Report for 1978 - Part 1

Computer Department

D. H. Rees

COMPUTER DEPARTMENT D. H. REES

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Introduction

This report is shorter and less detailed than in previous years but, if required, more specialised information can be obtained by writing to the Department.

Although the demands for computing have increased by some 30% this year, it has not yet been necessary to restore the third shift. The past year can be characterised as one in which the expanded facilities have been consolidated and a start was made on the

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assessment of future needs. The maintenance of the present System 4 computers is due to cease in 1984, and, as these are unique systems, it is certain that an equivalent service based on an alternative system will require some 12 to 18 months to establish. Thus 1982 is projected as the latest installation date for the replacement system.

In looking to the future, even for as little as 2 or 3 years, account has now to be taken of the impact of microtechnology both on computing and on telecommunications. One immediate effect has been to change the price/performance ratio of equipment and there are many situations where a proportion of the simpler tasks could be adequately carried out on lower cost equipment. However, there is a potential danger that local facilities could lead to organisationally isolated computing services. In contrast, developments in telecommunications offer the possibility of linking these facilities into a unified resource which can be shared between all users.

The balance between local and network facilities has been discussed and reviewed in depth by universities and Research Councils, and the emerging concensus is that whilst distributed computing facilities may expand, when software and manpower costs are brought into the equation, a unified network of interconnected facilities will prove to be the most efficient and economic solution. The ARC's Advisory Committee on Computing set up its own Study Group on this issue and will make recommendations in 1979.

Another important trend has been the users' growing interest in the application of computers to problems of storing, marshalling and retrieving data. These activities are encompassed by the generic term 'database management systems' and are the subject of considerable research and investigation by computer scientists. The Department is now actively involved or associated with the development of database systems on plant breeding data, seed store data, virology data, agrometeorology data, mass spectrometry data, soil survey data and bibliographic data. The scale and scope of these requirements will be another factor in shaping the future Rothamsted computing service. The outcome of the ARC's Working Party on Data Management for Plant Breeding and Plant Genetic Resources promises to be particularly significant here.

Computing in support of agricultural research seems poised, not only in the volume of work but in the scope, to expand quite rapidly over the coming 2 to 3 years. Microtechnology is going to play an important role in the development of flexible and adaptive instruments which could control, store and forward data directly to a general computing facility. The limitations will not be in equipment but in our ability to make this equipment function correctly and reliably in situations where increasingly the data collection process becomes invisible to the scientists. Programming these devices may appear to be a simple activity, but this could prove to be deceptive as tasks requiring some complex algorithms are required. There is a danger that inadequate or even faulty software could discourage these techniques and the computer scientist has an important role in ensuring the success of these techniques.

For convenience, user institutes are referred to by abbreviated titles in the Tables (see Appendix I for Glossary).

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 carried a 30% greater workload than last year (Table 1).

Despite the addition of four 60 Mbyte disc drives, 256 Kbytes of 4–70 store, 64 Kbytes of 4–72 store and two high speed drums, there is concern about our ability to

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TABLE 1

Distribution of work by Institutes

	ETUs		Jobs		Work Units	
	1977* 4 418 583 %	1978 5 870 056 %	1977* 283 570 %	1978 362 059 %	1977* 10 418 013 %	1978 13 609 926 %
RES						
CD						
Systems	17·7	16·8	9·8	9·4	5·9	6·3
Applications	9·4	6·6	15·8	12·8	9·1	6·3
Total	27·1	23·4	25·6	22·2	15·0	12·6
SD	17·6	19·1	11·6	9·9	24·3	25·5
OD	11·3	8·5	5·1	4·2	10·7	7·1
NIAE	10·3	11·0	15·2	14·8	10·0	10·8
GRI	5·7	6·7	6·2	8·5	6·7	8·0
NVRS	5·2	5·9	10·0	8·5	5·9	5·8
NIRD	2·6	4·5	4·0	5·2	3·0	4·7
EMRS	3·3	3·4	4·0	4·7	3·6	3·7
GCRI	2·8	3·0	2·8	3·3	4·0	4·2
MRI	2·9	2·7	2·1	2·0	3·7	3·5
IRAD	2·0	2·4	5·0	5·6	2·3	2·8
LL	2·2	2·3	1·8	3·4	2·7	2·9
SSEW	0·5	1·3	0·7	1·2	0·4	1·0
LARS	0·7	1·3	0·7	1·4	0·8	1·5
NIAB	2·6	1·2	1·4	0·6	2·8	1·3
WPBS	0·8	0·8	0·8	1·1	1·1	1·2
ARC	0·7	0·7	0·5	0·6	0·7	0·9
Others	1·7	1·8	2·5	2·8	2·3	2·5
	100·0	100·0	100·0	100·0	100·0	100·0
Per working day	17 674	23 387	1134	1442	41 672	54 223

