



**Ferranti ORION Computer System**

### Front Cover Illustration

*The Great Nebula in Orion photographed through a telescope. The soft greenish hue of the ionized gas gradually dimming toward the edge of the field, with its immobile shadings smooth and mellow in spots, hard and sharp elsewhere, together with the diamond-like scintillations of the four closely packed stars of the Trapezium, present a striking picture.*

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**The**  
**Ferranti**  
**ORION**  
**Computer**  
**System**



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# **Introducing the FERRANTI ORION computer system**



The ORION system enables a business to introduce automation of its procedures by stages, until eventually every aspect of its operations has been brought under an integrated system of control.

The principal features of ORION which enable it to be used in this way are:

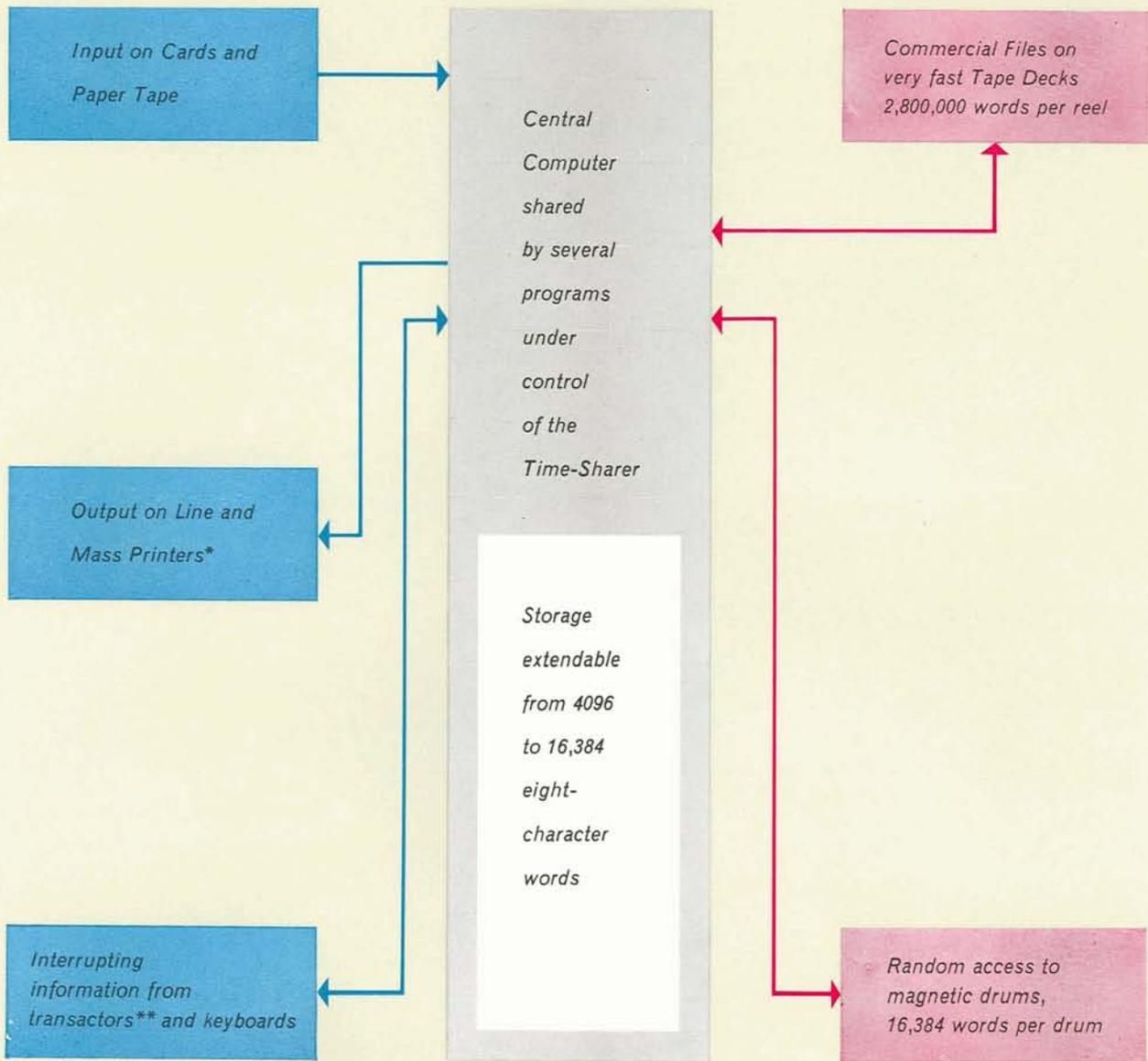
An extremely fast magnetic tape system, operating at 90,000 characters per second. With this tape system large files of business data can be processed at the speeds required.

