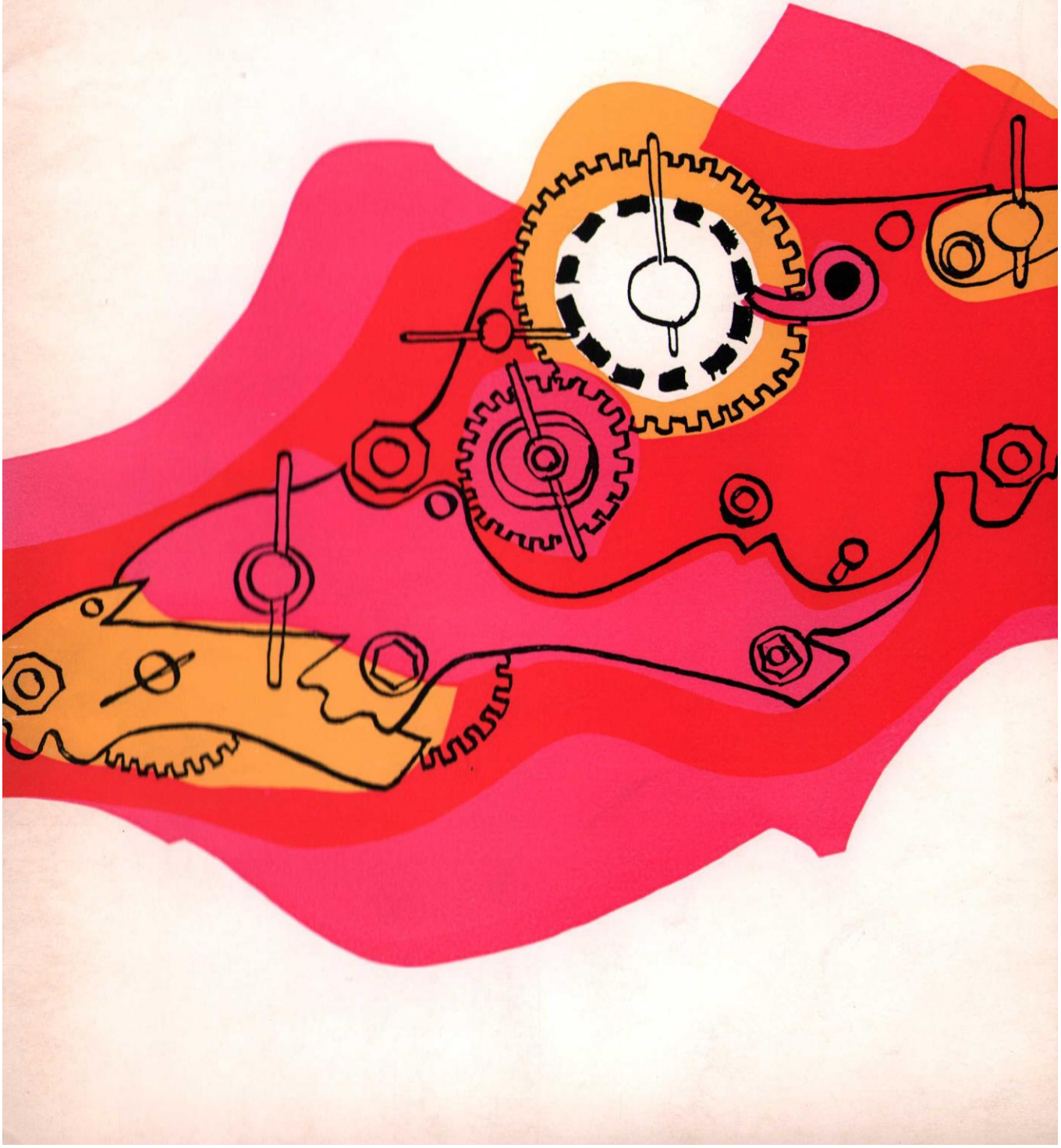
atlas

COMPUTER
LABORATORY



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COMPUTER
LABORATORY

SCIENCE
RESEARCH
COUNCIL
PUBLISHED 1967

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Brochure designed by HMSO
Brochure cover: Abstract based on model of Babbage's difference engine

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What it is

Though initially set up under another scientific body, the Atlas Computer Laboratory has come under the Science Research Council since this was formed on 1st April 1965 within the Department of Education and Science. The same Department administers also the Agricultural, Medical, Natural Environment and Social Science Research Councils. The Laboratory houses the large I.C.T. Atlas computer, which was ordered in 1961, and all the ancillary machinery and supporting services needed to operate a powerful computer efficiently.

