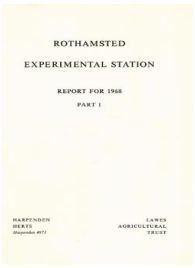
ROTHAMSTED RESEARCH

Report for 1968 - Part 1

Full Table of Content



Computer Department

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D. H. Rees (1969) *Computer Department ;* Report For 1968 - Part 1, pp 240 - 245 **- DOI: https://doi.org/10.23637/ERADOC-1-123**

COMPUTER DEPARTMENT

D. H. REES

In the first year of the Department work was divided between maintaining the service with the Orion and preparing for the new computer, which is due for delivery in late 1969.

The Orion computer room was flooded in September, but exceptional efforts by the maintenance staff confined damage to the floor-level trunking, and the computer was out of service for only two days.

The scope of the department's work, as given in the *Rothamsted Report for 1967*, will be significantly extended by the decision that other agricultural research institutes in England and Wales shall have direct access to the new computer. This resembles the arrangement the Agricultural Research Council (A.R.C.) had made with the Edinburgh Regional Computing Centre (E.R.C.C.) to provide computing facilities to agricultural research institutes in Scotland. This change to multiaccess computing will need a more formal structure of management than we now have.

Programming was largely restricted to necessary work for the Orion and to preparing for the new machine, with little done on new problems and applications. The newsletter and bulletin service have yet to start and a proposal made that a users' advisory committee be formed.

Orion service

Performance. The company responsible for maintaining the Orion changed the staff and our fears that this would adversely affect our working were justified.

TABLE 1

Orion performance, 1967–68 (hours worked)

	Maintained		Unmaintained		Total	Total 1968			
	1967	1968	1967	1968	1967	Jan.	Jul.	Total	%
Useful time	1686	1602	856	905	2542	1310	1197	2507	85
Faults	152	307	18	35	170	140	202	342	12
Restarts	66	62	18	19	84	46	35	81	3
Total	1904	1971	892	959	2796	1496	1434	2930	100
Maintenance					549	437	634	1071	
Total running time					3345	1933	2068	4001	

Table 1 shows that useful time was less than in 1967, the first time that useful time has decreased; fault and maintenance times each doubled. Total time, usually a good estimate of the operators' effort, increased by 5%; this excludes the hours operators put in waiting for repairs to be completed. The original site engineer left in June, and the effect shows by comparing performance during the two six-month periods. During July to December useful time fell by 8%; fault and maintenance time each increased by about 44% and the total switch on time increased by 7%.

https://doi.org/10.23637/ERADOC-1-123

Six full working days were lost because the machine was unserviceable, and only one during the first half of the year; average repair time increased by half for about the same number of faults. Unless the company improves its maintenance, our computer service, which must depend on the Orion for another two years, will be difficult to maintain.

Volume of work. The parameters of the costing program were changed to bring the charges more into line with commercial service bureaux. Although useful hours were slightly fewer, the new charges slightly increased total earnings and the hourly rate.

TABLE 2

Work done, 1967–68 (nominal value £000)

	1967	1968
Program development	145	120
Production	205	251
Systems	12	14
Total	362	385
Work per hour of useful time	£143	£154

Measuring costs is the only convenient way of assessing computer demand on the Orion. Costs which are recorded by institutes, could be used as the basis for allocating time either on the Orion or the replacement computer. Table 3 shows the use of Orion by Rothamsted and all other institutes (grouped).

TABLE 3

Distribution of work (% total costs)

	1967		1968	
Rothamsted				
Development	29		22	
Production	27		24	
		56		46
Other institutes				
Development	11		9	
Production	15		20	
		26		29
Experiments		15		21
Systems		3		4
Total		100		100

For the first time Rothamsted's share was less than half, largely because of reduced program development, reflecting the need to prepare programs for the new computer.