* 4–72 from 31 August 1977

meet the users' requirements to have more of their work completed during the daytime. Because of improved performance it has not been necessary to introduce the third shift, so that there is still spare capacity available for future growth. As day time turnaround becomes slower, users will be encouraged to transfer work for which overnight running is acceptable to the later shift. This situation was foreseen as inevitable as the network facilities grow. Pressure for expanding the network continues and planning for this must take account of all types of work and all needs of users. The large increase in the last 2 years is ample evidence of the effect of earlier capacity restrictions. The agricultural scientist is becoming more proficient and more dependent on computing in his every-day work.

The twin system is functioning well. However, full flexibility cannot be achieved until all terminals are connected via the front end processor, some time next year. On several occasions, the effects of a long failure on one computer have been minimised by transferring users and their work to the other one.

The utilisation of the system for user work is higher than last year (Table 2), but failures have also risen slightly (Table 3). System 4 software has performed very well latterly, though continued efforts are required to maintain and improve this position.

Systems and Programming. Programming and system developments have improved efficiency and reliability throughout the system, its operations, and in providing new facilities. The support of the system continues to consume a substantial proportion of

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TABLE 2
System utilisation

	1977		1978	
	4–70	4–72*	4–70	4–72
Production time (%)				
Day supervisor	45·3	43·7	53·9	52·2
Night supervisor	29·9	22·1	25·1	23·5
Housekeeping	10·1	10·5	10·5	9·9
System work	7·7	14·0	3·6	6·2
	93·0	90·3	93·1	91·8
Non-production time (%)				
Failures (all causes)	2·0	5·2	2·1	2·2
Routine maintenance	4·8	3·5	4·1	4·3
Additional engineering and unaccounted time	0·2	1·0	0·7	1·7
	7·0	9·7	6·9	8·2
Operational time (hours)	5081	1499	4476	4131
Working days	250	85	251	251
Operational time/day (hours)	20·3	17·6	17·8	16·5

*from 31st August 1977

TABLE 3
System failure distribution

		1977		1978	
		4–70	4–72*	4–70	4–72
Software					
ICL		77	19	78	43
RES		44	53	47	30
	Total	121	72	125	73
Hardware					
ICL		114	69	157	127
RES operators		1	1	8	6
'Other' failures		23	8	17	12
	Total	138	78	182	145
Total (All causes)		259	150	307	218
Total hours lost		103	79	94	89

*from 31st August 1977

programmers' effort. New equipment has permitted redistribution of both system and user files to improve performance and response. Continuing error clearance and enhancement have also improved the image. In the latter half of the year, a minimum of changes have been made to ensure the reliability of the system, when other parts have been less reliable for a variety of reasons. Some error clearance and improvement has been delayed until further front end developments can be started.

New developments include support of a quality printer, additional serial printers, and a text manipulating terminal containing a microprocessor. A much improved archiving system has been specified after consultation with users, but its implementation has been delayed by staff changes. Improvements have been made to the handling of input and

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output to cater for a greater number and variety of terminal equipments. Character codes have been rationalised round last year's publication of an enlarged standard set including lower case letters, etc., and some provision made for conversion when using devices with restricted sets.

During the year, and after protracted discussions with the Computer Service Group and its parent body the ARS Computer Users' Group, the ability of users to control the priority of their jobs by specifying the rank, stream and internal priority parameters was finally removed. Alternative means of handling urgent work were substituted.

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 encourages and supports users to exploit new software techniques and opportunities and as such its activities are so varied that only the major trends can be dealt with in the following report.

