ROTHAMSTED RESEARCH

Report for 1981 - Part 1

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Computer Department

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Introduction

Last year's report concluded with speculation on two topics: the ARC's future computing policy and the growing influence of microtechnology. The policy statement, issued in October, contains proposals for strengthening computing at Institutes with the support of an independent ARC Computing Centre. The distribution of computing resources between the Centre and the Institutes has yet to be resolved and staff remain uncertain about the nature and scope of their future duties. If the period of uncertainty is prolonged, our ability to attract and retain staff with skills and the flair to meet the new challenges will suffer.

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The statement, long awaited since first mooted in 1977, has emerged at a time of rapid transformation in the computing scene. Until 1980 a centralised multiaccess system would have been the natural successor to the present service, but the extraordinary development of microtechnology has overtaken both the technological and the economic assumptions on which such systems were based. A resulting range of small, cheaper computing systems, now available, can be linked economically, if required, to larger specialist external computing facilities through a much improved telecommunications service, and so provide an alternative approach to meeting the Service's computing needs.

In the past, agricultural research has not been a source of innovative demands on computing science either within the ARS or elsewhere, and the evidence points to research staff exploiting available software packages. There are signs now that scientists are responding to the introduction of microtechnology in a more innovative and adventurous way. The response to the formation of the new Microsystems Section within the Department has been very positive and the Section has become the clearing-house for enquiries on specification and techniques, and even for problem solving. Nevertheless, with a minimum estimate of 200 microsystems now installed at Institutes, the bulk of the future development will be carried out locally.

In the past 2 or 3 years the apparent increase in the workload of the present central service has been modest, but the published tables conceal a larger growth brought about by the improved operation and management of the service. Productivity has increased by about 20%, but now the pattern of demand, primarily statistical, may have stabilised for the system offered, and enhancements to the network have not generated new sources of work. Microtechnology has made computing attractive to a larger group of scientists, and inevitably significant growth in the application of computing in the agricultural research will ensue and be centred on the Institutes.

Operations Section

Operations

The equipment available now includes a small Prime 550 as well as the two ICL System 4s and their Honeywell Front End Processors. The Prime 550 has obviated the need for three separate computer systems in the Computer, Molecular Structures and Statistics Departments. NVRS also use the Prime for database facilities for their Vegetable Gene Bank Project.

System 4. Productive time has increased on both systems to 97·5% (Table 1). All routine maintenance is now done outside scheduled hours. Operational time is slightly down on last year and work has been contained within the two-shift operation, with the greater part of user work being done during multiaccess sessions. Some unattended operation took place towards the end of the year to deal with a number of larger jobs submitted.

Operations shift staff have been reduced by one, though additional temporary staff have been employed over the holiday period. Two young people have been partly trained and given some experience under the National Computer Centre Threshold Scheme. It has been necessary on occasions for other staff to provide cover in the computer room when shift staff have been ill or undergoing training.

The user workload has increased (Table 2) by 3% in etus (an elapsed time unit (etu) is a measure of central processor unit (cpu) capacity), by over 6% in the number of jobs and 8% in the number of work units. Improved job management facilities for users has contributed to a proportion of this increase, as has the larger file base.

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TABLE 1

System utilisation

	1980		1981	
	4–70 %	4–72 %	4–70 %	4–72 %
Production time				
Day supervisor	55·0	60·3	61·2	63·1
Night supervisor	25·2	23·6	26·0	24·0
Housekeeping	8·4	7·5	6·5	6·3
System work	3·8	5·0	3·8	4·2
	92·4	96·4	97·5	97·6
Non-production time				
Failures (all cases)	6·6	1·8	2·4	2·3
Engineering	1·0	1·8	0·1	0·1
	7·6	3·6	2·5	2·4
	100·0	100·0	100·0	100·0
Operational time (hours)	4219	4042	3985	3876
Working days	252	252	251	251
Operational time (day-hours)	16·7	16·0	15·9	15·4

