his state salary is $15 per month.

The atmosphere in the lab was casual. There was no evidence of any form of supervisory presence and staff seemed to be working on whatever they pleased. One physicist was experimenting with magnetic liquids, another the thermo-magnetic strips from which he was making novelty motors, which he hoped to sell. (Dima confided that the physicist's wife had been nagging him about money and his deficient entrepreneurial spirit in the new and insecure age of *perestroika*. So I bought a specially-made thermo-magnetic motor for $20 as a sample — a sum equivalent to six weeks state salary — as a way of alleviating this domestic difficulty).

This *laisser-faire* anarchy aroused my curiosity about lines of authority, delegation of duties and the hierarchies of responsibility. I presented the following scenario to Dima. I was a distinguished Russian physicist newly arrived at the Institute and I needed someone to write some programs. With a view to securing Dima's services I approached and described what I wanted. "What happens?" I asked, "How does it work?". "I tell you to go to hell" said Dima. "What do I do?" I asked, shocked. "Go and ask someone else". "What happens then?". "*He* tells you to go to hell".

He explained that he was not obliged to work for anyone and that I could secure the services of a member of staff only if I could establish some shared personal understanding and trust. I had read that in tsarist Russia survival depended on the mutual trust of a small group of close contacts, often using a system of nicknames known only to those in the group, and that reliance on personal ties remained the underlying social norm. Dima's response was a blunt reminder that Western preconceptions about the relationship between organisational structure and the *de facto* exercise of power could be misleading.

This was not the only instance in which the official hierarchy of authority concealed a subculture of personal networks of influence. On arrival at the Institute of Informatic Systems, Novosibirsk, Siberia, I asked after the legendary machines I had read about — Ural, MIR, and particularly the Burroughs-based supercomputer, Elbrus, the successor to the Besm. I was received with blank stares and polite evasions and I let it drop.

There were several days of intense negotiation over future collaboration between the Science Museum and the Institute, and over price and shipping arrangements for the consignment of historic equipment being bartered for. Agreement over each clause was accompanied by elaborate speechifying, a mandatory one-gulp swig of vodka, and renewed good fellowship.

On the third day our unremitting schedule of back-to-back meetings was suddenly cancelled. "At three-thirty" announced Dimitri Kouznetsov out of the blue, "you see Elbrus". This was the carefully guarded supercomputer the existence of which they had at first refused to acknowledge. The three days of negotiation appeared to have established a trust after which our hosts could not do enough for us.

Though bemused by our interest in arcane pieces of hardware long since consigned to obscurity, they sportingly foraged for us and took amused pride in not being defeated by any request. One of the prizes of these foraging parties was a large Russian-made 64K core store cloned for an IBM computer in the mid-Seventies proudly lugged into the meeting room by a grinning engineer and an equally chuffed deputy director of the Institute.

During the Cold War years the Co-ordinating Committee for East-West Trade (CoCom) controlled East-West technology transfer. CoCom regulations restricted the purchase by Eastern bloc countries of advanced technology from West — this to prevent piracy and advantage being taken, particularly by the military, of Western leads.

Long after 16-bit machines were off-the-shelf consumer items in the United States and Western Europe, CoCom regulations still confined advanced technology for West-to-East trade to 8-bit machines with restrictions on clock speed and memory size. I know from my own consulting experience that the DTI/CoCom bureaucratic labyrinth and the time taken to secure export clearance was enough to deter all but the most determined entrepreneur hoping to exploit Soviet market potential.

While being shown around the Institute of Informatic Systems I commented to our host that personal computers seemed plentiful. Secretaries had colour screens and Western software, and this conflicted with our received perception that personal computers were scarce and that technology transfer had been effectively controlled by CoCom. He laughed. Waving at the computers he said, "yellow PCs". He explained that these were branded and unbranded machines acquired from far Eastern plants under contract to Western companies. The Soviet market had been supplied by back-door arrangements for direct supply of PCs from the East where CoCom controls were impossible to enforce.

Dimitri Kouznetsov, a young computer scientist at the Institute, was our main translator in the protracted negotiations, and during our various visits. I asked him whether there was the same lust for personal computers in Russia as in the West. He pointed to the barred windows on the fourth floor of the Institute. "How far apart do you think they are?". I looked puzzled. "Just less than the width of a PC". He assured me that he was serious and that PCs had been lowered out of the windows to waiting recipients on the ground.