Data Management. Many agricultural scientists collect, retain and retrieve substantial sets of data, and increasingly use computers to hold this data and to explore and evaluate underlying relationships. Furthermore, these data sets can be accessed through the network by other scientists with an interest in but not directly involved with, their collection. Although unique programs can be implemented for each requirement, general purpose data management systems are becoming more readily available and the Applications Section intends to encourage their use. The following is a brief summary of data management systems already in use or under investigation at Rothamsted.

Bibliographic data. An improved version of the FAMULUS suite of programs for cataloguing and searching small collections of bibliographic data has been released for general use.

Meteorological data. Magnetic tapes containing daily records from over 100 sites and in some cases going back some 30 years are being released by the Meteorological Office, Bracknell, for use on the Rothamsted network.

Virology data. The World Reference Laboratory at the Animal Virus Research Institute has world-wide records of virus samples from animals with suspected diseases, together with data on subsequent laboratory tests. A scheme for the computerisation of this data has been evolved.

Mass spectrometry data. A searching program for matching unknown spectra against a library of some 19 000 known spectra is available. This will be extended as more data becomes available from the Mass Spectrometry Data Centre, UK Chemical Information Service, University of Nottingham.

Soil Survey data. Data relating to the soils of England and Wales are recorded in a coded form which can be stored and expanded by a generalised text translation program, DECODE, in a form suitable for immediate publication.

A new version of the generalised data management and analysis package G–EXEC has been released by the Natural Environment Research Council. The future role of this package has yet to be resolved with the Soil Survey of England and Wales.

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Plant breeding data. A program has been written to be used on a prototype apple rootstock breeding programme for the East Malling Research Station. Retrievals can be made relating to its data structure so that, for example, plants sharing a common pedigree and treatment history can be traced for disease control purposes. This particular package also interfaces with the general taxonomic information retrieval system, TAXIR.

Future database activities. The encouraging success of the last program led the ARC to set up a Working Party on Data Management for Plant Breeding and Plant Genetic Resources, on which this Department is represented by P. A. Clarke.

Database developments. Work continues on the Aberdeen University Database Management System to maintain facilities in line with those provided elsewhere.

The Fortran data manipulation language preprocessor has been rewritten to comply with the recently-published CODASYL Fortran database facility, *Journal of Development* 1977.

Computer graphics. As foreseen in last year's Report, there is considerable interest in local and remote graphical display systems. To minimise the proliferation of device dependent routines, GHOST, a package written by the Atomic Energy Authority, Culham, and which is widely used at other research and university computing centres, has been chosen as the preferred graphics software in the service.

With the important economies and the growing influence of microprocessors, graphics generally are likely to expand rapidly in the near future. Already there is interest in the application of both colour and general mapping techniques.

General programming. All staff have contributed to the introduction or transfer of new programs into the service. For example, a powerful new line editor has been added and the 300 routines which make up the Numerical Algorithms Group (NAG) Mark V Library tested and released. Two specialist programs on peptide energy calculation and molecular structure plotting have been transferred from other computer systems.

FORTRAN standards. The Department, through P. A. Clarke, supported, first as Secretary, then Chairman, the British Computer Society's Fortran Specialist Group. This Group represented the UK's interest in the new standard Fortran 77, now approved by the American National Standards Institute. Clarke is also a member of the British Standards Institution's Working Group on Fortran 82—the proposed next standard.

Rothamsted General Survey Program. This has been a year of some development but mainly of consolidation of the Rothamsted General Survey Program (RGSP). This will be completed when modifications arising from alternative versions have been incorporated into the master source.

Although there is sustained interest in this program, it is not yet widely accepted by the British universities. In general, surveys involve a wide range of data types and therefore require flexible data input and manipulation facilities. In RGSP this phase required a good working knowledge of Fortran. Other ways of achieving the same end but which would break this dependency on Fortran are being explored.

The outstanding success of RGSP in the Analysis of the Seychelles Census Data reported in 1977 was the subject of a presentation to the Royal Statistical Society in December 1978 by Mr. T. C. Jones (Seychelles Government), Mr. J. R. B. King (Ministry of Overseas Development) and J. D. Beasley.

