ATLAS@50

Science & Technology
Facilities Council

Rediscovering Atlas: A personal view

Over its 50-year history the Atlas building has housed many mainframe and supercomputers including the Ferranti Atlas-1, a Sigma 2, two IBM 360/195s, an ICL 1906A, a PDP15, and three Crays: an X-MP, a Y-MP and a J90. They have all been decommissioned now, but the hardware from three of them has been preserved. Well… that was the story anyway!

When the IBM 360/195 was decommissioned, the console was put on display in what used to be the Reception Area of the Atlas Building together with a number of pictures and other items which had been collected over the years. Every December it would be switched on to give the place a Christmassy feel, but over the years this became more hazardous as the layers of dust built-up on hot electrical wiring and there was concern that it might set-off the smoke detectors. In 2008 rumours began to circulate that the building was to be refurbished so everything was moved into a side office, well out of the way of any over-enthusiastic builders. A couple of years later when the office was needed again, the console was moved to RAL's Exhibition Centre where it is a regular feature on school tours.

When the Atlas-1 and Cray X-MP were decommissioned, they were put on display at RAL. Sometime in 2003 someone requested that they both be moved to our long-term storage warehouse, but unfortunately the paperwork was incomplete and then that person left so the hardware was lost in administrative limbo. Whenever I went to the warehouse I always kept an eye out for the Atlas console and the red panels of the Cray; each time I came away disappointed so sadly assumed that they must have been disposed-of years ago.

In July 2014 we held a reunion for computing staff. Two hours before the event started, the head of Logistics walked through the exhibition area on his way to a meeting. He asked what was going on then said:

"You should really have the Cray in here as well."

"Yes, but that was lost a decade ago."

"No – it's in our warehouse."

"The Cray? Red thing with seats round the edge? Are you sure?"

"Absolutely. Although it's not red any more, and there are no seats."

He was right.

We were unable to move the machine in time for the event, but we were able to announce that it had been found and had a couple of panels to prove it. We were later told that the seats/cooling system and processor boards were returned to Cray Inc. when the machine was decommissioned. Unfortunately, the red panels were packed-up for separate storage and have now been lost. (But we have said that before!)

Inspired by this find, I emailed a photo of the Atlas console to the new manager of the warehouse and asked if he had something like that in storage. He was unsure, but his database contained an entry "Console" which was of the right vintage so we investigated further. The database gave the location as "M2 B370"; the warehouse manager pointed to the top of some industrial racking and for a second I had no idea what he was looking at. However, if you bent down a bit then peered back up between two mountains of crates towards the top of the racking you could just about make out the edge of something metallic and grey, with a handle and buttons on the front.

We located a set of steps and, excitedly, I climbed up to get a better look. The Atlas console was there! After more than a decade, I had found it!

The Harwell/Rutherford Campus has seen huge technological changes in its 60 years, but few

The remains of the Cray X-MP

irst sight of the Atlas console in more than a decade; picture taken using a mobile phone while standing atop a ladder

departments have included heritage items in their visitor's centres. It was difficult to know what to do with a 50-year-old console, or even where to go for advice. I am especially grateful therefore to Diana McCormack and her colleagues at the Science Museum for advice on cleaning the console, and to my colleagues in the Mechanical Engineering and the Electrical Engineering Groups in the Central Laser Facility who helped source replacement parts and gave the console a temporary home in a corner of their workshop.

Many people helped us find the console, clean it up, and give it a 50th anniversary celebration to remember. They all deserve heartfelt thanks, but special mention must go to the following:

- Graham Wiggins of the Electrical Engineering Group in CLF who sorted-out the electrics and made the console come alive again;

- Nigel Diaper of Logistics Media and Transport Services who knew where to find the Cray;

- Trevor Pannell also of Logistics Group and my co-explorer of the warehouse;

- Steve Hook in the Mechanical Engineering Group in CLF who sourced new buttons;

- STFC Apprentice Rob Pocock who drove the forklift truck;

- STFC Apprentice Ashley Churchman who made the bulb extraction tools;

- Jason Barleycorn in CLF who sourced new bulbs and was the console's workshop buddy;

- Nick Moore in CICT who salvaged networking and other memorabilia from Atlas;

- Dr Tom Kirkham in SCD, Atlas@50 event co-ordinator;

- Trevor Amos with technical advice and stories from his years as an Operator in Atlas;

- Prof Bob Hopgood for his technical advice in person and via the magnificent Chilton Computing website

Dr Victoria Marshall, November 2014

**http://www.chilton-computing.org.uk/**

Atlas (1961-1973)

The Chilton Atlas is the largest of only three Atlas-1 super-computers ever made. It was intended as a national asset available to universities across the country, the NIMROD facility (now ISIS) at the Rutherford High Energy Laboratory, the Atomic Energy Authority's research laboratory at Harwell, and to other Government research establishments such as the Meteorological Office for work on weather forecasting, and the Medical Research Council for work on the structure of proteins and viruses.

Atlas was designed by Professor Tom Kilburn at Manchester University in collaboration with Ferranti – a company which, until the war, was more used to making transformers and domestic appliances. It took nearly three years to build in an old, converted steam locomotive factory in West Gorton. Funded by NIRNS (the National Institute for Research in Nuclear Science) in association with AERE Harwell, the computer cost nearly £3M and was considered so valuable that when it was finally delivered in June 1964, each unit was transported from Manchester on a separate lorry so that if there was an accident only one piece would be lost.

