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ROTHAMSTED
RESEARCH

Report for 1979 - Part 1

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Computer Department

D. H. Rees

D. H. Rees (1980) *Computer Department* ; Report For 1979 - Part 1, pp 71 - 78 - DOI:
<https://doi.org/10.23637/ERADOC-1-136>

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Introduction

The usual indicators such as users' forecasts and an expanding network pointed to a continued growth in total computing demand. Although there was a 6% increase in the number of jobs run, this was achieved with an overall small reduction in the use of the computing resources. Thus, for the first time, growth, which has been a regular feature

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in past years, has not been maintained. There is no fully satisfactory explanation for this, but undoubtedly there is considerable caution towards expansion since the change of Government. Impending economies, cash limits and limited staff recruitment are factors in this new situation.

The Department has suffered particularly through the loss of specialist programming staff who have perceived superior career opportunities in industry. Despite the improved salary position, this situation is common throughout the public services and is a cause for concern.

This change in mood could not have come at a more difficult time for the Department. We are now in the tenth year of service using equipment designed some 14 years ago. There had been every expectation that a decision in principle concerning the replacement of the mainframes would have been taken this year as a consequence of a new ARC policy on computing. This has not been forthcoming and the Department remains uncertain about the expected life of this equipment and the plans for its replacement. Planning for the next system will require a major effort by experienced staff in order to safeguard both the users' interests and the substantial investment made in the network. For this reason most of the effort has been concentrated on the completion of outstanding work. New work has been limited to those tasks where useful benefits could be achieved in a short time. I foresee difficult problems arising should this uncertainty continue far into the coming year.

Despite this situation all evidence points to an expanding role for computing in research, with growth in demand for resources and facilities to serve these needs. The technical options are greater and more challenging than ever and the wealth of computing experience and knowledge built up at Rothamsted over the past 25 years could play an important role in determining the way that computing will be deployed within the ARC for the coming decade.

Operations Section

This Section is responsible for the management and development of the mainframe, hardware, software and support systems.

Operations. The two ICL System 4 computers have continued to operate on a two-shift basis this year. The total load has been little different from 1978, though growth over the last 3 years has exceeded 50%, and new applications and facilities are still being added.

The increased capacity provided by the additional 4-72 computer introduced in 1977 has apparently altered the pattern of work temporarily, and this has only now settled down again. Workload is given in Table 1. The ETU is mainly a measure of processor activity, whereas a work unit takes account of more general resource use. A job is a run of a program.

Additional equipment planned last year and installed in the early part of 1979; a second drum on each computer enabled a faster response to interactive work to be achieved, and a further 64Kb of main memory on the 4-72 permitted better utilisation of that processor, particularly at night. Communications equipment has also been redistributed between both System 4 computers, both to provide a more even spread of work and to enable new terminals to be connected. A substantial number of terminals are still directly connected to the two mainframes, including serial printers at ten institutes. Fifteen institutes now have on-site printing facilities.

Utilisation of the system is given in Table 2. Most of the housekeeping work is done during the evenings and nights, and systems work is mostly done during the evening, with some time taken during lunch intervals.

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TABLE 1
Distribution of work by Institutes

	ETU		Jobs		Work Units	
	1978 5 870 056 %	1979 5 649 206 %	1978 362 059 %	1979 385 253 %	1978 13 609 926 %	1979 12 732 492 %
RES						
Computer Dept.						
Systems	16.8	19.2	9.4	10.1	6.3	6.7
Applications	6.6	6.3	12.8	13.1	6.3	5.9
Total	23.4	25.5	22.2	23.2	12.6	12.6
Statistics Dept.	19.1	15.3	9.9	9.1	25.5	20.6
Other Depts.	8.5	8.8	4.2	5.0	7.1	8.9
NIAE	11.0	9.8	14.8	10.5	10.8	8.3
GRI	6.7	7.4	8.5	7.4	8.0	9.7
NVRS	5.9	5.4	8.5	7.8	5.8	6.0
NIRD	4.5	4.8	5.2	6.7	4.7	4.3
GCRI	3.0	3.9	3.3	5.4	4.2	4.7
EMRS	3.4	3.8	4.7	4.7	3.7	3.7
IRAD	2.4	3.6	5.6	6.9	2.8	4.5
MRI	2.7	2.8	2.0	1.6	3.5	4.2
LARS	1.3	1.9	1.4	1.8	1.5	2.3
SSEW	1.3	1.7	1.2	1.5	1.0	2.0
LL	2.3	1.4	3.4	2.1	2.9	1.5
WRO	0.4	1.1	0.9	2.5	0.8	2.1
ARC Services	0.7	1.0	0.6	1.1	0.9	1.2
WPBS	0.8	0.8	1.1	0.9	1.2	1.1
NIAB	1.2	0.7	0.6	0.4	1.3	0.8
Others	1.4	1.2	1.9	1.4	1.7	1.5
	100.0	100.0	100.0	100.0	100.0	100.0
Daily average	23 387	22 507	1 442	1 535	54 223	50 727
% inc.(+)/dec.(-)		-3.8		+6.4		-6.4