A complete time-sharing system enabling the computer to make the best use of a number of input and output devices operating at widely differing speeds with time-sharing card-to-tape and tape-to-card conversion and tape-printing can be carried out economically without recourse to additional off-line equipment. The time-sharing incorporates full program protection, preventing mutual interference of programs under any circumstance.

Magnetic core storage extendable from 4,096 words to 16,384 words is available. Additional storage or peripheral equipment may be fitted at any time after installation.

Direct transference of data from peripheral equipment to any part of the core store is provided, thus virtually eliminating costly and clumsy buffer storage.

Special facilities are included for handling all types of commercial data from all currently available media, for printing results at high speed, and for dealing with the resulting paper.

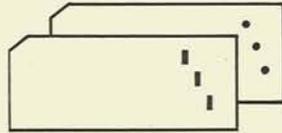


*\*A mass printer uses xerography to produce output at printing-press speeds*

*\*\*A transactor is a hand-fed card reader which can sense a pencil-marked card, interrogate a computer, and produce an edge-punched reply*

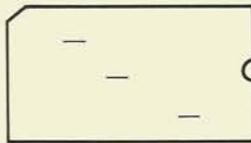
# INPUT

## Punched Cards



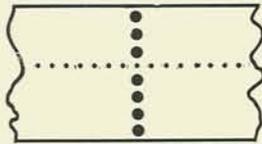
••▶ to latest available Punched Card readers of all types.

## Marked Cards



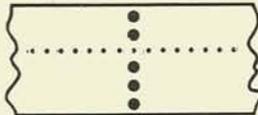
••▶ to remote Ferranti Transactors  
◀•••• with edge-punched reply.

## Flexowriter Tape



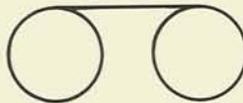
••▶ to Ferranti TR7, TR5 7-channel readers at 1000 and 300 characters per second.

## Creed Tape



••▶ to Ferranti TR7, TR5 5-channel readers at 1000 and 300 characters per second.

## Magnetic Tape



••▶ to Ampex FR 300 tape decks, operating at an instantaneous transfer rate of 90,000 characters per second.

For all types of data arising on punched cards, punched in any way, according to any coding system, with provision for interstage reading, alphabetical punching and all types of over-punching.

For interrogating the computer from an out-station, a sales office or a factory floor, by inserting a marked card into the transactor and obtaining an edge-punched reply.

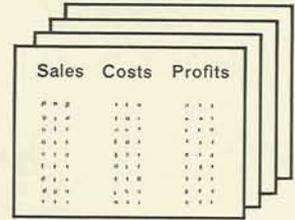
For Sales Order, Job Card, Goods Received data arising as a by-product of Flexowriter document preparation, and for preparing programs. Full range of alphanumeric upper and lower case characters with parity check.

For data arising as a by-product of keyboard accounting machine operations such as ledger-posting or pre-listing, and for information received by Telex.

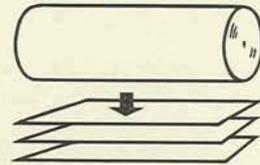
For input of file data in the extremely short time of 89 microseconds per word – equivalent to about 45,000 punched cards per minute. The magnetic tape may be read in either direction.

# OUTPUT

from Line Printers of the fastest available punched-card types, computer driven. ..▶



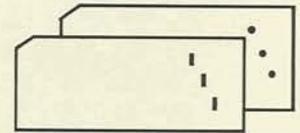
from Rank Xeronic Printer at 3000 lines per minute. Output is taken up on rolls as in a printing press, and subsequently cut and stacked as required. ..▶



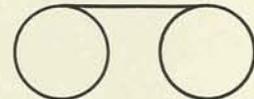
Rolled Mass Printing

Stacked Mass Printing

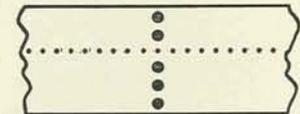
from latest available punched card punches of all types. ..▶



from tape control to Ampex FR 300 Tape Decks at an instantaneous transfer rate of 90,000 characters per second. ..▶



from Creed 3000 punch at 300 characters per second. ..▶



from on-line Flexowriter. ..▶



For medium volumes of results presented in the same form as conventional punched card tabulations, with very flexible layout, full range of upper case alphabetical characters, and multiple carbon copies. Such tabulations will be used for internal factory and office control.

For large volumes of results the Rank Xeronic printer provides the equivalent of a high speed printing press under computer control, with complete flexibility of layout and a wide range of typescript, including upper and lower case lettering in a variety of founts. Printing at this speed is needed for large scale despatching, invoicing, and purchase ordering operations.

For information for the office or shop floor, interpreted punched cards provide a convenient unit document.

For carry forward file data for re-input next time, the file is processed at 89 microseconds per word, equivalent to about 45,000 punched card equivalents per minute.

For printing off-line on Creed or Flexowriter page printers with sprocket-fed stationery, and for Telex transmission.