Experiments. The number of experiments analysed was 18% more than in 1967 which was unexpected because for some years the total seemed to have stabilised at about 6000. The number of experiments prepared at Rothamsted (5176) was 45% more than in 1967; whereas 18% less were prepared elsewhere. The numbers of experimental tapes that are re-

https://doi.org/10.23637/ERADOC-1-123 pp 3

TABLE 4

Numbers of replicated experiments analysed

	By hand*	On computer	Total	Number of variates on computer	Variates per experiment
1951	437	0	437	0	0
1966	109	6162	6271	40826	6·6
1967	17	6124	6141	50373	8·2
1968	29	7253	7262	53740	7·4

* In Statistics Department.

analysed are not included in the totals of experiments and variates, but are part of the total cost of experiments. This year 1919 or 26% of the total experiments and 21771 or 40% of the total variates were reruns. It is not practical to record in detail the reasons for the reruns, but a survey of the Rothamsted reruns during the first four months of the year is reported in Table 5. This survey was based on 2518 variates or 25% of all the

TABLE 5

Reasons for reruns—based on Rothamsted returns Jan.–9 May

	Variates	%
Incorrect or additional specification by user	1188	47
Punching equipment errors	704	28
Data tapes rerun unchanged due to		
(i) Suspicions about program errors	266	11
(ii) Suspicion of computer fault	158	6
(iii) Additional copies of results	202	8
Total	2518	100
Total Rothamsted rerun variates	10020	

Rothamsted rerun variates. The category of suspected program errors was introduced because new features had been added to Genfac. The proportions of the suspicious faults that were justified were not recorded, but the table shows that the major causes of reruns lie outside the computer service.

Programs. Programs were prepared for editing and analysing the punched paper tape from data-logging equipment. As an example paper tape from a crop drying experimental unit at N.I.A.E. is now checked by double reading of tapes and valid data stored on magnetic tape. Errors are monitored and reported and corrections made directly to the magnetic tape. (Clarke) Further programs were prepared to allow the results to be plotted. (Bicknell) Data-logging equipment is now being installed or recommended for use at several institutes. Because of this a general purpose input routine must be prepared to handle various data sets and formats.

There has been further experience with results from amino acid analysers and tapes were received from two institutes. The performance of the program is encouraging, but there are still problems in recognising and handling disturbed data. (Bicknell) Further investigations are necessary before all analyses can be confidently left to the program. This same method for resolving a curve into a set of normal equations was also applied to insect populations.

The new General Survey Program (GSP2) was implemented (Yates) and

https://doi.org/10.23637/ERADOC-1-123

is being tested on small surveys. It promises to be a more powerful program with more convenient user instructions.

Assistance was given in several problems at Rothamsted—on the schematic tabulation of root-infection data (Clarke); on the simulation of elution and absorption in a soil system (Bicknell); on the repeat of a Survey of Barley Diseases. (Bicknell) A series of lectures on programming was given, paying special attention to a modified form of EMA programming suitable for small computations. (Rees)

The new computer

The A.R.C.'s Advisory Committee on Computing agreed that the Department should develop and operate a multiaccess computer service for all A.R.C. supported research institutes in England and Wales. A similar arrangement is proposed for some Scottish agricultural research institutes at the E.R.C.C. where an International Computers Limited (I.C.L.) 4.75 computer was already on order. As many of these institutes had previously used the Orion service it was clearly necessary that programs and data files must be exchangeable between Rothamsted and Edinburgh. Although other factors were considered during the selection, the compatibility requirement greatly influenced the choice of a System 4.70 computer for Rothamsted. The list of equipment is given in Table 6.

TABLE 6

Initial System 4.70 equipment

1	central processor with 262 144 bytes of 1 μsec core store
4	replaceable disc drives (7·25 M bytes each drive)
3	magnetic tape drives (9 track; 60 k bytes/sec transfer rate)
1	card reader (800 cpm)
2	paper tape readers (5, 7 and 8 track; 1500 cps)
1	paper tape punch (150 cps)
2	line printers (750lpm; 132 columns wide)
1	multiplexor communications control unit
5	Teletypes (local connection)
1	video display unit (50 × 20 characters)

The 4.75 computer is a 4.70 with the address paging hardware; this is a special feature being exploited in the Edinburgh Multiaccess Project (EMAP). There is no possibility of the EMAP operating system being used on a 4.70. The corresponding 4.70 multiaccess operating systems are 'Multijob' and '7R' and much effort has to be made to ensure that I.C.L. provides compatibility between these three operating systems. The task is made difficult because the reference manuals are incomplete and information has to be sought indirectly.

The System 4.70 meets our immediate needs, whether it will continue to be suitable will depend on the future machine policy of the Company.

Preparations for the new computer

Communications with users. Two meetings held at Rothamsted were attended by workers at other institutes. At the first the multiaccess operating systems were described in general terms and at the second remote

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terminal equipment and data communication needs were described and costed. The meetings showed the value of direct contacts with staff from other institutes and will shortly lead to a formally based users advisory committee.