Where it is

The Laboratory is on the west side of the A34 (Birmingham to Winchester) trunk road, 14 miles south of Oxford, map O.S. 158 (1 inch) reference 480 ; 865. The nearest station, Didcot (Western Region), is 4 miles away ; London Airport is 45 miles away ; and the City of Oxford (Nos 12/112 —Oxford to Newbury) buses pass the site. There is a map on page 23.

The postal address is

Atlas Computer Laboratory
Chilton
Didcot
Berkshire

Telephone

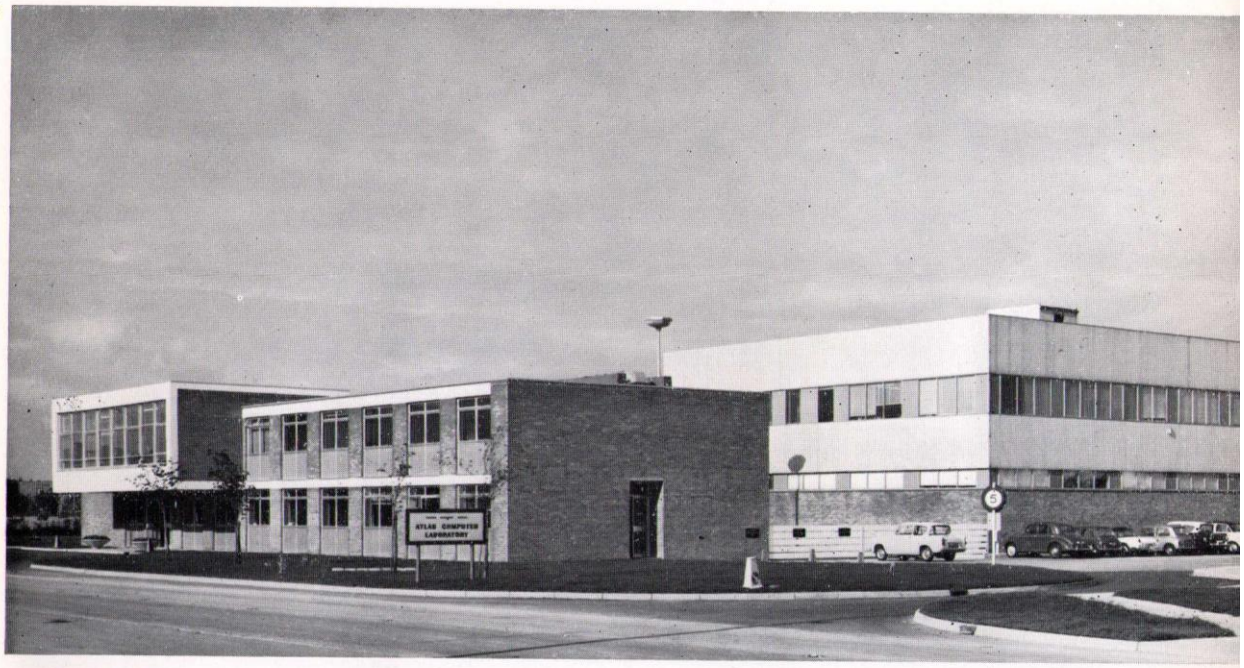
Abingdon 1900 Ext 6296 (Receptionist)

What it is for

The Laboratory provides a computing service to research workers in all British universities free of charge. It offers this service also to Government and other Treasury-supported research organisations

1 Close-up of the building from the outside
2 The 'think' room

1



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at a charge which works out at roughly £200 an hour. Bodies that are part of the Science Research Council itself, such as the Rutherford High Energy Laboratory and the Radio and Space Research Station, are not charged for this service.
Broadly, the aim is that the Laboratory shall be a place to which the research worker can turn when he has to attack a problem which demands computing power on a greater scale than his local machinery can supply.
In addition to this service work, the Laboratory offers professional help and advice to its users. It supports research projects by means of contracts with universities and by offering Fellowship appointments, and pursues research and development projects of its own.

