ROTHAMSTED RESEARCH

Report for 1970 - Part1

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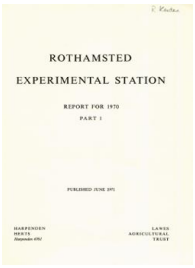

Computer Department

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COMPUTER DEPARTMENT

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The ICL System 4-70 computer was delivered in July, and a restricted console service set up in mid-October using the Multijob operating system. An alternative operating system, known as 7R, was cancelled by ICL. The terminal link to Edinburgh Regional Computing Centre (E.R.C.C.) was fully used for developing programs ultimately to run on the 4-70. There was a small increase in the routine production on the Orion.

Computing services

4–70. The 4-70 was delivered on 1 July and was assembled and switched on by 3 July. This rapid progress was in part because of design of the computer building. The commissioning of the equipment was speedily completed but the first attempt with the formal acceptance tests failed in August because of test program errors. The second attempt in September succeeded. The acceptance tests were made under a standard batch operating system. The company refused to make them under the Multijob operating system.

This early experience of reliable equipment but unreliable programs has set a pattern that still persists.

Multijob. Users must have direct access to the computer service and for this the Multijob operating system is necessary. Regretfully Multijob has proved unreliable and only Rothamsted users have this service. A full report on these difficulties would need a technical explanation inappropriate in a general review. Nevertheless, they are of sufficient concern to warrant a brief account of the major problems.

When Multijob is fully operational, users can either use the computer for rapid calculations—that is interactively—or queue their jobs in the batch stream to be run later. Interactive computing is attractive to the user, but makes the greater demand on computer resources and for this reason is limited to small jobs. Most routine computing will be done in the batch stream.

Multijob is not a fully specified system and there is no scheduled date for its completion. The system is currently supplied to selected sites as a series of releases. Each release contains additional features and corrections to some of the errors found in earlier releases. The company makes no claim for the reliability of current releases and the selected sites are used essentially as test beds. The first release at Rothamsted, M600, seemingly contained enough facilities and was expected to be sufficiently reliable for a computing service. Unfortunately we were to be disappointed on both points.

The most persistent fault has been the failure of the system catalogue which stores the identities and the locations of all work files held in the system. For reasons still not fully understood the catalogue becomes corrupted and users cannot work with their files. This corruption can be so severe that the system as a whole fails and takes about 2 hours to restore. The corruption is usually limited to the catalogue and the service can then be restarted within minutes, but it is restored to the state fixed by the last archiving of the work files. This could be as much as 2 hours earlier than the failure. Users must know quickly that this is the situation because any work run between the last archiving operation and the current incident is lost. With an average of 93 minutes between system failures, remote users cannot be kept informed.

The space for the work files is allocated and controlled by Multijob, and experience now shows that this means the disc space is often under-used causing spurious overflow

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of disc capacity. This has been temporarily eased by removing some compilers and other program utilities, so restricting the system software to one disc. The demands on disc space, even with the present few users, has increased greatly and more space will be needed. Interactive computing, and some console operations that have also caused system failures, have been restricted to improve reliability. There have been many unexplained errors in the Fortran compilers and the supporting system software. Many of these errors are still not corrected.

To finish on a more encouraging note, the Watfor Fortran compiler is now operating on the 4-70. It was extensively used on the Edinburgh link and is very suitable for inexperienced users who have small jobs. At present it runs from cards in the batch stream, but the company is implementing a scheme based on our proposals that will make it practical to use on consoles. This will not need the more unreliable features of Multijob and a service based on Watfor will shortly be extended to users away from Rothamsted. (Gledhill and Guthrie)

TABLE 1

4-70 performance (hours and % of total hours worked 12.10.70–31.12.70)

	Hours		%
Useful time:			
Console sessions	194		33·3
Batch sessions	43		7·4
ICL	29		4·9
		266	45·6
Supporting services:			
Restoring system	168		28·8
Error investigation	35		6·0
Housekeeping	44		7·6
		247	42·4
Scheduled maintenance		56	9·6
Idle		14	2·4
Total hours worked		583	100·0
Unscheduled maintenance:			
Breakdown	30		
Enhancements	5		
		35	
TOTAL AVAILABLE HOURS		618	
Average hours per working day (56 days)			10·41
Serviceability $\left(\frac{\text{hours worked} \times 100}{\text{hours available}}\right)$			94·3%
No. of Multijob incidents			181
Mean time between incidents			93 minutes
No. of hardware incidents			37

Operational performance. There can be no report on jobs done until the logging programs exist on Multijob because the 4-70 operators have no detailed knowledge of these. Table 1 summarises the performance of the 4-70.