David Burrell at the Engineer's console in the Atlas machine room. To his left is a hardcopy teleprinter and paper tape reader; to his right is a CCTV monitor trained on the tape units upstairs. Behind the console are the power supply units, and behind the engineer are some of the fixed store and CPU cabinets
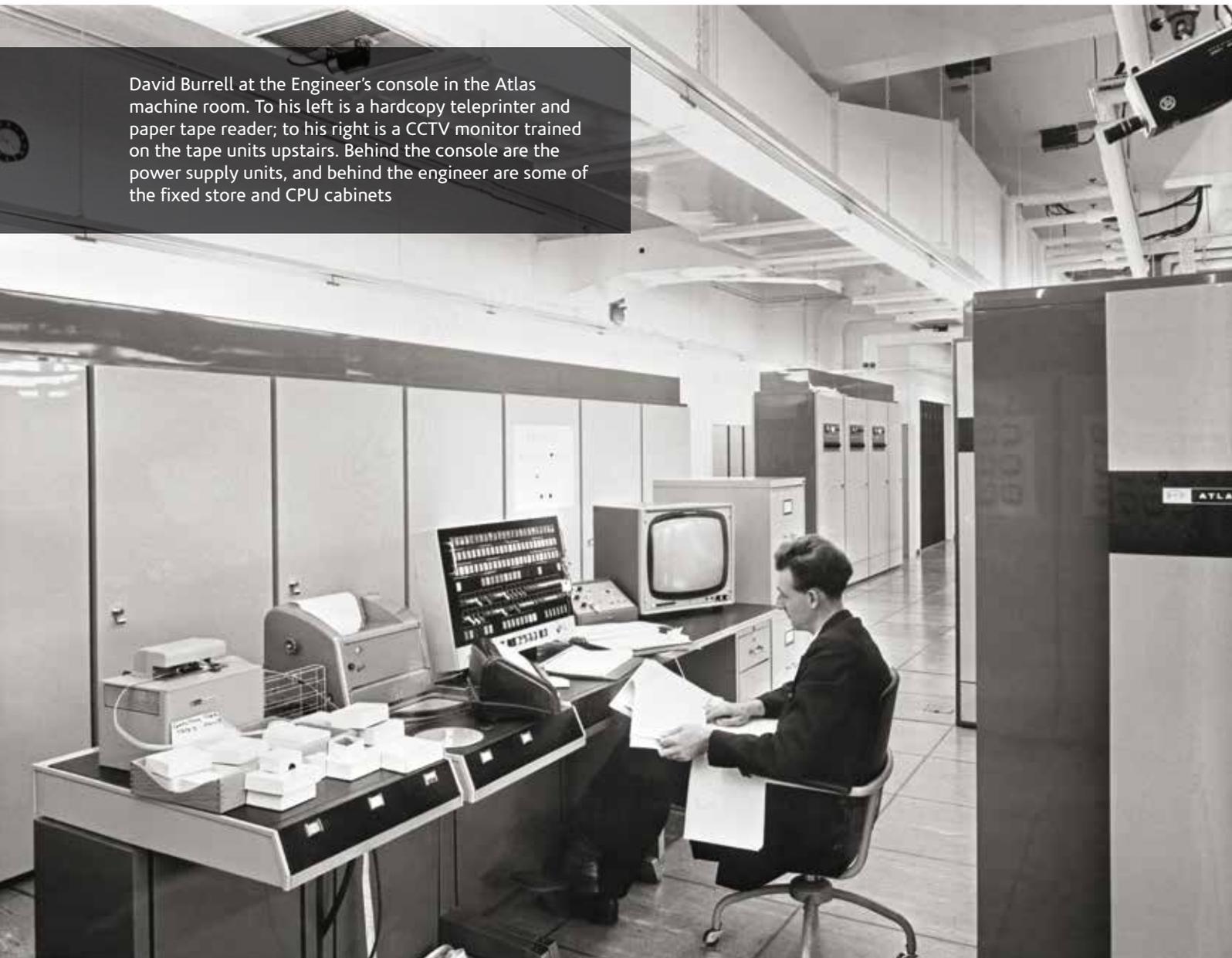
At the time, it was the most powerful general-purpose super-computer in the world, having 48K words of main memory, 48-bit words, one million words of storage in main memory or on drums, 16 magnetic tape decks, and a processing speed of about one million instructions per second. After commissioning, its first programme was a simple test routine to print "It works and about time too."

During the design process, Prof Kilburn filed 15 patents concerning aspects of Atlas' design; three of these developments have had a significant impact on modern computing:

Atlas is probably the first machine whose control program warranted being called an Operating System due to its innovative scheduler, known as the Supervisor. This managed the allocation of computer processing time, memory, and peripherals, and led to the design of the multi-tasking, multi-user operating systems of today.

Most programmes require more address space in which to operate than is physically available in the computer. This problem was solved in the design of Atlas by the use of One-level Store which automated the transfer of information between primary core memory in the computer

Debugging Atlas… with an oscilloscope!

and secondary memory on drum. This concept is now known as Virtual Memory and is used in practically every modern computer.

Higher-level computer programmes require a compiler to convert each line of the programme into a low-level instruction set for processing. Compilers are themselves compiled using a formal description of the language, and one of the first examples of this was the Atlas Autocode compiler written by Tony Brooker in 1960. These programmes are now known as Compiler-

The Atlas machine room seen from the other end of the room. The power supply and switching units are on the right of the picture; core store cabinets are on the left.

Atlas Operations Room. Along the back walls are the Ampex magnetic tape drives; in the foreground are two card readers, and in the centre of the room a line printer. Centre right are paper tape readers and a CCTV monitor trained on the Engineer's console. The camera in the ceiling allowed the Engineer downstairs to see what the tape drives were doing upstairs.

Compilers, inspiring languages such as XSLT on which the World Wide Web is based.

By 1967 Atlas had been enhanced by a small Sigma-2 satellite computer and a system of on-line, direct-access consoles on which users could develop programs step-by-step, do calculations or consult files interactively. By 1971, it was operated 24/7 Monday to Friday (and sometimes at the weekend as well) by seven Operators in three shifts, plus a couple of engineers.

The Chilton Atlas was finally shut-down with some ceremony in March 1973. Its final programme was to print "It worked... but now it's had its time too." Over ten years of service it had processed 836,000 jobs, run for 44,500 hours with a 97% up-time (although Operators say that it felt considerably less!), read 300,000,000 punched cards and 4,000,000,000 characters from paper tape, produced 800,000,000 lines of line-printer output, punched 17,000,000 cards, and supported 2300 university projects.

The two other Atlas-1 computers were built for Manchester and London Universities. Other than the console, a representative sample of Chilton Atlas hardware is in the National Museum of Scotland, parts of the London Atlas are held by the Science Museum Group, while the Manchester Atlas is on display at Manchester's School of Computer Science.

http://www.chilton-computing.org.uk/acl/technology/atlas/overview.htm

Dr Jack Howlett (1912-1999)

CBE, MA Oxon, PhD Manchester, MIEE, FSS, FBCS, FIMA

A mathematician who loved art, music, walking (especially in the Lake District), railways, trees, European culture, books and poetry, Jack Howlett helped boot the computer out of the mechanical era and into the electronic one.

Although his early career was at the LMS Railway Research Department at Derby, Jack worked during World War II on a mechanical Differential Analyser as part of a team of physicists led by Prof Douglas Hartree performing a non-linear parabolic partial differential equations on behalf of Rudolf Peierls who refused to divulge the purpose of this project, although clearly the need was serious. (This work was later found to apply to uranium isotope separation.) They also worked on an equally mysterious project for Klaus Fuchs (later identified as a Soviet spy), calculating the shock wave from a very intense spherical explosion.

In 1948 Jack became head of the Computing Section of the Theoretical Physics Division at AERE Harwell where he recognised that computers were increasingly important to all scientific research work, and encouraged his staff to use them. In 1963, he was appointed Director of the Atlas Computer Laboratory.

Jack was the sort of person who could get on with people, put them at their ease, and get the most out of them. He was a very practical sort of person who did not mind doing mundane jobs, although he took delight in finding better ways of

Jack Howlett's retirement: Judy Lay, Mike Claringbold, Pat Athawes, Jack, Gerry Pickavance, Roland Brandwood, Mrs Pickavance, ICL engineer, Joan Howlett

Working on the Differential Analyser; Jack is sitting front left.
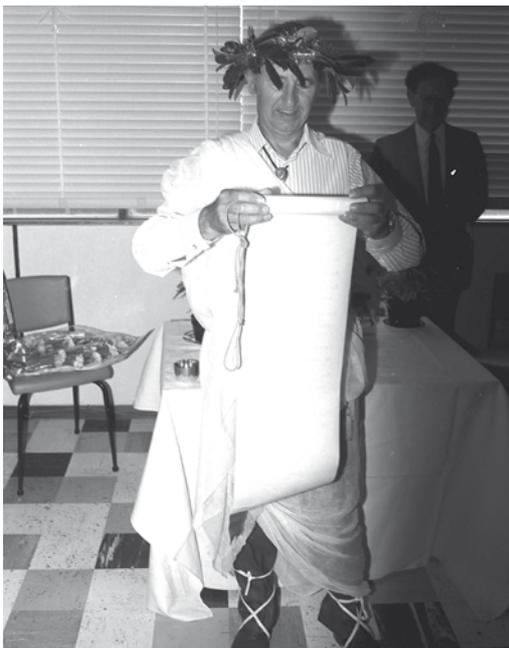
Always a good sport: Jack Howlett ready for retirement, dressed as Julius Caesar courtesy of Data Prep

doing them. He was also an exceptional physicist, and was awarded a CBE for his work in 1969.