How it is run

The organisation of the Laboratory is simple and expresses the needs :
to process work through the installation as quickly and efficiently as possible ;
to provide and maintain (in some cases in collaboration with the makers of the machine, I.C.T. Limited) the software needed in support of this ;
to keep intellectually alive, and therefore efficient, by means of research activities and contracts with outside bodies, notably universities.

The personnel

The Director, who is responsible to the Council for the whole Laboratory ;

The Operations Group, responsible for all the processing activities—reception and despatch, card and tape punching, operation of the computer and ancillary

3 Main entrance hall and
general reception

3

7

4 Computer reception

machines, management of the program and data libraries, liaison with users ;

The Programming Group, responsible for all basic software, assembling and maintaining the program library, specifying and producing special 'packages' (as for crystallographic calculation), statistical analysis and information retrieval ;

The Support Group, responsible for advisory and educational services including programming courses ; in general, for helping users to get their work through the installation ;

Individual Research Workers, selected for their individual distinction and in several cases elected to University or College Fellowships ;

The Administration Group, responsible for the general running of Laboratory. The Atlas Laboratory uses the services of the adjacent Rutherford High Energy Laboratory whenever possible—for example, payment of salaries and of accounts, personnel work, maintenance of buildings.

The Machine

This is the state of the installation at the end of 1967.
On page 22, there is a note of what has been or will be added during 1967.

Atlas Computer

Store :

48K ferrite core (K = 1,024 words of 48 bits each ; access time : 2 μsec/word)
8K fixed (read-only) store (access time : 0.8 μsec/word) 16K working store (access time 2 μsec/word)
96K magnetic drum store (transfer rate :

4 μsec/word) ; access time : up to 12 msec).
N.B. 8K and 16K stores are accessible only to the system programmers.

Magnetic Tape

16 Ampex TM. 2 decks (1 inch tape ; transfer rate : 64,000 characters/sec)
2 IBM 729 Mark IV decks ($\frac{1}{2}$ inch tape ; transfer rate : 62,500 characters/sec at 556 bits/inch, 22,500 characters/sec at 200 bits/inch)

Console

Engineers' console with input and output peripherals

Man-Machine Communications

'Operator' typewriter for communication with machine

Input

Card readers—2 ICT (600 cards/min)
Paper tape readers—2 Ferranti (300 characters/sec) ;
1 Elliott (1,000 characters/sec)