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Training and Advisory Services. There were seven courses on the 'Introduction to Multijob', three each on 'SPITBOL' and 'BASIC', and the first of what promises to be a popular course on the 'Introduction to Databases'. The advisory service continues to be well used and there is a discernible shift away from programming enquiries towards advice on the algorithmic content of problems. Six issues of the Newsletter were again completed and circulated on schedule, and a list of the more important documents is given in Appendix II.

Telecommunications Section

This Section is responsible for all aspects of the development, maintenance and operation of the network, which includes the front end processors and all the associated terminal equipment.

Operations

Network. The distribution of telecommunications terminals planned for the financial year 1978–79 is given in Table 4.

TABLE 4

Planned distribution of connected telecommunications terminals by March 1979

	T/T	VDU	SP	QP	PTR	CR	Ct/R	Gr	RJE
RES									
Telecomms.		2	1						
Prime	2	1							
MicroNova	1								
Operations	2	4							
Applications	5	3		1				1	
SD & OD	7	1		1					
ARC	1								
AVRI	3	1					1		
EMRS	4	2					1		1
FRI/JII	2						1		
GCRI	2	1	1						
GRI	3	3							1
IAP	1	1	1		1				
IRAD	5	1	1						
LARS	3		1		1	1			
LL	4	2	1		1				
MRI	3	1	1			1			
NIAE	7	5					1	1	1
NIRD	5	3	1	1	1				
NVRS	4	3							1
PBI	2	1	1			1			
WPBS	2	1	1		1				
WRO	2	1	1		1				
Dial-up	4								
Totals	74	37	11	3	6	3	4	2	4

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.

This is the largest increase in terminal connections ever attempted in one year, and is one of the clearest indications of the continued demand for computing facilities still being requested by the Institutes.

There is no simple but adequate index of overall network performance and the possibility of defining a 'user satisfaction' index was explored but abandoned because the

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volume of data required was unacceptable to the user. A simple view of performance is given in Table 5, where mean time between failures (MTBF) over the past four half-yearly periods is shown.

TABLE 5

Network performance—mean time between failures (MTBF)—hours, half yearly averages

	1977		1978	
Equipment	1st	2nd	1st	2nd
Operation				
Continuous				
GPO lines	2400	6400	6100	2688
Modems	30 940	37 912	16 000	26 880
TDM	1400	4739	7400	7168
8-hour day				
Printers	541	650	380	796
TTY	1750	2507	2800	2565
VDU	1940	2600	5500	7188

Equipment which is never switched off is described as having continuous operation, which over a 6-month period amounts to some 4300 hours. Other equipment which is switched off is nominally assigned an 8-hour 5 day a week operational period. A MTBF in excess of these norms corresponds to an average reliability better than one incident per half year.

The Table shows that apart from the still unexplained lapse in the performance of Post Office equipment during the latter half of 1978, all continuously running equipment is proving to be highly reliable. Of the other equipments, the serial printers remain a source of concern, although there was a welcomed improvement towards the end of this year. Serial printers have proved to be too popular with the user in that they have been more intensively operated than expected, and must eventually be replaced with more robust systems.

Front end processors. These are the focal point for network traffic and are one of the key factors determining the overall service performance. Following an early troublesome period, the processors are now proving to be very reliable. For example, there has been no service call for an engineer for the past 3 months. However, over 300 software incidents were recorded, at a rate apparently related to the growing workload. The difficulties encountered in solving these software problems have exposed design limitations on the basic processors and software facilities. To overcome these the controlling network software package will be split so that batch and interactive traffic will each run separately on two linked processors. For this, the standby development processor will be incorporated into the service.

This experience has exposed fundamental difficulties in the development and maintenance of complex real time software. In future more attention will be paid to the implementation of robust and well-monitored software during the analysis and design phase, using high level programming languages which are more appropriate for these purposes.

Developments. Splitting the original software package into two essentially discrete packages has been a major activity in the Section. When operational, cartridge, paper tape and card readers will be added to the network.

The present method of multiplexing clusters of network devices into a single communication link is proving to be too inflexible for the pattern of traffic observed on the

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network. Techniques, based on microprocessors, which match the active devices to the capacity of the communications link, are under development and should be incorporated into the network from 1979.