TABLE 2
System utilisation

	1978		1979	
	4-70 %	4-72 %	4-70 %	4-72 %
Production Time				
Day supervisor	53.9	52.2	57.1	56.7
Night supervisor	25.1	23.5	21.2	19.4
Housekeeping	10.5	9.9	10.9	9.7
System work	3.6	6.2	3.8	7.1
	93.1	91.8	93.0	92.9
Non-production time				
Failures (all causes)	2.1	2.2	4.2	3.7
Routine maintenance	4.1	4.3	2.7	2.9
Additional engineering	0.7	1.7	0.1	0.5
	6.9	8.2	7.0	7.1
Total operational (hours)	4476	4131	4191	3987
Working days	251	251	251	251
Daily operational (hours)	17.83	16.46	16.70	15.88

The number of software failures has been considerably reduced this year, though the hardware failure rate is about the same, and is similar on the 4-70 and 4-72, despite a marked difference in age. Of concern is the increase in time lost due to failures, attributable mainly to a number of faults which took a considerable time to resolve (Table 3).

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TABLE 3
Distribution of system failure incidents

	1978				1979			
	4-70	Total	4-72	Total	4-70	Total	4-72	Total
Software								
ICL	78		43		48		32	
RES	47		30		11		19	
		125		73		59		51
Hardware								
ICL	157		127		131		147	
Res Operations	8		6		2		4	
'Other' failures	17		12		29		39	
		182		145		162		190
Total (all causes)		307		218		221		241
Total hours lost		94		89		175		146

Systems and Programming. Both invisible and visible improvements have been made to the mechanism for dealing with user work. The file transfer mechanism to the FEP has been improved by redesigning the way in which the System 4 queues are handled, and support for remote drum plotters has been provided. Considerable enhancement to the user image has been made by introducing the University of Bath's Jobinput Macro Facility, which enables work to be submitted in a simple way. A means of removing work incorrectly or erroneously submitted has also been provided.

The demand from users and the trend in computing generally is to have more interactive computing. The existing system is limited in this respect, and while its image is being improved, real advancement will only be possible when new equipment and systems are introduced.

Applications Section

This Section provides applications software and packages, which are either known, or promise, to be of value to users, together with the associated documentation, training and advisory services. The Section trains and supports users to exploit new software techniques and opportunities.

Data Management. Although there have been several investigations and feasibility studies on potential databases, very little progress has been made in their application. One major reason for this was our inability to mount an operational version of the Natural Environment Research Council's relational database package, G-EXEC. This was a rare example of an unsuccessful transfer of an IBM package to an ICL System 4. Regrettably there is no other proven general purpose system available for this range of machines.

To illustrate how close we are in our ability to make progress in this field, a demonstration version of a relational database system using real but not significantly large data sets was operational within 6 weeks of the staff having access to the Multics system at the Avon Universities Computer Centre. The ease with which that demonstration was completed and the impact that it has made on those who have seen it confirms the view that there is a very real demand for database facilities within the service. Negotiations are under way with the Director of the Computer Centre for a long-term commitment of resources which would justify the effort of mounting a working database.

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Graphics. As indicated last year, the Atomic Energy Authority's graphics package, GHOST, has now been mounted on the service. The essential additional processors to deal with our particular graphics equipment have now been completed. Although this is clearly an important development, users are now urging the case for an interactive graphics facility on the service.

Training and Advisory Services. Of the 27 courses organised this year, 18 were based on video tapes prepared by the Department. This technique enabled eight of the courses to be held at institutes.

There have been seven significant additional packages added to the program library as well as 15 major updates. A start was made on the creation of a library for the specialist RESBOL language. Details of the documentation issued are given in Appendix 2.