Output

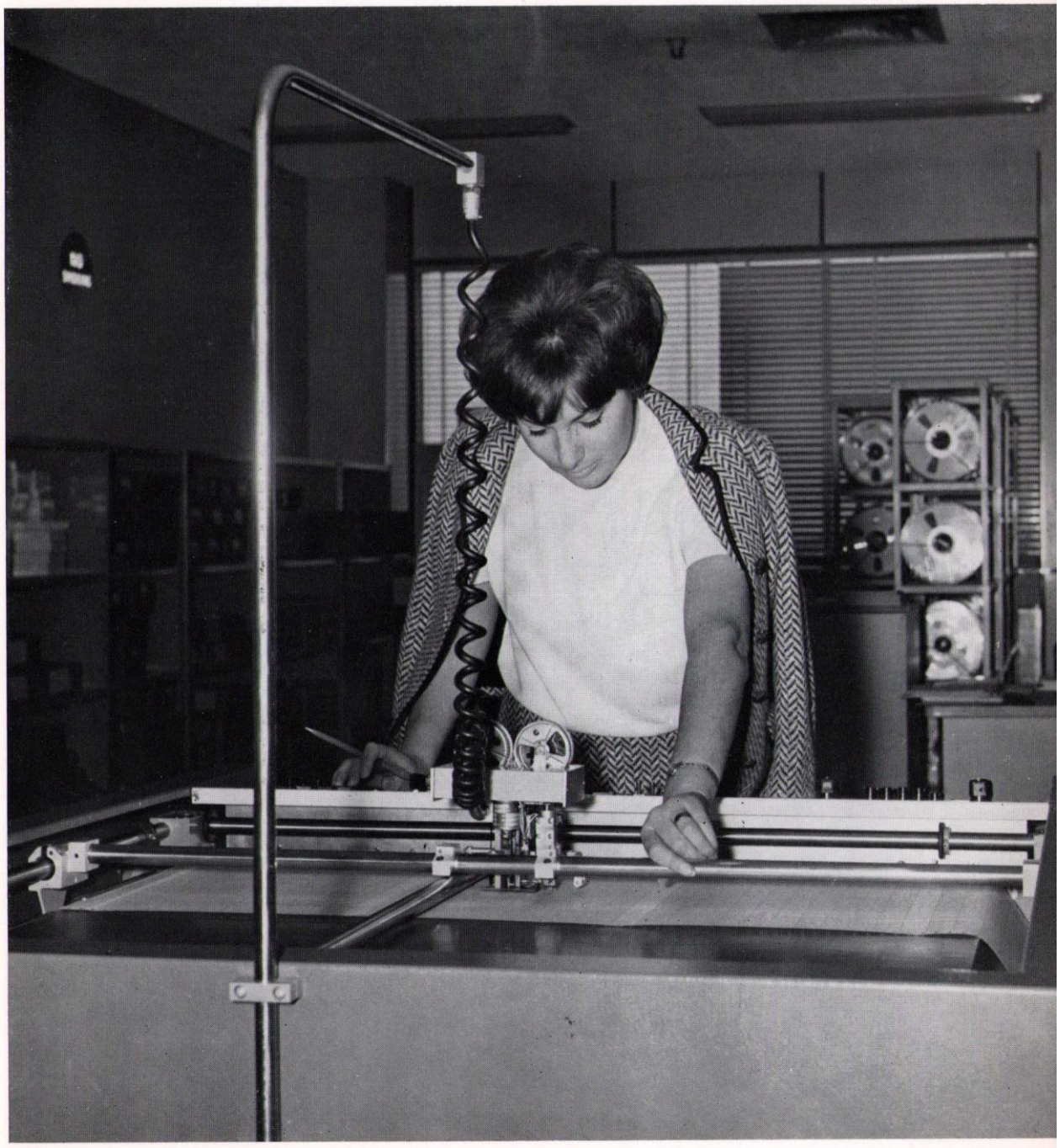
Printers—2 Anelex (1,000 lines/min ; 120 characters/line)
Card punches—2 ICT (100 cards/min)
Paper tape punches—2 Teletype (110 characters/sec)
Teleprinters—2 Creed 75 (one for magnetic tape operators ; one for main operators)
N.B. The paper tape equipment will handle 5, 7 or 8 track tape.

Ancillaries

Graph plotter —1 Benson-Lehner Model J
Card Sorter —1 ICT (750 cards/min)

5 Benson-Lehner model J
*g*raph plotter

5



6 Engineers' console, input lines and closed circuit television

7 Punched card and paper tape equipment in use

8 University user punching paper tape

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9 Everyone meets for coffee or tea in the conference room twice a week

10 Library

11 Machine room showing tape readers, card reader, Anelex printer and magnetic tape decks

11

12 Engineer testing
packages in the core store

12

Reproducers —2 ICT (100 cards/min)
Interpreters —3 ICT (22 characters/sec)

Date Preparation Machines

Card punches—9 IBM Type 026
Card verifiers—4 IBM Type 056
Typewriter and punches—2 ICT Type 35
Flexowriters—6
Teleprinters—2 Creed Type 54

The speed of the machine

If averaged over a typical day of varied work, the machine obeys instructions at about 350,000 a second.