When Rutherford Laboratory and the Atlas Computer Centre were merged in 1975, Jack retired; he died in May 1999. To have been a member of Jack's Atlas Computer Laboratory is still recognised as a privilege today.

http://www.chilton-computing.org.uk/acl/associates/permanent/howlett.htm

Atlas 45737

One of the Systems Programmers at Atlas – Len Ford – was a railway enthusiast. He discovered that there was a Jubilee class steam locomotive called Atlas and persuaded Jack Howlett that it would be a novel idea to purchase its nameplate. Because the original was unavailable, a copy was made by Newton Replicas and the two Atlases have been associated with each other ever since.

Atlas (the locomotive) was built in Crewe in 1936. She weighed 375 tons, pulled 11 coaches, and saw nearly 30 years of service before being withdrawn in 1964.
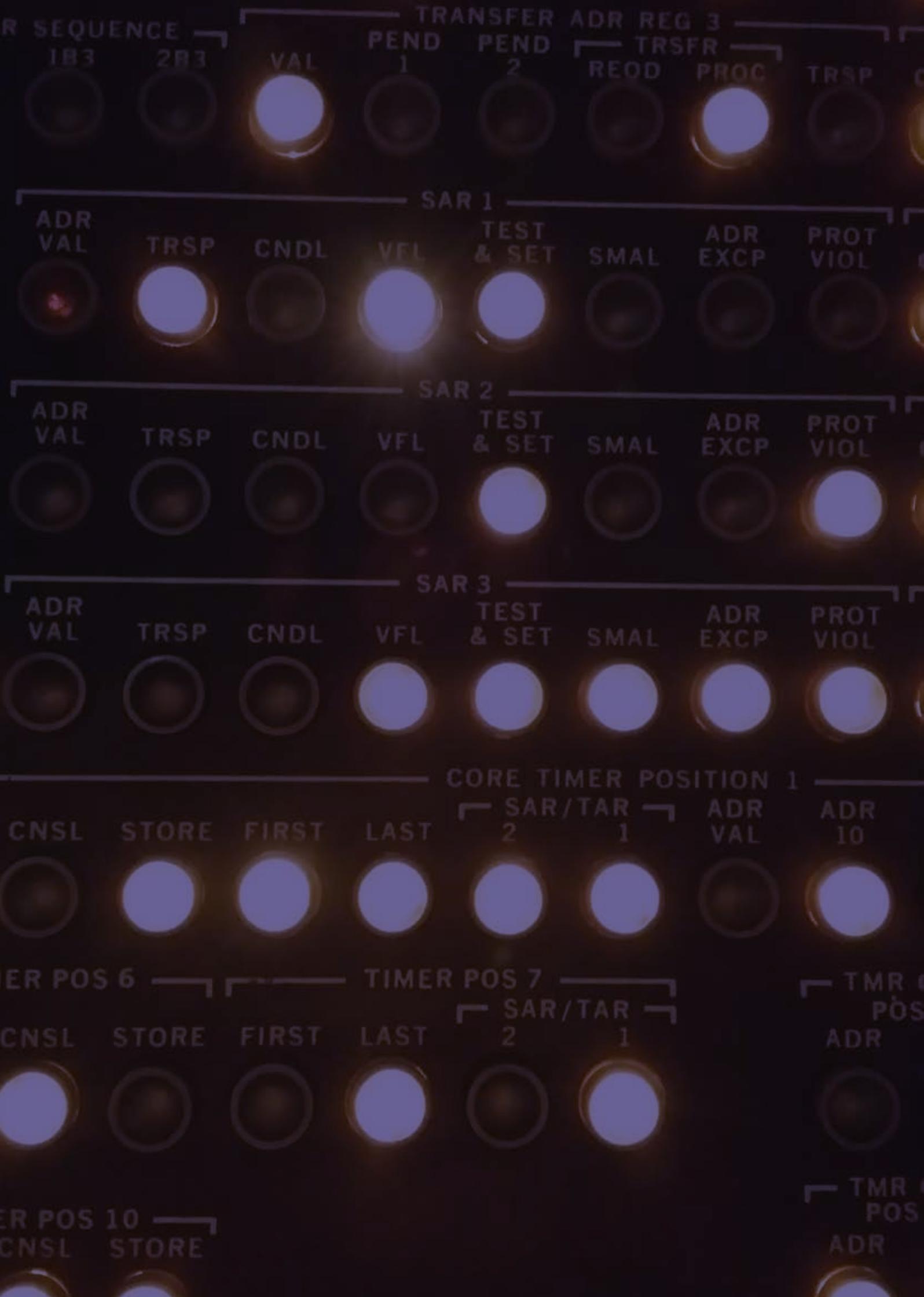

Jack Howlett and Brian Davies (Head of Computing Division at Rutherford Laboratory) next to the Atlas console in the entrance to the Atlas building; above is the locomotive nameplate and photograph

http://www.jubilees.co.uk/details/45737/

45737 Atlas at Scotforth, 17 August 1961
(photo by Noel A. Machell, courtesy of Mark A. Hoofe)

SEQUENCE
1B3   2B3   VAL

TRANSFER ADR REG 3
PEND   PEND   TRSFR
1   2   REQD   PROC   TRSP

SAR 1
ADR
VAL   TRSP   CNDL   VFL   TEST   SMAL   ADR   PROT
                              & SET   EXCP   VIOL

SAR 2
ADR
VAL   TRSP   CNDL   VFL   TEST   SMAL   ADR   PROT
                              & SET   EXCP   VIOL

SAR 3
ADR
VAL   TRSP   CNDL   VFL   TEST   SMAL   ADR   PROT
                              & SET   EXCP   VIOL

CORE TIMER POSITION 1
                              SAR/TAR   ADR   ADR
CNSL   STORE   FIRST   LAST   2   1   VAL   10

TIMER POS 6   TIMER POS 7   TMR
                              SAR/TAR   POS
CNSL   STORE   FIRST   LAST   2   1   ADR

                                                    TMR
                                                    POS
TIMER POS 10   ADR
CNSL   STORE

IBM 360/195 (1971-1982 and 1976-1983)

The Atlas Computer Laboratory housed two IBM 360/195s. The first IBM 360/195 was originally installed at Rutherford Laboratory in 1971. This was a 3Mbyte, single processor machine designed specifically for the science and engineering community. It was IBM's top-of-the-range model, and cost £3.6M including £122K for the building extension to house it. (Its predecessor, an IBM 360/75, processed diagnostic data from the NIMROD experimental hall.)