Rothamsted General Survey Program. There is ample evidence of continued interest in this package but our ability to transform this into actual commitment is to a large degree determined by the limited staff available for the project. The principles and methodology of RGSP are well established and proven in practice. The urgent need now is for a version which takes account of the operational experiences. However, with preparation for training courses and user documentation carried out by the programming staff, this leaves inadequate time to plan and develop this next important phase. Because of its obvious appeal to a potentially wide range of users, negotiations have been started in an attempt to find an independent funding source.

Telecommunications Section

This section is responsible for the development, maintenance and operation of the network comprising the dual Honeywell 716 front end processors through to the end user terminals at Institutes. Its output is on the 'critical path' for the expanding service and progress this year has been delayed badly through the loss, over the last half-year, of four of the six staff engaged in this Section.

Network Operations. The planned distribution of terminals for the current financial year is given in Table 4.

This again reveals a further increase in the network and the demand for further facilities appears to be insatiable. New techniques for dealing with this situation will be described in a later section. There is no satisfactory method for describing the performance of such a complex network. The average 'mean time to repair' and 'mean time between failures' may be adequate for significant changes in performance but otherwise hides more than it reveals. There will be no satisfactory solution to this until an independent computer-based monitoring facility becomes available. A start was made on this when a PASCAL compiler was obtained from the University of Lancaster and mounted in the MicroNova as a necessary first step in the development of monitoring software.

Another project to monitor the overall performance of the system was started when programs were written, again in PASCAL, to operate from the Prime 300 computer measuring response and error conditions of a simulated user. Data are now beginning to be collected and a full report should be available next year. Otherwise the overall hardware performance appears to have stabilised from year to year and compared with the software problems is not a cause for concern.

Front End Processor. The planned separation of the two front end processors into one dedicated to interactive traffic and the other for batch traffic was eventually completed in

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TABLE 4
Planned distribution of terminals by institutes—March 1980

RES	T/T	VDU	SP	QP	PTR	CR	Ct/R	Gr	RJE
CD	12	9		1				1	
Others	9	2						1	
ARC	1								
AVRI	4	1	1				1		
EMRS	5	3					1	1	1
FRI/JII	2						1		
GCRI	3	1	1						
GRI	4	4					1		1
IAP	1	1	1		1				
IRAD	5	2	2						
LARS	3		1		1	1			
LL	2	2	1		1				
MRI	3		1			1			
NIAE	8	6					1	2	1
NIRD	5	3	1	1	1				1
NVRS	4	3					1	1	1
PBI	1	1	1			1			
SSEW	3								
WPBS	2	1	1		1				
WRO	2	1	1		1				
Totals	79	40	12	2	6	3	6	6	5

Key: T/T=Teletype; VDU=Visual display unit; SP=Serial printer; QP=Quality printer; PTR=Paper tape reader; CR=Card reader; Ct/R=Cartridge reader; Gr=Graphics; RJE=Remote job entry terminals.

late summer. Although for most purposes these two systems work independently, the hardware system was designed and equipment purchased to allow the interactive traffic to be switched on to the alternative processor in the event of a major failure. The delivery and commissioning of these devices was seriously delayed with consequential delay on the software development.

However, the software was put into field trial in July, with an immediate improvement in the interactive service which has been sustained since. Similar improvement was not experienced with the batch service software which was designed some 5 or 6 years ago. That software lacked much of the element of design discipline which is now applied to real time programs and the necessary changes have been much harder to realise and more difficult to validate.

There is no doubting the advantage in moving from the less structured assembly coding of 3 or 4 years ago to the application of high level languages with facilities more appropriate for this type of work, e.g. CORAL and PASCAL.

Remote Concentrators. The limitation of the time division multiplexing techniques and the lack of data protection on the interactive traffic have been recognised. Very significant progress has been made in the development of a high performance concentrator based on the Honeywell MTS 7500 system. The first service version is shortly to be integrated into the network.

Prime 300. The development of the Prime 300 as a surrogate Honeywell H716 system was successfully completed and all H716 system software is developed on, and can be directly transferred from, the Prime. Access to the reliable powerful facilities of the Prime has transformed the programming outlook for the programmers.

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Management Services Section

This Section has a broad supporting role to the computing services and is increasingly involved in the system analysis and programming of management tasks on behalf of other Departments and Institutes.

Considerable programming changes were made to the Project Costing Scheme to meet the new 'full economic costing' requirements of ARC HQ. In addition, new style commission reports were completed and circulated this year. The procedures for validating and managing batches of data were enhanced.