TABLE 2

Distribution of work by Institutes

	ETU		JOBS		Work Units	
	1980	1981	1980	1981	1980	1981
Total	6 170 075 %	6 352 530 %	407 075 %	431 950 %	14 159 489 %	15 233 877 %
RES						
Computer Dept.						
Systems	18·6	18·4	11·8	10·8	5·4	5·0
Applications	5·5	5·1	10·8	7·4	5·3	4·7
Total	24·1	23·5	22·6	18·2	10·7	9·7
Statistics Dept.	14·0	12·8	8·3	8·5	18·5	15·9
Other RES Depts.	12·3	9·9	5·6	5·4	13·8	11·2
Total	50·4	46·2	36·5	32·1	43·0	36·8
NIAE	10·7	11·7	12·2	11·7	8·9	11·6
GRI	5·5	7·0	5·7	9·6	6·7	8·0
IRAD	3·7	5·3	8·0	11·5	4·4	6·3
NVRS	4·5	5·2	6·2	6·4	5·5	5·8
MRI	4·8	4·1	2·7	2·2	7·2	6·4
NIRD	3·7	3·7	5·6	5·6	3·5	4·1
LARS	2·4	3·6	2·0	3·0	2·7	4·0
EMRS	3·8	3·3	5·2	4·1	4·3	3·9
GCRI	3·5	2·4	5·7	3·9	4·4	3·3
LL	1·2	1·3	2·3	2·4	1·6	1·9
Man. Services	0·9	1·0	1·3	1·4	1·0	1·1
WPBS	1·1	1·0	0·9	0·9	1·3	1·2
WRO	1·1	1·1	2·3	2·1	2·3	2·1
SSEW	0·7	1·4	1·3	1·0	0·9	1·7
Others	2·0	1·7	2·1	2·1	2·3	1·8
	100·0	100·0	100·0	100·0	100·0	100·0
Average per working day	24 484	25 309	1 615	1 721	56 188	60 693
Increase over 1980 total	+2·96%		+6·11%		+7·59%	

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Individual site workloads are as variable as ever. The work done by the Statistics and Molecular Structures Departments at RES has dropped markedly on System 4, though they both now use the P550 also. NIAE's load has increased substantially as has that of GRI and IRAD. Large changes in a site's load can often be traced to a small number of users and even to a single individual.

A third interactive stream has been introduced to accommodate the larger programs that users wish to use in this manner. This was possible following the enhancement of the 4-72 main memory for a very small cost thus allowing better utilisation of its cpu power, the most limited resource. Efficiency improvements have also been made to both systems during the year, estimated at a minimum of 10%, but only introduced in the fourth quarter.

Lost time has been reduced from 347 hours to 185 hours, the result of much improved availability on the 4-70 and less engineering work during scheduled hours. The number of failures (Table 3) has been reduced overall, the largest reduction being on the 4–70 hardware.

TABLE 3

System failure distribution

	1980			1981		
System	4–70	4–72	Hours lost	4–70	4–72	Hours lost
Software	20	49	14	28	51	17
Hardware	154	91	312	81	101	146
'Other'*	21	16	21	28	17	22
Total failures	195	156		137	169	
Total hours lost			347			185

* Power supplies, operator errors, etc.

Front End Processors. The two front end processors (FEPs) support interactive and batch systems separately. The interactive service is given priority at the expense of batch operation should one FEP fail, although this is reversed for short periods following any long failure to enable the five remote batch systems to receive output and send input. The number of failures on the interactive FEP system has increased to 1·3 per day and availability is 0·6% down at 97·3% (Table 4). While the batch FEP system failures have been substantially reduced by both hardware and software investigation and correction, the available time is below 92%. DPCE, who took over responsibility for maintaining these equipments just before the beginning of this year, have worked hard on them during the year, but further work will be necessary.

TABLE 4

Service availability via FEP

	Service		User Image*	
	1980 %	1981 %	1980 %	1981 %
Interactive 716	97·9	97·3	97·2	96·4
Batch 716	88·9	91·1	86·9	89·9
Interactive 716+4–70	96·2	95·7	95·0	94·5
Interactive 716+4–72	96·6	95·8	95·6	94·6
Batch 716+System 4's	86·3	88·8	83·5	86·9

* User image figure includes time allowance for recovery purposes.