In 1976, shortly after the Atlas and Rutherford Laboratories were combined, a second 360/195 with 1Mbyte of memory was purchased for the Atlas Centre from VW in Germany; later that year, Rutherford's 360/195 was transported from building R1 to join it. This combined compute power was needed: by 1974, 50% of jobs were submitted from remote work-stations at several dozen institutes around the country, including Daresbury Laboratory and CERN.

The two IBM 360/195s were amongst the first computers to be connected to an early form of the Internet. At the time, the Post Office was developing EPSS (the Experimental Packet Switching System) – a network of telephone links and modems to connect computers across the country, while the Advanced Research Projects Agency Network (ARPANET) was being developed in the US. These operated over telephone lines so were very slow at just 2400 bits/second, but for
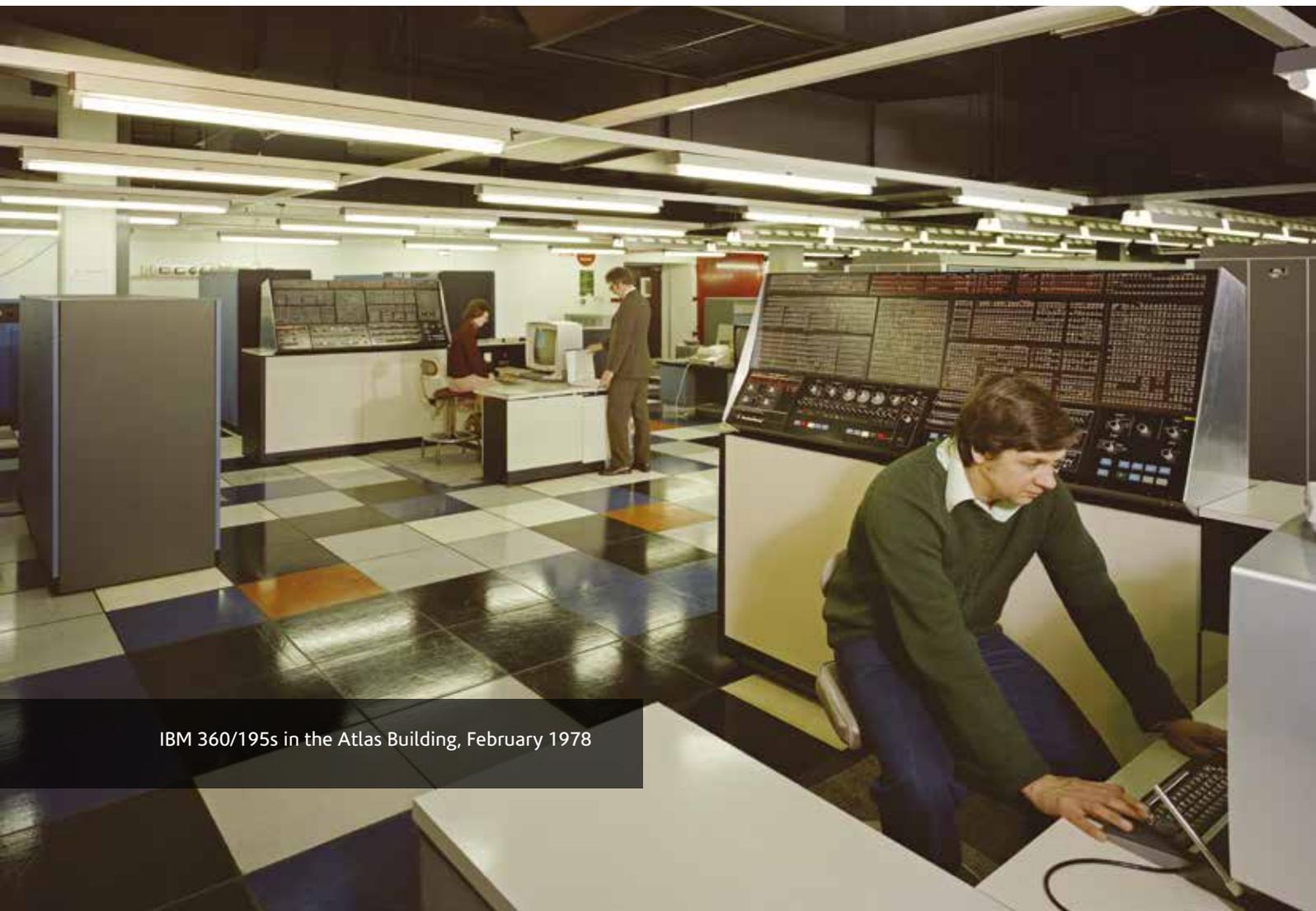
IBM 360/195s in the Atlas Building, February 1978

the first time ever a user in one country could use a computer in another.

In November 1982, the IBM 360/195 which had been at Rutherford Laboratory was switched off, followed a year later by the Atlas Laboratory's 360/195. It is believed that the console from Rutherford was retained for display, but there is some uncertainty because the two looked identical. (They were not identical inside however – one contained far more precious metal for scrap than the other.)

Central Computer Remote Facilities

Networking in February 1976

- GEC
- IBM
- Honeywell
- DEC
- Others

ARPANET via Norway

Glasgow
Edinburgh
Durham
Belfast
Manchester
Daresbury
Birmingham
Oxford
Bristol
London

SWITZERLAND

Synchronous Lines-Hasp Remote Workstations

2   Oxford University Nuclear Physics Dept.
3   Institute of Computer Science University College London
4   Birmingham University Physics Dept. (Film Analysis)
5   Queen Mary College London, Physics Dept.
7   Imperial College London, Physics Dept. (Film Analysis)
8   Durham University Physics Dept.
9   Glasgow University Dept. of Natural Philosophy
10 C.E.R.N.
11 Southampton University Mathematics Dept.
12 Appleton Laboratory Slough
13 Westfield College Physics Dept.
14 University College London, Physics Dept.
15 Institute of Geological Sciences London
16 Bristol University Physics Dept.
17 Reading University
18 Mullard Space Sciences Laboratory Nr. Dorking, Surrey
21 Institute of Oceanographic Sciences Godalming, Surrey
26 Royal Holloway College Egham
27 Institute of Marine Environmental Research Plymouth
28 Leicester University
29 Edinburgh Regional Computer Centre
30 Royal Observatory Edinburgh
31 Daresbury Laboratory
34 University of Sussex
36 York University Chemistry Dept.
37 St. Andrews University Chemistry Dept.
38 Sheffield University

Asynchronous Lines connected to Graphics Displays

A   Salford University Manchester
B   London Polytechnic
C   University of Surrey Guildford

Experimental Packet Switching Centres

G   Glasgow
L   London

Synchronous Lines – 9600 BPS
                     2400 BPS
                     4800 BPS
Asynchronous Lines – 1200/75 BPS
Asynchronous Dial-in – 110 BPS
Dial-up (SPN) – 2400 BPS
Packet Switching Networks

Cray X-MP/48 (1986-1992)

The Cray X-MP/48 cost £13M and was delivered to the Atlas Centre at the end of 1986. It contained four processors, 8M words of memory, a 14.4G byte disk, and had a peak performance of 940MFlops (or nearly a thousand million arithmetic operations per second). Together with the IBM 3090 mainframe, the Atlas Centre had, for a time, the most powerful computing equipment for academic science in Europe.

