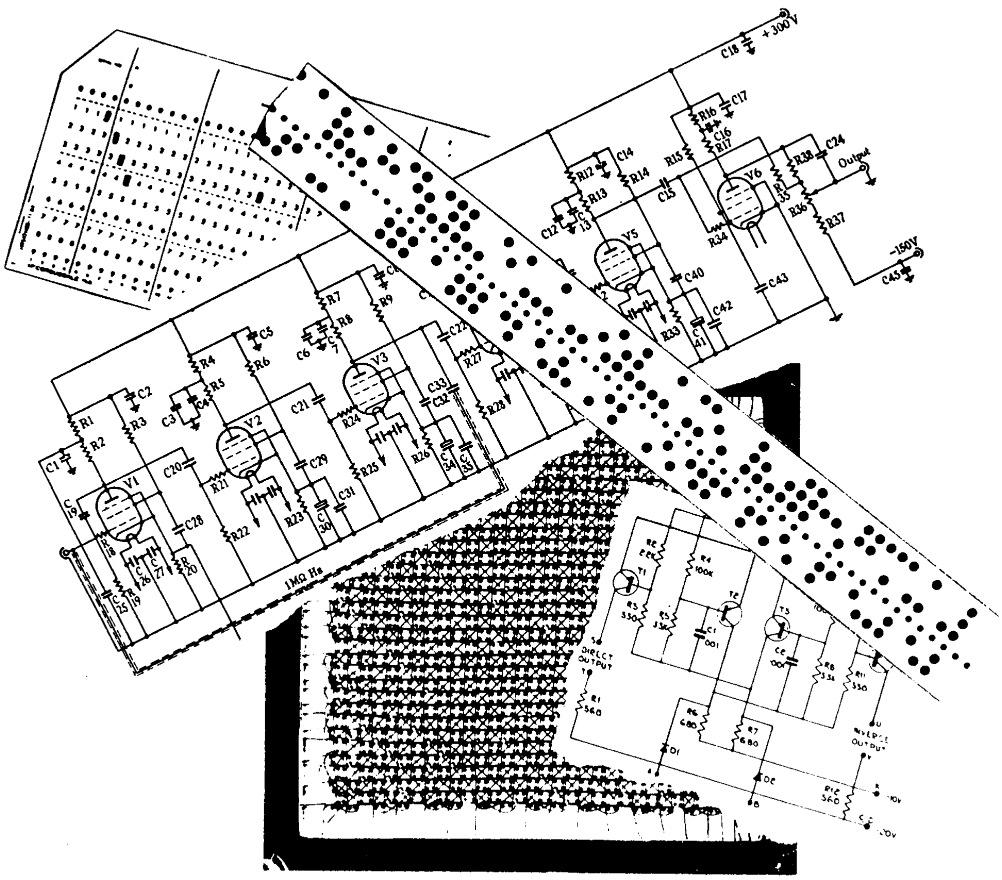
Volume 1 Number 3 Spring 1991

Computer

RESURRECTION

The Bulletin of the Computer Conservation Society



The British Computer Society

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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 and the Science Museum of London.

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

The aims of the CCS are to

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

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

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

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

Resurrection

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Editorial

Nicholas Enticknap, Editor

Welcome to the third issue of Resurrection. It's been quite a time since the second issue. The Christmas break and the paralysis of the transport system in February didn't help at all, while we have also suffered from production difficulties.

The Society has put on three events since the last issue. The Open day in October proved a great success, attracting well over 100 visitors. Our Pegasus was restored to working order just in time for the event, and proved a star attraction. We believe this is now the oldest working computer in the world.

The popularity of the Open Day persuaded the Committee to set up other opportunities for members to see our computers: these are known as "In Steam" days. On these days usually the first or second Wednesday in each month - members have an opportunity to run their own programs on the systems that are working.

The machines on which it is possible to do this at present are the Pegasus, the Elliott 803, several DEC PDP-8s, the Philips P350 and the Burroughs L5000. In Steam days start at 10 am and finish at 5 pm, and the dates for the next few months are listed in our Future Events section. Those interested in attending should contact the Secretary in advance.

In November the Society held a meeting to commemorate the 30th anniversary of Algol. An imposing array of speakers involved with Algol in its early days turned up to describe their always interesting and sometimes bizarre experiences.

In January George Felton of ICL George operating system fame gave a talk on the timesharing system used on the Ferranti Orion. Reports on this talk and on the Algol meeting are planned for the next issue.

Many of our younger readers will be unfamiliar with the terminology used to describe the technology of early computers. For their benefit we are including in this issue an article by the Society's Secretary, Tony Sale, which explains the major electronics concepts of the forties.

Society News

Tony Sale, Secretary

After the peak of activity organising the Open Day and Evening Reception, the Christmas lull has been a welcome relief.

The Computer Weekly article generated a number of phone calls from people with equipment to throw out. The message seems to be getting round and more people have been coming forward with interesting memorabilia and personal papers.

Membership now stands at 250 and is still rising.