For monitoring information put out by the Organisation Programme during operation.



An ORION word can store any of the following:

8 alphanumeric characters

FERRANTI

decimal number up to

140737488355327

Floating-point number up to

about  $10^{38}$

sterling amount up to

£586406201480'10'7

8 groups of 6 binary digits



$=2^{47}-1$  as a 48-digit binary number



40-bit signed fraction

8-bit exponent



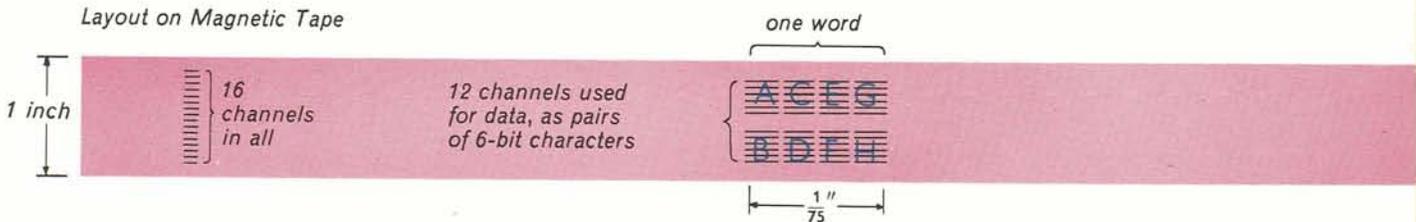
$=2^{47}-1$  pence as a 48-digit binary number



or several such items packed in one word

product code/quantity in tons/ value in £.s.d.