A typical daily routine is to run three batch sessions interleaved with two console sessions. Watfor jobs are run during the batch session, also large jobs requiring much core store. The archiving of work files onto magnetic tape is done twice daily during the batch sessions. The ICL time shown in Table 1 is part of a contractual arrangement by which they use the 4-70 after normal working hours. The restoring system time includes

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the very lengthy generation of new versions of Multijob, as well as the more frequent restorations after system failure. Error investigation is restricted to system faults; other investigations of program errors are irretrievably included in the useful time. Scheduled maintenance is based on 3 hours per week and the time counted against unscheduled maintenance refers only to time lost during the normal day, not during evenings or week-ends.

The serviceability of the computer, at 94%, is encouraging but some repairs to the card reader, tape drives and line printers have taken long to complete. This has not yet affected the use of the computer, but as users demand more time there will be less free time for the engineers. Hardware failures were inflated by the recent power cuts. The on-call arrangements for engineering support has worked well.

The cost of unreliable system software shows in Table 1, where time for supporting services nearly equals the useful time on the system. The 181 Multijob incidents refer to a failure of the system and not to programming errors or partial system failures. These incidents are recorded only during useful time and average 93 minutes between failures; they irritate and make users lose interest. (Guthrie)

Communications. The Post Office datel equipment installed includes eight exchange lines and four private circuits sharing eight datel 200 modems into the computer. All lines and modems were tested into the computer. An answering set is installed to deal with routine messages on the state of the computer service. Institutes are using their consoles to pass messages to the data preparation staff for jobs run on the Edinburgh link (Martin)

ICL programmers, familiar with the vagaries of Multijob, developed a small program on the Rothamsted 4-70 from their Reading office.

Remote data terminals. The console service is the first phase of the multiaccess service. There is a need for terminals with more powerful input and output devices. ICL propose only one type of terminal to which there are technical objections, and alternatives to be based on a new communications computer linked to the 4-70 are being considered. This computer will control the terminals and link them to the 4-70 system. For this, new communications and interfacing software will be required but these may be shared with another 4-70 installation faced with similar problems. (Gledhill and Martin)

Development service, documentation and training. The development service, in addition to dealing with enquiries, has assisted in the transfer of programs and routines to the 4-70. They have also made a start on the Rothamsted Program Library.

Ten Newsletters and Guides were produced and circulated, and two meetings of the Remote Access Users Group held. Two one-day courses on Multijob were held, one for Rothamsted staff, and one for other institutes. A two-day course on Multijob was prepared and will be given to all institutes early in 1971.

All ICL documents, including amendments and corrections, are checked and distributed. An enquiry was made with all British University Computing departments about future program interchange, but this did not produce an encouraging response. (Gledhill, Christine Lessells and Christine Shelley)

Orion. Despite the transfer of programming effort to the Edinburgh link and the 4-70, work done on the Orion increased. Table 2 shows more total hours worked, with a 5% increase in useful time, than in 1969.

Table 3 shows that the main increase in work over 1969 was in production.

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The total experiments analysed, Table 4, was the second largest and the number of variates analysed the most ever. Rothamsted's share of the variates analysed increased from 54 to 67%.

