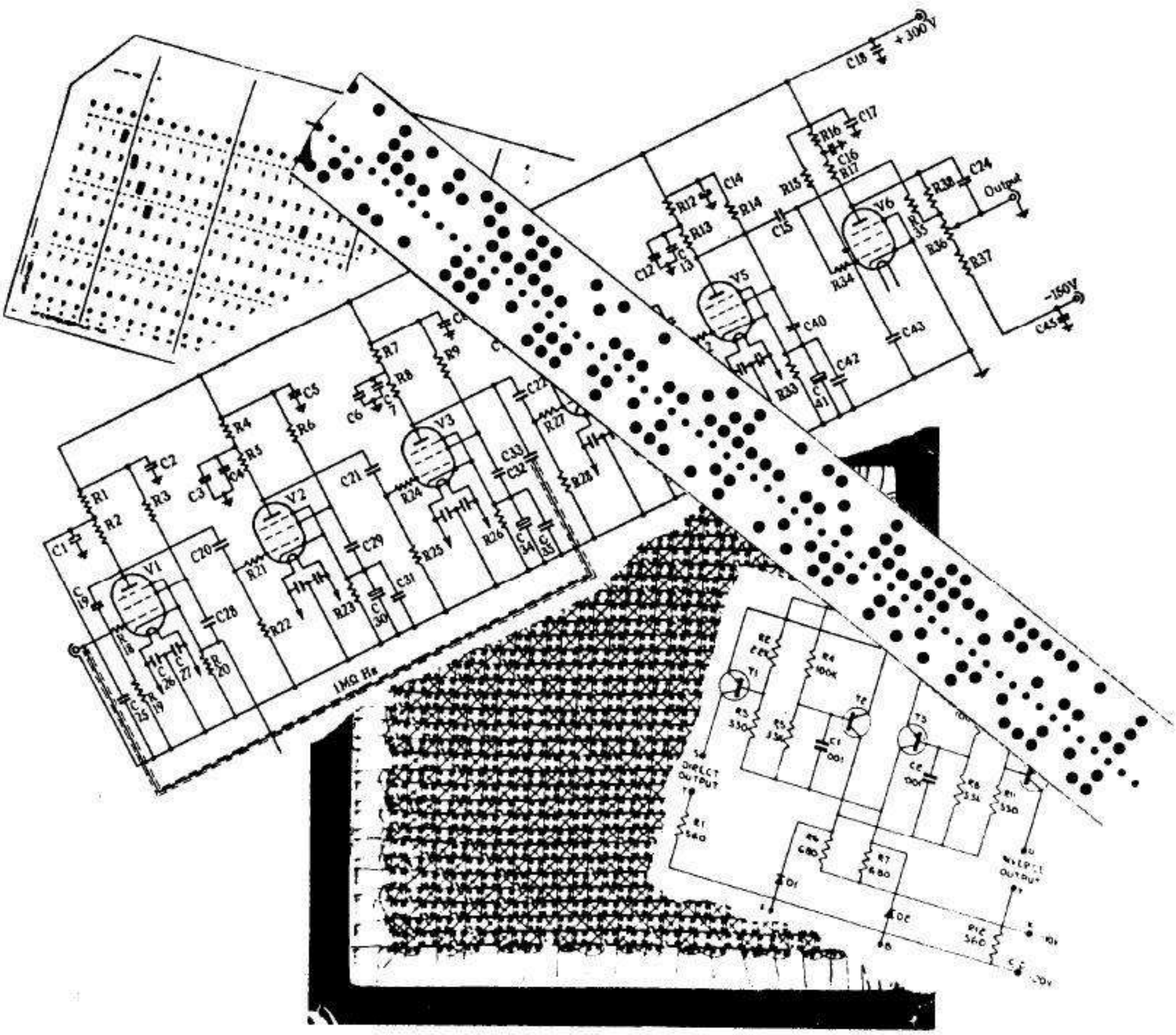
Issue Number 56 **Winter 2011/2**

Computer

RESURRECTION

The Bulletin of the Computer Conservation Society



The British Computer Society

&

The National Museum of Science & Industry

Science Museum

Computer Conservation Society

Aims and objectives

The Computer Conservation Society (CCS) is a co-operative venture between the British Computer Society (BCS), the Science Museum of London and the Museum of Science and Industry (MOSI) in Manchester.

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

The aims of the CCS are:

◊ To promote the conservation of historic computers and to identify existing computers which may need to be archived in the future,

◊ To develop awareness of the importance of historic computers,

◊ To develop expertise in the conservation and restoration of historic computers,

◊ To represent the interests of Computer Conservation Society members with other bodies,

◊ To promote the study of historic computers, their use and the history of the computer industry,

◊ To publish information of relevance to these objectives for the information of Computer Conservation Society members and the wider public.

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

The CCS is funded and supported by voluntary subscriptions from members, a grant from the BCS, fees from corporate membership, donations and by the free use of the facilities of both museums. Some charges may be made for publications and attendance at seminars and conferences.

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

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ISSN 0958-7403

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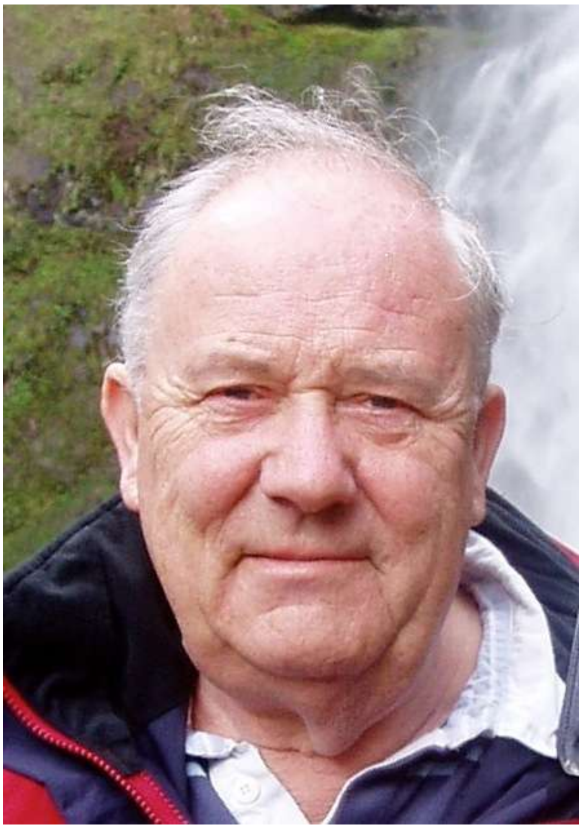
Chairman's Report

David Hartley



This is my fourth and final report as Chairman of the CCS Committee and covers the period October 2010 to September 2011.

Absent Friends

Sir Maurice Wilkes died in November 2010 aged 97 after almost a century of pioneering in the field of computing. He was always a strong supporter of the CCS. Your Chairman gave a tribute lecture at the Computer History Museum in May. A major tribute was held in Cambridge in June and a CCS tribute took place recently as part of the CCS London programme.

It is especially sad to have to report the death of Tony Sale in August 2011. Many tributes have been paid to Tony, including BBC radio and television and there will no doubt be more. In the context of CCS there are three things that stand out: his contribution to the founding of the Society, his fight to preserve Bletchley Park and the incredible achievement in rebuilding Colossus.

Projects

Technical progress in the various CCS projects is reported regularly in *Resurrection*. Here are some of the highlights of the year.

> Once again, at Bletchley Park the Turing Bombe and Colossus continue to be major attractions at the cryptography museum and the National Museum of Computing respectively. During the year a volunteer group at TNMoC completed the Tunny replica, which uses keys found by Colossus to decrypt messages from German Lorenz cipher machines. In July our projects figured prominently in a visit of the Queen and the Duke of Edinburgh to Bletchley Park. The

indomitable veteran Jean Valentine demonstrated the Bombe and Colossus was demonstrated by the late Tony Sale.