The times for basic operations are

Floating point addition—1.8 to 2.2 μsec;
Floating point multiplication—5.9 μsec;
Organisational instructions—1.6 to 1.8 μsec.

The times for some complete programs are

Evaluate a polynomial of degree N—9N μsec;
Form the scalar product of two vectors each of order N—13N μsec;
Invert a matrix of order 100—14 sec;
Find all the eigen values (all complex) of a matrix of order 24—2 sec;
Sort 5,000 numbers into order—1 sec.

As a test of the routines for high-precision arithmetic, the machine has calculated

π to 5,000 decimal places in 20 mins;
$\sqrt{2}$ to 10,000 decimal places in 14 mins.

The languages it accepts

Atlas has an elaborate automatic operating system which takes care of many of the tasks which, with a simpler computer, fall on the machine room staff. This contributes

greatly to the speed with which complete jobs can be put through the installation. In particular this system, called the Supervisor, makes it easy to change from one programming language to another and thus to process a succession of jobs written in different languages. We can accept work in any of these languages:
Machine code ABL
Fortran
Algol
Atlas Autocode
Extended Mercury Autocode
The List-Processing Languages
LISP; SLIP; IPL-V
The simulation language SOL

What it is doing

The machine is now—October 1967—working 24 hours a day for 5 days a week, or from Sunday midnight to Friday midnight.

Each week we

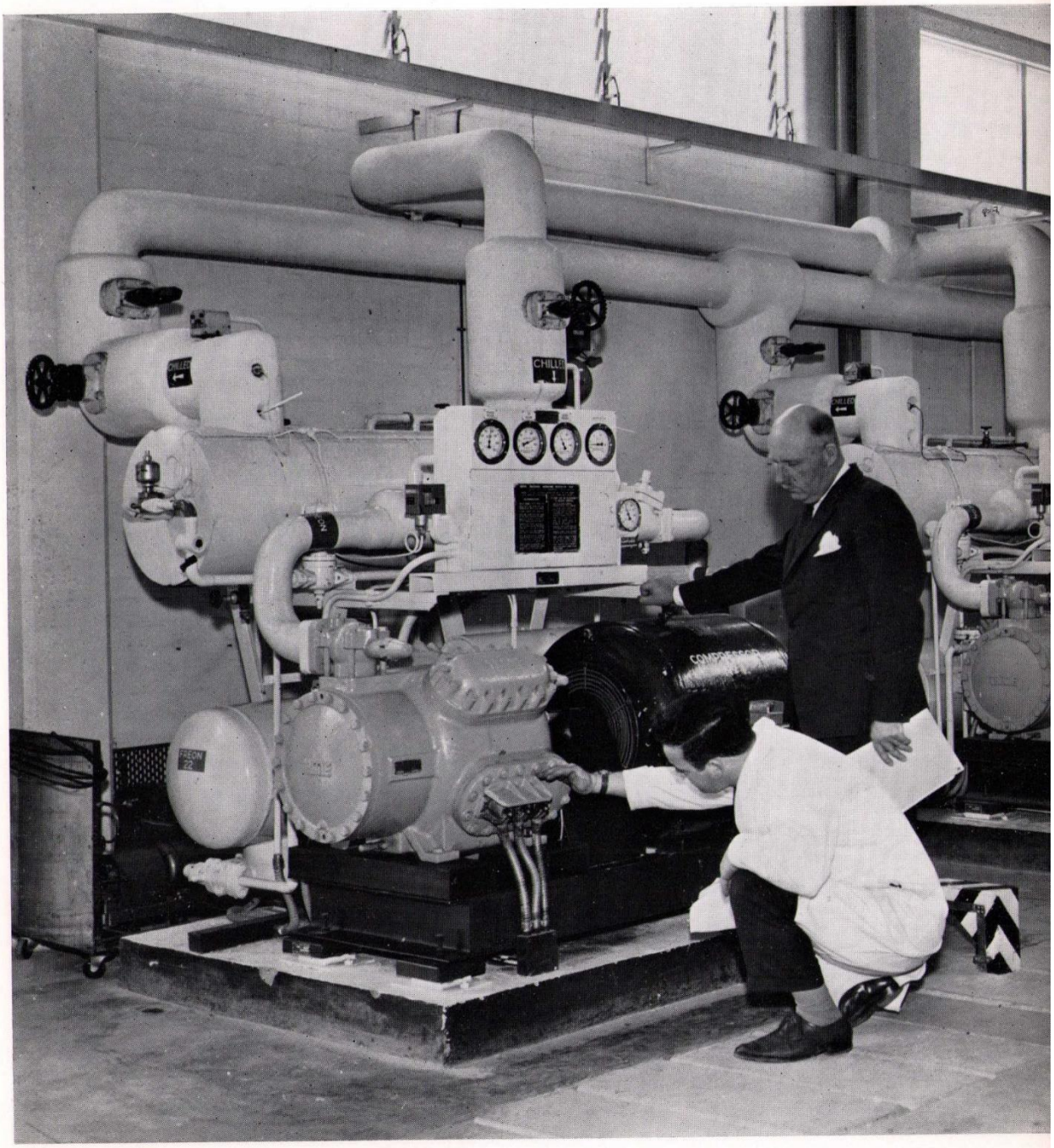
run 2,500 complete jobs;
read in a million cards and 30 miles of paper tape;
print 2 million lines of output;
punch 50,000 cards;
handle 1,200 reels of magnetic tape.