Layout on Magnetic Tape

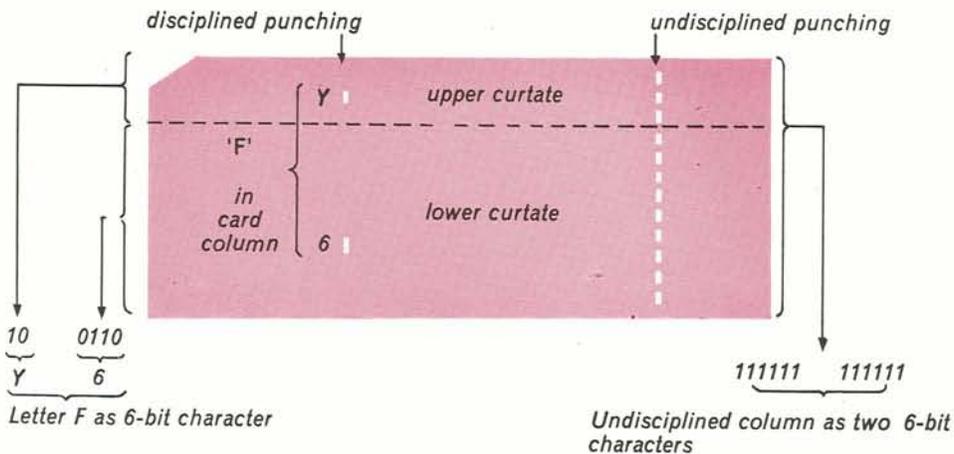


Write forwards ► Read backwards or forwards ◄.....►

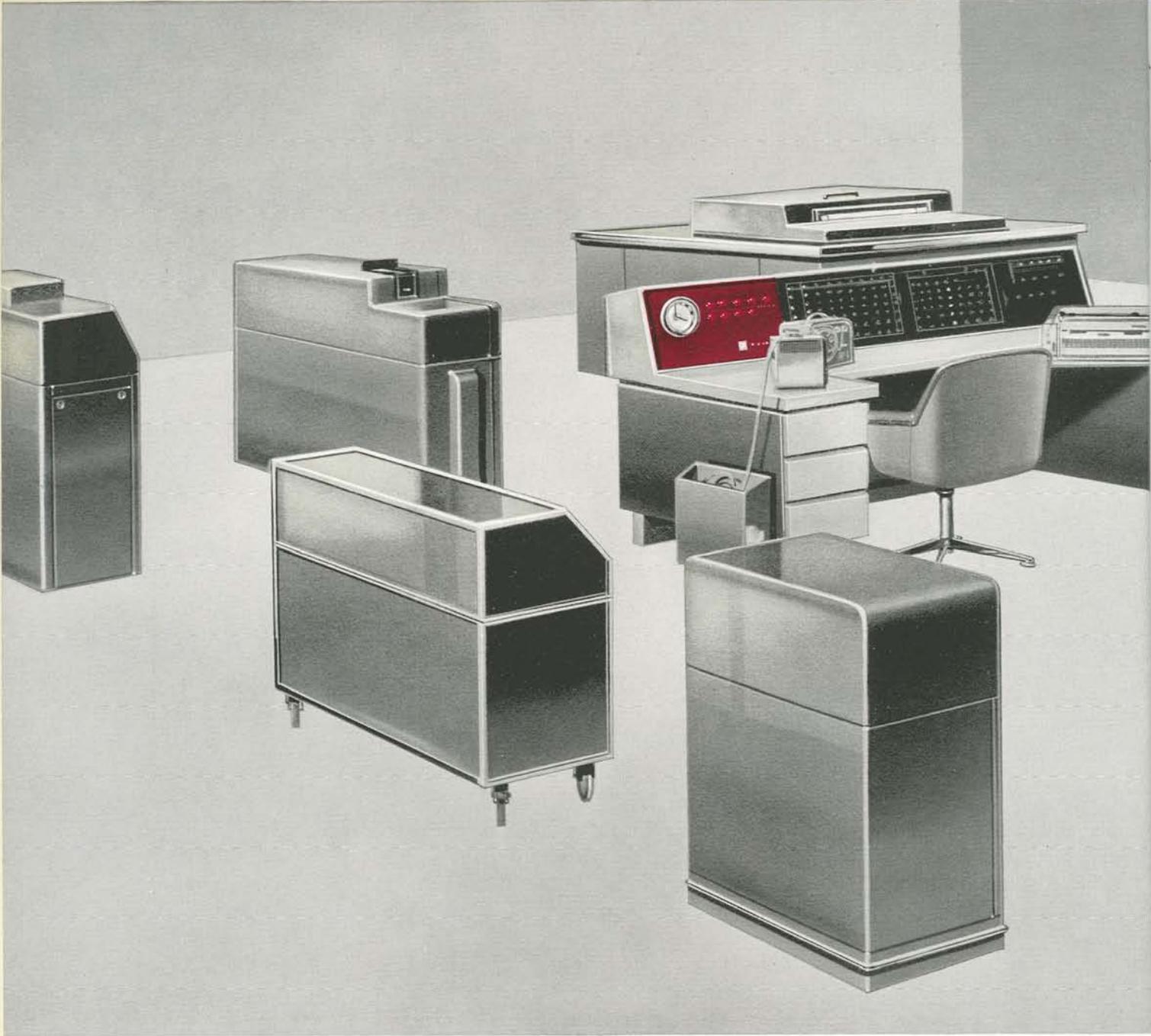
Layout of 25 records of average length 10 words on a 250 word block



Representation of data on a punched card.



The Ferranti **ORION** computer system





# Data transfers



When Orion uses a peripheral device for the input or output of data the transfer proceeds, and meanwhile the computer is able to continue with other work until the peripheral device requires access to a word in the core store. Then the computer "hesitates" for 16 microseconds (maybe half way through an instruction) to allow the word to be transferred. The computer then continues with its work from where it had left off. The diagram shows simultaneous reading from one tape deck, writing on another, and operation of an (independent) program.

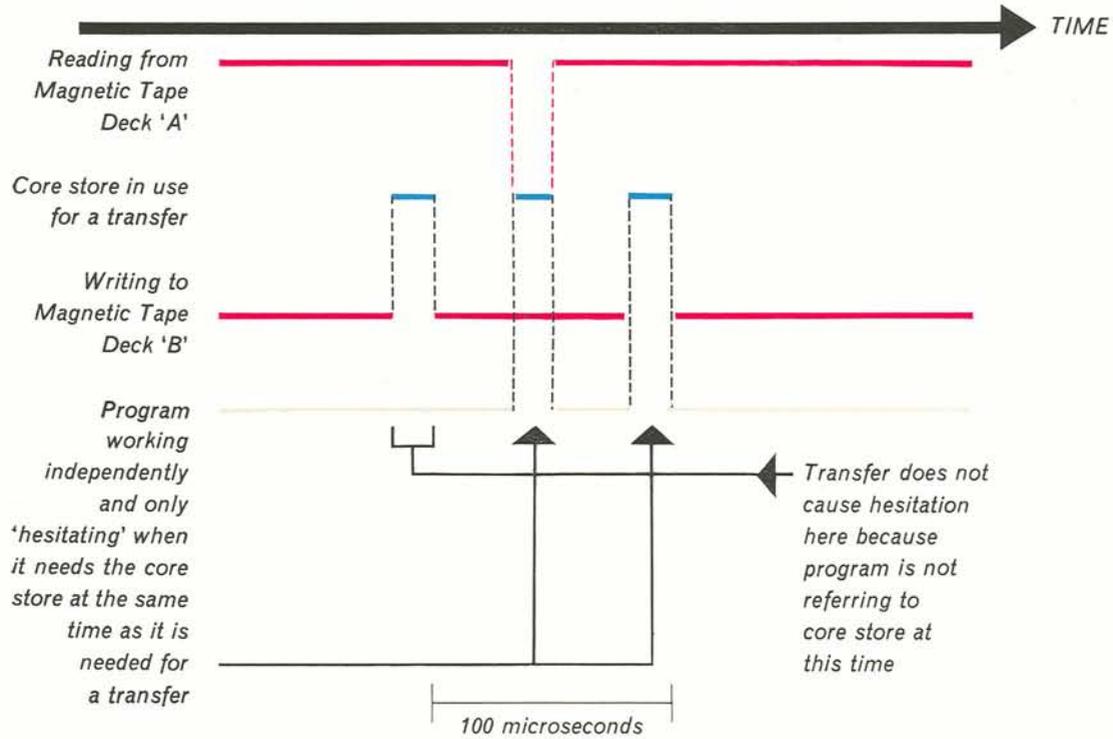
Thus, even when transferring to and from magnetic tape, more than 80% of the full speed of the computer is available for other work.