Also at TNMoC, progress has been made with the ICL 2966 and the IRIS air traffic control system, although work on the Harwell Dekatron Computer has been slow due to illness.

Some important circuit diagrams have been acquired for the PDP 8, thanks to the assistance of the Computer History Museum in California.

The SSEM (the “Baby”) has been re-installed in the new gallery at the Museum of Science and Industry in Manchester and is again being regularly demonstrated by our volunteer team.

Following a visit from members of ISACA (Information Systems Audit and Control Association) a donation to help support the team was received. Progress continues with the restoration of the Hartree Differential Analyser.

At the Science Museum in London, the re-restoration of the Pegasus has continued to be delayed, but the necessary work including the certification of the volunteer team and tests connected with electrical safety have started. The Elliott 401 project is being reviewed. More volunteers are needed, and in anticipation work has been done to establish model roles for volunteers. The Museum has submitted a successful first stage bid to the Heritage Lottery Fund for a gallery entitled *The Making of Modern Communications*. CCS members are active in the development of the new gallery.

Two substantial new projects were established during 2010-11. The EDSAC Replica project aims to build in as authentic a manner as possible a replica of the original Cambridge computer that ran its first program in May 1949. Work so far has involved discovery of necessary archive material and reconstructing the technical design details. The replica is scheduled to be built at TNMoC and construction work is planned to begin there in 2012. The project is being managed by a charitable trust and is being funded by a consortium led by Cambridge computing entrepreneur, Hermann Hauser.

A project has been established to plan and build Charles Babbage’s Analytical Engine, the first phase of which is to digitise and conduct a detailed examination of the technical drawings in the archive held by the Science Museum. Doron Swade is the CCS representative on the project’s management board.

North West Group

Ben Gunn has retired after 17 years as secretary to the CCS North West Group. In May, Group Chairman Tom Hinchliffe led a small party to Ben's home in Penistone for the presentation of a Certificate of Appreciation from the BCS together with a whisky decanter from all his friends in the North West Group. Gordon Adshead has taken over the position of Group Secretary.

Publications and Websites

Thanks to the energies of editor, Dik Leatherdale, *Resurrection* has continued to be circulated quarterly to all CCS members. *Resurrection* is not only a journal of record for the Society, but publishes much material of historical value.

Alan Thomson continues as website editor ensuring that the site remains up to date. Further work has been done to integrate the website with the main BCS site and now includes information on historic computers initially provided for the BCS by Simon Lavington. A new venture has been to add pages to the website providing details of many of the computer museums in the UK. These pages will be updated as the CCS becomes aware of them.

Alan Turing Centenary

Last year the CCS instigated planning for a public exhibition at the Science Museum to mark the centenary of the birth of Alan Turing. The Museum has been successful in obtaining sponsorship and we look forward to seeing the fruits of this in 2012. At the same time, under the editorship of Simon Lavington, a book entitled *Turing and his Contemporaries: Building the World's First Computers* has been written by various members of the CCS Committee and will be published by the BCS in 2012.

Events

Roger Johnson as Meetings Secretary continues to manage the London events programme, while Gordon Adshead does this for the North West Group. Included at the two venues were *Research Machines* by John Leighfield (Chairman of Research Machines and a Past BCS President), *Tales of the Unexpected: an Alternative History of the Computing Industry* by journalists John Naughton and Bill Thompson, *Konrad Zuse and the Origins of the Computer* by his son Horst Zuse, *The Story of Elliott-Automation Computers, 1946-1986* by Simon Lavington to mark the publication of his book and *The LEO Story* by Gordon Foulger.

Introducing.....

Rachel Burnett

My career combines law together with experience in the IT industry. After graduating, I worked as a systems analyst, in systems development and subsequently project management. I started off at the Post Office, which then included BT. The Post Office was one of the largest of the relatively few organisations using IT at that time, on a range of computers including ICL System 4 and IBM 360/370 machines. In the 1970s I was part of a team developing the Broadcast Receiving Licence system, the first to use the new postcode system nationally for all UK households, then one of the most complex storage and retrieval systems in Europe. I went on to work at Sainsbury's (on distribution systems, using ICL 1900s), at the Midland Bank (the first on-line system for foreign exchange dealers) and at Brooke Bond Oxo (mainly IBM 360/370).

While working in IT full time, I studied law by distance learning, to become a solicitor. Expansion in software development, particularly the move away from manufacturer-supplied software and the introduction of the PC in the early 1980s, brought in the new area of IT law. I joined another solicitor in one of the first IT legal practices. I subsequently became a partner in City of London law firms, then ran my own niche firm and am now Head of the IT/IP law team at Paris Smith LLP in Southampton, acting for both IT suppliers and users.

I am author of several books on IT law, including books on IT contracts, outsourcing and the *IT Law Guides* series published for the Institute of Chartered Accountants. I have been awarded an Honorary Doctorate in Technology from Southampton Solent University and work with the Open University Law Programme. I am a Livery member of the City of London Information Technologists' Company and past Chair of the Institute for the Management of IT Systems.

I was President of the British Computer Society 2007-2008. Other BCS roles have included Chair of the Management Forum and membership of the Security Committee. I am delighted to become CCS Chair, although it will be a hard act to follow David Hartley's Chairmanship. I am looking forward to being closely involved in all the exciting work which members carry out.

Editorial

Dik Leatherdale

As you will read elsewhere in this issue of *Resurrection*, at the end of August we lost one of our founding fathers, Tony Sale. As a mark of our regard for him, readers will have noticed that the front cover reverts to Tony's original design for *Resurrection*, taken from issue 1, May 1990. Tony will be missed by all sorts of people for all sorts of reasons, but his contribution to the founding of *Resurrection* will be remembered with gratitude.

This issue also marks the end of David Hartley's chairmanship of the Society. After four years he has handed the baton to Rachel Burnett who introduces herself on page 5. I have worked closely with David over most of his period as chairman and I feel compelled to pay tribute to the way in which he has devoted himself to the affairs of the Society over his period as chairman. As well as giving us the benefit of his seemingly boundless energy, he has that deft touch with people which seems to make them want to do what he wants them to do. All the best managers have that and David has it in spades. He is also entertaining company. An evening spent with him in a restaurant (and there have been a few) is always an evening well spent. Thank you David.

2012 brings the centenary of the birth of Alan Turing, surely one of the most significant figures in computer history, albeit one on whom opinions remain sharply divided. We will hear a great deal about Turing in the coming year with the CCS contribution well to the fore.

But 2012 is also the 50th birthday of the Manchester University/Ferranti Atlas 1, in its day the most powerful computer in the world, albeit not for very long. As you can read elsewhere, Flossie, our pet ICT 1301, will also have clocked up 50 years in 2012.

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Society Activity

ICL 2966– *Delwyn Holroyd*

I finally resolved the stubborn problem that although the machine passed all diagnostic tests it still wouldn't boot. Following study of the bootstrap source code I realised that the mechanism by which it communicates with the SCP is not exercised at all by the diagnostic tests – quite a significant omission! With everything else eliminated this proved to be the problem and we then found another open circuit on the connectors between the two platters in the OCP. I have now buzzed out every wire to make sure there are no more!

Thus the machine is now able to run 2900 order code and passes almost all the higher level tests (the only failures are two tests which should cause an exception but don't, which doesn't impact normal code). I have completed reconstruction of the remaining data from the diagnostic disk pack onto a new virtual Engineers' Test Library tape. This contains TOSD (a multi-tasking Test Operating System similar in style to 1900 operators' exec) and a selection of peripheral tests to run under it.

The 7501 terminal has been successfully interfaced to the DCU but appears unable to run the terminal executive available in the test program. The line printer has been re-commissioned and tested and we were able to use it to dump the memory of the 7501 and a comms trace to aid investigation of this problem.

Recently I demonstrated Maximop running on the 7501 (under emulated George 3 on a PC) for Arthur Dransfield, one of the original development team. He is still in contact with most of the team. Unfortunately the source code is not thought to have survived – I only have a binary copy.

Work has started on the two card readers. The mechanics aren't too bad but all the major boards in both readers are faulty and one has a faulty power supply too! Luckily we have schematics and technical descriptions for everything, so restoration should be possible.

A new 2900 interface PCB is under development to replace the somewhat unreliable hand wired board currently in use. The new PCB will be able to act as either a peripheral or controller end and additionally will enable speedier data capture from the remaining EDS80 disk packs (containing VME).

The Hartree Differential Analyser – *Charles Lindsey*

Most of the items that were mentioned in my last report as "ongoing" are now in place. The solenoids are installed and working, the missing clutch has been bypassed so that we can now use both integrators and so we are now able to run the classic "circle test". This starts from the differential equations

dx/dt=y and
dy/dt=-x

which lead to the obvious solution

x=sin(wt)
y=cos(wt)

so if you plot x against y you get a circle, which is precisely what the machine does. The interesting question is whether the circle comes right round and joins up where it started, which it does within about 2mm – pretty good considering the amount of backlash present which causes the circle to grow a bit every time one of the variables passes through zero.

The only blot is that one of the shafts broke (possible due to stress caused by misalignment). But we manufactured a new one and all is going again.

Future work will mostly be directed at how we are going to exhibit the machine to the public. We need gadgets like a toy integrator and a toy slide rule for the public to learn about analogue computing and we need to reorganize the display material already present in the gallery to explain what it is all about.

A short video of the Differential Analyser in action can be seen at *www.cs.man.ac.uk/~chl/hartree.html*.

Bletchley Park 1

On Friday 15th July, the Queen and Duke of Edinburgh visited Bletchley Park to meet some of the veterans involved in the World War II code-breaking achievements. As part of the event, the Bombe reconstruction was demonstrated to the Queen by Jean Valentine, one of the veterans who regularly show the machine to visitors; while John Harper, leader of the Bombe team, explained about the machine's reconstruction to the Duke of Edinburgh.

The Royal party also visited The National Museum of Computing which included a demonstration of the Colossus rebuild by the late Tony Sale.

ICT 1301 – *Rod Brown*

The seventh open day of the project went off on the 17th July with good visitor numbers. In what seemed like a whirl of a day many new contacts have been forged.

Special visitors on the day were Brian Spoor and Lorna of 1900 emulator fame, who made the journey from Devon to see the event. Lorna was seen to take over some of the questions at front of shop from visitors. We appreciated her help. Brian also delivered several boxes of paper tapes and teletype rolls, a most welcome gift. Delwyn Holroyd also made the trip and we had a chance to talk and compare notes between the 1301 project in Kent and the 2966 project running at Bletchley Park.

Another notable visit on the day was from Peter Ling, his wife and some of the grandchildren. This is what we love to see, children goggling at the size of the machine and being able to experience the spectacle of such a machine running and on public display. Further special thanks go to Peter for donating the 1302 console he has kept safe all those years and also the 1302 manuals which we are now going to trawl through to discover more about this very rare gem in ICT/ICL's history.

Another visitor on the day was a nice surprise this time from CCS member John Edwards. It was an IBM 026 keypunch which John has donated to the project after your editor's article in *Resurrection 54*. Many thanks go to John for this kind act. Mrs Edwards said she was only too glad to get a piece of the garage back! Many of the visiting children also agreed that John had done the right thing and left with freshly punched cards clenched tightly in their hands, having had the fun of producing them as well.

After the rush of the open day the project has settled down again to completing the interface which is designed to capture the raw magnetic tape data from the system (our last remaining original project target). This needs to work at four megabits per second in burst mode as each assembled register of tape data is spat out of the machine. It has been quite a challenge to complete so far.

We will be having another open day on the 21st of October which is reserved for the local Kent U3A to discover us and what we do for the CCS. The project is trying to organise a 2012 event which will take place in the 50th year of the machine. A trawl through the original documents shows a final sign off date of approx. 19th September 1962, so 50 years on is the date on which we are focusing as the official celebration point.

As usual all updates are online at *www.ict1301.co.uk/1301ccsx.htm.*

ICL Archive – *Hamish Carmichael*

Three ICL 1900 manuals have been added to the ICL Archive at the Science Museum Library as has a book by one J. Sandford Smith on Punched Cards, MacDonald & Evans, 1960. An interesting point is that it is marked as having been the personal copy of Mr Cecil Mead, who was a director of BTM and later of ICT.

KDF9 Emulator – *Dave Holdsworth*

The KDF9 emulator is now available for MS Windows in addition to the Mac and Linux versions announced earlier. Details can be found at: *www.findlayw.plus.com/KDF9/emulation/emulator.html*

A new user program has come to light, to add to our collection of KDF9 software that we can now execute. We would very much like to hear from anyone who has KDF9 programs from their past as well as any paper tape, cards or printer listing.

At Leeds University we developed KAL4, a new assembly language for KDF9 in which much of our (now lost) system software was written. However, I have a printer listing of the assembler and have hopes of getting it executing. KAL4 was also used at NPL, so I would also like to hear from anyone who has KAL4 software in whatever form.

EDSAC Replica – *David Hartley & Chris Burton*

The establishment of the charity to oversee the project is continuing but slowly. The trustees will be Hermann Hauser and Andrew Herbert (appointed by the Hauser Raspe Foundation), Andy Hopper and Peter Robinson (appointed by the University of Cambridge), David Hartley and Kevin Murrell (appointed by BCS). Once the charity has been set up, the project will have a more formal existence and fund raising will commence.

Andrew Herbert, lately Chairman of Microsoft Research EMEA and an alumnus of the Cambridge Computer Laboratory, is to be Project Manager.

The interim management board, consisting of Chris Burton, Martin Campbell-Kelly, David Hartley, Andrew Herbert, Jack Lang and Kevin Murrell, met on 27th September to review progress.

Little design progress has been made due to pressure of other work. The logic simulator has reached the point where it will require input from “new” logic for undocumented areas of the machine.

The engineering drawings for the example chassis mentioned in the last report were taken to a local (to CPB) company who claimed to have the appropriate machinery. Laser-cutting of the sheet metal parts was very satisfactory, but they seem to have little control over accurate bend radii on the folded flanges. Consequently the chassis was difficult to assemble without forcing hole alignments. A further sample will be needed, from another supplier yet to be identified.

Proposals for implementing the Delay Line store have been reviewed. Because of the cost and safety implications of mercury, we may have a single such delay line as an example and rely on either semiconductor or wire delay lines as the main realisation. In any event, initial implementation of semiconductor store will be straightforward and take the pressure off early dependence on a delay line store. It is likely that we ought to replicate the complete design of the store regeneration chassis (the sole extant chassis type preserved in the Cambridge Computer Lab) rather than make a cut-down version suitable for semiconductor or wire delay lines. The consequence will be the need to make many tuning coils and to set them up and to provide special 13.5 MHz interfacing to whatever modern store technology we use. More thought needs to be applied to this area.

A start has been made on teasing out the design of the store gating system in the three chassis in the middle of the store racks, but little convincing progress has been made so far.

Bletchley Park 2

In October it was announced that Bletchley Park has been awarded a grant of £4.6M (yes! £4,600,000.00!) by the Heritage Lottery Fund. The grant is for the restoration of huts 1, 3 and 6 which is where codebreaking took place. The grant also covers development of a visitor centre in Block C which is currently derelict.