Of this load, about

75 per cent. comes from universities (we have 800 separate projects on our books and usually work on 170 of these each week);
15 per cent. comes from government and similar laboratories—the Rutherford High Energy Laboratory of the Science Research Council is much the biggest user here at the moment, while the Meteorological Office has been a regular

13 Air conditioning plant
(compressors)

13



14 Main entrance

14

user from the start and has written programs which stretch the machine to its limits ;
10 per cent. is for the research and development work of the Atlas Laboratory itself.
Almost all fields of study are represented in this work load. Naturally, the physical sciences take most of the time, but there is a significant and increasing use by sociologists, psychologists, economists and others.

The distribution of the university work is roughly

Mathematics	22 per cent.
Physics	18 per cent.
Chemistry	12 per cent.
Engineering	31 per cent.
Medical and Biological Sciences	5 per cent
Social Sciences	5 per cent.
Others	7 per cent.

The value of a typical week's work, at current commercial rates, is about £40,000.

Research

The Laboratory undertakes and supports research in four ways

1. it has its own research program ;
2. several members of the regular staff have research interests of their own ;
3. it is able to give contracts to senior members of universities for specific investigations ;
4. it has a small number of posts for individual research workers who need the resources of a powerful computing installation to enable them to tackle their problems. They are not burdened with any of the day-to-day obligations of the

Laboratory, and in several cases their posts have been linked with Fellowships of Oxford or Cambridge Colleges.

Plans for the future

During 1967, the Laboratory has added or will add to Atlas. (i) A 16-million word disc file, which can later have its capacity increased to 30 million words. This will hold permanently all the Supervisor programs, the compilers and the most frequently used library programs. It will act as a buffer store for all input/output operations in place of the present magnetic tapes and as a backing store for big programs. Users will be able to reserve areas of the disc, often for long periods, to store private files of data or programs that they are developing. (ii) A system of on-line, direct-access consoles linked to the machine through a small satellite computer and the disc file. We shall start with 12 consoles, most of them in offices in the Laboratory but a few outside. Atlas will share its time between obeying the instructions put in at these consoles and running the ordinary batch-processing service. Users of the consoles will be able to develop programs step-by-step, do calculations or consult files, while getting a virtually instantaneous response from the computer. The satellite machine will be a GEC S-2 with 32K of core store (16 bit words, 1 μsec cycle time) with quite powerful software of its own. This will do the pre-processing of the information coming from the consoles so that Atlas time is not taken up by this work. (iii) A Stromberg-Carlson Model 4020 microfilm recorder for high-speed production of output in the form of tables, graphs, charts, diagrams or cine-films.