*Lockouts* are provided as shown, to prevent the program from interfering with a transfer once it has begun.

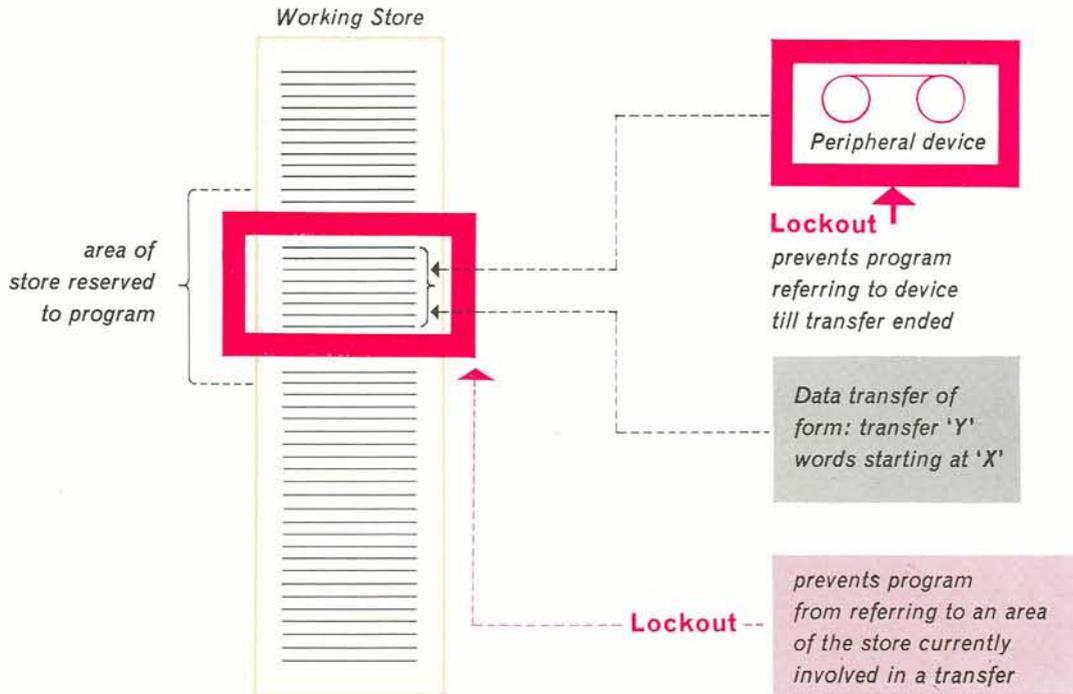
Transfers of data may take place to or from any part of the store, and are of the general form: transfer Y words starting at X.

All transfers are fully checked, with built-in check-sums on magnetic tape, and checked for both reading and punching of cards.

## Simultaneous reading and writing and program operation



## Lockout operation



# How ORION uses time



The diagram opposite illustrates the way the time-sharing system operates in a simple case. It shows a few milliseconds in the history of two programs.

In this case, two summaries are being prepared simultaneously. The first of these is a sales analysis formed from recorded quantities and values on punched cards. The second is a similar summary of costing data taken from magnetic tape.

At the instant at which the period illustrated starts, the first of a series of sets of cost data is being read from magnetic tape while a sales analysis program is completing the analysis of a card read in previously.

The card program has priority over the tape program in order to ensure that the comparatively slow card reader is not kept waiting.

On the other hand, while the sales card is being read in, the computer is able to use the time by getting on with the costing work.

In general, probably four programs will be found to be the most usual combination to run at once, although provision is made for many more programs.

**Computer Programs**

**Peripheral Devices**

① SALES

② COSTS

① CARD READER

② TAPE DECK

Sales Analysis

Program continues till next card needed

Sales Program tries to refer to card before it is available so switch

go on with the Sales analysis

First cost data read from tape. When finished attempt is made to interrupt sales program, but the latter has higher priority

Sales card reading starts

to Cost program which in turn calls for second cost data and then processes first cost data. When tape transfer ended looks to see if sales card is available. It is not. So calls for third cost data while processing second, and so on until eventually the sales card is read and this causes a switch to the sales program

Second cost data read from magnetic tape

Third cost data read from magnetic tape

Card reading ends

TIME

# How ORION decides what to do next



In order to enable ORION to make full use of the time available during a data transfer, a complete automatic priority scanning facility is provided. This enables a number of distinct programs to share the computer.