TABLE 2

Orion performance, 1969–70 (hours worked)

	Maintained		Unmaintained		Total		%	
	1969	1970	1969	1970	1969	1970	1969	1970
Useful time	1619	1807	461	388	2080	2195	83	84
Faults	341	316	13	10	354	326	14	13
Restarts	57	62	3	4	60	66	3	3
	2017	2185	477	402	2494	2587	100	100
Additional maintenance					882	804		
					3376	3391		

TABLE 3

Distribution of work 1969–70 (% total nominal value £000)

	1969 %		1970 %	
Rothamsted				
Development	15		8	
Production	21		26	
		36		34
Other institutes				
Development	12		6	
Production	25		30	
		37		36
Experiments		24		28
Systems		3		2
		100		100
Total work (£000)		300		314

TABLE 4

Replicated experiments and variates analysed 1969–70 (% totals)

	Experiments		Variates	
	1969	1970	1969	1970
Rothamsted programs				
Data prepared at Rothamsted	67	69	54	67
Data prepared elsewhere	30	30	42	32
	97	99	96	99
Other programs	3	1	4	1
	100	100	100	100
Totals	5750	6494	46 918	55 984
Variates/Experiment	8·2	8·6		

The Orion was to have been closed down by March 1971 but it will need to continue until the 4-70 can provide a similar service for routine production, and for this there must be suitable programs. New maintenance arrangements have been agreed with the company to keep the Orion in service during 1971 but these may affect its operational performance. (Fearne)

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Edinburgh link. The IBM 2780 link to the E.R.C.C. computer was essential to the 4-70 programmers. To meet increased demands the connection time was extended in June from 5 hours to 7 hours daily. Although all Watfor jobs are now processed on the 4-70, there is still a demand for the link, especially for the larger programs, and it will remain until March 1971. (Fearne)

TABLE 5

General performance

Working days	247	Days with incidents	233 (94%)
Nominal connect hours	1626	Lost hours	369 (23%)
Incidents	692		
Incidents/day	2·8	Lost time/incident	32 minutes

The IBM 2780 card reader and line printer terminal is an example of equipment that other institutes should have on the 4-70 service. Our operational experience with the 2780 is a useful guide to the value of a similar link at institutes. Table 5 shows its performance and that, even with proven systems, there was a loss of 23% in the total connection time. Failures averaged almost three a day and only 14 days had none. Table 6 shows that most happened on the private link circuit, but there were also many because of a new operating system at Edinburgh.

TABLE 6

Breakdown by source (% total)

	Terminal	Link	Computer	System	Total
Incidents (692)	6	35	27	32	100
Lost hours (369)	22	23	32	23	100

10 931 jobs were run on the link, 61% originating at Rothamsted and others shared between seven institutes. On average about 11 000 cards and 20 000 lines of print were transmitted daily but this, in total, represents less than 4% of the 360/50 service. The total daily transmission of 33 000 cards or lines per day is close to the maximum of 30 000 transmissions estimated in 1969. About 40 users retained programs and data as work files at Edinburgh. Most jobs run on this link relate to program development, which tends to be a self-generating process because faster turn-around time increases the number of runs requested. This would not be typical of the work pattern at institutes where the greater requirement would be for routine processing. The present capacity in terms of jobs, cards and lines of print transmitted is large by present known demands at institutes and a terminal of about this capacity would probably meet computing needs at institutes.

U.C.L. Only 367 jobs were run on the IBM 360/65, mainly to convert punched card and paper tapes. These are not conveniently done on the Edinburgh link.

Punching service. The increased computing has meant more work in the punch room where, for example, there were 564 000 cards used, an increase of 28% over the previous year. Eight-track paper tape punching service still waits for suitable input routines on the 4-70, and this lack also delayed demand for the Tracee digitiser service, although some work was done on graphs from other institutes. (Fearne)

Programming

The programs developed were mostly for general use. The Edinburgh translator was used to convert Orion programs into equivalent Fortran programs. Many routines are now working on the 4-70, but problems are being encountered with large programs.

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The current list of programs and routines either completed or under test is too long to report. Details will be circulated to users. Some of the more important and interesting routines are discussed below.

Routines. This is the smallest working unit in a program. Routines are designed to provide useful operations or functions that could be incorporated into a program without reference to the internal coding details. They are identified by names, are held in routine libraries and are easily obtained by users.