The Project Costing Scheme continues to be used by the MAFF Sea Fisheries Laboratory, Lowestoft, and the Department of Agriculture, Northern Ireland.

At very short notice and with considerable haste, the Rothamsted inventory system was designed and implemented. User and operating manuals have been issued to all Departments as well as new updating input forms. The Section also designed and programmed an itemised pricelist for the Stores. Updated lists are produced quarterly.

The PBI Seed Store Stock Control system has been amended, making the production of monthly reports easier. Of the 40 registered users of the store, 36 receive these monthly reports.

Staff, Conferences and Courses

Two scientific staff, S. J. Bassill (HSO) and I. L. Barrett (SO) and five Data Processors, Madelaine Buckingham, A. J. Brejza, Eileen Doyle, N. P. Gray and Margaret Holt, left the Department. Two other scientific staff, I. M. Richmond (PSO) and G. G. Starkins (ASO) have also resigned and will be leaving early in the New Year.

New staff include Diane Bennett (HSO), I. C. Crouch (ASO), together with the following Data Processors—Christine I. Alvis, Jillian Curl, M. S. Driscoll and L. D. Thompson.

D. H. Rees took part in a seminar on 'Computers in Agricultural Research' arranged by ICL and held in China. Whilst there, and on his return, he also visited agricultural research institutes in both China and Malaysia. H. J. V. Gledhill, R. P. Sharma and J. A. Malcolm attended the ICL System 4 Conference on 'Telecommunications Tomorrow', and they, together with other members of the Department, attended, part-time, the first European Conference organised by the International Federation for Information Processing held at Wembley. R. P. Morton attended the Fourth IEEE International Conference on Software Engineering in Munich, and P. A. Clarke represented the British Computer Society at the meeting of the American National Standards Institute Fortran Committee in Boston, USA. K. E. Bicknell, Christine Thomas, P. A. Clarke and P. J. Verrier attended various training courses.

Publications

CLARKE, P. A. & (CASIERO, B.) (1979) A genealogical database for plant propagation records. *Euphytica* **28**, 785–792.

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APPENDIX 1

The following is an alphabetical list of abbreviations used in the Report, together with their full title and location.

ARC	ARC Headquarters, London.
AVRI	Animal Virus Research Institute, Woking.
EMRS	East Malling Research Station, Maidstone.
FRI/JII	Food Research/John Innes Institutes, Norwich.
GCRI	Glasshouse Crops Research Institute, Littlehampton.
GRI	Grassland Research Institute, Maidenhead.
IAP	Institute of Animal Physiology, Cambridge.
IRAD	Institute for Research on Animal Diseases, Newbury.
LARS	Long Ashton Research Station, Bristol.
LL	Letcombe Laboratory, Wantage.
MRI	Meat Research Institute, Bristol.
NIAB	National Institute of Agricultural Botany, Cambridge.
NIAE	National Institute of Agricultural Engineering, Silsoe.
NIRD	National Institute for Research in Dairying, Reading.
NVRS	National Vegetable Research Station, Wellesbourne.
PBI	Plant Breeding Institute, Cambridge.
RES CD	Rothamsted Experimental Station, Harpenden, Computer Department.
SSEW	Soil Survey of England and Wales, Oxford.
WPBS	Welsh Plant Breeding Station, Aberystwyth.
WRO	Weed Research Organisation, Oxford.

APPENDIX 2

Documents published by Computer Department

Program Guides		
PG/81/8	Genstat 4.02	H. Simpson, Statistics Dept., RES
PG/104/2	MLP	G. Ross, Statistics Dept., RES
PG/127/4	The NAG Mark 6 Library	P. J. Verrier
PG/150	A Line File Editor	P. J. Verrier
PG/152	The TRANS Program	A. D. D. Williams
Amendments		
DA-PG/152/2	The TRANS Program—new facility	P. J. Verrier
System Guides		
GSYS/28	Character Codes	A. D. D. Williams
GSYS/31	Use of the Diablo	A. D. D. Williams
Amendments		
DA-GSYS/8/5	Multijob Error Codes	P. J. Verrier
DA-GSYS/11/6	Use of the Graph Plotter	C. F. Thomas
DA-GSYS/23/14	Multijob Command List—new macro commands	Various
Multijob		
MJ/4/5	Introduction to Multijob	P. J. Verrier