Programs. As the Extended Mercury Autocode (EMA) cannot be used on the 4.70, Orion programs cannot be directly transferred to the new computer. New programs for the 4.70 will therefore be written in Fortran IV. This will improve the chances of exchanging programs with workers in other countries which was not possible with the Orion programs.

Preparing the new programs will take time and although the Orion will continue to operate into 1971, the possibilities of translating an EMA program into Fortran as a temporary expedient was considered. There are some similarities between these languages and a program was written at E.R.C.C. to translate EMA statements into corresponding Fortran. However, this does not necessarily produce an equivalent operational program and the derived program has still to be examined in detail. For example, in Fortran the order in which multiplication and division are done in an integer expression can affect the final computed value. This never arose in EMA. Therefore for consistent results in both versions derived Fortran statements of this type may have to be rearranged. The additional effort involved for this approach to succeed is being studied. (Clarke and Thomson) Should it prove practical, an attempt will be made to convert the General Survey Program. (Yates)

Data conversion. This is a problem associated with program conversion. Many records held on Orion one-inch magnetic tapes will have to be transferred to half-inch tapes. A general program was defined to convert and re-organise the data, originally stored in EMA format, into a suitable form for input in Fortran. (Sharma)

Fortran testing service. With the emphasis now on Fortran IV, a suitable service for testing programs is necessary. Arrangements were made to use the IBM 360/65 at the Computer Centre, University College, London. Programs are prepared on punched cards and staff trained in the new conventions using an IBM 029 card punch. (Fearne) This service we owe to the co-operation of the Centre's Director, Dr. P. Samet. We are also indebted to the programming staff of the Centre for advice and guidance on program problems, so valuable during the early stages of such a service. As with the EMA on the Orion, one member of the staff (Bicknell) is responsible for dealing with all Fortran enquiries and the experience gained on the London machine should be very beneficial with the 4.70 Fortran service.

The Director of the A.R.C. Unit of Structural Chemistry, University College, London, has also allowed us to use their IBM 1130. It is a small computer and uses a restricted version of Fortran, so is only of limited value, but as 1130s are being installed at other research institutes and could become a feature of the multiaccess network this opportunity to get operating experience is very welcome.

https://doi.org/10.23637/ERADOC-1-123

There appear to be ambiguities in the definition of the IBM and ICL versions of Fortran. The implementation of the compilers may also lead to inconsistent results when the programs are run. These are being investigated (Bicknell, Clarke and Thomson) and reports will be prepared and circulated periodically.

Multiaccess. A multiaccess system, by which other research institutes can operate on virtually the same basis as users at Rothamsted, will only be possible when high-speed data-communication links and terminal equipment are improved and become cheaper. A key factor in an efficient multiaccess service is the performance of the controlling operating system, and these are often a compromise between conflicting needs. Therefore local changes can often greatly improve the service, and to this end the structure of the operating system is being studied in detail. (Rees, Sharma)

The first multiaccess service will be based on Teletypes (electric typewriter devices). Five will be installed with the initial equipment at Rothamsted and more will follow at other research institutes. These are slow (10–15 characters per second) and will be most useful while programs are being developed. Users will be able to type a small program to be held in the central filing store; this program can be tested, corrected and linked to other programs by a set of commands also typed by the user. Error reports can be selectively printed at the terminal as well as parts of other results.

A video display unit will be connected to the 4.70 in the department. A television-like device, it has a keyboard able to display up to 1000 characters. Its flexibility and speed should greatly aid users during exploratory analyses and for retrieving information, but new systems support programs have to be written for it.

New Computer Building. The building to house the new computer has started. The Technical Support Unit (T.S.U.) of the Ministry of Technology again assisted with the appraisal of design proposals for the air-conditioning plant and the equipment will be tested to their standards. They will act as independent advisers during the acceptance trials. Another section of the T.S.U. will also supervise the acceptance tests for the new computer both at the factory and the site.

Staff

A. H. Martin left and P. A. Clarke, R. P. Sharma and J. A. Thomson were appointed. F. Yates is employed part-time.

D. H. Rees attended the Congress of the International Federation for Information Processing at Edinburgh. F. Yates participated in a Symposium on Survey Sampling at Chapel Hill, North Carolina, U.S.A., and K. E. Bicknell attended a summer school on 'Computers in Biochemistry'. D. H. Rees shares with J. Matthews (National Institute of Agricultural Engineering) the responsibility for a joint advisory service on automatic data logging equipment and computer methods now available to research workers at A.R.C. supported institutes.

https://doi.org/10.23637/ERADOC-1-123