The unusual "C" shape of the machine enabled the circuit boards to be close together; the wires connecting them were all four feet in length to maximise performance whilst eliminating any timing issues that different lengths of wire would introduce. An innovative refrigeration system using Freon was developed to cool the machine which was housed in "seats" around the main body. The out-rigger final section of the C housed input/output processing.

The machine was replaced by a Cray Y-MP8I/8128 in 1992. The refrigeration system and most of the circuit boards were returned to Cray Inc. as agreed in the original contract.

http://www.chilton-computing.org.uk/ccd/supercomputers/overview.htm
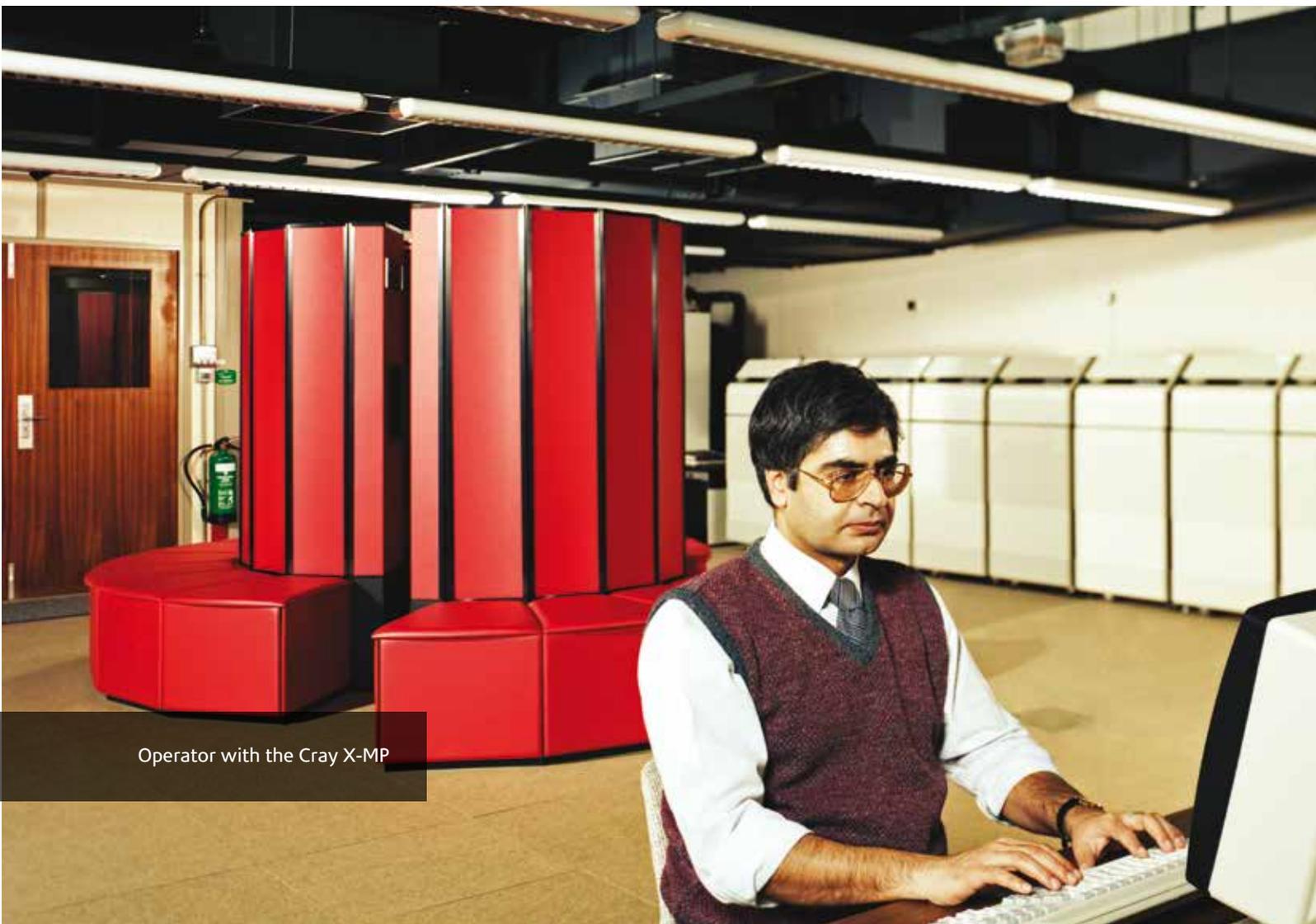
Operator with the Cray X-MP

The Atlas Computer Laboratory building

When it was constructed between 1962 and 1964, the Atlas Computer Laboratory was one of the first purpose-built computing facilities in the country. Although somewhat unprepossessing from the outside, the interior was neat and tasteful, designed to meet the demands of the work and to provide a pleasant environment for the people working there. In the early 1960s, offices were "ponderous Victorian articles which encumber other Government establishments," but Jack Howlett broke free from this tradition to create a more European feel; even the desks were of Scandinavian design (made by the Birmingham Aston Cabinet Company).

In 1964, "Orbit" (the journal of the Rutherford High Energy Laboratory) reported: *There are half size offices called "cells" which house short term visitors and "think rooms" which are equivalent to library "quiet rooms" elsewhere. Perhaps the Atlas inmates think noisily. … The Computer*

Room itself is a science-fiction writer's dream-world of machines taking over man. Tapes wheel about on the 18 tape decks, results chatter out of machines wherever they will, seemingly completely independent of human control. Next door is the Card and Tape Store where the names

Atlas Computer Laboratory entrance, 1965

on the data files really bring home the wide range and interest of the work the computer is handing. From frightening esoteric mathematical exercises like "Multivariate Analysis" we go via "Bubble Chamber (Geometry)" to "Children in Care," "Manager's Diaries," and "Animal Feeding Trials".

The building was extended in 1966 to include a second office block and a library cantilevered above the main entrance. (The heavier journals were housed on the inner side of the room just in case!) It was extended a second time in 1970 to include a third office block, a second computer block for the ICL 1906A, the Atlas Colloquium lecture theatre, and a fish tank in the new Reception Area.

ATLAS Reception, 1969

Jack Howlett's office

**http://www.chilton-computing.org.uk/acl/
literature/acl/p002.htm**

**http://www.chilton-computing.org.uk/acl/
technology/building/overview.htm**

Animation at the Atlas Computer Centre

In the late 1960s animated films were still made by photographing thousands of individual drawings on celluloid – a hugely time-consuming process. If a computer could be used to do most of the work however, then this process could be vastly speeded-up. In October 1970, the Graphics Section under Bob Hopgood began work on graphics and computer animation. This work was highlighted in a *Tomorrow's World* programme entitled "Computers and the animation industry," broadcast in September 1971.

In 1972, Colin Emmett, an artist from the Royal College of Art, was at the Atlas Computer Laboratory when he met animator and designer Alan Kitching. Alan was dismayed by the lack of tools available for animation; he felt that designers didn't know programming and the programmers didn't know animation. Colin promptly persuaded him to learn Fortran to tackle the problem himself. Together they experimented with the SC-4020 microfilm recorder attached to the ICL 1906A computer to develop the ANimated Technicolor Image Computer System (ANTICS) – a software package designed specifically to meet the needs of animators and graphic designers. (By happy coincidence, microfilm used by the SC-4020 was identical to 16mm movie film.)