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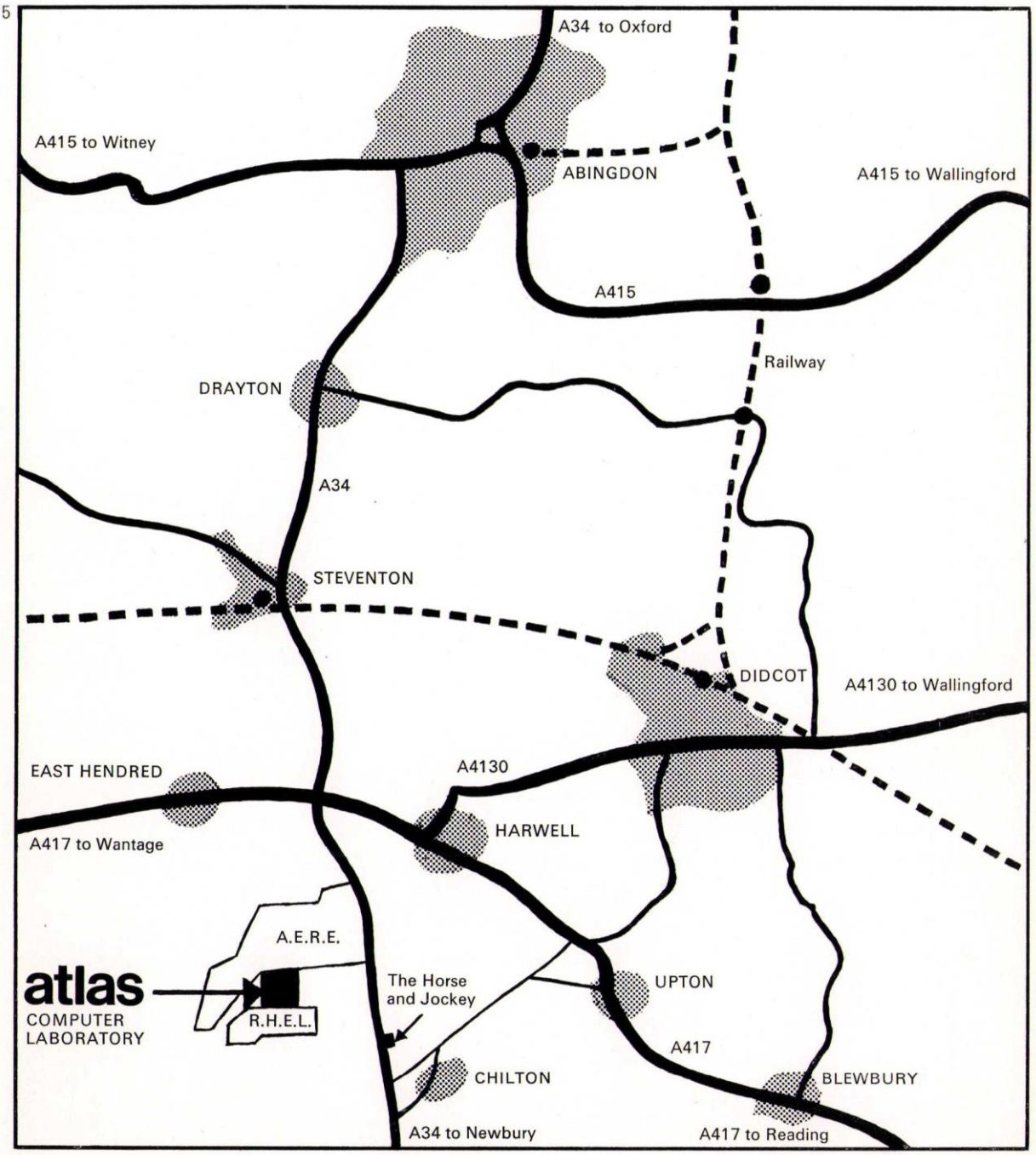

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