The attitude of Dimitri and his cronies to bureaucracy and officialdom was not always entirely reverent. The team had arrived at the Institute one morning to find uniformed guards on each of the landings prohibiting access to their labs. Apparently the place had been temporarily commandeered for secret military or space research computation. Security clearance was required though no instructions had been given to the guards about what form of ID was required or who had right of access. *Perestroika* and the uneasy adoption of market reforms had begun to undermine the formerly guaranteed security of academic tenure.

The Novosibirsk Institute has been singularly successful at attracting interest from Western companies seeking to outsource research and development in the former Soviet republic. The Institute sought increased financial security from such arrangements and Western companies hoped to take advantage of the vast untapped intellectual resource of the accessible Eastern bloc scientific communities. Several companies, Hewlett-Packard included, had sent delegations to explore R&D opportunities and individual company representatives had given Dimitri their business cards. Confronted with a demand for ID, Dimitri pulled out one of the Hewlett-Packard business cards, and offered it to the guard. The guard did not know what it was but was suitably impressed and let Dimitri pass.

Our Siberian hosts took us to a vast flea market that operated year-round in frozen wastes outside Novosibirsk. The market was called *barasholka* which literally means 'rubbish place'. This black market had operated throughout the Communist era and Dimitri regarded its survival as a monument to the indestructibility of something as fundamental to human nature as free trade.

The visit was concealed from the directorate of the Institute because of the physical risk to foreigners from hostile and mistrustful natives. We were warned to carry no money, not to carry a camera and in no circumstances to speak English. If we wished to purchase anything we were to signal and withdraw out of earshot and our renegade young hosts from the Institute would transact for us. They speculated that we were possibly the first foreigners to visit this market. Temperatures dropped to up to 30 degrees below zero. There was light snow and the winds were bitterly cold.

Next to livestock, car spares, furs, frozen meat, and household goods were stalls with ICs, electronic components, peripherals, radio spares and partial chassis and subassemblies — an open-air Siberian Lyle Street. Prized among this loot were reverse-engineered Sinclair ZX Spectrum clones with games tapes and Russian documentation.

These 'Sinclairs' as they were called came in a variety of shapes, colours and designs, and bore little resemblance to their Western counterparts. Motherboards were made unofficially in state electronics plants by underemployed workers. Sinclairs were assembled at home and sold in ones and twos. Vendors vied with each other to tout their latest mods. One of the two Sinclairs we purchased came with a guarantee — a handwritten note with the pinouts of the DIN connector for the tape player, and the telephone number of the teenager who had assembled the device. Cost: the equivalent of $19.

There was clearly a thriving market in home computers. In apparent contradiction, beside the cash till in most shops and hotels was a Russian abacus (*schyotti*). Calculations were done on the *schyotti* and the result entered and rung up on the till, even though most of these tills were capable of automatic addition.

When I asked about this curious practice I was told that the lay public was mistrustful of new technology and insisted on the *schyotti* as a symbol of traditional trusted procedure. Paradoxically, the *schyotti* is now threatened by rampant inflation — the traditional wooden frames and wire cross-pieces cannot hold enough beads to reckon with the smallest denominations of an increasingly devalued currency.

The leap by Apple Computers from Californian garage to multinational, and the efforts of Jobs and Wozniak in this remarkable saga, are part of the established legend of the personal computer revolution. The drive behind the Californian 'home brew' computer movement in the mid-to-late Seventies was the desire to possess and control your own PC at a time when the smallest available computers were minicomputers at prices largely prohibitive to individuals. It transpires that there was a similar initiative in Russia that started in the early Eighties.

A group of young computer scientists in Novosibirsk wanted their own computers and set about designing and making one. The first processor board (Kronos-1) was cobbled together from Russian-sourced ICs smuggled from various labs. Kronos-1 had 16-bit organisation though the microprogramming was written for 32-bit operation and memory extension to 128K. The processor board was designed to be plugged in to a multiprocessor host — typically a PDP-11 Q-bus clone.

By 1985 the plug-in processor was complete as well as a home-grown operating system called Excelsior and a 'Modula 0' cross-assembler. Later developments resulted in a stand-alone Kronos workstation used for offline software development for the MARS supercomputer project as well as other applications. The parallels with the Apple saga are remarkable though slightly delayed in time.