Still from "Tomorrow's World": Graham England, Stan Hayward and Bob Hopgood watching the output coming off the SC4020 printer
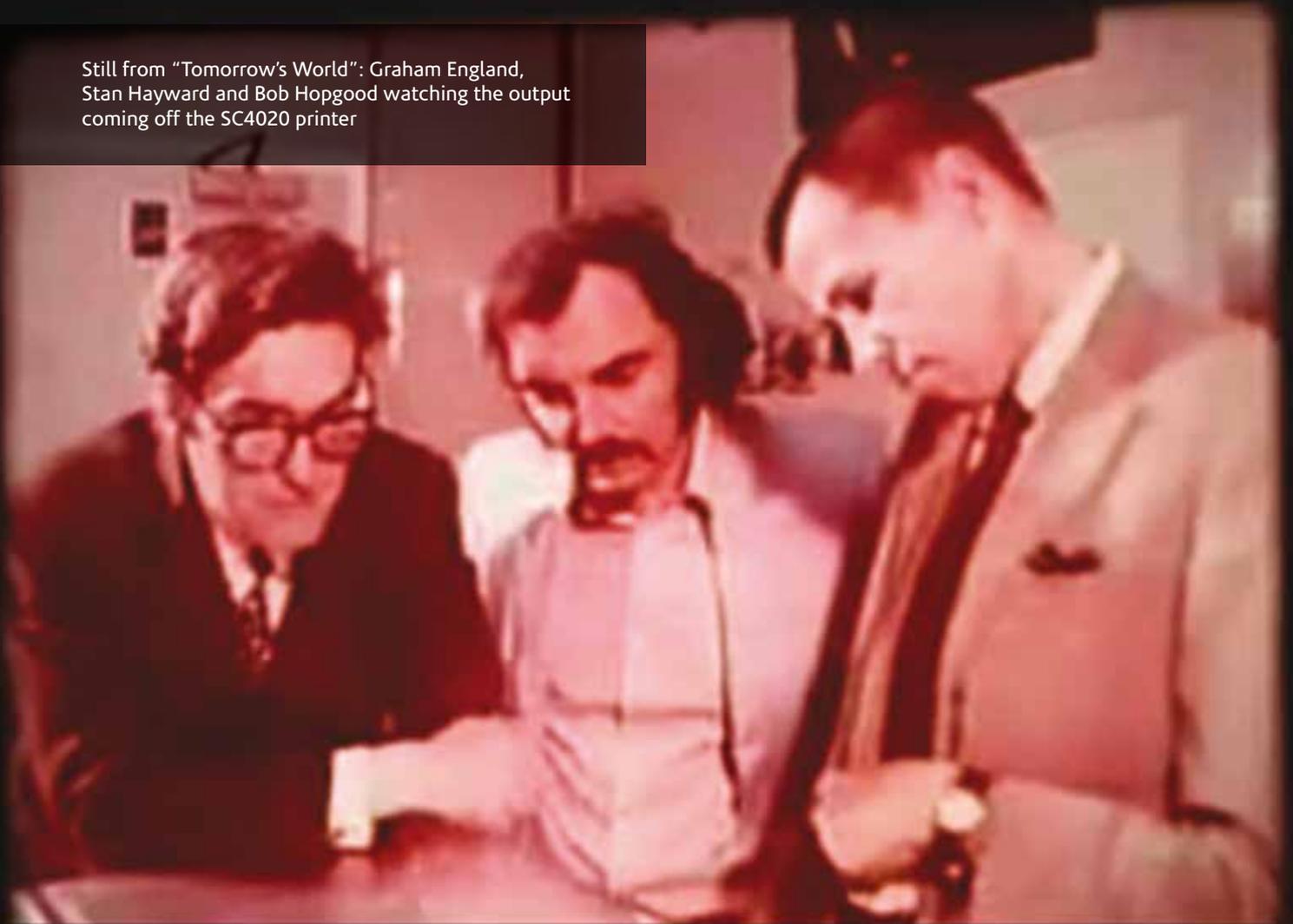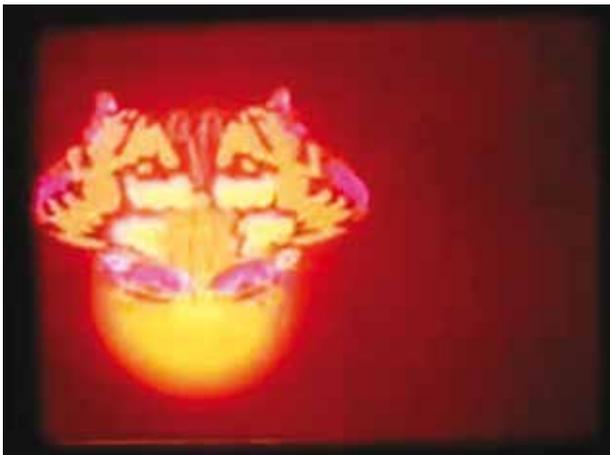
Two films entitled "Antics" and "Finite Elements" were made in 1975 to demonstrate the package and what it was capable of. "Finite Elements" illustrated the application of finite element analysis to real engineering problems including the load on a bridge over the M6 which was under construction at the time, and a simulation of the flow of effluent in the Solent as the two tides wash around either side of the Isle of Wight. With its optical sound-track, "Finite Elements" was the first entirely computer-produced engineering film to be made in the UK and in October 1976 was the award-winning Great Britain entry in the International Technical Films Competition in Moscow.

A few years later in 1979, Brian Wyvill used ANTICS to produce an animated sequence for the Ridley Scott film "Alien" which depicts the Nostromo's descent around the planet.

ANTICS 2D is available to download, but further versions are unlikely.

Frame from "Alien," 1979
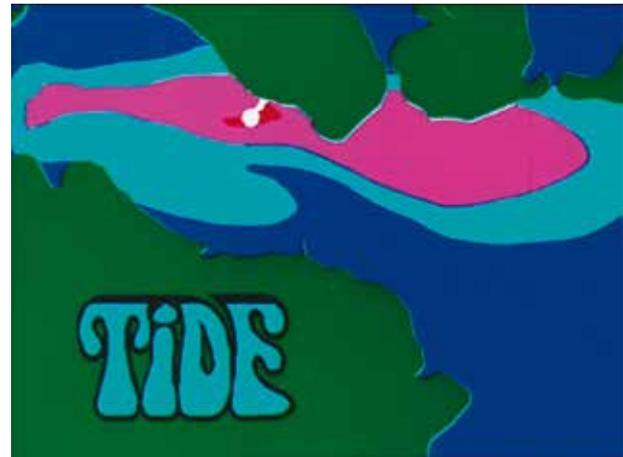
A still from "Finite Elements" showing tides in the Solent

Still from "Tomorrow's World"

http://www.chilton-computing.org.uk/acl/applications/graphics/overview.htm

http://www.chilton-computing.org.uk/acl/applications/animation/p007.htm

Sylvester Squirrel, first Antics character animation, September 1973

Perhaps it is the rainbow's egg
Or maybe the serpent's egg…

This iconic print was designed by Colin Emmett and Alan Kitching in August 1974 as an example of what could be achieved by the high-quality printers at the Atlas Computing Laboratory. It was produced using the Animated Technicolor Image Computer System (ANTICS) animation system on the ICL 1906A computer. The scales of the snake's body are the months of the year in-betweening from one name to the next so that, for example, "January" transforms to "February" in 31 steps/days. The design was digitised on a DMAC digitiser, output to a Stromberg Datagraphix 4020 microfilm recorder, printed and then silk-screened onto gold paper.