The "In Steam" days, which take place on the first or second Wednesday each month, have started well. The Elliott 803 is now working, and although Pegasus has been a little temperamental, some genuine applications programs have been run. This is the main purpose of the In Steam days, and we would like to see many more people coming forward with original programs to run on all the working computers. In the long term it will be invaluable to have video recordings of applications programs being run and described by the people who wrote and used them. One of the first questions lay people ask about an old computer is "What could it do?". Our video recordings should provide an answer, so all you old programmers dig out your programs and come along.

Open Day and Evening Reception

Nicholas Enticknap, Editor

The Society was able both to demonstrate and celebrate the extent of its first year's achievements at the Science Museum on 11 October 1990. During the day, 120 Society members and other interested persons were able to inspect the progress of the restoration work on the Society's computers. At close of play, there was a reception sponsored by *Computer Weekly*, held to say thank you to the corporate members and to others who have materially helped the Society.

The Open Day allowed the Society to demonstrate progress made over the last year to the public. The machines are normally accessible only to Museum staff and to members of the Society authorised to work on them. Because of the popularity of the Open day, however, the Society is now organising "In Steam" days, where its machines are open to inspection by the public once a month (see the Future Events section for dates).

The computers on show in the Information Age project office represented the history of the computer industry in microcosm. There was a first generation computer, the Pegasus, first delivered in 1956. There was a second generation system, the Elliott 803, only four years younger. There was an early minicomputer, an original DEC PDP-8. There were a number of visible record computers, that curious hybrid of accounting machine-cum-computer that enjoyed great popularity with small companies in the late sixties and early seventies. And there was a first generation personal computer, the North Star Horizon - or rather two of them, one stripped down so that visitors could inspect the technology.

The star of the show was undoubtedly the Pegasus, the machine described by John Cooper in the first issue of Resurrection. The Pegasus Working Party had completed the task of restoring it to working order, so visitors were actually able to watch it working, playing tunes and printing out lists of prime numbers. They were able to hear it working, too: the alternator makes a lot of noise, and demonstrator Chris Burton had difficulty making himself heard over the din.

Next to the Pegasus was the Elliott 803, a machine that is not much younger though it is a generation more advanced, using transistors throughout. Like the Pegasus, it is the only extant model known (though the Society has most of a second machine that will be used as a supply of spare parts).

The machine was switched on for the first time just a week before the Open day. The console immediately produced a burning smell so it was hurriedly switched off again. The fault was traced and rectified, but unfortunately a similar problem arose on the Open Day itself, so the Working Party was unable to demonstrate it to visitors.

Even as a static exhibit, the Elliott is an impressive sight. An unusual feature is its backing store not tape, drum or disc but magnetic film. Our system has the maximum five permitted film handlers, which look not unlike the tape drives of the period. The film itself is 35mm ciné film with an oxide coating, and comes in 1000 foot reels.

Another interesting feature is the battery, supplied to keep the machine running for a few minutes in the event of a power failure, to permit an orderly powering down of the machine. Our battery dates to 1965, and is a little the worse for wear - the casing is holed, and some of the 20 cells do not work.

Working Party chairman John Sinclair has discovered that this type of battery is still being made, and is in use in aircraft such as the Nimrod.

The Society's richest collection of machines is the DEC PDP-8 range, thanks mainly to the generosity of corporate member DEC and the energy of

DEC working party member John Willis, who works for DEC as a field engineer and thus has inside knowledge of when machines are being replaced.

The PDP-8 is a machine that has existed in seven incarnations, starting with the original PDP-8 itself in 1965 and culminating in the DECmate III, launched in 1985 and continuing in production until 1989.

The Society has one of the original PDP-8s, which came from Rutherford Laboratories. This is the main focus of the Working Party's activity. The machine works but is not fully operational, as there are unresolved problems with the memory subsystem.

In addition, the Society has two DEC systems (a 300 and a 310), a VT78, and a DECmate III, all of which are operational and were available for inspection at the Open Day. A Data General Nova, which can be regarded as an evolution of the PDP-8 as it was designed by PDP-8 Engineer Edson de Castro, was also on view: this computer still awaits restoration.

Visible record computers started to appear in the late sixties, and the Society is building up a representative collection. On display at the Open Day were two of the most popular machines of the early seventies, a Burroughs L5000 and a Philips P352. Representatives of Unisys and Philips were on hand to demonstrate them.

The activities of the S-100 bus Working Party were represented by the presence of two North Star Horizons, both in working order. These computers were in widespread use in the late seventies and early eighties and can be regarded as typical first generation personal computers. They used eight-bit Z80 microprocessors, supported 64K bytes of RAM, and relied on floppy discs for subsidiary storage.

The Evening Reception followed the pattern of the launch party held in November 1989. It was held in the Fellows Library of the Science Museum and was attended by 80 people, including all of those who had worked to make the Open Day such a success, representatives of the corporate members and many distinguished computing pioneers.

As at the launch party, there were several past presidents of the BCS, including this time Lord Halsbury, who as first managing director of the NRDC worked so hard in the fifties to get the British computer industry on a sound commercial footing. Others included Maurice Wilkes, Sandy Douglas, Cecil Marks and Graham Morris.