As soon as any program tries to refer to data or equipment which is locked out during a data transfer, or as soon as any transfer is completed, the program priorities are automatically scanned and a switch made to an appropriate program.

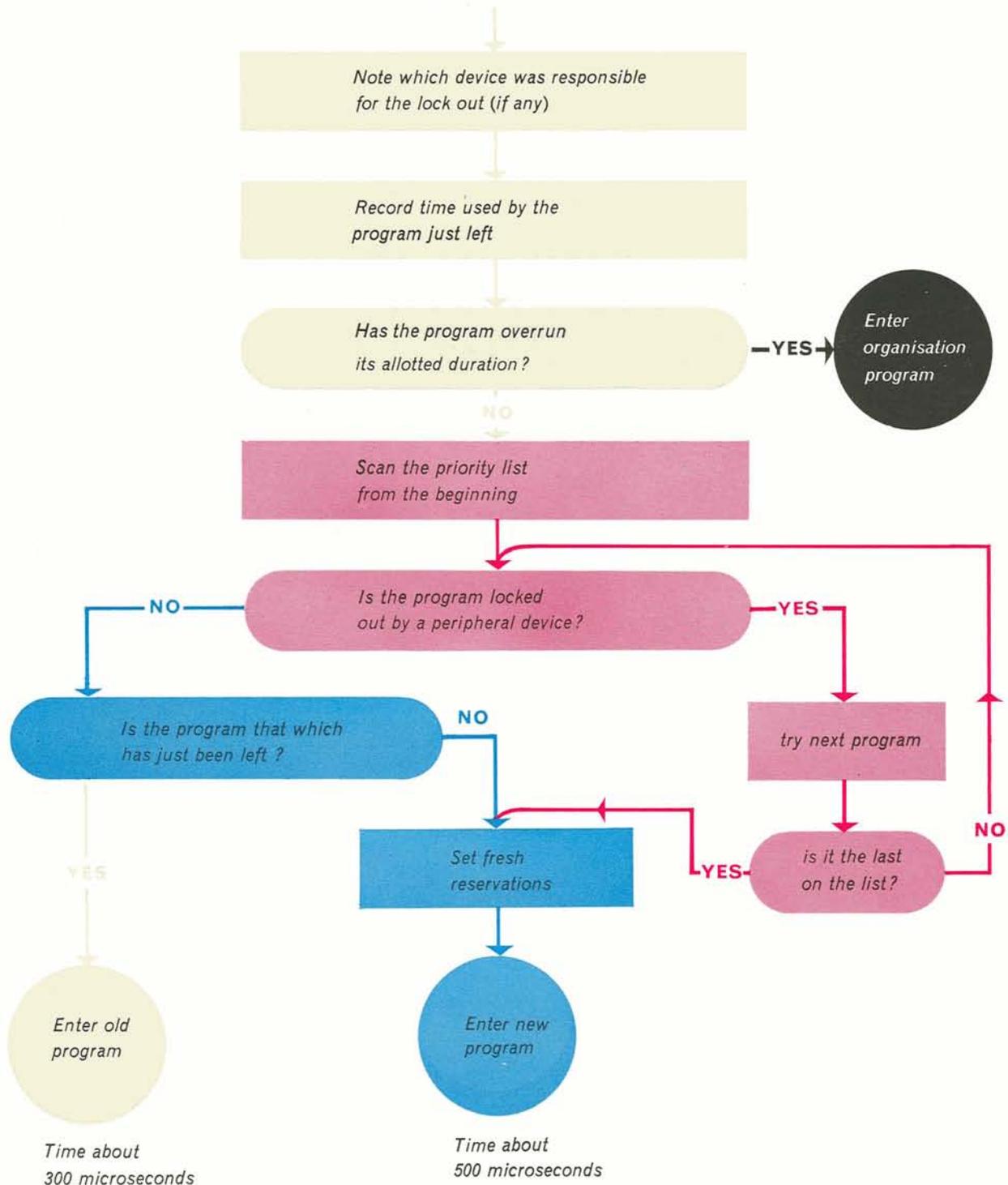
*An essential feature* of the ORION time-sharing system is the built-in program protection facility. By this means, each program has a section of the system reserved to it, consisting of two areas in the working store, an area of the drum store and a set of peripheral devices. Reservations are noted automatically during input of the program and the machine is so constructed that a program *cannot* alter or refer to the contents of any part of the system outside its own reservations.

Priority scanning is carried out by a permanent program at the end of the store called the Time Sharer routine. This routine also keeps account of the computer time used by each program.