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Prime. In comparison with the older technology of System 4, the operational attraction is reliability. There have been nine system failures in 11 months, plus a handful of device faults. It also requires little manpower to operate it. Detailed operational data is not yet available on the Prime but utilisation is estimated to be about 25% from week 9. The introduction of NVRS to the service has occasionally degraded the response and steps are in hand to avoid further development of this situation. The Molecular Structures Department has used the equivalent of approximately 254 000 etu on System 4, and the Statistics Department approximately 44 000 etu out of a total load of 525 000 etu (approximately 750 cpu hours).

Software

System 4. Little work will be done on System 4 beyond the end of the current year. Only those items which relate to future systems, new applications or essential extensions of existing ones will be considered. During the year several new and improved items were introduced, they included: BENSON plotter software to improve reliability and throughput; efficiency improvements to the operating system and some utilities; and job management alterations including a third RIRO stream. A more versatile interface to the '2780' protocol and file transfer with the P550 are nearing completion.

Prime. A service for RES Molecular Structures and Statistics Departments was introduced in March. Little work has been done on the system provided by the manufacturer, but some work has been done on the latest version known as Revision 18 and some of the missing management facilities are being inserted. The data management package INFO was acquired under licence and made available to NVRS. EMRS are also interested in using the INFO package for their research records.

Documentation. The Operations Advisory team are now responsible for the distribution of documents. These are listed in Appendix 1.

Microprocessor System Section

The Section was formed in April this year out of the original Telecommunications Section. The title reflects a new and important field of interest within the ARS but one which retains close links with telecommunications.

Microprocessors. Earlier this year the ARC Computing Committee supported a proposal that there should be a centre of expertise for the application of microprocessors to scientific work within the ARS. It was expected that this would encourage users to work to guidelines, if not standards, presented by this group and this enables a broader community of users to share and contribute both to hardware and software developments.

With the advice of Professor Martin Healey (University College, Cardiff), a member of the ARC Computing Committee, the following equipment was purchased. One North Star Horizon; two Superbrain QD systems; two MIDAS 3D systems; one MIDAS special; one Intersystems DPS-1 system; one Watanabe flat-bed plotter; one Data type Tektronix emulating VDU; one Lear Siegler serial printer; one Anadex serial printer; two graphics tablets; and one cassette reader.

This equipment uses the CP/M operating system, one of the most widely distributed systems available today. This gives users access to a large and growing number of languages and application packages, of which the following have already been obtained; FORTRAN, BASIC, PASCAL, WORDSTAR, DATASTAR and d-BASE II. The Midas systems also embody the S-100 bus, which enables a variety of equipment to be

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attached and seems likely to become a standard for the industry. The following lists the more important tasks already in hand.

Initial developments. Because of the pressure to complete outstanding tasks on the service network and also because of persistent staff losses, the effort available was less than one would have wished given the urgency of the tasks. All systems were configured for CP/M and staff, including those from other Sections, have been able to familiarise themselves with the various facilities.

Microsystems inter-connection. One of the first tasks was to devise a protocol for linking microsystems. This was accomplished by A. Windram (GRI), in collaboration with the Section on the methodology. The next task was to link these systems to larger computing facilities and a solution was developed from a package available from Dr R. A. Haskins, Loughborough University. The extended system allows CP/M based microcomputers either to emulate a VDU to a Prime or to permit the interchange of files between them.

Modifications to the Prime software was carried out by the Operations Section (Williams). This version is fully operational and is used between the Superbrain based at NVRS and the Prime 550 at Rothamsted.

This software is also the basis of further development, already in hand, which will include: attachment of microsystems to System 4, initially as VDUs; remote monitoring of other CP/M systems, which will be particularly useful for software and advice to users at other Institutes; a general purpose CP/M system which will speed up the assessment and testing of the ever increasing range of peripheral devices.

Peripheral connections. