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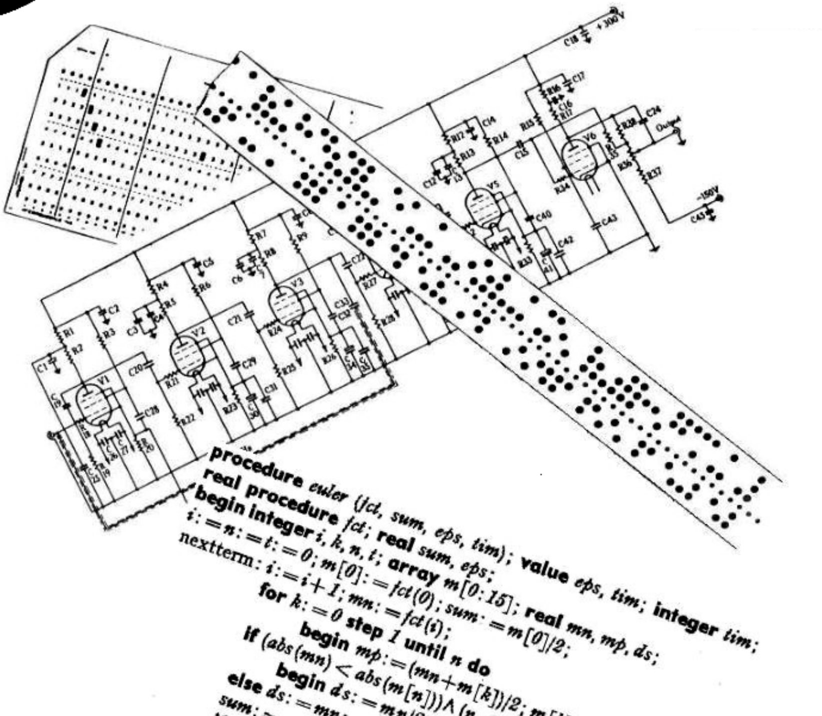
The Chartered Institute for IT

RESURRECTION

The Bulletin of the Computer Conservation Society



Computer Conservation Society

Aims and objectives

The Computer Conservation Society (CCS) is a co-operative venture between BCS, The Chartered Institute for IT, 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 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 BCS, fees from corporate membership, donations and by the free use of the facilities of our founding 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.

The CCS also enjoys a close relationship with the National Museum of Computing.

Resurrection

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Chair’s Report

Rachel Burnett

Events

We have enjoyed a programme of presentations in London and Manchester organised by Roger Johnson and Gordon Adshead respectively, given by authoritative speakers, with informed questions, observations and discussion to follow. These are always well attended. The varied topics have included:

- Computers: Babbage's Analytical Engine, Atlas, Bracknell Ferranti, CAP;
- Manchester´s Telecoms Firsts;
- Computing before computers, machine translation, computer memory, information retrieval, conservation of data, websites and software, the development of IT law;
- Barclays Bank and Technological Change;
- Andrew Booth – Britain´s Other Fourth Man.

At our Christmas meeting we watched some historic computer films, which we have had digitised.

An all-day visit to IBM’s Hursley Park in Hampshire was kindly hosted by the volunteer curators of their museum.

There were two two-day events, and attendees at both came from home and abroad, far and wide.

- The *Atlas 50^th^ Anniversary* event, organised by Simon Lavington, was held at the Museum of Science and Industry in Manchester. It combined exchange of information on Atlas and opportunities to meet up with colleagues after many years and nostalgia, and was greatly appreciated by over 150 attendees.
- The conference *Making the History of Computing Relevant*, in collaboration with IFIP, the Science Museum and Google, was held at the Science Museum. The aim was to discuss what needs to be done to make the history of computing relevant and interesting to the general public today. There were over 100 delegates and a number of the speakers were members of the CCS.

Apart from the conferences and other individual events, our London meetings are held in the afternoon, and Manchester meetings are normally held in the evenings. We are very willing to arrange presentations to groups about the Computer Conservation Society and its work and projects, or about a specific project, if asked. We have joined the list for collaboration in this way with other Member Groups of BCS.

Museums

The current activities of the Science Museum, The National Museum of Computing, Bletchley Park Trust and the Museum of Science and Industry are reported to each Committee meeting.

The Science Museum is progressing a new gallery to open in September 2014, *Information Age*, for information and communication technologies over the last 200 years.

Simon Greenish, former CEO of Bletchley Park Trust from April 2006 until January 2012, was awarded an MBE for services to English heritage.

The National Museum of Computing has extended its opening hours. Its Learning Programme for educational institutions is into its second year. Professor Brian Randell gave a talk earlier in the year on uncovering the secret of Bletchley Park and Colossus in the early 1970s. The CCS made a donation towards scanning copies of *Computer Weekly* for the museum.

Projects

Resurrection reports regularly on the continuing work on the various CCS projects.

A couple of points to note:

- The Harwell Dekatron (aka WITCH) computer was switched on and has become a popular attraction at The National Museum of Computing.
- The ICT 1301 has been dismantled and shipped to storage, for future assembly at The National Museum of Computing.

Pegasus Project

The machine was demonstrated at the Science Museum in June.

For the future:

The gas for cooling will last another year, but is being phased out over the next 18 months, and will cost £4,500 to replace.

The museum area in which Pegasus is currently installed will come up for review after the new Information Age Gallery opens in September 2014, and the future is uncertain.

So the intention on the part of the Science Museum is to run the machine just one more time, and for the Science Museum and the CCS to work together to create an archive related to the working machine, by documenting all that has been achieved, including capturing the machine in operation and oral histories, for an interpretive and narrative legacy. The Science Museum wants to film and interview the volunteers about the computer and their life, but is not able to do so in-house, and has no budget. It is investigating costs and resourcing.

Pegasus would then be held in storage, and at some stage would be found a permanent home.

Publications, publicity and website

We now have a CCS logo and a brochure.

Resurrection, edited by Dik Leatherdale, is issued four times a year. It publishes articles and reports on CCS activities, projects, events and other news. It is translated into HTML for the website.

Our CCS website gives information about the Society and its programme of events. The *Our Computer Heritage* website provides technical information on the majority of British-designed computers 1950 – 1965, with data compiled by the CCS.

Our projects get good press, radio and TV coverage, from time to time.

Members and Networking

Computer history and conservation continues to get increasing media coverage.

Our membership has increased.

Dan Hayton represented the CCS at a Paris conference on computer and digital society museums and collections in France, about a possible French museum of the Information Age, and made a presentation to them about the CCS.

We are pleased to be working more closely with the IBM Hursley Museum.

Over the year we have been in touch with a number of associations in similar areas, and with other organisations who are interested in what we do. We provide information in response to enquiries where we are able to do so.

In conclusion, my thanks to all Committee Officers, Committee Members, Project Managers and other volunteer workers, and to all who attend our meetings in London and in Manchester and support the CCS.

Society Activity

EDSAC Replica — *Andrew Herbert*

The project is on schedule and running under budget.

At the time of writing approximately an eighth of the replica has now been constructed and another eighth has been designed, awaiting approval for construction.

Chris Burton has finalised the design of chassis 01 (storage regeneration unit) and written a construction guide. Some 42 of these are required to make up over ¼ of the chassis required in total. Three have been wired commercially by Dytecna Ltd to check out Chris' instructions. Further construction will be undertaken by volunteers (viz., Tom Toth) and by Marshall Amplification of Milton Keynes ("*fifty years of loud*") who have kindly offered to do so free of charge, utilizing spare capacity in their valve amplifier production facility.

John Pratt has completed the first chassis 09 (Tank Flashing Unit Common Controls). Alex Passmore has completed the first chassis 08 (Tank Flashing Unit). These complete construction of the first of four banks of address decoding circuits and these were demonstrated at the Wilkes anniversary event. Alex is now building chassis for the remaining three. Meanwhile John Pratt has been designing the "Coincidence" system that synchronises EDSAC with the delay line main store and awaits approval to begin construction.

James Barr has an initial design for "Main Control" (instruction fetch and decode) circuits, chassis mechanical layout and placement of chassis on racks.

Nigel Bennée continues to unpick the design of the "computer" (i.e., arithmetic unit) and has constructed the accumulator shifting unit, but is not yet able to demonstrate it fully working. Peter Isley has completed the final two (of four) half adders required for EDSAC – two are used in the computer and one each by the store (major address) counter and the sequence control counter (program counter).

John Sanderson has now completed three of the seven digit pulse generators required and continues with the remaining four.

Peter Lawrence has made some improvements to the clock pulse generator that was commissioned, along with the first digit pulse generator for the Wilkes anniversary event. Peter is now working on a design for clock and digit pulse distribution.

Bill Purvis has a converted Creed 9 teleprinter working to EDSAC code, driven by a Raspberry Pi. Some more mechanical work remains to be done. Bill is now ready to start work on the interface to EDSAC.

In addition Bill has reprogrammed his ELSIE EDSAC logic simulator to emit Verilog, which in turn has been compiled to run on an FPGA development system donated by Simon Moore and the Cambridge University Computer Laboratory. This gives us a fast gate level simulation of EDSAC, and was demonstrated at the last volunteers meeting. The eventual aim is to have a FPGA based tester that can be used to drive individual chassis and/or EDSAC sub-systems to verify conformity with the logic design.

Bill Purvis is also starting to look at building a paper tape reader based on John Deane's research. Chris Burton has two sprocket wheels from the original!

Andrew Brown has a provisional mechanical design and circuit for the initial orders "unit". This awaits further design input from Chris Burton and Andrew Herbert.

Peter Linington continues to investigate nickel delay lines as a substitute for mercury delay lines. Short nickel delay lines are working satisfactorily. Long delay lines remain problematical and it may be necessary to experiment with alternative steels for the delay line.

Alex Passmore and Chris Burton have established design parameters for power supply, distribution and control (240V AC 3 phase input, 240V AC, 250V DC output to computer, 240V AC ring for ancillaries). Other infrastructure needs (flooring, fencing, cable trays) are under development.

Chris Burton is starting to investigate the "three oscilloscope" unit.

Following a suggestion by Andrew Herbert, Martin Campbell-Kelly has constructed and tested a set of "coordinating orders" that allow "Initial Orders 2" to be loaded from paper tape at the head of further code in IO2 form. The original coordinating orders developed by David Wheeler for this purpose have been lost, so their reinvention is an important software milestone. It will allow us to run later EDSAC programs on the 1949 design of the replica machine.

Planning is underway with the TNMoC management for the EDSAC area of the Large Systems Gallery. It is planned to remove the false ceiling and cut down the rear wall to waist height. A small wooden dais will be build for EDSAC to match the original's wooden flooring and to provide access for "house mains" cabling.

David Allen is giving thought to the production of a number of educational videos giving explanations of how EDSAC works.

Software — *David Holdsworth*

Leo III

The aim is to preserve as working systems the Leo III Master Routine, and the Intercode Translator, both as ends in themselves, and as a preserved platform upon which other surviving Leo III software can also be run.

The main starting materials were printer listings of the Intercode Translator and the Master Routine, and User Manuals Vol I, II and III. We do also have microprogram diagrams, although these have not been much used so far.

Status: We have electronic images of all the paper material, either photographs or scans. In addition, the user manuals have been converted to searchable form by a process of OCR followed by manual editing.

The Intercode Translator is the cornerstone of this work, as both it and the Master Routine are written in Intercode. The 24,000-line listing of the Intercode Translator has been copy-typed in duplicate, and an interim translator is being written to translate it into machine code (called computer code in the Leo III documentation). An emulator is also under development to execute the resulting machine code.

We are now at the stage of executing the real Intercode Translator through the first two or three passes, with just a few minor questions. We need some new functionality of our emulated magnetic tape system in order to progress further. We have not yet tried the bootstrap translation.

On-line access

Most of this material is on-line and can be accessed via:

sw.ccs.bcs.org/leo

The Intercode Translator can be run on-line on our test bed at:

david-h.dyndns-web.com/LEOIT/N/leo/runleoIT.htm

Please do not ask too much of this facility by giving it enormous programs. It is only running on a Raspberry Pi.

Atlas I Emulator

The revival of the Compiler Compiler continues to make progress. Some 2,000 lines of program expressed in octal have been successfully compiled. This, in turn, compiles a further 6,000 lines of assembler code which then compiles over 1,000 lines of genuine Compiler Compiler code to which more is being added. But it's a slow process. OCR isn't good at characters like α, β, ≡ and ≠.

Dik Leatherdale and Iain MacCallum have scanned all this material from two identical paper source listings and OCR'd most of it three times in an effort to find infelicities in the recovered source code. It is pleasing to report that, during the third pass, only three errors were discovered.

TNMoC — *David Hartley*

In September we were able to announce that TNMoC, has been pledged its largest-ever single donation of £1 million and is seeking the required matched funding to double its value. The donor is Matt Crotty, a trustee of TNMoC and a technology entrepreneur. The donation will be phased as matching funding is received and will enable the Museum to develop its enormous potential. Early priorities include refurbishing the Museum and increasing its capacity for visitors and exhibits.

Software Gallery

The Software Gallery, sponsored by Insight Software, was formally opened in June by Sir Charles Dunstone, chairman of Carphone Warehouse.

Women in Computing gallery

Sponsored by Google, the Women in Computing Gallery was formally opened by Dame Stephanie Shirley in September. Using the latest in interactive digital signage display technology, the gallery presents a multimedia tribute to female pioneers of computing.

At the same time Google organised a gathering of "Heroines of Computing" attended by over 200 pioneers and their friends.

Storage

TNMoC has acquired the lease of a nearby storage unit in Bletchley within a mile or two of the Park. It is planned, over time, to decant our substantial collection of artefacts and archives there and to vacate a number of dilapidated buildings on the Park itself.

Winter Lectures

TNMoC is hosting a series of winter lectures at Bletchley Park. Details are announced on our website.

Bletchley Park Trust

TNMoC has reached an agreement with BPT whereby all past debts will be settled.

Pegasus Paper Tape Equipment — *Dave Wade*

I have now lubricated the bearings and re-assembled the Creed 6S reader. Re-assembling the bearings was "interesting" as they are retained by pairs of plates. The outer plate had locating lugs so you just drop it into place. The inner plate, which has the tapped holes in it has no locating lugs, so it’s a real fiddle to get it located in the right place. If I ever have to do it again I will screw in some 8BA rods to replace the retaining screws as I disassemble it. That way re-assembly will be simpler.

I have also cleaned the contacts on the governor and it now feeds tapes when the feed magnet is manually operated.

So I have had power on both the tape reader and the printer and they seem to operate but I can't do real tests.

At present I only have one mains lead so in order to operate both machines I need to make a second. I also need a "loop supply" to operate the receive magnet in the Creed 54 Printer and the control magnet in the reader. Unless MOSI have objections I'll start on this next. On completion we should be able to print sample tapes.....

Elliott 803/903 — *Terry Froggatt*

Regarding the 803, Peter Onion reports that he is running some Algol-60 sessions to try and encourage more people to write demonstration programmes for the 803 to run. CCS members are welcome. Due to work commitments it now looks like they will be running in second half of December.

Regarding the 903, this was been behaving well until recently, when faults developed both with the main store and the extra store. Initially the fault with the extra store was thought to have been cured by reseating the cards. However, what is possibly another extra store problem is currently under investigation, so the machine is currently only running with an 8K store. In the main store, one store driver card is suspect, and has been replaced by a spare card until the faulty card can be checked and/or fixed.

Regarding the 905, there has been no progress. Access may become harder if and when the Elliott machines are moved to make space for EDSAC.

Regarding 900-series documentation and software, Andrew Herbert has had some of the Elliott 920 Blue manuals scanned to add to the collection of Elliott 903 Grey manuals. I now have uploaded the 905 RADOS system and CAP’s 920 CORAL compiler, each of which is a box of paper tape, on modern media.

Harwell Dekatron — *Delwyn Holroyd*

We are now approaching a year since the official reboot event, and the machine continues to be in almost daily operation at the museum. Since the last report we have experienced a power supply failure, caused by an adjustment pot which we were able to replace with an identical unused one from our stores. We've also had some more Dekatron anode resistor failures and another trigger tube problem.

The printer solenoids have been cleaned of stray oil which was preventing reliable operation and are now working well again, although they were not used for daily demos to avoid undue wear and tear.

ICT 1301 — *Rod Brown*

After a considerable wait , the project team was delighted to discover that the machine has arrived safely at the TNMoC store. This has started the team on the formulation of a new plan to implement the project and at the same time continue with current objectives.

In the long term once a location is found, a partial (processor only) installation can be implemented and as space permits, the magnetic tape data transfer unit can be added behind the machine once the CPU is up and running again.

Until such time as this can be started the project has come back together and formulated a plan to continue with the magnetic tape library capture. Using a single magnetic tape deck and, if permitted, working at the storage facility. All that stopped this project going forward with this proposal was the fact that we had failed to resolve software tape format decoding difficulties.

Perhaps it was the good news of the arrival or more likely just hard work from the team members but I am glad to say that within the last week the team has resolved the issue of decoding tape images by software and now have recovered at least a full program tape of historic software.

The team is delighted with the support received so far and are very grateful to the CCS and its members for funding the move and saving the machine in early February this year. Further we could not think of a better place to restart than at the TNMOC so our thanks go to all the trustees and members of the TNMOC who made this happen.

ICL 2966 — *Delwyn Holroyd*

The machine worked well over the summer and good progress was made on tracking down the causes of the intermittent crashes. The duct fans have been replaced with more powerful ones which has reduced the OCP internal temperature to around 6°C above ambient.

However there have been a few setbacks in recent weeks and the machine is currently not operational. One of the intermittent crashes was traced to yet another open circuit in the C connectors between the two OCP platters. After some consideration, we decided it was time to service these connectors, which involved withdrawing all boards and removing the platters from the machine. The risk of course was that this would introduce new problems, which it duly has done. During the process of working through those, an unrelated new fault occurred which even prevents running the CUTS diagnostic software on the OCP. We suspect this is either SCP or DCU related, although all CUTS tests for those units pass.

Our Computer Heritage — *Simon Lavington*

Four volunteers are active in compiling information to extend the scope of the project to include British-designed minicomputers:

1. Kevin Murrell — Business Computers Ltd.
2. John Steel — Computer Technology Ltd.
Ferranti Ltd. (the post-1965 Argus computers).
3. John Panter — ICL. including System 10, System 25 and DRS/20.
4. Lisa Robinson — High Level Hardware Ltd.

This still leaves the following companies for which additional volunteers are being sought:

(a) Digico Computers Ltd. including Digiac and Digico Micro 16-S, 16-P, 16-V.
(b) Information Computer Systems: ALP1, ALP2, ALP3.
(c) GEC Computers Ltd.: the 2050 series, 4000 series & System 63.

Ben Gunn

We are sad to report the passing of Ben Gunn, the long-serving secretary of the CCS North-West Group. We hope to print a tribute in the next edition of *Resurrection*.

News Round-Up

A row of Atlas cabinets with one from a Ferranti Mercury on the right

Following a visit to the National Museums Scotland by CCS members, a veritable treasure trove of previously unknown (to us) old computers has been located. More anon, perhaps... But the original motivation for the visit was to investigate the Ferranti Atlas 1 (from Chilton) which is located there in storage. We are anxious to find one Alan Simpson who worked for the Royal Scottish Museum (as it then was) in the 1970s and was responsible for acquiring the Atlas. If anybody can help, please contact Simon Lavington at *lavis@essex.ac.uk*.

101010101

We have been approached by the *Railway & Canal Historical Society* with a request for help:

"We are trying to find anyone who was involved with the computerisation of British Railways from 1950 onwards for a research paper entitled *How Computers Changed the way BR was Managed*. Basically the request is aimed at ex BR staff to commit their experience to paper before the record gets lost but it is also possible that CCS members may have something to contribute. Clearly it is primary knowledge being sought and not secondary or anecdotal."

Contact is Graham Boyes (*g.boyes1@btinternet.com*).

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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.

100 Years of IBM (Part 1)

Terry Muldoon

An entertaining, highly personal and definitely not an authorised view of the history of IBM. Part 2 will follow in the next edition of *Resurrection*.

Introduction

The article is not intended to labour old ground but rather spend more time on the lesser known and/or interesting products. Additionally, most previous histories of IBM tend to concentrate on the United States whereas here we will pay more attention than is usual on IBM United Kingdom and IBM United Kingdom Laboratories at Hursley Park.

The Computing-Tabulating-Recording Company (CTR)

In 1911 Charles Ranlett Flint (1850 – 1934) merged three companies – the Computing Scale Company, the Tabulating Machine Company and the International Time Recording Company – into one corporation called the Computing-Tabulating-Recording Company or CTR. (If one includes the Bundy Manufacturing Company, the number is four companies.) Flint's reasoning was that, because of the three disparate product lines of the three companies, if one of the constituent companies had a bad year, the corporation's profits would be buoyed up by the other two companies.

A “computing scale” is one that has a dial that not only shows the weight of the item(s) placed upon it but, as long as the operator knows the price per unit of weight, calculates the price of the item(s). The Computing Scale Company of Dayton, Ohio, USA made such scales. In the UK the products were sold under the Dayton Scale brand before and after the creation of CTR.

In 1931 the scale business became an IBM Division – the Dayton Scale Division. In 1935, IBM sold the whole Division to Hobart Manufacturing.

The Tabulating Machine Company was the creation of Herman Hollerith and developed initially to build punch card based automation for the 1890 US Census. By using the Hollerith machines the time taken to process the census was cut from eight years for the previous census, in 1880, to just one year.

The machines built for the census were what we would call today “fixed function” or “hard-wired”. That is to say they could do one job and one job only – process the census data. Later Hollerith realised that if his machines were programmable, by the addition of plug boards, they could be used as general purpose machines, processing all sorts of business data. It was those programmable machines designed in 1906 that formed the basis of modern data processing and IBM.

In the UK and the British Empire (other than Canada), Herman Hollerith's company had already licensed its products to the British Tabulating Machine Company (BTM) which made and sold them in the United Kingdom and British Empire (except Canada). So the UK was not affected by the CTR merger in 1911 and carried on producing Tabulating Machine Company products under the "Hollerith" brand until October 1949 when IBM (as CTR was by then known) and BTM parted company.

After several mergers and acquisitions, BTM became International Computers & Tabulators (1959), then International Computers Ltd. (1968) and finally, Fujitsu UK (1990).

IBM United Kingdom was not formed until 1951.

Prior to the CTR merger, Flint had brought together most of the time recording companies under the International Time Recording Company (ITR). ITR was a manufacturer of time recorders. That is to say clocking-in and clocking-out clocks. Later in the 1930s, ITR introduced Master/Slave Clock systems. An electrically wound clockwork Master Clock sends pulses every minute to the slave clock thus ensuring the same time is displayed across a building or campus.

In the UK, there was an ITR UK long before the founding of CTR and it continued in business from its Hammersmith headquarters under the ITR brand.

In 1958 the US Time Recording Division was sold to Simplex Time Recorders. However in the UK, ITR remained a subsidiary of IBM United Kingdom until 1963 when it was the subject of a Management Buy-Out. It was later sold again to Blick Industries of Swindon, Wiltshire, England.

Thomas J Watson

In 1914 CTR appointed Thomas J Watson as General Manager. Watson had previously worked for the National Cash Register Company (NCR) of Dayton Ohio. NCR was run, maybe "ruled" is better term, by John H Patterson. Patterson's business methods were, to put it kindly - dubious. His view of the world was that NCR was entitled to control the cash register business throughout the United States.

As General Sales Manager, Watson bore quite a lot of the brunt when the Federal authorities caught up with NCR and its business methods and Watson was found guilty of several offences. Although he appealed, Watson had the threat of a prison sentence hanging over him when he joined CTR. One CTR Board Member, agreed that Watson was a good man for the job but asked: "*Who will run the company while he's in jail!*"

Watson turned CTR from small company with a dispirited workforce making a lot of disparate products into a major corporation. To achieve this, he brought with him from NCR the best (and legal) programmes that he had introduced there, for example: The Hundred per cent Club and the Think signs. He left behind him the dubious methods that he had practised in the past. In fact he told CTR employees that CTR would be an ethical company and they had to be "straight shooters". Whether Watson did this because, free of Patterson, he could revert to his New York State Methodist upbringing or he was scared of going to prison we will never know but IBM became known as an honest company – and having a reputation as straight shooters was good for business.

IBM

In 1924, Watson renamed the company International Business Machines to more accurately describe the business that IBM was carrying out. Over the years, the name and the famous three letters have become synonymous with Information Technology.

Electromatic

In 1933 IBM acquired the Electromatic Typewriter Company. Electromatic had recently perfected the electric typewriter. An electric typewriter is powered by an electric motor, thus taking away the physical effort required to operate an unpowered, or manual, typewriter. Under IBM's ownership, Electromatic went on to invent the proportionally spaced "Executive" typewriter (1941) and later the famous Selectric or "golf-ball" typewriter (1961), the latter forming the basis of the very first word processing machines.

The most famous of these Electromatic typewriters is probably the one given by Franklin D. Roosevelt to Sir Winston Churchill during the Second World War. (To the author's certain knowledge this was still in use in Number Ten in the 1970s.)

Electromatic later became the Electric Typewriter Division (1955) and then the Office Products Division (1964). It was spun off in 1991 as Lexmark International Inc.

The Automatic Sequence Controlled Calculator (ASCC)

In 1944 IBM unveiled the Automatic Sequence Controlled Calculator (or Harvard Mark One) an electro-mechanical computer. Although very fast (for an electro-mechanical device) and successful at what it did, the ASCC was a sixteen metre long, four and half tonne dinosaur. Neither IBM, nor Harvard, nor most of the rest of the world knew of the existence of the top secret Colossus at Bletchley Park. The electronic Colossus had out-evolved the ASCC before the latter had even been switched on.

The 1940s

In the years immediately following the Second World War, IBM was an extremely successful and profitable business. In addition to its usual product lines, IBM had even found time, during the War to manufacture parts for various weapons, and almost 350,000 complete M1 Carbines.

However IBM's success was built on electro-mechanical devices epitomised by the ASCC. The world was moving towards electronics, initially powered by thermionic valves (vacuum tubes) and later (1947) transistors.

Thomas J Watson Junior

In 1946 Thomas J Watson's son, Thomas J Watson Junior, returned to IBM after wartime service as a pilot in the United States Army Air Force, becoming President of IBM in 1952. There is little doubt that it was Watson Jnr. who drove the company in a new direction – computers. Some accounts say that this was against the wishes of his father but Tom Watson Jnr. has quoted his father as telling him to go look at what the people in the labs are doing: "I don't know what they are doing but they are doing it at two hundred thousand times a second!" he said to his son.

So during the 1950s, IBM became a computer company. Like every other entrant to the new business it did not make a lot of money building computers but, funded by its legacy punch card business, it was able to build plants and expertise.

Thomas J Watson Jnr. took over complete leadership of the company from his father in 1956.

The 1950s

<u>IBM 701</u>

In 1952 IBM announced its first mass produced computer, the IBM 701. The 701 used thermionic valve (vacuum tube) logic and electrostatic storage.

In the early days of electronic data processing, computers were usually described as being a scientific computer or a business computer. The IBM 701 was a scientific computer. Its business computer equivalent, the IBM 702, was announced the following year.

Vacuum Tape Column

The IBM 725 Magnetic Tape Unit was announced in 1953. Pulling the tape from a pair of loops in vacuum columns allowed better speeds and areal density. Almost from that time onward, whenever a "computer" is shown on film or television it is nearly always represented by a magnetic tape unit.

Core Storage

The IBM 704 announced in 1954 was the first computer to feature floating point arithmetic and the first IBM computer to have core storage from the outset. The 704 was a scientific computer; its business computer equivalent was the IBM 705 announced the same year. One of IBM United Kingdom's first large computer sales was of a 705 to the Royal Army Pay Corps at Worthy Down in Hampshire. In fact it may have been the first. The research is ongoing.

RAMAC

The first magnetic disk in the world, IBM 350 Disk Storage was a major component of the IBM 305 RAMAC announced in 1956. RAMAC stood for Random Access Method of Accounting and Control.

FORTRAN

Created in 1954 and commercially released in 1957, FORTRAN (FORmularTRANslator) was the first standard computer language.

Designed for scientific and engineering applications, FORTRAN is still in use today.

IBM 608

Announced in 1955 the IBM 608 was the first fully transistorised Standard Modular System (SMS) based computer that was commercially available.

IBM 1401 and IBM 1403

Announced in 1959, until the arrival of the System/360 Family in 1964, the fully transistorised SMS (Standard Modular System) based IBM 1401 was IBM's most successful computer. The 1401 had a printer called the IBM 1403. The 1403 was a originally a "Chain Printer". With the replacement of the chain with a "train", later models of the 1403 outlasted its host computer, living on into the 1980s and possibly longer. (The author would be very interested in hearing of any in use later than the 1980s.)

SAGE

SAGE (Semi-Automatic Ground Environment) was the first computerised air defence system built for the United States Government. The IBM computers used in SAGE were based on the thermionic valve (vacuum tube) driven IBM 701 Scientific Computer but with ferrite core storage. The expertise that IBM gained on SAGE and its manufacturing competence with core storage was immensely important to the company's future.

The 1960s

SABRE (Semi-Automated Business Research Environment)

In 1953 two American businessmen were sitting next to each other in an airliner. One of them worked for the airline, American, and the other for IBM. Noticing that they were both called Smith, they started talking.

They discussed the American Airlines ticket booking system which was based on moving paper around between boxes. The IBMer was sure that this system could be improved based on the advances in computing that IBM was making at the time.

Based on lessons that IBM had learned implementing SAGE, SABRE went live in 1960, running on an IBM 7090 computer.

The average time to process a reservation in the old manual paper-based system was 90 minutes – SABRE cut it to seconds.

The Magnetic Stripe

In the 1960s IBM was asked by the CIA for a way of adding data to a plastic identity card. An IBM engineer figured out how to do it and the rest, as they say, is history.

The magnetic stripe became an international standard in 1971 and was, until the arrival of the Smart Card, the basis for much personal electronic business, including the ATM in 1972.

The Selectric Typewriter

In 1961 a true icon was announced by IBM - the Selectric Typewriter.

Unlike, previous typewriters, the Selectric had no typebars and no carriage. The lack of the former allowed faster typing speeds by negating the chance of the typebars "clashing" whilst the latter allowed a faster return, due to the lower mass of the Selectric "carrier" versus a traditional typewriter carriage.

The Selectric's “golfball” typing element was easily changed by the operator. This feature meant that different typefaces and even languages could be printed on the same machine. In addition to the left-to-right machines for western languages, there were right-to-left machines for languages such as Arabic, Farsi and Hebrew. There was even a switchable right-to-left/left-to-right version that could cope with both! The most unusual element was probably the one developed for ballet/dance notation.

The ability to change fonts by simply changing the element led to the proportional spaced composers.

The Selectric's operating mechanism lent itself much more to mechanisation than traditional typebar equipped electric typewriters. This feature led to computer consoles, terminals and word processors.

<u>System/360</u>

The story of System/360 has been told many times and how TJ Watson Jnr. “bet the company” on it and so it is not intended to go into it all again but rather choose some parts relevant to IBM Hursley.

A famous Hursley member of staff at the time, the late John Fairclough, was part of the team of senior IBMers who were sent away to an hotel for several months, in the early 1960s, and told to think about where to go next. This was covered by John Fairclough himself at a CCS lecture at the Science Museum some years ago and, again, will not be repeated here. (see *Resurrection 21* [ed].)

John and his team had previously been working on a computer called SCAMP. (Not to be confused with the IBM US SCAMP that led to the IBM 5100 computer.) A lot of the technology introduced with SCAMP, for example the Transformer Read Only Storage (TROS), was used for the early System/360s. The first System/360 to be powered up was at Hursley. In Fairclough's own words: “Endicott and Poughkeepsie were months later”.

<u>The Magnetic Tape Selectric Typewriter (MT/SC)</u>

The Selectric typewriter that was announced in 1961 lent itself more than any previous electric typewriter to mechanisation. It was used as an input/output device for computers and in 1964 it formed the basis of the first Word Processor – the IBM Magnetic Tape Selectric Typewriter (MT/SC). It was not originally called a Word Processor because the IBM Laboratory in Böblingen, Germany had not yet coined the term.

The MT/SC consisted of a modified Selectric electric typewriter connected by an umbilical cable to a desk-side console. The console was equipped with one or two tape drives and the MT/SC logic. The Selectric itself was simply modified by the addition of switches and magnets. The console logic was provided by interconnected wire-contact relays. In other words, it was an electromechanical device rather than electronic.

CICS

CICS (Customer Information Control System) first announced as "Public Utility Customer Information Control System" in 1968 is probably one of the most important software products in the world today.

CICS is middleware and is designed to support rapid, high-volume transaction processing. It mostly runs on large mainframes, these days under z/OS and z/VSE. CICS is used in banking applications, Automated Teller Machines, insurance applications, and many other types of interactive applications.

CICS development moved to Hursley in 1974 where it continues today. Over the years, Hursley has made CICS more and more feature rich. Customers use it today to support devices that were not even thought of at its inception.

The Moon Shot

IBM had been working together with NASA and its predecessors for 30 years at the time of the Moon Shot. The guidance computer of the Saturn V rocket, called the Instrument Unit was built by IBM.

Mission control at the time of the Moon Shot contained several IBM System/360 computers. The first three Apollo missions used IBM 7090s.

The 1970s

The Diskette

In 1971 IBM invented the diskette (later called the "Floppy" disk) and diskette drive. Originally diskettes were invented for loading microcode but they were later used for all types of offline storages and data entry. The diskette went through various iterations: nine inch, five and quarter inch and three and a half; the latter being the most pervasive version. Today diskettes are only rarely used.

The Automated Teller Machine

The first true Automated Teller Machine (ATM) was deployed by Lloyds Bank Ltd. in December 1972 at their branch in Brentwood High Street, Essex, England. It was an IBM 2984 Cash Issuing Terminal. The "29" prefix means that this product was a “Request for Price Quotation”, that is to say a special product developed specifically for Lloyds Bank.

Unlike earlier cash issuing machines the 2984 was a true ATM. That is to say the customer authenticated his or her self with a magnetic stripe card and personal identification number (PIN), and was then able to draw a variable amount of cash, based on an interaction with the bank's host computer. This is as opposed to previous cash issuing machines that issued fixed amounts of cash based on vouchers or plastic cards that were later returned to the customer in the post.

IBM Hursley was more easily able to develop the 2984 partly because Lloyds Bank had already deployed an IBM 3980 Branch Banking System to which the 2984 was able to attach with some additional code developed at Hursley.

Had Lloyds Bank marketed their IBM 2984s as such, or even called them “Cash Issuing Terminals”, the terms may well have been forgotten but they choose to call the machines “Cashpoints”. A term which, like “Hoover” has stuck, and is often used generically. However, Cashpoint is a Lloyds Bank trademark.

“Winchester”

The IBM 3340 Direct Access Storage Device (DASD) – “Winchester” – was announced in 1973. The key difference between Winchester and the disks that preceded was that the platters (disks) and read/write heads were encased together in a clean air environment. This is known as a head/disk assembly or HDA. This technique allowed the heads to “fly” closer to the surface of the platters and so by doing this, IBM was able to increase the areal density of the data storage.

In the past there has been some confusion over the term “Winchester”, the IBM 3340's code name. The confusion was probably caused by one of the IBM laboratories that developed disks being at IBM Hursley Park, close to the City of Winchester. However IBM Hursley and the City of Winchester have nothing to do with the code name. The IBM 3340 was originally intended to have two spindles each with a 30 megabyte disk assembly. The Winchester firearms company had a rifle that fired a cartridge with a bullet that was .30in. in a calibre and was propelled by 30 grains (1.994 gm.) of gunpowder. That cartridge was known as the Winchester 30-30 and so a disk with 30-30 megabytes become known as the Winchester.

The Universal Product Code

The Universal Product Code (UPC), more usually called the “barcode” was developed in the 1970s at IBM's Research Triangle Park facility (often known internally as “Raleigh” even though it is outside that city) in North Carolina. Coupled with scanners in IBM's 3660 stores system, a complete Point of Sale (PoS) system was available to supermarkets.

The first swipe was done on June 26, 1974, at a Marsh’s supermarket in Troy, Ohio, which the industry had designated as a test facility. The first product swiped was a pack of Wrigley’s Juicy Fruit chewing gum, now on display at the Smithsonian’s National Museum of American History in Washington, D.C.

<u>IBM 6640 Document Printer</u>

Originally named the IBM 46/40 was announced in 1976. It was later renamed 6640 in order to come in line with the naming conventions of Office System/6 (announced in 1977) of which family it was a member.

The 6640 was an ink jet printer that squirted electrically charged ink drops through a pair of deflection plates which moved the drops up or down, in a very similar manner to a Cathode Ray Tube (CRT).

<u>Data Encryption Standard (DES)</u>

The 56-bit Data Encryption Standard (DES), developed by IBM in the 1970s, was one of the catalysts that gave the confidence to allow online banking. Due to the short key (56 bits) DES is no longer considered secure enough for many applications.

<u>IBM 3279 Colour Terminal</u>

In 1979 IBM announced the first Colour/Graphics computer terminal. Designed at IBM Development Laboratory, Hursley Park, the 3279 was a cathode ray tube (CRT) based 3270 subsystem terminal. It attached to a host computer via an IBM 3274 control unit. The 3279 could either display four-colour or seven-colour text and/or graphics depending on the model.

The 3279 did not carry out “vector to raster in the head” but rather the picture was formed in the host which then broke it into a set of “soft” characters which were then downloaded into the 3247/3279. There they were loaded into the screen buffer and formed the picture. The loading took a few seconds and could be set either to be accompanied by “Green Lightning” or simply a blank screen.

The host software used to drive the graphics function was usually the Hursley developed GDDM (Graphical Data Display Manager). The laboratory Director John Fairclough said at the time: “Today we announce colour – with a U”.

Terry Muldoon started with IBM as a Customer Engineer in 1970. He is currently a volunteer curator of the IBM Hursley Museum. His email address is terry_muldoon@btinternet.com

The ICL Historical Collection and 1900 Computers – What Still Exists?

Alan Thomson and Delwyn Holroyd

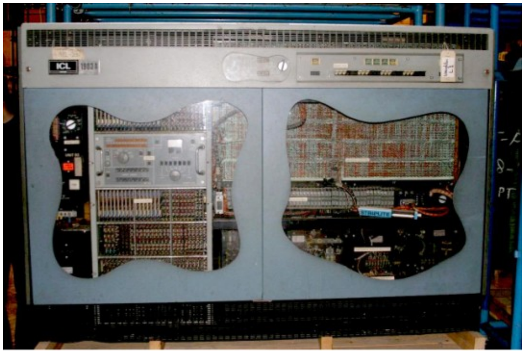
To track down what 1900 hardware still exists a research visit was made to the Science Museum large objects store in September 2013. The article outlines the findings and makes suggestions for further investigations.

The ICL Historical Collection was built up over many years at the ICL laboratories at Stevenage. In 1990 the company decided to close the outbuilding in which it was located, and most of the collection was donated to the Science Museum. The collection contained many hardware items and a large library of documents.

There is a forthcoming 50th anniversary of the launch of the 1900 range of computers in Sept 2014. To research what real 1900 equipment was still around a visit was arranged to the Science Museum large object store at Wroughton. The visit was on 25th September 2013, led by Delwyn, along with Alan Thomson (who worked on the early 1900 systems at Putney), Johan Iverson of TNMoC, and Rachel Boon (the assistant curator of technologies and engineering, and our Science Museum contact). We saw briefly what was in one of the storage hangers, and then visited the reading room to study some pre-requested documents from the ICL Archive.

Before the visit an initial search of the catalogue of hardware items held by the Science Museum for 1900 Series came up with 43 hardware items that were in store at Wroughton. The curator also explained that the objects are stored on pallets on racks in a four-high store in an old aircraft hanger, and that only the bottom run of the racks are accessible and directly visible. Further the location information in the catalogue for individual items was out of date, and that help was welcome on identifying the computer items. Some have labels with catalogue references, but many don't.

So that looked like a challenge, and indeed that was what we found on site. We were somewhat overwhelmed to find that, as well as the items we expected, there was a lot more in the store than the ICL Historical Collection that had been donated in 1990. There were also other ICT and ICL items that had been donated in 1972 and 1982. A subsequent search by the acquisition reference revealed that the catalogue had 265 hardware items for the collection, of which 71 were in the large object store at Wroughton and 194 smaller objects were in storage at Blythe House in London. The description text in the catalogue entries is rather brief, and without much description text to identify what was the system in which it was used in and what was the date of manufacture.



The original ICL Historical Collection mostly had punched card equipment items, both square hole and round hole (from BTM and Powers). Computer equipment has been added later. Three complete 1900 processors were seen. One of the two 1903A processors donated in 1972 has been modified for exhibition – it has covers with perspex insert panels. There is also a 1901A system which was donated in 1982. The 1900 equipment is mostly from Stevenage developed small ICL systems.

The ICL equipment is not located together, but dispersed among other items on pallets in several bays. We could see in some of the racks above the ground floor level Aztec blue and Tango orange covers of ICL items, and the browns and greys of punched card equipment. The lack of accurate location information is a severe limitation – and is something that would need fair amount of work to resolve jointly with the Science Museum.

What can be done is shown by what has been done for the document library that was part of the collection. Hamish Carmichael worked as a Science Museum volunteer and did sterling work over some years to prepare description text and index information for over a hundred metres of shelves of documents comprising the ICL archive. That catalogue has been published online for the CCS – see the CCS website under Web links/the ICL Archive. It was set up online by David Holdsworth,

We visited the document reading room to see some documents we had identified from the online catalogue of the ICL Archive and requested in advance. Very useful, and a pity we can't borrow or scan any of the manuals which would be helpful for restoration projects.

There was one significant find that will help computer restoration projects. The machine manuals from the archive that were looked at were found to have drawing reference numbers which have subsequently enabled location of some drawings in the `ICL Engineering Library' of microfilm aperture cards which is now at TNMoC.

Bringing the hardware catalogue up to the same standard as done for the ICL Archive document library will need much work by people who can identify the hardware items and provide more detailed descriptions. The items at Blythe House are more accessible with fewer restrictions on researcher visits than Wroughton, so it would be best to start there. Any proposed work on this by CCS volunteers would need to be agreed with the Science Museum taking account of other commitments and constraints on resources in their curatorial and conservation teams. To investigate further a specific visit to the ICL Collection items at Blythe House is being requested.

There are also computer equipment items in the Science Museum store from other companies that became part of ICL. Research on these continues along similar lines by CCS and TNMoC people – specifically on Elliott equipment by Terry Froggatt and on the Ferranti Atlas by Simon Lavington.

Another avenue of further research is to identify if any large 1900s survive anywhere. These were developed at West Gorton in Manchester. Part of that would be to establish what MOSI have in their collection of ICL equipment.

So where is this heading in the bigger picture? The CCS should be interested in the future of this significant collection of UK developed computer systems, and help towards its recognition (via an online catalogue, photos, and exhibits). As well as cataloguing all the items, the CCS could help by identifying the significant items for the history in the development of computer systems, and campaign for preservation and conservation of significant and iconic objects.

The opportunity this collection gives us is to show the story of the sequence of developments of one range of UK computers in a period of rapid technological change from the 1950s to the 1990s. Note that the 1900 software is well preserved by CCS members, and can be run on emulators, but there is no real 1900 equipment still working on which to run it.

So we hope to find a way that CCS people might work with the Science Museum to help improve the catalogue of the 1900 hardware items in the collection, and to get more of the collection available in the public domain – by photos and exhibits. The ICT punched card equipment is another area for further research.

Anybody who has first-hand experience on Stevenage-developed 1900 computer equipment and could help on work to identify and catalogue items is invited to contact the authors of this article.

Alan Thomson and Delwyn Holroyd are both prominent members of the Society. They may be contacted on alan.thomson@bcs.org *and* delwyn@dsl.pipex.com *respectively.*

The Cambridge Meccano Differential Analyser No. 2

William Irwin

In my younger, Meccano model building days I knew that there was a Meccano Differential Analyser in Auckland, having read about it in the Meccano Magazine of October 1973. A picture of Dr. Harry Whale setting up the Analyser at the Museum of Transport and Technology (MOTAT), was reproduced from an article in the "New Zealand Herald" entitled "Toy Used to build Brain Box in 1930s".

The Differential Analyser is a mechanical analogue computer which solves differential equations by integration. It makes use of one or more wheel and disc integrators, interconnected by shafts in various ways to suit the problem equations. Many full scale Differential Analysers were built in USA, UK and Europe between 1934 and the early 1950s, until they were eventually replaced by faster digital computers.

Some Differential Analyser History

The first full scale Differential Analyser was built in 1931 by Vannevar Bush at MIT in the USA. On seeing this machine on a visit to MIT, Douglas Hartree remarked that it "looked as if someone had been enjoying themselves with an extra large Meccano set". On his return to Manchester University he set about constructing a small scale Meccano based model with the able assistance of Arthur Porter in 1934. This is commonly known as the Meccano Differential Analyser No. 1. The Manchester machine proved to be so successful that a second Meccano Differential Analyser was constructed at the Cambridge University Mathematical Laboratories by J B Bratt under the direction of Prof. J E Lennard-Jones in 1935. It initially had four integrators, a fifth integrator being added by Maurice Wilkes in 1937. During the war years it was co-opted for military use, and various improvements were made to it at this time under the direction of Dr. J Crank. This is known as the Meccano Differential Analyser no. 2, the machine currently on display at MOTAT. Dr. Harry Whale, who had used the Meccano Differential Analyser briefly while studying at Cambridge, bought it for £100 in 1950 and had it shipped to New Zealand for use in his research at the Seagrove Radio Research Station in Auckland. It subsequently saw service at the Applied Mathematics Laboratory of the DSIR in Wellington until 1961, and ended up at the Wellington Polytechnic. In 1973 it was donated to MOTAT and shipped to Auckland, where Dr. Whale, assisted by two students Kevin Ryan and Darcy Millar, got it operational again for demonstration purposes. This machine was the first analogue computer to be used in New Zealand and as such has great historical value. It is also the only remaining complete working Meccano based Differential Analyser in the world, out of about 15 constructed during the period 1934 to 1951.

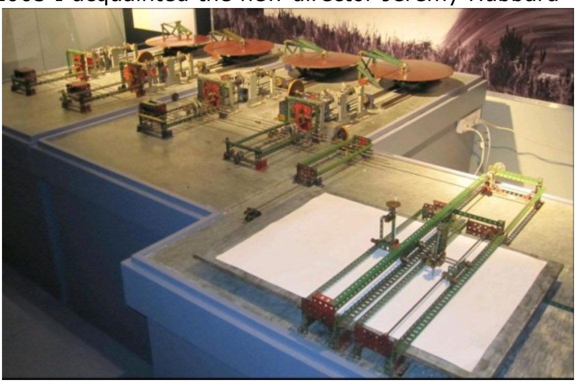
Examples of the type of calculation for which the MOTAT Meccano Differential Analyser has been used to predict results are:

A. During World War II in UK: Military applications, thermal conduction and convection problems, detonation waves of high explosives, and electrical transmission line studies.

B. In New Zealand: Radio studies, geothermal studies, Waikato river hydro-electric scheme studies, Grassmere saltworks design, and rabbit population predictions.

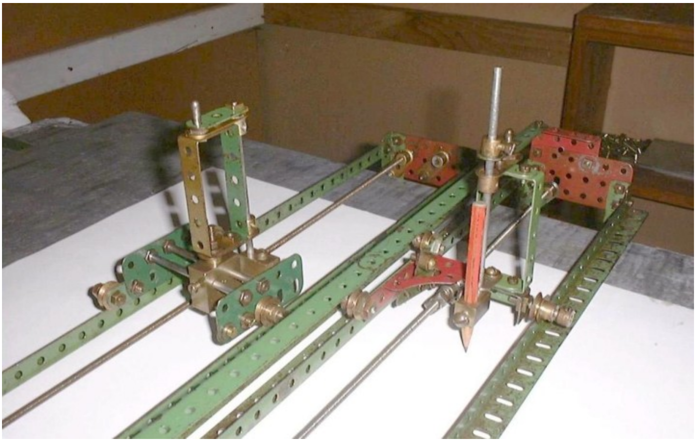
My Involvement

After emigrating to New Zealand in 1998 I naturally visited MOTAT only to discover that the analyser was not on display and no-one seemed to know anything about it. A few years later in 2001 I discovered through Doug Harris, a fellow Meccano enthusiast that steps were being taken to restore the Analyser which had sustained some water damage after many years in container storage. I was invited to sit on the small committee set up by then MOTAT director John Syme in order to oversee the restoration, possibly in conjunction with the Auckland University Physics department. A report was also commissioned from a Christchurch conservator. In 2002 John Syme suggested that I should become a volunteer, so I joined up. In 2003 I acquainted the new director Jeremy Hubbard with the Differential Analyser story, and presented a proposal to him for its restoration. He made a room available to me for the purpose and the rest is history. With the assistance of John Denton, a fellow member of the Auckland Meccano Guild, we restored two integrators and the combined input/output plotter.



The restored Meccano Differential Analyser

We were fortunate in being able to call on Dr. Harry Whale to view our work and to advise on the accuracy of our restoration and set up. The aim was to restore the Analyser to its appearance and settings when it was first displayed at MOTAT in 1973. This machine was referred to by older MOTAT staff for many years as the "Crank Differential Analyser". This originated from the book "The Differential Analyser" written by Dr. John Crank in 1947. Dr. Crank had been in charge of the Cambridge machine during the WW2 period and it features prominently in his book, which has become our "bible" for reference purposes.


The Plotter Table

The first public display of the restored Analyser took place at the Auckland Meccano Guild convention and exhibition at Pakuranga over Easter weekend 2005. Also present at its unveiling were Dr. Harry Whale, Prof. Bob Doran and Dr. Garry Tee from Auckland University, Allan Rudge from MOTAT, and Dr. Tim Robinson of the Computer History museum in California USA. Subsequently the Analyser was included in the *Machines that Count* exhibition at MOTAT which ran from June 2007 to July 2008.

We then proceeded to restore two further integrators, and later that year volunteer Gary Higgins and I managed the impossible and got the machine working again in November 2008. This was quite a feat considering that our work had been a conservation exercise rather than restoration. All the shafts and axle rods are original and their straightness leaves a lot to be desired after all these years especially the long screwed rods! Currently the Analyser, consisting of the four integrators and plotter, is on display in the *I Am The Last Tram* exhibition. The fifth integrator has been restored and is ready for display in the future if required.

How does the Differential Analyser Work?

A typical mechanical Differential Analyser consists of the following components:

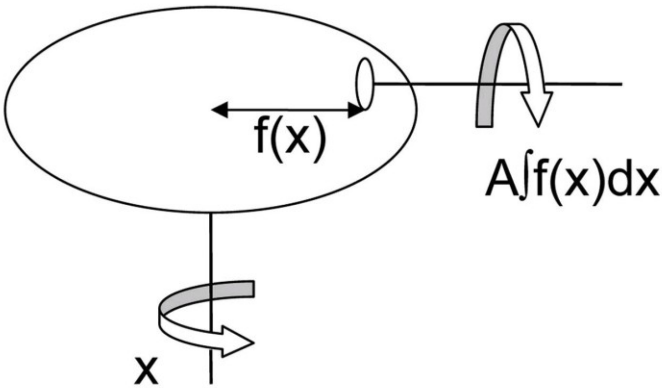
Two or more Integrator units (including one Torque Amplifier per unit).

Adding and counting units.

Input and Output tables.

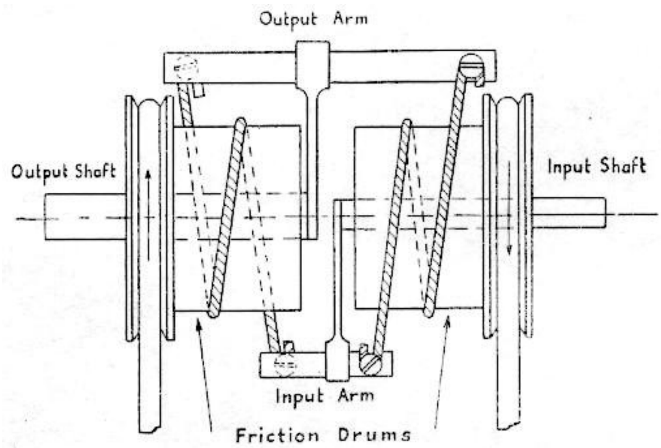
A gearing and shafting system to link everything together.

The Integrator:



The Integrator is in essence a variable-speed gear, and takes the form of a rotating horizontal disc on which a small knife-edged wheel rests. The principle used is shown in this diagram. The vertical axis of the horizontal disc is supported in a movable carriage so that the distance of the point of contact of the wheel on the disc, from the centre of the disc, can be varied. The two inputs to the integrator are therefore the rotation of the disc x, and the carriage movement f(x). When the unit is integrating, the disc rotates and undergoes a translational movement simultaneously. The rotating disc drives the wheel by friction. The rotation of the wheel represents the output of the integrator. For proper operation the wheel must not slip on the disc so the rim of the wheel must be as sharp as possible, usually hardened steel on a polished glass disc or bakelite.

The Torque Amplifier:



The torque on the shaft carrying the integrator wheel is very small due to the low frictional force between the wheel and disc. In order to drive other units of the machine, the shaft from the integrator passes into a torque amplifier, the output shaft of which rotates with the same velocity as the input shaft but with greatly increased torque. The principal of the torque amplifier is essentially that of the capstan, where a small force, applied at one end of a friction band wrapped around a rotating drum, produces considerably increased tension at the other end of the band. The principle is shown diagrammatically above. The two drums are driven by a motor in opposite directions. Movement of the input shaft tightens the thread on the motor driven drum, which causes the output shaft to rotate with amplified torque.

Adding and Counting Units:

These can be included in the shafting when required. Adding units consist of a differential gear system so arranged that the angular rotation of one shaft connected to it is the sum of the angular rotation of two other shafts. Counters are used when it is desired to know the number of revolutions made by a particular shaft.

Input and Output Tables:

The input table is a unit whereby information concerning the differential equation is transmitted to the machine. A stylus is manually made to follow a pre-plotted curve, representing the known functional relationship between the variables. The result is mechanically linked to the input drives. Not all problems require the use of the input table. The output table is similar in construction to the input table. The solution to the equation is drawn by a pen on paper, in the form of a curve, thus plotting the results from the various mechanical linkages.

Operation:

Motors are required for each torque amplifier, and one motor is required for the main input drive. Secondary inputs are manual via the input table. I have purposely not gone into any mathematical background here. Suffice it to say that the integrators, input and output tables, adders and counters if required, are all linked together by gearing and shafting to suit the particular differential equation solution required. This requires a lot of effort in setting up for each different problem. This is in effect the "programming" of the machine which defines it as a computer. Of course a thorough knowledge of the mathematics of the problem is required by the user.