When ORION reaches the end of a problem, or a batch of data (such as a pack of cards in a reader), it will not stop as previous computers would have done, but will enter another permanent program called the Organisation Program. This will carry out appropriate changes in the program priority list and continue with the remaining programs. Or it may read in another program and alter the reservations accordingly.

## The Time Sharer

is a fixed routine entered if the computer encounters a lockout and whenever a transfer comes to an end



# The form of instructions

The *working store* of ORION consists of 4,096 words of magnetic cores, extendable to 16,384 words. This is backed by the *drum store*, consisting of a number of drum units, each of which has either one or two drums. Each drum has a capacity of 16,384 words.

The instruction code has been carefully chosen so as to provide a compact and rapid means of coding complex operations, such as those encountered in sorting and file handling.

Most instructions are available in either a two-address or a three-address form. In the three-address form, the third address designates the destination of the result of an operation on the first two addresses, and is restricted to the first 64 words in the part of the store allocated to those programs concerned. These 64 words are known as the program's accumulators. In the two-address form, either or both the addresses will be "modified" by the contents of an accumulator.

A new feature in the ORION code is that described as *replacement*. This enables either the first or second address in any instruction to be replaced by the contents of the register specified by the address in the original instruction, before the instruction is obeyed. This form of instruction is particularly useful when referring to items whose position in the store is random, but which can be referred to indirectly through an index. Addresses may be both replaced and modified, replacement happening first.

For simple arithmetical instructions, the times depend on the type of instruction and the extent of replacement, as follows:—

3-address instruction – 64 microseconds

Unmodified 2-address instruction – 48 microseconds

Modified 2-address instruction – 68 microseconds

and for each replaced address a further 16 microseconds.

Multiplication (cumulative, double-length product) takes from 156 to 172 microseconds. Other forms of multiplication are available.

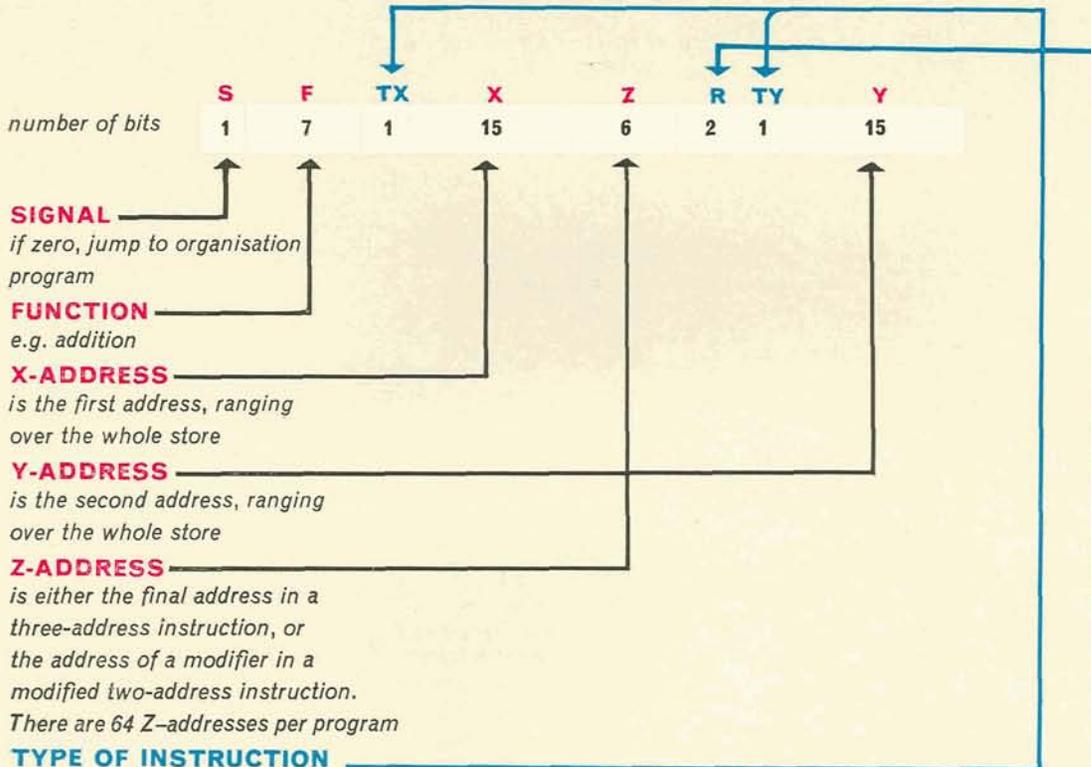
The time for division depends on the binary structure of the numbers operated on. Division (e.g. unrounded with quotient and remainder) takes from 564 microseconds minimum to 1,112 microseconds maximum. The statistical expectation of the time for random dividends (double-length) and divisors is 574 microseconds.

Special instructions are provided for packing and unpacking fields, for radix conversion and for table search.