Only 100 prints were made; the Atlas Computing Laboratory retained print number one which is entitled "Perhaps it is the rainbow's egg;" number twelve is now in the V&A Museum and entitled "The serpent's egg."

Detail from "The rainbow's egg"

http://www.bbk.ac.uk/hosted/cache/archive/BCS/Comp Bulletin 1975/Computer Bulletin March 1975.pdf

http://computer-arts-society.com/static/cas/cache/CAS0003.HTM

The Great Wall of China

The Great Wall of China picture hung for many years in the Reception Area of the Atlas Centre. It took people a few seconds to realise that it was not a photograph, but a superb embroidery. It was presented in May 1983 by Mr Wei-Sam Shi and Mr Jia-Lin Hu of the Computing Division of IHEP, Beijing at the conclusion of a successful collaboration.

The Great Wall of China embroidery

Presentation of the Great Wall of China embroidery
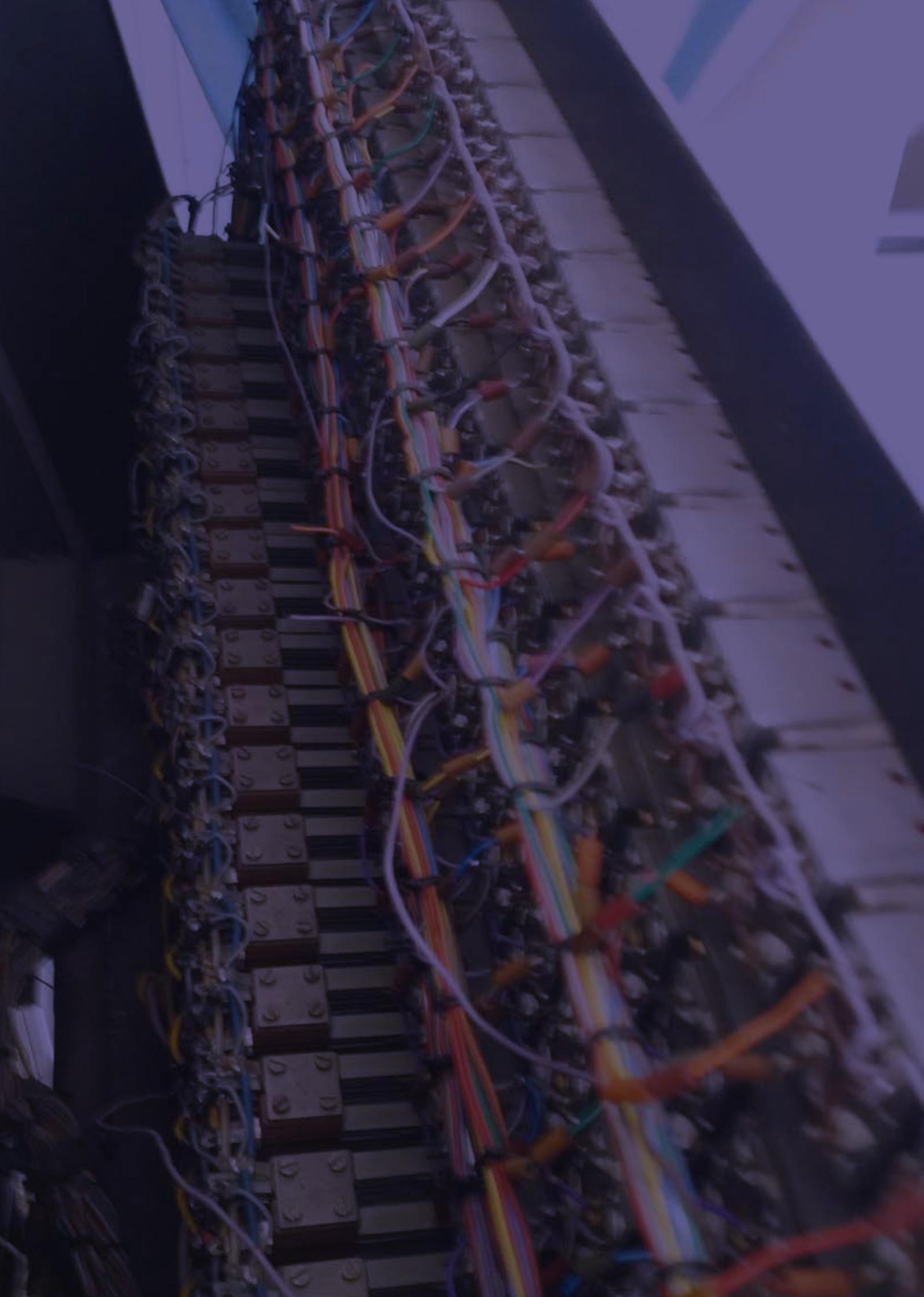
What's in a console?

Many people have been involved in the restoration of the Atlas console; most of them were not even born when it was in use, only two of them have ever used it "for real." It has been a real labour of love, and at times, has required a considerable amount of detective work. It is surprising what you learn…

Weight: In the 1960s, equipment was built to last so the console is constructed from sheet steel. It took four men to slide it off the pallet and onto the workshop floor. Even after we discovered the castors built into the chassis, it takes a not inconsiderable effort to move so we estimate that it weighs about 150kg.

Electrical supply and wiring: The power supply is 28V, and the wiring is to Ministry Of Defence standard. The rubber sleeves around the wiring have started to deteriorate. The original power cable has collapsed because of this deterioration, and although most of the metallic parts survive, many have been compromised. A few of the thin wires connected to the bulbs have snapped; quite a few were deliberately severed to create a display for Jack Howlett's memorial celebration in 1999. We were told that the lights had been set up to display the octal 7004472 idling pattern, but when we first applied electrical power it was clear that this work was considerably more extensive than anticipated, and that quite a few "sneak circuits" had been created. For safety reasons therefore some circuits have been unplugged.

Buttons: Only the lowest row of buttons (RESET, ENGINEERS INTERRUPT…) have in/out positions; the others are simple indicator lights with connectors for four bulbs behind them. The buttons are of a design which was in common use at the time for control systems, and are believed to have been manufactured by Honeywell. We have made a few button covers to replace missing or badly damaged ones; they were deliberately coloured to match the (faded and yellowed) originals.

Bulbs: The bulbs are marked with a variety of stamps (mostly the first):

The modern equivalent is a Chicago Miniature T-1 ¾ Midget Flange Base CM387 with an expected 7000-hour life-time.

One of the Engineers on the London Atlas recalls:

We got through vast numbers of small indicator lamps shaped like small revolver bullets. They were used in all the Honeywell indicator lights and switches. We believed they were designed to fail because the American military used them and the military also had top priority for factory output. Each indicator should have had four bulbs but often we could only insert two and even resorted to moving bulbs around. Later, during the Vietnam War, they were even harder to obtain.