More details at *www.bletchleypark.org/news/docview.rhtm/651072*

Elliott Project – *Terry Froggatt*

The remit of this Project has been extended to cover the growing collection of Elliott computers at TNMoC.

The Elliott 803 went “pop” when it was turned on one day in July. The fault was traced to a 0.1µF mains suppressor capacitor in the paper tape station which had exploded. This was replaced with a modern suppressor and all was well.

As reported in *Resurrection 53*, TNMoC was offered an Elliott 903 last year, which arrived in November after it had been standing for several months on a wet carpet. A small team has been working on it intensively since February. The CPU with its 18-bit 8192-word core store was ferried to Hampshire where it stood alongside a working 903, enabling several faults to be located by card-swapping. The rust on parts of the tape reader and some of the chassis has been cleaned up by electrolysis. When the system was reassembled at TNMoC, the 903 successfully ran ALGOL and Basic programs, using a DEC VT220 current-loop VDU in lieu of a working Teletype. The front metal covers were replaced by acrylic sheets so that the internals can be seen safely by visitors, then it was placed on display in August. Work continues on an extra 8192-word store module, the paper tape punch and the engineering display panel.

Finally, an Elliott 905 was donated to TNMoC in 2008. Whilst this has been on display for some time, no attempt has been made to reconnect the cables or power it up. TNMoC would appreciate help with this dual-processor 905 from anyone familiar with its internal workings.

Bombe Project – *John Harper*

We now have enough people trained to operate to enable us to provide demonstrations every Saturday and Sunday plus ad hoc offerings on Tuesdays between other team activities. The operator schedule has been taken over by one of the BP management team.

The reliability over the last year has been very good. We almost always run a real job although I have to admit that we know the correct stops. On the other hand this does show that the machine is working correctly.

With many different operators, I thought we would have problems with such things as drum brush damage. However this has not been a problem worth worrying about. In fact we have had just a few brushes coming loose due to missing something during assembly rather than problems due to handling. We have unfortunately had minor handling damage to the drum covers and have asked for more care to be exercised.

The main machine has failed twice over the last year. One problem was due to a motor fuse blowing. We have had this before so we went back to a specialist supplier armed with start-up current figures and waveforms. They came back saying that we had the wrong specification fuses. Subsequently they supplied replacements for free and we hope that we shall not now have a repeat of this problem.

The second problem was a taper pin falling out because it had not been punched in tight enough. This and the previous problem were quickly fixed. It is quite gratifying to realise that our replica has comparable reliability figures to the originals.

Analytical Engine – *Doron Swade*

Two grinningly positive developments since the last activity update. *Plan 28* (as the project to construct Babbage's Analytical Engine is known) is now a registered charity with the legal process complete.

Secondly, the Science Museum's digitisation of the complete Babbage archive is underway and is expected to be completed by mid-October. The archive consists of some 7000 manuscript sheets describing not just the Analytical Engine but all Babbage's calculating engines and inventions. Included in the exercise are 20 volumes of Babbage's notebooks which are an indispensable aid in deciphering Babbage's intentions. The Science Museum has generously agreed for us to have immediate access to this material for research purposes and the material will be made public during next year through a website prepared by the Museum. The digitisation programme is a major step forward: it is the first stage of four in the delivery of the project and is a prerequisite for Stage 2 (analysis and specification). Further, public access next year will be a major boost to the study of Babbage's designs, which until now has been hampered by the need for physical access to the material. There is a project news website that tracks project progress (*plan28.org*). We are greatly encouraged.

Appeal for Help

Richard Hind is trying to restore a 1960s Canon transistorised calculator the Canola 130S owned by Prof. Jim Austin at York University. Bereft of documentation, he enquires whether any CCS member might have a schematic or a service manual. Contact *rhind@cs.york.ac.uk* or +44(0)1904 627202. Stranger things have happened.

News Round-Up

Your editor has had the pleasure of proof reading several chapters of the forthcoming book *Turing and his Contemporaries: Building the World's First Computers*. On the basis of what I've seen so far, I can't recommend it too highly. Pre-publication orders are already being taken on Amazon for the princely sum of £12.99. Worth waiting for.

101010101

To the local fleapit to see the acclaimed new production of John le Carré's *Tinker, Tailor, Soldier, Spy*. I was surprised and not a little alarmed to recognise Blyth House – home to the Science Museum's Elliott 401 and many other precious objects – playing the part of *The Circus*, fictional headquarters of MI6.

101010101

The prestigious MacTaggart Lecture at the 2011 Edinburgh International Television Festival was presented by Eric Schmidt, chairman of Google. Much of the lecture was given over to an assertion that the Internet is Television's friend, not its nemesis, but there was also some attention given to computer education in Britain. Displaying an impressive grasp of UK computer history, Schmidt opined that the sharp divide between arts and the sciences was holding Britain back. He quoted Steve Jobs – "*The Macintosh turned out so well because the people working on it were musicians, artists, poets and historians – who also happened to be excellent computer scientists*".

Schmidt made no reference to the *Two Cultures* controversy of 50 years ago, nor indeed did any formal reports of the lecture seen by your editor. One blogger, however, was quick to write "*C.P. Snow called – he wants his lecture back...*".

But Snow does make a fleeting appearance in computer history, for it was as a result of attending one of Snow's lectures that Tom Kilburn was inspired to volunteer for what turned out to be a long association with Freddie Williams.

The full text of the MacTaggart Lecture can be found at *www.guardian.co.uk/media/interactive/2011/aug/26/eric-schmidt-mactaggart-lecture-full-text*.

101010101

David Holdsworth reports that some more material from the BBC Domesday project is now on-line. In particular the National Disc which is not part of the BBC's *Domesday Reloaded* project is there. David would like a volunteer to test out the BBC emulation system on MS Windows of any vintage. Contact details inside the back page.

101010101

We have been contacted by another computer museum in the making, *Time-Line Computer Archive*, in Wigton, Cumbria. Only open by arrangement at present, its star exhibit is an *LGP-30 Eurocomp*, a small desk-sized first generation computer. It has 113 valves and 1450 diodes, a drum memory and was first introduced in 1956. It is believed that its designer Stanley Frankel has a link to the Manchester Mark1 computer.

Arthur

They also have *Arthur*, an ICT 1301 the former partner of *Flossie*, our own adopted 1301. Sadly *Arthur* is not in working condition, though its accommodation is of a rather superior quality.

101010101

Summer visitors to South Devon may also like to pop in to the Totnes Museum where there is a room dedicated to Charles Babbage. Babbage may or may not have been born in Totnes. The museum seems to lack its own website but *www.devonperspectives.co.uk/babbage.html* gives an interesting perspective of the controversy.

101010101

Steve Jobs, co-founder of Apple sadly died in October. Never less than controversial, his achievement in rescuing Apple from the brink of oblivion was incontrovertible. By sheer force of personality, he changed the computer from an office tool to a mass media consumer product.

His obituary in the *Daily Telegraph* is particularly thorough with a good balance between achievement and criticism.

We have also lost Dennis Richie co-creator of the Unix operating system and the C programming language. As so often, Martin Campbell-Kelly's obituary in *The Guardian* can be relied upon.

Finally John McCarthy, AI pioneer and creator of the seminal LISP programming language. His obituary in *Stanford University News* is authoritative except for an error regarding the status of LISP.

Mercury and its Autocode

Tony Brooker

Mercury was an industrial development of Meg, a prototype megacycle computer built in the Electrical Engineering department at Manchester University that had earlier developed (under the direction of Prof. F.C. Williams) the "Baby Machine" and the forerunner of the Ferranti Mark 1 computer. The Meg team was led by Tom Kilburn and his Ph.D students D.B.G. Edwards and G.E. Thomas. Work on Meg began soon after the very first commercial Mk1 had been delivered to the University in 1951. Meg was fully operational in the summer of 1954 but it was a further three years before the first Mercury was delivered to a customer (see ref.4).