Current setup (as found):

The Differential Analyser is currently set up to solve the simple equation

$$\frac{d^2y}{dx^2} = -y$$

This is the equation for simple harmonic motion and the plotted result is a sine curve. Only two integrators are required and careful examination of the shafting will reveal that the output from one Integrator is fed as input to the other Integrator, and vice versa. The output from either Integrator plotted against the independent x (time) variable will yield a sine curve. The output of the integrators plotted against each other yields a circle. This is the standard circle test for testing the accuracy of the machine.

Addition of the Fifth Integrator:

In June 1937 a research student at Cambridge, Elizabeth Monroe, had a differential equation to solve which required five integrators. Prof. Lennard-Jones agreed to provide the funds for the construction of a fifth integrator and the parts were ordered. According to Maurice Wilkes in his book, *Memoirs of a Computer Pioneer*: "I had spent many happy hours when young building things with Meccano, this being an English boy's birthright. Elizabeth, who was American and a girl to boot, had been underprivileged in this respect. I therefore gallantly ceded to her the job of assembling the Meccano parts, only intervening to make sure that the nuts were tight. It is satisfactory to record that the new integrator was a great success."

This article originally appeared in The Driving Wheel *and appears by kind permission of the editor. The author may be contacted at* irwins@ihug.co.nz*.*

Obituary: Professor Frank Sumner

Simon Lavington

It was Alan Turing who in 1952, first introduced Frank Sumner to the Ferranti Mark I which Frank used for molecular orbital calculations. In later life he observed of Turing's programming manual "*All the example programs in this manual had slight errors in them and by the time you had worked out what the code should have been you had become quite a competent programmer.*"

Finding computing much more interesting than chemistry, Frank devoted the rest of his professional life to computing at Manchester University. He joined Tom Kilburn's project to design the Ferranti Atlas supercomputer and worked on the logical design of the CPU and on the implementation of Virtual Memory. Atlas was in service from 1963. It was followed by a new high-speed computer project called MU5 and Frank was a member of the MU5 design team.

In 1964 a separate Department of Computer Science had been established at Manchester, Frank becoming the Admissions Tutor. He was deeply committed to the development of Computer Science as an undergraduate discipline and was a member of the UGC Mathematics and Computer Science Committee.

Frank was promoted to Professor of Computing Science in 1967 and in 1983 he became the part-time Director of the University of Manchester Regional Computing Centre. In the wider world, Frank was invited to serve on many national and international committees. He also had many responsibilities within the British Computer Society and was President in 1978/79. From 1993 Frank was active in the North West Branch of the CCS and he served on the main CCS Committee from 1995 to 2000 when his health started to deteriorate. He was a strong supporter of the project to build a working replica of the June 1948 'Baby' computer.

40 Years Ago ....
From the Pages of *Computer Weekly*
Brian Aldous – TNMoC Archivist

Argus 700s to control Motorway traffic; the Department of Main Roads, New South Wales, has placed a £400,000 order jointly with Ferranti and Plessey for a dual Argus 700 system and electronic warning signs for a new Expressway being built near Sydney.

The installation of a £6 million, twin ICL 4/72 system at RAF Supply Control Centre, Hendon, is forecast to save the RAF £1.5 million a year. When complete it will manage £2,000 million of equipment, representing parts 'in use' by RAF squadrons.

IBM is picked to meet Post Office R&D needs with a £2.5 million order for a 3MB IBM 370/168 instead of the much expected ICL 1906S.

The Minimodem Acoustic Coupler manufactured by Modular Technology of Oxhey, Herts., that excited so much attention at Compec, has been approved by the Dutch PTT. Currently, Eire and Holland are the only overseas countries to have approved its use.

Alpha 16 aids fast tunnelling machine; with projects like the Channel Tunnel moving from the possible to probable category, the Transport and Road Research Lab. is to carry out experiments in a chalk quarry in Chinnor, Oxfordshire, with a fast new tunnelling machine. The target tunnelling speed of 10 metres per hour is too fast for manual control and data-logging. Sturge Automation of Birmingham has been called in to develop a highly specialised data collection system using an Alpha 16.

Unidata's first ready for launch; the pan-European partnership's first mainframe, the Unidata XO, lies at about the point where the IBM 360 and System 3 ranges meet, but with a price-performance characteristic said to make it twice as competitive as anything from the IBM stable. But conflict looms on the horizon with Swiss company Unidata AG registering its own Unidata 200 machine right under Siemen's nose in Munich.

Digital launch DECLAB; comprising of a 16K PDP–11/40, independent graphics processor, 12 inch CRT, twin disc drive, LPS-11 and DECWriter, DEC hase launched a new laboratory system package called DECLAB.

Canadian bank to develop network to link all branches; employing six large IBM configurations, the largest being a 1MB 370/135 and 240KB 370/135 in dual-processor configuration, the Royal Bank of Canada is planning to link all its branches together.

4080 Traffic Control system for Hong Kong; following signing of contracts between GEC-Elliott and Hong Kong Public Works, the GEC-Elliott dual 64KB 4080 system using the GEC-Elliott Transyt package is to be installed in the busy West Kowloon district.

German company buys share in BCL; in the first major expansion into the UK computer industry since Britain's entry into the Common Market, Kammerei Dohren AG of Hanover is to acquire a 40% stake in Business Computers Ltd. for £600,000.

First Cyber installed in UK; a CDC Cyber 70 Model 72 for Sun Life Assurance Society's London office has become the first Cyber system installed in the UK. It will replace a KDF9 and a 1902A over the course of the next two years.

HP-65 nearest yet to hand-held computer; with all the features of the existing HP-45, plus the capacity to accept pre-programmed magnetic-stripe cards or user-generated programs using the HP-65 function keys, the HP-65 is being hailed as the nearest thing yet to a hand-held computer.

OCR wand for use with the NCR 280; bringing a major step forward in PoS processing, NCR has announced an optical character recognition wand capable of recognising eye-readable characters for product identification. It replaces the NCR 785 light pen which reads complex three-colour bar codes on tags produced by expensive NCR 747 tag printers.

Machine for reading hand-printed characters; developed by University College London, the UCLM 3 can read any font which it has learned to read, from a few characters per second to document reader speeds of 400 cps. Top speed is limited by the paper handling mechanism.

First New Range machine at Bath; in what seems likely to become a stream of ICL New Range computers to be acquired by British universities, the first has been installed in the new computer centre at Bath University. Understood to be a P4, it will be linked to and augment the existing ICL System 4-based network of the South Western group of Universities.

Coral 66 to be real-time standard; following the DTI-led feasibility study for recommending a standard language for real-time applications, the decision has been made to recommend Coral 66. The new standard was not intended to be as rigorous as that imposed by the MoD, and tenders for Government contracts based on other real-time languages would not be immediately rejected.

Forthcoming Events

London Seminar Programme

12 Dec 2013	The Antikythera device	Tony Freeth
16 Jan 2014	The Harwell Dekatron	Kevin Murrell
20 Feb 2014	The EDSAC Replica	Andrew Herbert
13 Mar 2014	Structured Software and the Break with Electrical Engineers	David Grier
10 Apr 2014	The History of Computing in Colour	Martin Campbell-Kelly

London meetings normally 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

21 Jan 2014	The CDC 6600 Computer	Dik Leatherdale
18 Feb 2014	Tales of the Unexpected: an alternative history of the computing industry	Bill Thompson
18 Mar 2014	Babbage's Analytical Engine	Doron Swade

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.*

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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, Saturday and Sunday 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 : An excellent display of computing and mathematics machines can be found on the second floor, but elsewhere machines from ICT card-sorters to Cray supercomputers via Pilot ACE, arguably the world's oldest surviving computer may be discovered. Admission is free. See *www.sciencemuseum.org.uk* for more details.

Other Museums : At *www.computerconservationsociety.org/museums.htm* can be found brief descriptions of various UK computing museums which may be of interest to members.

CCS Website Information

The Society has its own website, which is located at *www.computerconservationsociety.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.

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Point of Contact

Readers who have general queries to put to the Society should address them to the Secretary (see page 12 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 BCS, however, need only notify their change of address to BCS, separate notification to the CCS being unnecessary.

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