There is one obvious difference. Unlike the Apple II, the Kronos development did not result in a mass-production consumer product. Only 150 Kronos workstations were built. However, in a local sense, the project succeeded. Each of the team has a Kronos workstation in his home.

Kronos was a male deity worshipped by pre-Hellenic Greeks, and later identified with the Roman god Saturn. On the advice of his mother, Kronos castrated his father and took for his consort his sister Rhea and swallowed five of the children that ensued from the union. His son Zeus was spared from being swallowed when Rhea tricked Kronos into swallowing a stone instead. Zeus grew up and forced Kronos to disgorge his siblings and prevailed over Kronos in battle.

It is tempting to read allegorical significance into the name of the Novosibirsk computer project and I admit speculating that this young renegade team had chosen the name for symbolic reasons. Kronos denied history and disowned the past by castrating his father. This would seem to emphasise the independence of the new initiative and the wish to empower the young team at the expense of the establishment. The triumph of Zeus over Kronos could be seen as the repossession of history by the new generation having been denied by the old guard.

Any pretensions about the value of such speculation was rudely dispelled by the account given of the circumstances in which the project acquired its name. The team was sitting around one night at a loss for a project name and they decided to ask the first person to walk through the door to name the project and to be bound unconditionally by the result. When the friend arrived and was taxed with the task he said, "Kronos", and this was duly adopted. When quizzed the following day for an explanation the friend maintained that he had been seriously drunk, that he had never heard the name Kronos, and could offer no clue to its significance.

This account was corroborated on different occasions by different members of the development team. I tell the story against myself and the dangers of presupposing mythological meanings where none exists.

The Besm range of supercomputers is arguably the most influential series of computers in the history of Soviet computer science. Besms were the workhorses of scientific and military computation and successive generations of programmers used these vast machines.

The prototype Besm-1 dates from 1953 and Besm-6, the last of the line, dates from 1966. The Besm-6 is of particular interest: it is reputedly the last indigenous Russian computer to be performance competitive with its Western contemporary — the Control Data supercomputers from the mid-1960s. Over 350 Besm-6s were built and after 25 years the last of these were being taken out of service in the early 1990s.

The focus of the visit to Novosibirsk was to negotiate for and secure for the Science Museum the last of their four working Besms. The single surviving machine was surrounded by the debris of its predecessors which had been melted down for the salvage value of the precious metal content. In November 1991 the last machine was still operational and the timing of the visit was hastened to preempt the final threatened melt-down for salvage.

The four-Besm system had supported over 300 independent users and had provided a computing service for advanced research for military, space, engineering, meteorological and computer science applications. The installation had been progressively upgraded since its installation and the processor as found was a hybrid germanium/silicon discrete component transistor system with IC memory supporting standard disc and tape storage and an intact roomful of operational punched card equipment.

The negotiations for the Besm were tortuous though ultimately successful. The logistics of getting two 20-foot Euro-containers of equipment out of Siberia in a context of collapsing infrastructure is a tale for another time. The consignment of equipment is now stored in an aircraft hangar at Wroughton in a Science Museum store.

The shipment includes a Kronos workstation, three generations of Kronos processor boards, a PDP-11 cloned host for Kronos, an AGAT personal computer (the Russian Apple II), and a large Russian-made core store. The Besm system constitutes the largest collection of items. This consists of a full Besm processor, power supply cabinets, multiple examples of peripherals, cabling, documentation and spares. A condition of the exchange was that the Besm was to be decommissioned, packed and shipped with a view to its restoration to working order in London.

The intention is for the CCS to restore the Besm to working order in public view with a team of Russian and British engineers, and to conduct the first non-aligned comparative evaluation of Eastern and Western contemporary machines. Sponsorship initiatives are in progress to raise the £40,000 needed for the project. With a more detailed understanding of this seminal Soviet Cold War supercomputer we can perhaps revisit Cold War claims about rumoured Russian technology lag and dispel or confirm some of the myths about our new allies.

Doron Swade is Senior Curator (Computing and Information Processing) at the Science Museum. This article is a condensed and edited version of the talk given by him to the Society at the Museum on 30 September 1993. Technical material and discussion of particular Soviet computers has been omitted.