Extracting the bulbs from behind the button covers was a problem. An extraction tool which fitted the bulbs perfectly was reverse-engineered to gently push past the four retaining fingers and pull the bulb out. Then we discovered that the modern equivalent bulbs are slightly thinner, so we had to make a second extraction tool. Then we discovered that the original bulbs each differed slightly in diameter anyway.

Flip switches: These were originally thought to have been used in Spitfires, but this theory has now been disproved – the switches are too obtrusive and too easily altered to be safe in a confined space. (Rutherford and Atlas Laboratories and AERE Harwell were founded on the site of RAF Harwell during the war so this connection was attractive.) It is thought that the switches are actually of a type used in GPO telephone exchanges, although this has yet to be verified.

VTY 995-9118 28V .04A	ATLAS 28V – 04.5A L1338	ATLAS ENG 327	ATLAS 28V – 04A 005-9118

The newly-arrived Atlas console in the workshop, looking very much worse for wear

The plastic end caps were covered in black grease as though someone had repaired their car and then rearranged the caps without bothering to wash their hands first. A few of the plastic end caps were missing, damaged, or just crumbled away so replacement red and yellow versions were made. There is a single white end cap which was the most satisfying to clean, and which seems undamaged.

Behind the front face: Out of curiosity we removed the small, angled panel at the front of the console desk. There was nothing behind it apart from some 50-year-old grime and detritus.

1383: This label is the warehouse inventory reference number.

Deteriorated wiring

Old and new flip-switch end-caps

"PRE-PULSE" and "V/ADDRESS" volume knobs: The various units in the computer were synchronised using a 10 KCS oscillator signal, and a loudspeaker on the wall of the machine room enabled the Engineers to hear a steady "hooter" note derived from it. If the hooter stopped and the pre-pulse light on the console went out, you knew there was trouble. Several Operators recall hazing stories from their first week working at Atlas, and being sent to Stores to fetch a bucket of pre-pulses when the machine crashed again. Stores staff were very understanding: "So you're new then?"

The pre-pulse knob controlled the volume of sound, and the V/address knob the pitch so it was possible to programme Atlas to play tunes (when

Front panel hinged forward to show wiring behind the buttons and switches
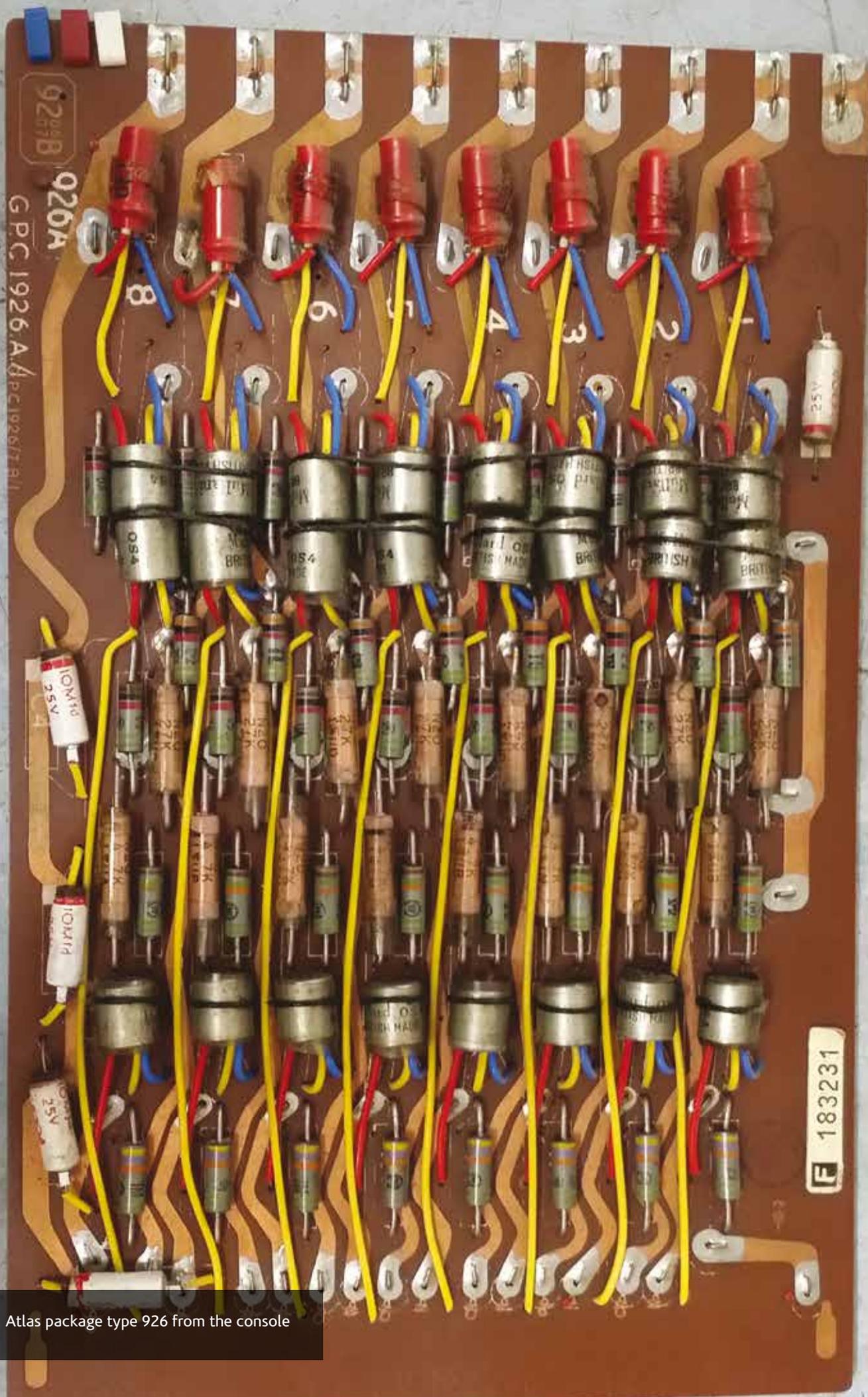
Atlas package type 926 from the console

it wasn't processing user requests of course). Every time the machine obeyed an instruction that wrote a logical "1" to a particular V-store address, an audible blip could be heard from the console's loudspeaker. If the programmer timed the pulses with care, a steady tone could be heard. By varying the timing of one or more loops of instructions, a variety of tones could be produced which sounded like a sequence of musical notes played on a recorder. Operators recall that "Daisy Bell (Bicycle built for two)" was a favourite.

If the programmer was really good they could produce chords, and something resembling four-part harmony. There are rumours that Atlas could talk as well. (My thanks go to Simon Lavington for these details.)

Modern display: There was much debate over whether we should try to re-electrify the console or leave it alone. Because the wiring had already been modified in 1999 however we based our work on that; the rest is guess-work. None of the original 1960s wiring or circuits are used (we believe!) as they would now be unsafe; the 1999 wiring has been re-used however, with a new power supply and PLC to control the lights. We hope we have managed to bring the console back to life, albeit minimally.

Back view of the console

Console part-way through re-wiring. The covers have been removed from buttons we wanted lit so that new bulbs could be inserted, but it is not just these which are on!

"ATLAS" stamped bulb

http://www.chilton-computing.org.uk/acl/pdfs/pdf09.pdf

The Ferranti Atlas-1 console, November 2014

The Atlas restoration team: Ashley, Victoria and Graham