The Director of the Science Museum, Neil Cossons, welcomed the guests and started by proposing a toast to celebrate "the successful re-operation of Pegasus". He told them that "the world's first computer conservation society" was performing an indispensable task. It was impossible for the Museum to employ the expertise necessary to restore all these old computers, as restoration work could only be properly carried out by those who had worked on the machines in their prime.

He gave a special word of thanks to corporate member ICL, and particularly David Dace and Gordon Collinson, for the donation of the ICL historical collection to the Museum, a priceless assembly of equipment and documents.

Cossons was followed to the rostrum by Roger Johnson, representing the BCS as its Vice-President (Technical and Specialist groups) in the absence of both the current and incoming BCS presidents, who were unable to be present. Roger had a difficult task, as he is also Treasurer of the Conservation Society, and his talk was characterised by a deft swapping of hats as he spoke on behalf of first one body and then the other.

Roger commented on the enormous number of man hours that went into first the design of the early computers, then their maintenance throughout their working lives, and now their restoration. Reflecting on the fact that BCS members were recognised as Chartered Engineers earlier in 1990, he commented that the Pegasus provides an excellent illustration of the fact that software truly is an engineering process.

He hoped that the work of the Conservation Society would prove instrumental in kindling interest in computer conservation abroad, especially in France, Germany and Italy. Roger concluded by looking forward to the creation of the new computing gallery at the Science Museum.

The reception's sponsors, *Computer Weekly*, were represented by the editor, John Lamb, who added his note of encouragement for the Society's work. He commented that it was strange to find an S-100 bus machine as a museum piece: he could recall as a junior reporter telephoning to the US to find out what an S-100 bus was!

Tony Sale then spoke on behalf of the Conservation Society itself to give formal thanks to those who have helped the Society in its inaugural year. First came the five corporate members - in alphabetical order Allied Business Systems, Bull, DEC, ICL and Unisys - and the Allied Lyons Trust, which between them have provided the money that has funded the restoration work.

Tony also paid tribute to others who have helped in various ways. They included Systems Reliability and the City University, who allowed their employees John Sinclair and John Cooper respectively to devote a large number of working hours to restoring the Elliott and the Pegasus.

Tony acknowledged the support of DEC, for the efforts and time of its staff in the PDP-8 restoration programme, and Philips Business Systems, which similarly contributed to the restoration of the P352.

Thanks were given for donations of a DECmate III by DEC and a Multibus by Allied Business Systems. Tony also thanked Judith Milledge, the former owner of the Pegasus, and David Dace, who stored the Pegasus at a time when the Science Museum had no room for it, as well as John Gray, who donated the Elliott 803.

Finally, Tony thanked Tony Higgins, long serving deputy editor of Computer Weekly from its formation in 1966 until 1980, and subsequently press relations manager with Unisys until his retirement in 1989, for his donation of a set of Computer Weeklys covering the time of his service on the paper.

Maurice Wilkes then spoke on behalf of the many computer pioneers present. In a characteristically witty address he thanked the Conservation Society not only on behalf of the pioneers but on behalf of the computers themselves, before concluding the formalities by calling for refreshments to be served.

A gentle introduction to 1940s electronics

Anthony Sale

The electronics of the 1940s is a completely alien world to a large number of today's computer professionals. This article has been written to give some insights into this earlier era.

The dominant technology throughout the period was the thermionic valve, invented in the early 1900s. In the valve, electrons are emitted in a vacuum from a heated element, the cathode. These electrons are attracted to a second element held at a high positive potential with respect to the cathode, called the anode.

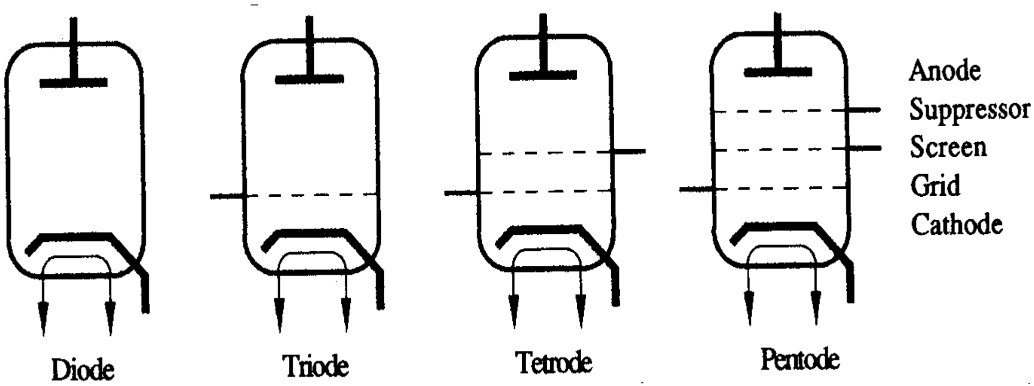
The simplest form of valve is a diode containing just a cathode surrounded by an anode. It has similar characteristics to modern day silicon or germanium semiconductor diodes; that is current flows when the anode is positive with respect to the cathode, no current flows when the anode is negative.

The next advance was to place a single grid of fine wires between the cathode and the anode, creating the triode. By applying a negative potential to this grid, the electron flow to the anode could be reduced even though there was a high positive potential on the anode. More importantly there is negligible current flow into or out of the grid and so considerable current amplification is possible.

In a triode, the current flowing to the anode depends on both the potential on the grid and the potential on the anode. For a number of applications it is desirable that the anode current, whilst still being controlled by the grid potential, should be independent of the anode potential. This is achieved in the screen grid, or tetrode, valve by placing a second grid between the first grid and the anode. This second grid, which is known as "the screen",is held at a constant high potential with respect to the cathode and substantially reduces the dependance of the anode current on the anode potential.

Another advantage of the screen grid is that the input capacitance at the control grid is substantially reduced. In a triode, this input capacitance is amplified due to the anode voltage change inducing a current flow in the grid via the anode-grid capacitance. This is known as the Miller effect. At the high frequencies involved in computers, this can be a significant effect and the screen grid substantially alleviates it by reducing the anode-grid capacitance.

A further improvement came with the pentode valve. This was achieved by placing yet another grid, known as "the suppressor", between the screen grid and the anode. The suppressor was usually held at cathode potential, but it could be used as a separate control grid and later assumed some importance in logic circuits.



All the above enhancements to the basic valve were aimed at improving its performance as a linear amplifier or oscillator. Virtually all valves were used as linear amplifiers or oscillators. Only a very few people were using valves in an on/off mode, even though Eccles and Jorden had shown how to build switches using valves, in 1919. Thus manufacturers paid no attention to controlling the static, DC, characteristics of valves: any uniformity in this was purely as a side effect of controlling linearity and gain in the linear, AC, amplification mode of working.

There are a number of considerations arising from having to use valves as switching elements in a computer. First the cathode needed heating in order for electron emission to occur. Typical heaters consumed 0.3 amps at 6 volts, which is 1.8 watts per valve. Secondly, high voltages of the order of 200 volts were required on anodes and screen grids. Since currents of up to 100 milliamps may be involved, this adds a dissipation of up to 20 watts per conducting valve. The valve is a high impedance device and these levels of current were needed to charge and discharge the grid and anode capacitance at the high speeds required. All this meant that power consumption on early computers was many kilowatts and this had to be dissipated somehow.

It also meant that power supplies were non-trivial pieces of engineering, requiring 20 - 40 amps at 200 - 400 volts fully stabilised. It also means that you can always recognise an early electronics engineer, since when he approaches a piece of equipment, the first thing he does is to put one hand firmly behind his back. This is to avoid touching both hands across a high voltage and getting a lethal shock passing through the heart!

Another problem was the requirement, in computers, for valves to handle waveforms which contained transients which were very fast for those days.

This problem had been encountered in amplifiers for counters of atomic particles and in amplifiers for television signals. It was this application area which led to the term video amplifier being used. The bandwidths involved were from dc to 1.5 Mc/s. Wartime radar and other applications both extended the frequency range and improved reproducibility through the vast numbers of valves produced. It was however still difficult to achieve bandwidths of 10 Mc/s, that is to be able to handle transients of less than 0.1 microsecond.

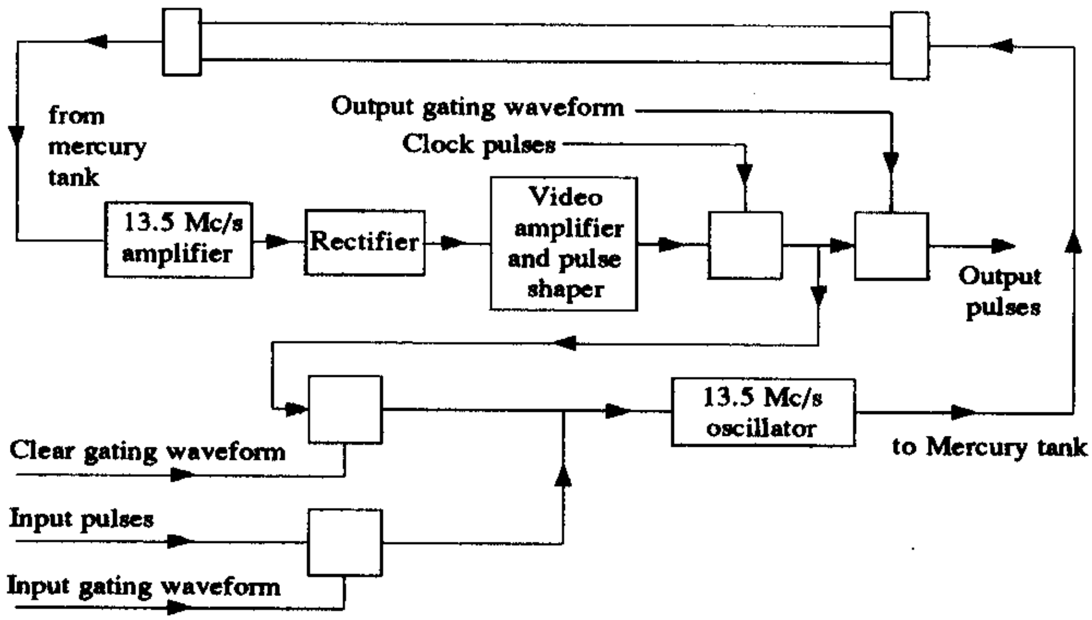
Another expected problem was valve reliability, or mean time to failure. In prewar electronic equipment and in most wartime equipment this was not a significant problem, but for computers employing many hundreds, even thousands, of valves this was of real concern. In the event it proved not to be the problem which some people had anticipated. This was probably because valves were inherently more reliable than manufacturers guarantees indicated. Most valve failures occurred due to breakage of the heater wire as a result of the thermal shock which occurred when the heater voltage was applied. The answer was to bring up the heater voltage slowly from zero.

The main components used with valves were resistors and capacitors. Of these, resistors usually caused the main problems. Since valves are high impedance devices, high values of resistance were often required. 50 K ohm was not unusual and 10 K ohm quite common. It was extremely difficult to manufacture such high resistors with good long term stability unless very expensive techniques were used.

A further problem with resistors was heat dissipation. An anode load resistor could well be called upon to dissipate tens of watts when the valve was switched on. Wire wound resistors could not be used because their high inductance was unacceptable. Resistors made from composite materials suffered from changes in value over a period of time due to the heat load.

Capacitor failure generally resulted from voltage breakdown due to the high voltages associated with valves. Very often such breakdown was accelerated by the high heat environment arising from valves and resistors.

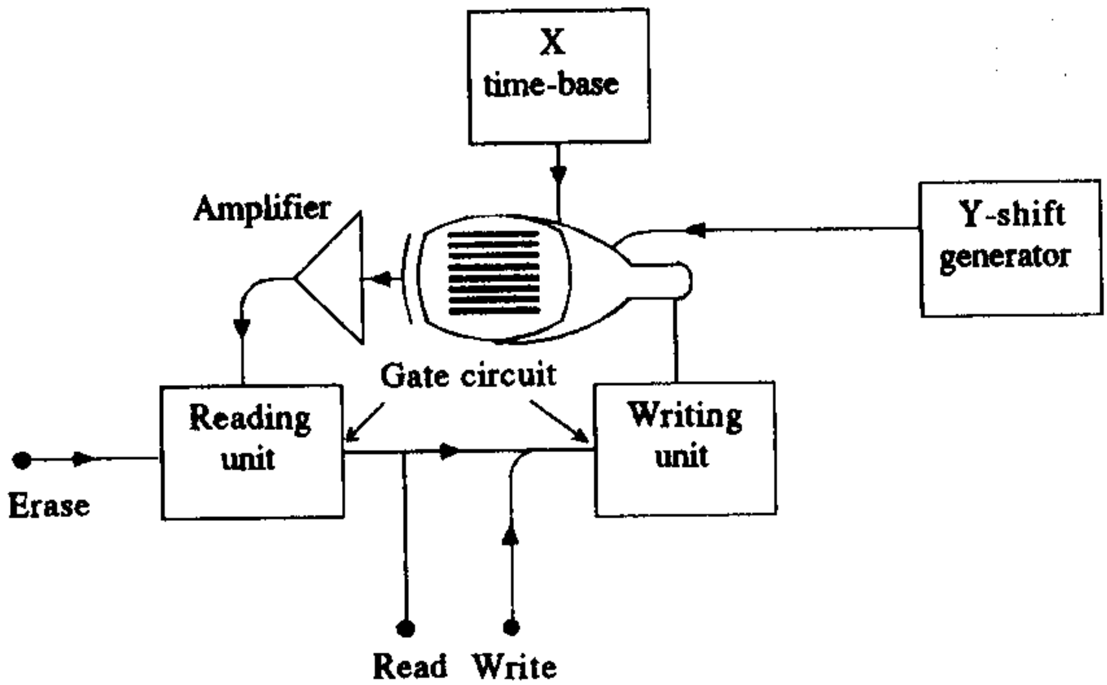
In mercury delay line memories an electrical signal was transformed into an acoustic signal launched into a column of mercury where it travelled at a velocity of about 1,500 m/sec, eventually arriving at the far end where it was transformed back into an electrical signal. This received electrical signal could then be re-constituted, re-timed and relaunched back into the column of mercury. The electrical signal was thus "stored" by the delay line but only available at one delay intervals. Thus a sequential bit pattern corresponding to the contents of adjacent words in a modern memory could be stored, but a particular word could only be accessed as its bits emerged from the far end of the delay line. Pulse intervals of one microsecond were used. New data could be entered by substituting the new bit pattern for the old pattern as it emerged from the delay line. The pulse patterns were usually modulated onto a high frequency carrier before being launched into the mercury filled tube.



Delay line memories were thus very similar to modern disc storage in that when a delay line (track) had been selected, data appeared in serial form. With long delay tubes the worst case wait time could be as long as one millisecond. This led to the concept of *optimum programming*, where the sequence of instructions to be obeyed was made to correspond, as closely as possible, to the emergence of required data from the delay lines.

In electrostatic memory, the hits corresponding to the contents of words of store were held as charge patterns on the inside face of a cathode ray oscilloscope tube (CRT). Since the charge patterns slowly leaked away, they had to be regenerated at frequent intervals. This corresponds to the refreshing that has to occur in modern dynamic ram.

In the first applications of electrostatic memory, individual words could be directly addressed but the contents of a word was read out serially. Later applications, mainly in America, used a storage tube for each bit in the word, up to 40! In this case any word could be accessed randomly and all bits read out in parallel. This arrangement corresponds to the modern memory organisation where eight ram chips are used, one for each bit in a byte. Since the electron beam used to read and write could be very rapidly deflected to any point on the face of the CRT, access was very fast. Memory cycle times of less than 10 microseconds were common.



One disadvantage of electrostatic memory was that the detected signals needed to read or refresh a particular charge pattern were very weak, and thus considerable engineering was required to reduce interference to an acceptable level.

Most early computers had extensive sets of hand switches which could be used for very slow input, particularly for testing. The exception was EDSAC which only had four switches and relied on hardwired initial orders. Most early computers had a loudspeaker attached to some suitable internal circuit which enabled the user or operator to hear what was going on inside the computer.

I/0 was dominated by two technologies, paper tape and cards. Paper tape usage was well developed through telegraphy used before the war. Five hole code was used but the whole process was rather slow. Paper tape was usually prepared offline and then read into the computer. The results were either printed direct onto a teleprinter or punched onto paper tape which was then printed up on a teleprinter, again offline.

Punched cards were also used. Key-to-card punches existed as used with punch card office equipment and card readers and punches could be interfaced to a computer. Again, programs and data were prepared offline and the results were printed offline from cards punched out by the computer.

The Young person's Guide to... The Elliott 8O3B

Adrian Johnstone

During the sixties, many University and College Computer Centres were based around an Elliott 803. The machine was compact (requiring around 400 square feet of floorspace) had undemanding power requirements (3½ kilowatts plus at least 10 kilowatts of air conditioning) and, most importantly, offered hardware floating point arithmetic as an option, so the Elliott could be used as a low cost scientific machine. We believe that at least 250 systems were supplied, and the Society has a fine example recently restored to working order under the auspices of John Sinclair and his working party.

Several aspects of the machine's technology are rather unusual. On first acquaintance the most surprising feature is the magnetic tape subsystem, which comprises modified film handlers of the kind used in movie studios instead of the more familiar half-inch tape decks. The principles are the same oxide coated celluloid tape passes near a multichannel read/write head, but the 'tape' is conventional 35mm film stock coated with oxide, and the mechanics include sprockets and spring loaded tension arms. A clue to the origin of this technological cul-de-sac may be the address of Elliott's computing division in Elstree Way, Borehamwood.

The films were specially made by Kodak and formatted at the factory, although service engineers could effectively reformat them by using a special film copy program to replicate a known good tape. Given the much publicised finite lifetime of data held on magnetic tape there was some concern that the museum's machine would be crippled since we can not format a completely new film, but it turns out that the formatting information is still readable on at least some films. The 1000' films could hold over 7 million characters.

A second (and also potentially disastrous from a restorer's point of view) novelty is the power supply, which is based around a battery charger weighing some 200lb and a large accumulator from which the logic in the processor is powered. When I first saw the museum's 803 in store the battery was a corroded mess. Since the machine will not run without the battery it was vital that a replacement be found. Fortunately technology changes rather more slowly in the battery world than in computing, and the batteries are still made to the same specification for use in the aerospace industries.

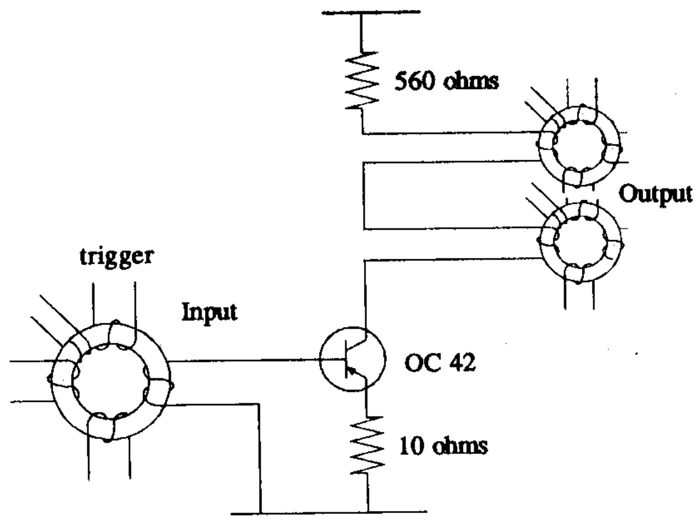


Figure 1: Elliott 8O3B switching element

Perhaps the most interesting aspect of the machine's design is the basic switching technology. The machine is built from germanium transistors and a large number of ferrite core logic elements used, not as memory, but as a logic gate. The most common configuration is illustrated in Figure 1. The core has five windings: three inputs, a trigger and an output which feeds the base of an OC42 transistor. The collector feeds inputs of other cores.