The Prototype - Meg

Meg/Mercury was designed to be faster and more reliable than the Mark 1 and also to overcome the two main problems with programming that machine. These were the lack of floating point hardware and secondly the working store of just 256 40 bit words (eight pages of 32) with an access time of 0.44 milliseconds. This small fast store was supplemented by a much larger and slower magnetic drum store. To transfer a "trackful" of 32 words on the drum to the fast working store took 36 milliseconds.

The Architecture

There was no alternative but to retain the drum as a backing store with such improvements as technology then permitted and provide a significant increase in the size of the working store. It was also decided to retain the full 40 bit word size to represent floating point numbers with

10bits for the exponent and 30 for the mantissa. Instructions would be represented by half-words of 20 bits.


Mercury Installed at Manchester University

The clock speed of the central processor (CPU) was increased from 100Kcs to a megacycle. The availability of crystal diodes meant less dependence on thermionic valves and hopefully an increase in reliability. A balance between serial and parallel techniques had to be struck: the latter would speed things up but at a cost and possibly at the price of reliability.

Meg was provided with a fast store of 512 words of 40 bits; later doubled to 1024 words in Mercury. Parallel techniques were essential for the memory to match the megacycle clock speed of the CPU. Meg had parallel cathode ray tube stores but these were replaced by planes of 1K ferrite cores in Mercury. These were arranged (physically) so that they could be read in parallel units of 10 bits (plus a parity bit), the read time being 10μsec.

The CPU now had to provide for addition and multiplication of floating point arithmetic and entailed registers consisting of both electromagnetic delay lines and a few flip-flops. Gates etc used the aforementioned diodes and pentode valves. (Division was to be implemented by a subroutine.)

Although access to a trackful of full words on the drum had been speeded up (24ms as against 36ms), access to the working store had improved even more so (0.1ms as against 0.44ms) so that the drum in Mercury was relatively less accessible (six times so) than in the Mk1. Fortunately however with the larger size of the working store there was less need to refer to the drum.

The 1024 (full 40-bit) words which made up the working store of Mercury were treated as 2048 locations of ½-words of 20 bits. However (½-word) instructions could only be stored in the first half of the store, namely locations numbered 0, 1…1023. An instruction consisted of three parts: a *function part* (seven bits) specifying the purpose of the instruction, an *address part* (10 bits) giving the location involved and an *index part* (three bits) referring to one of eight 10-bit index registers. The index (integer) selected in this way was added to (i.e., incremented) the specified address.

Thus 40-bit floating point numbers were stored in the even locations 0,2,4, … 2046, each number occupying two consecutive addresses, 0,1 … 2046,2047. Of the 40 bits 10 were reserved for the exponent (a power of 2) and 30 for the mantissa M where $(1 > M \geq -1)$

Thus in an *arithmetic* instruction the 10-bit address refers to one of the even addresses (but see below: automatic halving of even addresses). In a *control transfer* instruction the address part referred to the instruction to be executed next, stored in any (½-word) location in the first half of the store.

There were also instructions for loading and unloading the eight index registers and for performing 10-bit arithmetic on addresses themselves. These referred to the 10 bit words in the first quarter of the store, namely locations 0,0+, 1,1+, …… 511,511+ ,together with a duplicate set of instructions referring to the second quarter of the store, namely locations 512,512+, …... 1023, 1023+

A basic instruction was written (for the input routine) as

$D_1D_2\ D_3\quad L$

where **D** denotes a decimal digit and **L** specifies a location *(see shortly)*. The digits D_1 and D_2 defined the *function* (*see next*) and D_3 specified one of the eight index registers (register 0 is always 0).

D_1,D_2 specified the row and column of a 10×10 array in which the possible functions were categorised. Thus for example row 4 contained the floating point operations, 40 being the function “transfer the number in location **L** into the accumulator” and 41 being the reverse instruction; 42 and 43 were the add and subtract functions.*(There was no simple relation between the two digit function code and the nature of the function.)*

The location **L** referred to one of the 2048 ½-word locations, 0,1, … 2047. However the address part of the instruction is 10 digits, so that a floating point arithmetic instruction referring to address 2046 would automatically halve this to 1023. Likewise instructions involving 10-bit words would automatically double the address, more precisely 1 becomes 2, 1+ becomes 3 and so on.

It is worth mentioning that it was also possible, for those programmers who wished to get closer to the store, to specify the address in page and line form. Recall that information was transferred to and from the drum in pages, each page being a trackful of 64 ½-words. The transfer is to/from 64 consecutive ½-word locations in the store, starting at a location which was a multiple of 64. Page and line form thus referred to the page number (0 to 31) in the store and line number (location 0-63 within that page).

Finally on the matter of addresses, most of those appearing in a basic program would have been in symbolic form, following the ideas pioneered by the Cambridge team (see ref 3). For example if one wanted to load the value of π into the accumulator one could write

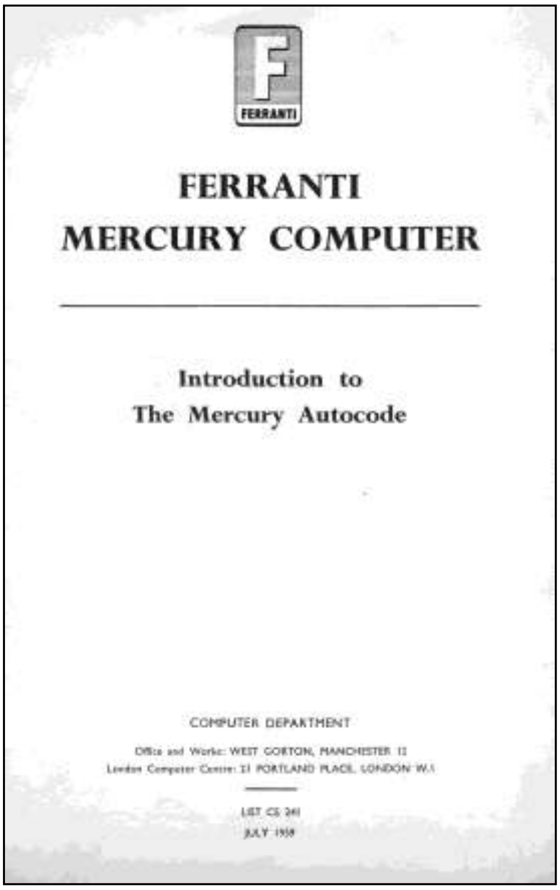
```
400     v1
```

and later in the same routine insert

```
3.14159265 (1   .
```

Symbolic addresses (or labels) are associated with routines (not complete programs) so routines could be written independently.

This is really all the author proposes to say about basic programming. The detailed instruction code can be found in ref.4 and a description of the input routine in ref.2 Except for the writing of system programs most programmers used:-



Mercury Autocode

The built-in floating point arithmetic meant that the translated object program resulting from a “high level” autocode program would not be of an interpretive nature and hence would free the fast store from the burden of hosting an interpreter. The size and accessibility of the two levels of storage were such that it was not worthwhile to disguise them as a one level store. More precisely it was thought that the inner loops of a typical "scientific" program could be accommodated in 1024 instructions. As regards data the situation was less clear. If half the store were allocated to the program would 512 floating numbers always be enough to engage the demands of an inner loop?

In hindsight it might have been worthwhile introducing a paging system like that adopted for its successor machine, Atlas, i.e., treat the fast store as consisting of 32 pages of 32 words (64 instructions) and to use the replacement algorithm which Tom Kilburn invented, namely when the processor needs access to a number or instruction currently on the drum store then replace the least frequently used of the 32 pages by the relevant track (page) on the drum bearing the required number or instruction. Of course in the Atlas this information was automatically maintained by hardware for each page in the working store. A software equivalent may not have been so easy. It would have meant keeping a list of 32 counts and updating them every time we executed an instruction. These updating instructions could have been included automatically by the Autocoding software. It would have been expensive both in storage space (for the updating) instructions and time consuming to execute them. Rightly or wrongly we gave little thought to the idea of a one level store and instead decided to place the responsibility on the programmers by providing them with:

(1) Comprehensive commands for transferring numbers to and from the drum to the working store. For example
`Ø1(x'750, a1, 10)`
would mean: transfer 10 consecutive variables from the drum store, starting at `x'750` in the drum store (where "variable" groups have primed names) to replace the variables `a1,a2, ....a10` in the working store. Replacing `Ø1` by `Ø2` performed the reverse operation.

(2) Facilities for organising the program into *chapters* deemed to be sufficiently substantial in terms of execution time to justify transferring them from the drum when needed; or alternatively substantial in store usage but only infrequently needed, for example as a prelude or appendix to the main programme. In one sense they could be compared to the classic subroutine without parameters. *But there were no parameterised routines in the accepted sense, as in Algol or Pascal*.

Two Example Programs


Mercury and Pegasus computers in Ferranti's West Gorton Factory (Courtesy MOSI)

So without more ado we give an example of a single chapter program. It will be apparent at first glance that identifiers are limited to a single letter, like those of the original Mk1 Autocode but unlike those in all subsequent high level languages. This was because most of the problems arising in the university environment had an applied mathematical origin, in which the formulae mostly used single letters. Even now if you open a book on mathematics (e.g., The Road to Reality by Roger Penrose) you will find single letter symbols predominate.

The program tabulates the first n terms of the series (see Penrose $4.3)
$1 - x^2 + x^4 - x^6 + x^8 - x^{10} \ldots$ for various values of **x** and **n**. This is equivalent to $(1 + x^2)^{-1}$ although the series itself doesn't converge for all values of **x**.

A program for this exercise follows. Readers familiar with high level languages should have no difficulty with it.

```
chapter 1
1) read (x)        read real value of x from paper tape
read (n)           read integer value of n likewise
y = 1
z = 1
i = 1(1)n-1        i takes values 1 in steps of 1 to n-1
z = - z x x        computes next term
y = y + z          accumulates next term
repeat             denotes end of loop
print (n, 2, 0)    print number as 2 digit integer
print (x, 0, 10)   print as 0. ...  to 10 places
jump 1             return to read next pair of x and n
across 1/1         enters the program itself at label 1)
close
```

The input tape might look like

```
0.5  10    0.9  10 0.9  20  1.1   10…
```

where a double space serves to terminate a number.

Our second example illustrates the use of arrays. It is a program to read and verify a 9×9 Sudoku puzzle grid. This is done by verifying first the rows and then the columns. As each row (or column) is scanned the integer in each cell, **k** say (between 1 and 9) is used to inspect the **k**th cell of a separate row of nine check cells. Suppose for example there are two 5s in a row (or column). The first 5 encountered will mark the 5th cell in the (initially empty) check row and when the second 5 is encountered the program will find that it is already marked.

There are thus two groups (1-arrays), **d** of 81 integers and **c** of nine integers. However we have to represent these integers as 40-bit (floating point numbers) because (see later) we can only declare arrays of such numbers. A program to do this is:-

```
Chapter 1
1)d -> 80            D0 D1 …. D80
c -> 8               C0 C1 ….C8
k = 0(1)80           prepare to read in the 9×9 Sudoku grid
read (dk)            as 9 consecutive rows from tape
repeat               end of read cycle
i = 0(9)72           prepare to check the 9 rows
j = 0(1)8            cycle to
ci = 0               zeroise cells of check row
repeat               end of cycle
j = i(1)i+8          scan the ith row
k = intpt(dj)        select kth cell (to use as index)
jump 2, c(k) ≠ 0     jump to error exit if k is a duplicate
c(k) = 1             else mark it as OK
repeat               end of ith row check
repeat               end checking of rows
```

The same cycle of 10 statements can also be used to check the columns by simply replacing

```
i = 0(9)72              i = 0(1)8
j = i(1)i+8      by     j = i(9)72
```

If both row and column cycles are successfully executed then

```
newline
print ('CORRECT)
stop
2)print ('ERROR)
stop
across 1/1           enter program at instruction label 1)
close
```

A chapter was limited to 896 locations. This accounted for most of the 1024 locations in the first half of the working store. The remainder were reserved for system needs. Very many programs did not extend beyond one chapter but the format provided for multi-chapter programs.

The Autocode language used the symbols available on the teleprinter keyboard –

`a b c d e f g h i j k l m n o p q r s t u v w x y z π`

`0 1 2 3 4 5 6 7 8 9 + - = ≠ > ≥ * ( , ) ≈ -> / Ø '`

The letters **`a b c d e f g h u v w x y z π`** were reserved to identify floating point variables (**π** contains **`3.14159`**… and is constant) and the letters **`i j k l m n o p q r s t`** to identify index variables.

The first example used only scalar variables, but, as in the second example, letters could also be used to name groups of variables (essentially one-dimensional arrays indexed 0,1,2 etc).

Naming arrays of variables

Of the 512 locations in the second half of the store 480 could be allocated to groups of floating point variables (1-arrays) as follows

These would reflect the groups of data occurring in the problem. For example two arrays **`a`** and **`b`** each of 10 variables and two arrays **`x`** and **`y`** each of 100 variables would be declared thus –

```
a -> 9
b -> 9
x -> 99
y -> 99
```

These would be accessed individually as **`a0`** to **`a9`**, **`x0`** to **`x99`**, etc

The Index Variables

`i, j, … t` were kept in the (first half) of 20-bit locations in the first half of the store. They could assume values in the range -512 to 511 but would normally take positive values when used as subscripts to variables, e.g., **`xi    x(i-1)`**. So if **`i = 99`** then **`x(i-1)`** refers to **`x98`**.

Numerical values

Standardisation of form was not necessary, for example √**2** could be written in the program (or punched on the tape) as **1.4142...** or **001.4142...**

Assignments

Assignments were the essential computing statements. The right hand side (RHS) of an assignment statement (a *simple expression***)** could take the form of a sum of products, for example

y = 2mna(m+1) + amn + man + 0.1m + 0.1n

which is the one dimensional (flat) form of

$y = 2 \times m \times n \times a_{(m+1)} + a_m \times n + m \times a_n + 0.1 \times m + 0.1 \times n$

The convention is that **am** means a_m, **not** $a \times m$. The latter would be written **ma**.

A division sign (**/**) could be written before the last factor in any product, e.g.,

u = x/a + y/b + z/c; v = 2x/n

An example of an index assignment is **i = 2mn + m + n + 1** where the RHS was restricted to indices and integers and no division allowed.

Functions

The RHS of an assignment could also be a function of a simple expression for example

y = sqrt(x); y = sin(2π/n); a = log(xx + yy)

Others single variable functions are: **cos,tan,exp,mod,intpt,frpt**.

There were also functions of two arguments, such as

arctan(x,y) meaning arctan(y/x)
radius(x,y) meaning sqrt($x^2 + y^2$)

Every time one of these functions was referred to 17msec would be spent on transferring the necessary set of instructions (routine) from the magnetic drum to the instruction store. Alternatively, if there was room, they could be included in the program itself by listing them in order of preference at the end of the chapter.

Cycles of operation

A cycle or loop of instructions was introduced by a "stepping" statement for an index variable. This took the form **i = p (q) r** followed at the end of the loop by a **repeat** statement. Here **i** is any index variable and **p, q, r** can be any index variables or values. The foregoing example employed an outer loop and an inner loop, thus:-

```
i = 0(9)72         outer cycle
j = 0(1)8          first inner cycle
...
repeat             end of 1st inner cycle
j = i(1)i+8        second inner cycle
...
jump 2, c(k) ≠ 0   premature exit from cycles
...
repeat             end of second inner cycle
repeat             end of outer cycle
```

Control transfer operations.

These took the form **jump N , V1 ≥ V2** (or **> ≠ =**)

where the integer **N** referred to another instruction bearing a label **N**.

The second of the two example programs contained a conditional jump instruction

jump 2, c(k) ≠ 0

In both programs the label **1)** is used to start the program via the **across1/1** directive at the end of the chapter. It is also referred to (in the first program) by the *unconditional* jump instruction at the end of the main loop, to read further data. (Strictly speaking we need to test for the end of the data sequence.)

Autocode also included a further related instruction **n) = N** which could be used for calling in a subsequence of instructions (and returning to the main sequence). This is illustrated as follows –

```
Main sequence           Sub-sequence
....
n) = 3                  .....
jump 10                 .....
3).....                 .....
....
....
10).....
....                    .....
....                    jump (n)
```

Input and output

The **input** mechanism was a five bit paper tape reader (200chars/sec). Paper tape was also the **output** medium via a 33 char/sec punch. It was transcribed via a teleprinter at seven chars/sec. Later a lineprinter became available. If these speeds seem abysmally slow now, they did then!

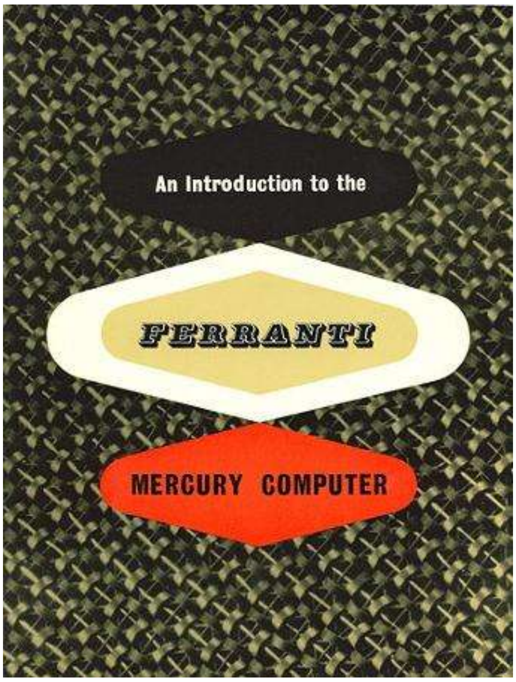
These facilities have been illustrated to some extent by the examples. Further information if needed can be found in the references.

Hindsight about Autocode

We have already commented on the restriction of identifiers to single letters. This was aggravated by the absence of upper and lower case letters on the teleprinter.

Special brackets for enclosing subscripts, for example `x[i-1]` would also have been desirable.

It was a mistake to use the equals sign on its own for assignment. ALGOL's "`:=`" was a much wiser choice. The same could be said about relying on adjacency to signify multiplication instead of using a specific multiplication sign.



Ferranti's Sales Brochure

Readers will recognise the syntactic correspondence between the Autocode statement

```
i=0(9)72
```

and its ALGOL equivalent,

```
for i:=0 step 9 until 72 do
```

Unfortunately there was no such equivalence between the conditional jump instruction and the ALGOL

```
if <condition> then <statement> else <statement>
```

because there were no compound statements in Autocode (and more fundamentally there were no user-defined procedures).

Looking back I recall a driving need to keep things simple. I remember how the essentials of the Mk1 Autocode were described on one side of a sheet of foolscap paper. This was certainly welcomed by new users.

Conclusion

Nineteen Mercury computers were manufactured and delivered from August 1957 to May 1961 to various research establishments, all but one being in Europe. (The exception was Buenos Aires University). The applications covered academic research, atomic energy, meteorology, linear programming, chemical engineering, electrical engineering, etc.

The Mercury at Buenos Aires

Notable among the “academic research” applications was crystallography and in particular its role in the work of D.W.J. Cruickshank in elucidating the structure of vitamin B12. It is worth noting the comment by Mills and Rollett (also crystallographers) in *International Tracts in Computer Science & Technology & Their Application (Aug 1960)* – “whilst automatic coding procedures inevitably result in some loss of programming, with Mercury this loss is kept very low, is some cases … as low as 20%, which time can often be recovered because of the simplicity in developing the program”.

Acknowledgements

The author was familiar with Mercury and responsible for the development of Mercury Autocode. I have been heavily reliant on reference (4) and my own papers in the *Computer Journal* (1). I am also grateful for the sight of some notes from Prof. D.B.G Edwards.

References

1 (i) The Autocode Programs developed for the Manchester University Computers
(ii) Further Autocode Facilties by R.A.Brooker
2 An Input Routine for the Ferranti Mercury Computer by J.A.Fotheringham and M.de.V.Roberts
3 Symbolic addresses paper by M.V.Wilkes
4 *Our Computer Heritage* website *www.ourcomputerheritage.org/wp/*

Editor’s note: Tony Brooker is Emeritus Professor of Computer Science at the University of Essex having previously distinguished himself at Imperial, Cambridge and Manchester. His profile was in Resurrection 45. *He can be contacted at* tony.brooker1@btinternet.com.

Tony Sale: Tribute and Memoir

Doron Swade

There have been many fitting tributes to Tony Sale since his sad passing on 29th August 2011. In accounts of his life, career and many accomplishments, Tony's work on the reconstruction of Colossus and his efforts to preserve Bletchley Park feature prominently, and rightly so. His connection with the Computer Conservation Society and his role in establishing it tends to be less fully elaborated and usually receives mention *en passant* as a back-story indicative of inspired historical imagination and of the breadth and variety of his interests. Tony and the early days of the CCS are inseparably entwined and the relationship between the two is a rather special one. Tony played a major role in the Society from its very earliest days and it is to this that I wish to pay special tribute here.

I first met Tony on 5th September 1989 at a meeting at the British Computer Society. I was curator of computing at the Science Museum at the time and director of the Information Age Project (IAP), a planned new computing gallery scheduled to open in 1991, the bicentennial year of Charles Babbage's birth. I wanted working historic computing machines on display in the new gallery though the Science Museum had neither the internal resources nor the expertise to restore such machines to working order. I conceived of a society for this purpose and had approached the BCS with a proposal to found, as a joint enterprise with the Science Museum, what I then called the "British Computer Conservation Society". In the presentation to the BCS meeting that day I outlined the ambitions of the Society which were two–fold: to restore to working order for public display historic machines in the Museum's collections; and to provide a social and organisational structure for practitioners, designers and engineers, to participate in conservation and restoration activities.

Tony, then BCS Technical Director, was quiet at the meeting and I barely registered him other than as an intensely attentive presence. With the welcome support of those present, the outcome of the meeting was the BCS's blessing to found the Society as a BCS Specialist Group.

The following day, Tony showed up at my office in The Old Canteen in the Science Museum car park. The Old Canteen, of folkloric fame in the annals of the CCS, was a single-storey hut that I had commandeered as a project office for the Information Age Project, after the Museum's staff lunchtime catering facilities were scrapped. Tony was wearing his signature light grey suit, white shirt and tie and a brown raincoat. He said that my presentation to the committee to establish a society had "pushed all his buttons" and he would like to join me to do this.

Prof. Sir Maurice Wilkes sometimes highlighted the freedoms he had to operate when he was appointed as director of the Mathematical Laboratory in Cambridge in 1946. I once asked Maurice why he thought he had succeeded where others had failed. He said, with his hallmark twinkle, that others had committees to help them. I was the budget holder for the IAP which was funded through sponsorship from five computer companies active in the UK (ICL, Hewlett Packard, Rank Xerox, Siemens Nixdorf and Unisys) and I had authority to disburse funds as I thought fit. I immediately created the post of "Manager: Historic Machines Programme" at the equivalent grade to my own and, poaching Tony from the BCS, appointed him with a direct reporting line to me. This appointment was the platform we used to create the CCS.