**Instructions for Orion are written in the following form**

03	A8821	A1906	A46
Function	Register (X-address)	Register (Y-address)	Accumulator (Z-address)

As these are read into the computer they are automatically converted into the following form, in which they are stored and obeyed



If both these bits are zero the instruction is of three-address type, e.g.

"add the contents of registers 1000 and 2000 together and place the result in register 200."

In two-address instructions these bits signify whether the X or Y addresses, or both of them, are to be modified by the addition of the contents of Z. Thus the following operation can be carried out by a single two-address instruction:

"add the contents of register 1000 + m to the contents of register 2000 + m where m is contained in register 200."

**REPLACEMENT**

To facilitate the use of indexed or computed addresses either X or Y (or both of them) may optionally refer not to the operands, but the registers containing the addresses of the operands. Thus the following operation may be carried out in a single instruction:

"add the contents of register a + m to the contents of register b + m where a, b, m are contained in registers 1000, 2000, 200."

# Advantages of using **ORION**



The ORION System is supplied by the most *experienced* computer manufacturer in Europe.



The System is supported by first rate systems analysis, programming and maintenance engineering groups, with a proved record of achievement in putting computers to work economically and quickly.



The System has been designed by people with a background of operating experience which has influenced its conception at every stage.



The Time Sharing System particularly has been designed to make the system easy to use, from both the programming and the operating points of view.



Advanced automatic programming facilities are available, greatly simplifying the task of putting the computer to work.



Close co-operation is maintained with all manufacturers of peripheral equipment, which (like the computer itself) can be added to at any stage.



The Computer Centre helps in the preparation of basic file data, which can be prepared using either Pegasus or ORION equipment and kept up to date on magnetic tape, ready for use when ORION is installed.



Prospective owners and users of Ferranti Computers are encouraged to gain concrete experience of computer use at an early stage by undertaking service work planned and programmed by themselves.

# Some Ferranti computer customers

Ferranti Computers are being used in all types of organisations, for all kinds of work, including banking, budgetary control, insurance, sales analysis, sales forecasting, production planning, material requirement calculations, costing, payroll and a wide range of scientific applications. Some of the customers for Ferranti Computers and Data-Processing Systems are given below.

## *Commercial Users in the U.K.*

British Petroleum Co. Ltd.  
Imperial Chemical Industries Ltd. (Dyestuffs Division).  
Martins Bank Ltd.  
The London and Manchester Assurance Co. Ltd.  
The Prudential Assurance Co. Ltd.  
The Scottish Widows' Fund and Life Assurance Society.  
The Standard Life Assurance Co.

## *General Users in the U.K.*

Associated Electrical Industries (Rugby) Ltd.  
Babcock and Wilcox Ltd.  
Bruce Peebles and Co. Ltd.  
Imperial Chemical Industries Ltd.  
(Central Instrument Laboratory).  
Shell International Petroleum Co. Ltd.  
The General Electric Co. Ltd.  
The Steel Company of Wales Ltd.  
The United Steel Companies Ltd.

## *Commercial Users Overseas*

AB Datacentralen, Stockholm (*Insurance*).  
AB Turitz and Co., Gothenburg (*Retail Stores*).  
Skandia Insurance Company, Stockholm.  
South African Mutual Life Assurance Society, Cape Town.  
Svenska Flygmotor AB, Trollhättan (*Production Planning*).

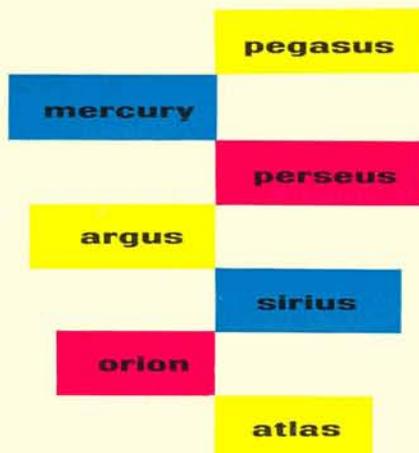
## *Universities and Scientific Organisations*

The Universities of Buenos Aires, Durham, Leeds, London, Manchester, Oxford, Southampton, Stuttgart.  
Admiralty Research Laboratory.  
Air Ministry, The Meteorological Office.  
Council for European Nuclear Research, Geneva.  
D.S.I.R., The Road Research Laboratory.  
The Belgian Atomic Energy Authority.  
The Swedish Atomic Energy Authority.  
The United Kingdom Atomic Energy Authority, Harwell, Risley, and Winfrith Heath.

## *Aircraft Design Groups (excluding data-processing)*

British Aircraft Corporation (3 Ferranti computers)  
Hawker Siddeley Group (5 Ferranti computers)  
Royal Aircraft Establishment (2 Ferranti computers)

Ferranti  
range of  
computer  
systems



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 **Ferranti**

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