After the Elliott 400 series

Hugh McGregor Ross

This article provides an eye-witness view of the events following the design of the Elliott 401, resulting in two separate lines of development at Elliott Brothers and Ferranti.

There were three vital characteristics of our work in the fifties. The first was that it was highly innovative; we were aware that work on digital computers was important without knowing or even being much interested in what way it would go. We were launching into the unknown.

The second characteristic was that most workers were young; many were almost straight out of college. Largely as a consequence of this, intensive personal loyalties developed to the leaders of the individual groups. These leaders became for some of us like hero-friends.

The third feature was that each project was markedly new. It was built on the experience of previous projects but was emphatically not a copy, nor were there any considerations of backwards compatibility. That was a concept which had not been invented in those days, though today it is a primary factor in the development of computer technology. But we had no interest, or awareness even, of the importance of looking back to an earlier machine.

I was introduced to the Elliott Brothers Research Laboratories by the Cambridge University Appointments Board, and John Coales became one of my hero-friends. He created a job for me in the Laboratory. I was engaged amongst other projects on a small scale analogue computer; all these involved very high reliability, high performance, conventional electronics for those days.

My laboratory was across the corridor from the laboratory where Bill Elliott was developing the 401. George Felton was assisting me, and we used to travel to and from work together. He would tell me about these new-fangled digital machines and this extraordinary business called programming which I, as an analogue electrical engineer, found all mumbo-jumbo. We became very good friends as a result.

Some of us at the Research Laboratory had very great personal loyalty to John Coales. We recognised the capability of Leon Bagrit; we recognised his technical guidance from Dr Ross, and in no way do I now wish to belittle the great achievements of those two men. However they were as different from John Coales as chalk is from cheese.

We were aware that marked tension was developing between Bagrit and Ross on one hand and John Coales on the other. A particular episode occurred; we had a lunch canteen, and I was sitting there when Coales and Dr Ross came in. I saw Dr Ross hand his coat and hat to Coales in exactly the same way as one would hand a hat and coat to the concierge at the club. I realised as a result of that discourtesy that John Coales' number was up.

That evening I started to seek alternative employment. It took a little time but eventually I approached one of my other hero-friends whom I'd worked under previously, Vivian Bowden. He was a man of fantastically innovative thinking; furthermore he had an extraordinarily penetrating form of thought and he could draw conclusions with extreme vividness and accuracy.

He had been engaged by Sir Vincent Ferranti to join the Ferranti computer department in Manchester. At that time they were working on the engineering development of the Manchester University computer designed by Professor FC Williams, exploiting the CRT high speed storage technique.

So I approached Bowden and he took me into the Ferranti computer department. He had previously been recruiting, and remembering one of his long-term friends, Bernard Swann, had managed to prise him out of a high level in the Civil Service in Whitehall to go to Manchester to work on this new-fangled digital computer. I was appointed as deputy to Swann.

I became a computer man in the same week as the first electronic digital computer was sold commercially anywhere in the world. Bowden, aided by Swann and three or four of the Manchester team, had managed to persuade Shell Petroleum Company that a digital computer would be useful for optimising the movements of their merchant tanker fleet.

I often reflect that in one working lifetime I have seen the progress from the very first commercial sale of all to the position where you can go along to the High Street and buy a computer from somebody who has just been selling sweets. That was the start of the computer business. It had not been a business before then: it had been an academic research activity or a way of finding solutions to military needs.

Bernard Swann soon realised from his experience in Whitehall that trying to sell computers from Manchester was not practical. He decided that a group had to be set up in London, so he shifted me down there.

Very soon I was joined by Chris Wilson and Conway Berners-Lee. Chris went on to hold high office in ICL, and Conway still does very valuable work in ICL.

In order to develop this business for computers Swann realised that we had to have a computer centre in London, not just a sales representative, so I was largely involved in setting up the first computer centre. This was at 21 Portland Place, nearly opposite the BBC.

We very soon found that we would have to have software capability in this computer centre, and so I suggested to Swann that George Felton should be approached to join us. By this time John Coales had in fact left Elliott Brothers — my hunch during that lunch-time had proved true — and his leaving produced a great deal of distress. So it was not at all difficult to get George Felton, who also much admired John Coales, to come to Ferranti.