The operating principle is the same as the ferrite core memory-the core may be magnetised in one of two polarities by passing a current through one of the input windings and these two states are identified with the one and zero logic states. At the start of each cycle the core is guaranteed to be in state zero. Positive going pulses on the inputs will flip the core into the one state. A subsequent trigger pulse flips the core back to the zero state. As the core passes from the one to the zero state, the change in magnetic flux induces an pulse in the output winding which switches on the transistor to drive the inputs of other cores. It might be that no inputs were received on this cycle in which case the core would already have been at logic zero, and the trigger pulse has no effect. Thus the basic logic operation is a logical OR of all three inputs. In addition, input connections can be reversed so that an input acts so as to counteract (or inhibit) one other input. So in fact, the inputs can have states 0 (no input pulse), +1 (normally connected pulse) or -1 (reverse wired input pulse) and the gate produces the arithmetic sum of the three inputs. To further complicate matters the trigger winding could be reversed, effectively producing an active low output. This versatile logic element did not subsequently find favour with computer designers as a result of its relatively large size and the costs of manually winding the cores.

The 803 is a bit-serial machine based on a single-address, single accumulator instruction set and a 39 bit word length. An auxiliary register was used for multiply and divide instructions. 19-bit instructions are packed two to a word with a so-called B-bit completing the 39. Within an instruction, three bits specified the group, three bits the instruction type and the remaining thirteen bits were used for addressing or specifying an I/0 function. Hence the direct addressing capability was 8192 words.

When the B-bit in a word was set, the contents of the location addressed by the first instruction in the word were added to the second instruction before execution, allowing indirect and other more esoteric forms of addressing and instruction modification at some cost in comprehensibility.

Simple arithmetic instructions all executed in 576*u*s. Jump instructions required 288*u*s and floating point instructions up to 9.792ms for a divide.

As well as unusual hardware, the machine has a place in history for some of the software developments and people associated with it. In particular we must mention the Algol compiler project at Elliotts, who employed a classics graduate by the name of Hoare as a programmer in August 1960. His first task was to implement the Shell sort for the new Elliott 803. Like many programmers before and since, Hoare believed he knew a better sorting algorithm - a claim that drew scepticism from his more experienced colleagues.

It turned out that Hoare really had thought of a better algorithm, and subsequently the availability of recursion in Algol enabled him to express it elegantly and concisely. As well as publishing the Quicksort algorithm Hoare went on to dominate the many aspects of Computer Science inventing, amongst other things, the CASE statement and a theoretical basis for parallel computing that has found concrete form in the Transputer. Hoare recounts some of his experiences at Elliotts in the 1980 ACM Turing Award lecture (*The Emperor's Old Clothes,* Com.ACM **24** 2 Feb 1981).

The museum's 803 can be seen working during the Society's in-steam days, the dates of which are listed on page 20.

I would like to thank John Sinclair for his patient explanation of the 803's mysteries.

Miscellany

Nicholas Enticknap, Editor

- Unabridged transcripts of the Society's meetings are in preparation. When this work is complete, photocopies will be available on application to the Secretary.

- Edited videotapes of the Pegasus and Algol meetings held in 1990 are also in preparation.

- The Society is just embarking on a new enterprise - the videotaping of interviews with computer pioneers. Committee member George Davis is in charge of this work.

- This year sees the bicentenary of the birth of the Father of Computing, Charles Babbage. The Science Museum is mounting a special exhibition in honour of the occasion, of which the centrepiece will be a full size Difference Engine, currently under construction and scheduled for completion at the opening of the exhibition on 1 July.

- An article by Doron Swade describing the formation of the Society appeared in Interdisciplinary Science Reviews Volume 15 Number 3 1990.

- The Society also featured in an article in The Guardian of 13 September 1990, which concentrated on the restoration of the Pegasus.

- Software Working Party chairman Martin Campbell-Kelly received the Wadsworth Prize for Business History last year for his book "ICL: A Business and Technical History".

Working Party Reports

Elliottt 803 Working Party

John Sinclair, Chairman

Work was completed on the processor not long after the Open Day. When it was switched on, we found that around .20 transistors were blown. It took around two days to locate and replace the failed components, but thereafter the machine worked perfectly till Christmas.

During this time we experienced no intermittent processor faults, which shows the value of thoroughly cleaning the gold-plated edge connectors. The machine ran for a period of 10 days, being switched off each night and on again in the morning. I cannot recall this happening with an Elliott 803 before - our machine is obviously a particularly good example.

When it was switched on after Christmas, however, it had developed a fault in its core store, which gave rise to parity errors. There was also a Group 5 instruction failure. This proved temporary, but we have not yet had time to diagnose and fix the memory fault.

Work has also started on restoring the peripherals. Before Christmas, we cleaned the paper tape reader and punch. The reader still requires further attention, but the punch is operational, and has been used to create a tape for one of the Society's other computers. Work has also started on wiring up the film handlers, but these have not yet been switched on.

I have now found a source of batteries and battery cells, and we hope to obtain replacements for the currently defective cells soon. We have also obtained a copy of the Algol compiler. Our major problem now is that in replacing the blown transistors, we used up all our spares.

As others are sure to go in time, we desperately need more. The transistors in question are a germanium type with code numbers OC42, OC44 and OC45. The last two types were used in some of the earlier transistor radios. If anyone has any or knows where a stock might be kept we would very much like to hear from them.