With the transfer of the present development processor into the service, ongoing software maintenance and future developments will be carried out on a PRIME 300. This was chosen not only because of its compatibility with the original processor, but also because of its superior software development facilities. The PRIME system will also enable us to gain access to the Post Office's Experimental Packet Switching Service (EPSS) and could eventually become the node by which users generally will gain access to the National Packet Switching Service which is scheduled for 1979.

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.

Project costing.   Amendments requiring significant programming changes were made to meet new ARC requirements. Further major changes are currently being investigated.

The program continues to be used by the Department of Agriculture, Northern Ireland, and MAFF Fisheries Laboratory, Lowestoft.

Other programs.   There are 26 users of the Seed Store Control System, Plant Breeding Institute, where updates of the 12 000 seed lot deposits are issued weekly. A general purpose mailing and subscription program has been prepared for the ARC's Information Section.

Data preparation services.   There is a further 3 % increase in the number of punched and verified cards produced in the Section, and the service continues to be used by ten outside Institutes. In appropriate circumstances the operators also load the cards as computer files on behalf of the client.

Staff, Conferences and Courses

The Department was saddened by the death of Ian Wright, one of its younger operators, following a protracted illness. Another member, Mrs. P. Daniel, transferred to a new post in the Central Administration Services. A. D. Williams joined the Department as a Systems Programmer in the Scientific Officer grade.

P. A. Clarke and J. A. Thomson attended a course on Project Management at the Civil Service College, London; G. V. Smith attended a training course for Shift Supervisors; K. E. Bicknell, P. A. Clarke and P. J. Verrier attended meetings in connection with the introduction of the new standard Fortran 77; J. A. Malcolm and P. T. Matthews attended a course on 'Advanced Computing Systems Reliability' at Newcastle University; K. E. Bicknell attended the Annual Conference of the Cybernetics Society, and meetings arranged by the Institute of Mathematics and the University of Cambridge on graphical software and systems; P. A. Clarke attended a meeting of the European Association for Software Access and Information Transfer, in Paris; he also attended, together with H. J. V. Gledhill, R. P. Sharma and I. M. Richmond, the System 4 Users' Association Conference; I. M. Richmond attended the IEEE Software Engineering Conference in Atlanta, USA; C. W. Fearne attended a Management Services Workshop at Cranfield; P. J. Verrier attended the Inter University Computing Committee's Conference on Generalised Graphics Software.

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Publications

RESEARCH PAPERS

1 BICKNELL, K. E. & MADDISON, A. C. (1977). Outbreak and spread of *Phytophera palmivora* in Cocoa; examination by sequence analysis. *Proceedings of the 6th International Cocoa Research Conference, Caracas, Venezuela, November 1977.*

2 BICKNELL, K. E. & MADDISON, A. C. (1978). Spatial problems in epidemiology. *3rd International Congress of Plant Pathology, Munich, August 1978.*

APPENDIX 1

Glossary of Institute abbreviations

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 OD	Rothamsted Experimental Station, Harpenden, Departments other than
RES CD	RES Computer Department.
RES SD	RES Statistics Department.
SSEW	Soil Survey of England and Wales, Oxford.
WPBS	Welsh Plant Breeding Station, Aberystwyth.
WRO	Weed Research Organization, Oxford.

APPENDIX 2

Documents published by Computer Department

Program Guides

PG/117/2	DELIC	A. Windram (GRI)
PG/127/3	NAG Mk. 5	J. B. Beasley, P. J. Verrier
PG/134/5	GLIM Release 3	B. Baker (Statistics Dept. RES)
PG/148	RGSP Mk. 1A	J. D. Beasley
PG/148/2	RGSP Mk. 1B	J. D. Beasley
PG/149	Famulus	P. J. Verrier, B. M. Hersom
PG/150	A Line File Editor	P. J. Verrier, J. D. Beasley

System Guides

GSYS/8/4	Multijob Error Codes	C. F. Thomas

Front End Guides

FEP/1	Operation of Remote Batch Terminals	P. Morton
FEP/2	Remote Terminals on the FEP	P. Morton
FEP/3	Interactive Traffic via the FEP	P. Morton
FEP/4	Batch Teletype Paper Tape Input System	S. J. Bassill

Program Manuals

PM/5	Famulus Reference Manual	B. M. Hersom

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