What followed were the early glory days of the Society. Tony was tireless, inspired, inspirational and a whirlwind of initiatives, focus and energy. He took the lead role in a start-up committee that included Roger Johnson, then VP, Technical and Specialist Groups, BCS, who enthusiastically supported the foundation of the Society, Ewart Willey and Sandy Douglas, who were no less supportive. Ewart became the Chairman, Roger the Treasurer and Tony the Secretary (1989-1996). Tony drove the immediate negotiation of the CCS constitution as a Specialist group of the BCS. His contract with the Museum started in November 1989 though he was assiduously active from early September preparing publicity for the CCS launch, drafting press releases, setting up restoration working parties, formalising working practices and mapping out a work plan. The basis for much of this was in place for the inaugural meeting on 12th October 1989, an open public meeting held in the Science Museum's main lecture theatre. Tony was instrumental in founding *Resurrection* – from naming it, scoping ambitions, to designing the cover – as well as establishing and maintaining a programme of seminars and lectures that became and remains, a unique forum.

Tony was based in the Old Canteen which became the clubhouse, headquarters and restoration workshop of the CCS. He was the driving force behind many of its major initiatives. In short order he marshalled and co-ordinated working parties for Pegasus, the Elliot 803 and several DEC machines that were transported from the Museum's store to be worked on. On any given day there were happy folk whistling away working on these machines. Tony was the hub of this activity, supporting, arranging and encouraging through advice and example. The atmosphere was cheery, exhilarating, enjoyable, industrious and technically challenging.

"In-steam days" were one of Tony's astute initiatives. The restoration activities needed funds and the obvious source was the computer industry. Tony reckoned that companies could not fail to be inspired and supportive if they witnessed restoration work in progress. He orchestrated and publicised annual "in-steam days" – Museum open days in The Old Canteen during which the machines being restored could be seen working, or near working. These events were celebrations of the pioneering and sometimes renegade feel of the whole venture. On open days The Old Canteen was packed to the rafters with visitors – members of the public, computer practitioners, academics, enthusiasts and sundry interested parties. The Corporate Sponsorship scheme attracted several corporate donors that supported the Society's activities through annual subscriptions. Tony had a free hand and he, and the Society, flourished.

From September 1989 to July 1993 Tony was the organisational and technical rocket-engine of the Society's activities. The thriving state of Society is a legacy of his energy, commitment, vision and focus.

When the recession in the computer industry led to the collapse, in 1991, of the Information Age Project, Tony's tenure became precarious. I secured some fragile extensions which kept things going till mid-1992 but when the restoration programme was transferred to the newly formed Conservation Unit my ability to influence events was diminished. The new Unit funded a one–year pilot project ostensibly to capture and consolidate the lessons to be learned from CCS restoration and documentation practices for application to other collections. Tony was reprieved until July 1993. But the single–minded focus that had been so productive had now to operate under a duvet of bureaucracy. Anyone who knew Tony knows that he was uncomprehending of unnecessary delay and properly intolerant of hidden agendas. When Tony left in July 1993 the CCS restoration activities suffered a near terminal setback.

Tony went on to the work for which he is perhaps now best known – the reconstruction of Colossus, a monumental accomplishment of vision, stamina and technical inspiration. He excelled in "operational replication", that is, the construction of devices and systems that perform the same function as the lost original. With the documentation and description of the original Colossus incomplete, Tony's special talents found uniquely fertile ground. The machine is a lasting monument to a remarkable man who made a unique contribution to our field.

Forthcoming Events

London Seminar Programme

17 Nov 2011	The Emergence of Computer Science	Pierre Mounier-Kahn
15 Dec 2011	Historic Computer Films	Dan Hayton et al.
19 Jan 2012	Misplaced Ingenuity, some dead ends in Computer History	Hamish Carmichael
16 Feb 2012	Bloodhound on my Trail: Building the Ferranti Argus Process Control Computer	Jonathan Aylen
15 Mar 2012	Turing and his Contemporaries	Simon Lavington et al.
19 Apr 2012	Centring the Computer in the Business of Banking: Barclays 1954-1974	Ian Martin & David Parsons
17 May 2012	Turing	Brian Carpenter

London meetings take place in the Fellows' Library of the Science Museum, starting at 14:30. The entrance is in Exhibition Road, next to the exit from the tunnel from South Kensington Station, on the left as you come up the steps. For queries about London meetings please contact Roger Johnson at *r.johnson@bcs.org.uk*, or by post to Roger at Birkbeck College, Malet Street, London WC1E 7HX.

Manchester Seminar Programme

15 Nov 2011	Early Silicon Compilers	John Vernon
17 Jan 2012	Some Historic Computer Films	Kevin Murrell & Chris Burton
21 Feb 2012	Hartree's Differential Analyser Project	Charles Lindsey
20 Mar 2012	EDSAC Replica Project	Chris Burton

North West Group meetings take place in the Conference Centre at MOSI – the Museum of Science and Industry in Manchester – usually starting at 17:30; tea is served from 17:00. For queries about Manchester meetings please contact Gordon Adshead at *gordon@adshead.com.*

Details are subject to change. Members wishing to attend any meeting are advised to check the events page on the Society website at *www.computerconservationsociety.org/lecture.htm*. Details are also published at in the events calendar at *www.bcs.org* and in the events diary columns of *Computing* and *Computer Weekly.*

Museums

MOSI : Demonstrations of the replica Small-Scale Experimental Machine at the Museum of Science and Industry in Manchester are run each Tuesday between 12:00 and 14:00. Admission is free. See *www.mosi.org.uk* for more details

Bletchley Park : daily. Exhibition of wartime code-breaking equipment and procedures, including the replica Bombe, plus tours of the wartime buildings. Go to *www.bletchleypark.org.uk* to check details of times admission charges and special events.

The National Museum of Computing : Thursday and Saturdays from 13:00. Situated within Bletchley Park, the Museum covers the development of computing from the wartime Tunny machine and replica Colossus computer to the present day and from ICL mainframes to hand-held computers. Note that there is a separate admission charge to TNMoC which is either standalone or can be combined with the charge for Bletchley Park. See *www.tnmoc.org* for more details.

Science Museum :. Pegasus "in steam" days have been suspended for the time being. Please refer to the society website for updates. Admission is free. See *www.sciencemuseum.org.uk* for more details.

CCS Website Information

The Society has its own website, which is located at *ccs.bcs.org*. It contains news items, details of forthcoming events and also electronic copies of all past issues of *Resurrection*, in both HTML and PDF formats, which can be downloaded for printing. We also have an FTP site at *ftp.cs.man.ac.uk/pub/CCS-Archive*, where there is other material for downloading including simulators for historic machines. Please note that the latter URL is case-sensitive.

Contact details

Readers wishing to contact the Editor may do so by email to *dik@leatherdale.net*, or by post to 124 Stanley Road, Teddington, TW11 8TX. Queries about all other CCS matters should be addressed to the Secretary, Kevin Murrell, at *kevin.murrell@tnmoc.org*, or by post to 25 Comet Close, Ash Vale, Aldershot, Hants GU12 5SG.

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Readers who have general queries to put to the Society should address them to the Secretary (see page 32 for contact details). Members who move house should notify Kevin Murrell of their new address to ensure that they continue to receive copies of *Resurrection*. Those who are also members of the BCS, however need only notify their change of address to the BCS, separate notification to the CCS being unnecessary.

Resurrection is the bulletin of the Computer Conservation Society. Copies of the current issue are available from the Secretary for £5.00 each.

Editor – Dik Leatherdale   Printed by the British Computer Society