As another by-product of Coales' departure, Bill Elliott also left Elliott Laboratories. He had gone to Cambridge University along with the 401, and so I suggested to Bernard Swann that it might be very good for Ferranti if we could get Bill to join us.

This was exceedingly tricky because it was obvious to everybody that Brian Pollard, engineer in charge and general manager of the Ferranti computer activity in Manchester, and Bill Elliott would never mix. Often as I was living through the consequences of this I used to think to myself "the moon cannot stand the sun".

So a device was thought of to establish a laboratory for Bill Elliott in London. When he went for interview with Brian Pollard I, as the only person in Ferranti who knew Bill, was deputed to meet him in Manchester and escort him to the interview. It all went all right until at the last moment, Pollard unnecessarily and meanly insulted him.

As we came out of the interview Bill said "What does that mean?". I was just beginning to be a salesman then, and I had to do some very slick sales talk to persuade Bill to stay with us. It must have succeeded because he did join us.

In doing so he brought several of his colleagues from Elliott Brothers, and the one who is particularly remembered is the late Charles Owen. He also engaged engineers from other walks of life because you must remember that there was nothing like a computer industry — the business had only been going about six months. I would particularly mention Brian Maudseley and Ian Merry.

The NRDC had been supporting Bill Elliott's work on the 401 at Elliott Brothers, and they were certainly interested in promoting the development of package computers. So they agreed to underwrite the development of 10 new machines by Ferranti to be developed by Bill with the London team. I want to emphasise that this was a true new development, a genuine advance on the 401, building on Bill's experience; it was *not* a transfer of the Elliott Brothers design.

A crucial factor in NRDC's arrangements with Ferranti was that Christopher Strachey should have influence over the design of the new machine in order to meet programmers' needs. Again and again Christopher Strachey would suggest that some or other fancy new feature had to be provided.

Bill Elliott was primarily concerned to ensure that a really good engineering machine should be made, which could be made quickly, easily, cheaply and above all should be reliable. So whenever Christopher Strachey asked for a new feature, it clashed with interests which were paramount for Bill Elliott.

Bill says he doesn't remember there being fierce tussles between himself and Christopher Strachey, but I do. They were quite intense, as both men were of the highest calibre who would never give way and would stick to their principles. In the event Bill always came up with a satisfactory engineering solution to Strachey's requirements.

George Felton became Christopher Strachey's in-house right hand man. While he'd been at Elliott Brothers he'd met Peter Hunt who was exploring the use of digital computers at de Havilland Aircraft at Hatfield. I also knew Peter, so it was not too difficult for us to propose to Bernard Swann that Peter should be invited to join the Ferranti software group in London. So we then had in-house these two highly able software people, both of whom have gone on to hold high positions in ICL.

So that is how there came about the split of digital computing activity from a single line in Elliott Brothers to two lines in Ferranti and Elliott Brothers. The people I've mentioned were the key players: everything centred around them.

As they built up groups of men and women to support them, these groups centred their attention and their loyalties on their respective leaders. All this work was intensely related to personalities and the intangible qualities of inspiration and enthusiasm.

The work at Ferranti on package computers became Pegasus, which in my view was the most seminal computer of all time. It led to Pegasus 2, evolved to suit commercial applications better, and then Perseus.

Particularly from experience gained on Perseus, George Felton was able to develop ideas which went into the later Ferranti Orion 1 and 2 computers. Those ideas were particularly associated with the operating system.

Orion 1 used a very poor kind of package, but Orion 2 was really good and had without question far and away the most advanced operating system and facility for simultaneous programming of any computer of its time.

Together all this determined many of the crucial features of the ICL 1900 range, and much of Pegasus can even be seen in the 2900 range. The software capability of Orion 2 led in due course to the George operating systems, which in my experience were very much better than the IBM operating systems. Indeed I consider that it was better basic software which enabled ICL to keep its head up in competition with IBM. All of that can be traced back to the work on Pegasus, and particularly the software side introduced by Christopher Strachey.

There's a last vital point I must make. From his experience in Government, Bernard Swann thought it important that prospective customers for computers — and remember that we were building up a computer business — should themselves learn how to use these new machines.

This was a revolutionary idea, and quite contrary to the idea of a computing service where people bring their work in for say Ferranti or Elliott to do the work for them. The idea was that people who knew their own work should come in and get their feet wet with computing. No doubt Bernard Swann was actively supported in this by Vivian Bowden who had extraordinarily farsighted vision.