S-100 bus
Robin Shirley, Chairman

Our major activity since the last issue has been the Open Day on 11 October. We pulled out all the stops to put on a good show, with a view to attracting new Working Party members. We were not as successful in that aim as we would have liked, but it was an enjoyable day and we made several useful contacts, as well as receiving an offer of an unused (!) Ithaca Intersystems machine with its associated documentation.

The Open Day display was organised and run by Peter McIlmoyle, an old hand at personal computing journalism, and myself, drawing on my own hardware resources. The main working exhibit was a 64Kbyte multiuser North Star Horizon running the Northshare timesharing system and supporting two terminals. The one which attracted most interest from visitors was running a teach-yourself BASIC program, which was originally designed by the late Chris Evans of "The Mighty Micro" TV fame. The other terminal ran a selection of games such as Wumpus, Swords and Sorcery and Hamurabi.

We also showed a second Horizon, demonstrating single user applications. To give visitors a flavour of early PC hardware we had on display a working Mullens extender and bus display board, modified by myself, and a Horizon motherboard with 8K, 32K and 64K byte memory boards to show the evolution of memory chip technology and packaging.

Things have been quiet since the Open Day, and we would welcome new members. People who feel they might be interested in our activity need not be put off by any lack of early PC experience or technical knowledge. Much of the work we need to do is concerned with documentation and systematisation, particularly of software of which we now have a large pool. People with librarian skills and an interest in modern history would be likely to find this kind of work very rewarding.

DEC

Adrian Johnstone, Chairman

The DEC working party continues to grow, both in numbers of workers and numbers of machines. In particular we welcome Colin Smith who has written a detailed emulation of the PDP-8 to run on a VAX which is good enough to run Focal, the interactive PDP-8 programming environment.

One of the highlights of our open day display was a music program running on the DS300. This machine has no loudspeaker - the four-part harmonies are picked up by an AM radio tuned to the rf interference generated by the core driver circuits. For best results, pull your PDP-8 processor cabinet right out and place the radio immediately above the core stack.

Work on the ex-Rutherford original 8 continued during the open day. The machine is now running well after the ferrite core memory address driver modules were upgraded. At the reception after the open day DEC donated one of the last DECmate III systems, so we now span the 25 year production history of this long lived machine.

We continue to receive donations from various parties especially PDP11 equipment from the University of London which includes a very early PDP 11/20 - possibly one of the first machines to be sold in this country.

Pegasus

John Cooper, Chairman

Our display at the Open Day proved very successful. The Pegasus did develop faults during the day, but this if anything heightened the enjoyment of our visitors, as they were able to watch us open up the machine to tackle the problems. It gave them a live demonstration of what computing was like 30 years ago.

The system has since run reasonably satisfactorily on the "In Steam" days. We have again had faults, which have been wide-ranging - there has been no one individual cause of the breakdowns. I think these faults are because we have not properly commissioned the system yet. In particular we have not got the marginal test system working, and we need this if we are to reach a satisfactory reliability level.

Since the Open Day we have done a number of things. We have got the autocode up and running. We have been recommissioning an incremental graph plotter that was attached to the machine in its operational days, and have managed to get it working again. We have also been developing an IBM PC-based editing system to produce Pegasus paper tapes, which will allow people to write Pegasus programs remotely. This is at the time of writing nearly finished.

Derek Milledge has started working on an emulator, in conjunction with the Software Working Party. This is also intended for use on an IBM PC, but is being written in C with the intention of making it as portable as possible.

We believe the Pegasus is the oldest working computer in the world. There is evidence that it may have been built in 1958, but we are not certain of this, as no dated contemporary documentation survives. If anyone who used to work at Ferranti or at Skandia, the first user of the machine, can help us date Pegasus number 18 with precision we would be very grateful.

Software

Martin Campbell-Kelly, Chairman

The first meeting of the Software Working Party was held on 24 October 1990. The main business was to establish the aims and objectives of the Working Party. It was decided that the highest priority should be actively to seek out software artifacts for the machines being preserved by the Computer Conservation Society, plus those machines for which emulators are being developed. The secretary, Chris Mollens, has prepared a circular letter to help in this task.

On 13 December we held a meeting on machine emulators. Three systems were demonstrated: they were Colin Smith's PDP-8 simulator; my own EDSAC system; and Peter Union's Elliott 803 simulator. All the systems ran original software. The PDP-8 system ran DEC 's FOCAL interpreter of the late sixties; EDSAC demonstrated Sandy Douglas's noughts and crosses program, which was written around 1952; and the Elliott 803 ran some original test programs complete with sound effects. All these systems will be demonstrated at the forthcoming general meeting on 27 June, which promises to be a fascinating evening.

Forthcoming Events

25 April 1991 DEC computers

Adrian Johnstone, chairman of the Society's DEC Working Party, talks about the development and evolution of the various DEC PDP families with special emphasis on the phenomenally successful DEC PDP-8.

8 May 1991 In Steam day

23 May 1991 The influence of Manchester University

Professor Tom Kilburn presents his view of the contribution of Manchester University to the development of the computer, covering all five systems developed under his aegis.

12 June 1991 In Steam day

27 June 1991 Emulating early machines

The meeting will discuss the problems involved in creating emulators of early machines for use on modern PCs. Speakers to be arranged.

10 July 1991 In Steam day

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