As an example, a routine was prepared that allows Fortran format statements to be altered without recompiling the program. (F. Yates) A user has merely to 'call' it in a program and it will be incorporated by the system. Another routine allows the user to control the number of significant digits when a floating point value is printed. (Christine Lessells)

Yet another will pass system information such as date, time, error information to a Fortran program. (Bicknell) This last is an example of a routine written in machine code, others were written in Fortran. Many routines were obtained from other computer departments, but these have to be tested before they are added to the library. More than 30 routines were collected and tested for the 4-70 and are being documented. (Christine Lessells and Christine Shelley)

Occasionally routines 'call' other routines and the system ensures that all required routines are incorporated in the program. As an example, there are 11 graph-plotting routines available to Fortran programmers but these are bound together through three basic machine code routines not known to the programmers. This set was supplied by the plotter manufacturer and had to be proved on Multijob. (Thomson)

General program. The 1969 Survey of Fertiliser Practice (SFP) was analysed on the Orion using the General Survey Program (GSP). GSP has been under continuous development on the Orion. The combined table print feature enabled about 220 tables to be presented on 12 pages. The photographic reproduction of these pages, including additional type written notes, was a success. A preliminary analysis was made on the 1970 survey.

The GSP program is divided into two, Part I for data input and the formation of the basic tables, and Part II for operations on these tables and printed results. The output from Part I becomes the input to Part II. A start was made to convert the Orion GSP into Fortran using the Edinburgh translator. Part I was converted and fully tested on the IBM 360/50 but Part II of the conversion is incomplete. The translator produces a Fortran program that is basically satisfactory, but requires some editing to make it more compact. Part I is being transferred to the 4-70 but, as with other large programs, is encountering problems with Multijob.

Improvements were made for Fortran versions of GSP; the restriction of eight characters to a name was lifted thus making it unnecessary to use unsatisfactory abbreviations. Other changes were also made to improve the format of printed tables. Progress was slower than hoped, partly from problems on the 4-70. (Yates, Clarke and Woodford)

A start was made on converting two other major Orion programs for fitting constants, Fitcon and Fitquan. (Clarke) The three programs GSP, Fitcon and Fitquan are complementary to the general statistical program Genstat now being written in the Statistical Department.

With the increasing use of data logging equipment, problems arise with checking the paper tapes, which can be satisfactorily done only on a computer. This is a general requirement and the 4-70 has a new data validation program. The output from data

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logging equipment almost always conforms to a repeated format where, for example, a sequence of channels is repeatedly scanned in fixed order throughout the life of the experiment. This enables the experimenter to specify relationships between items either in the same scan cycle or between cycles by which he would assess the accuracy of the data. The validation program gives the experimenter a standardised way of specifying these tests and provides error reports in a way helpful for later corrections. (Clarke)

Reference was made in a previous report to the Continuous Systems Modelling Program (CSMP) as a powerful technique for exploring the behaviour of processes by simulation. This is a standard IBM program that will be transferred to the 4-70. Major components of this program were compiled on the 4-70 but not run because of the difficulties experienced with large programs under Multijob. (Bicknell)

A group of general input programs are almost complete for the 4-70. These, in contrast to the previous general programs, are written in the basic machine code and directly connected to the Multijob software. The most important program reads 5, 7 and 8 track paper tape in various formats, creates Multijob data files, deals with a wide class of error conditions, allows restarts and connects data files to any processing program. The other programs are versions of a general card input program for reading binary and Porta punch cards. Future routine production on the 4-70 depends on these programs. (Sharma)

Finally, as an example of the potential for international program exchange, a Fortran program was obtained from Italy on the 'Fitting of Constants in Multiexponential Models by the Peeling Method'. It is now working on the 4-70 complete with its Italian comments. (Tan)

Sponsored programs. A new version of the MAFF Cereal Disease Survey for the 1970 data was run on the Orion. (Bicknell)

With one exception, only those sponsored programs already working on the Orion were transferred to the 4-70. They include the analysis of the directly recorded potato infections (Beryl Hersom), the amino acid analysis programs (Bicknell), Penman's natural evaporation program (Clarke) and the analysis of plant proteins (Clarke). There is a program for calibrating Warburg apparatus from data submitted at a console (Janice Bending), and a small program for the analysis of salary adjustments was run for the Station and the ARC (Guthrie). In co-operation with the Physics Department, a start was made on the organisation of the input and file structure for their large scale data logging experiments (Beryl Hersom).

Staff

Christine Lessells, Christine Shelley, J. M. Guthrie, R. Martin, Bery Hersom and T. G. Tan were appointed.

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