This concept was only realisable because of two particular qualities of Pegasus, which were at the time unique. The first was its engineering reliability.

I have a note in my diary saying "11 o'clock, 6th March 1956, Pegasus handed over to users". My memory is that on that day Brian Maudesley and Ian Merry had been doing the final engineering checkout on the machine and they said "Right; now it's for you to allow the users to come in on it". That meant that George Felton and Peter Hunt had full time on it and that we as sales representatives could bring in people from outside to try to use the machine.

The second unique feature was its ease of programming. It's only because of that that we had any hope at all of getting people from outside to try their hand at it. George Felton and Peter Hunt particularly put great effort into training not only our own staff but also customers. This could only be implemented because of these qualities of this machine that we'd got, qualities that were absolutely fundamental to the creation of the computer business.

This article is an edited version of a talk given by the author as part of the Elliott/Pegasus all-day seminar at the Science Museum on 21 May 1992.

Editorial fax number

Readers wishing to contact the Editor may now do so by fax, on 081-715 0484.

Working Party Reports

Elliott 401

Chris Burton, Chairman

The conservation of the sub-units of the system is expected to be completed soon, whereupon everything will be transported to the Elliott room at Blythe House.

Some progress has been made with elucidation of the logic diagrams; this is more and more bound up with understanding and refining the definition of the order code. The work has been helped by input from members who were once programmers for the machine.

Collection of as much drum track data as we think possible is now complete. Regrettably, one track has been damaged due to collapse of a speck of dirt which allowed the head to touch the drum surface. Preliminary analysis of the coding of the Initial Orders on Track 0 has started activity towards a fuller annotated description and understanding of their function.

A large three-phase Variac has been acquired for the Society, which will be used initially for the systematic recommissioning of the power supply system.

North West Group Pegasus

Charlie Portman, Chairman

The Working Party has now been set up and is in operation. Membership is Adrian Cornforth, George Roylance, Ken Turner, Keith Wood and myself.

The first meeting took place on 18 January. This involved induction into the Museum's health and safety procedures, as well as a briefing on conservation procedures and standards. After these necessary preliminaries, we started planning our "attack" on the Pegasus conservation project.

DEC

Adrian Johnstone, Chairman

Work will soon begin in our new home as a result of the Museum's agreement to allow Working Party Chairmen to act as surrogate curators.

We have been offered a PDP-11/70 and some other VAX and PDP-11 kit which Tony plans to find space for at Bletchley Park. The catch is that the equipment is presently on board a ship moored on the Victoria Embankment, and can only be unloaded when the tide is right!

One of the aims of the Society is to interest young people in these fine old machines so that technical expertise can be passed on to a new generation. I have formed a group of interested students at London University, who are learning how to drive old DEC systems and who will in time, I hope, develop new applications for them which will interest the general public as well as contemporary users of the machines.

In particular, we hope to make use of the speech synthesiser on our PDP-12, and some of my students are interfacing a speech synthesiser of our own design to a PDP-11. We are also restoring an array procesor for image processing complete with camera which runs with an LSI-11/23. We hope that the combination of speech and vision will enliven future Open Days.

North West Group

The North West Group would particularly welcome any material — data, manuals, film — on the Ferranti Sirius and Metrovick 950 computers. Anyone who can help here or who would like to play any part in the group's activities should contact secretary William Gunn at 23 Chatsworth Road, High Lane, Stockport, Cheshire SK6 8DA: tel 0663 764997.

Forthcoming Events

9-10 April 1994, and fortnightly thereafter Guided tours and exhibition at Bletchley Park, price £2.00

For details see Society News.

19 May 1994 All day seminar

The design and development of the IBM 360 series, starting 11.00 am at the Science Museum. *(To be confirmed)*

14 or 21 June 1994 North West Group meeting

"How on earth did we ever manage to make the hardware useable?"

September 1994 North West Group meeting

Highlights from the best of the London meetings.

December 1994 North West Group meeting

The transition from valve to sold state machines.

The North West Group meetings will be held in the Science Museum Conference Room, Manchester, at 5.30 pm. Details of speakers and of precise dates will be notified to members when plans have been finalised.

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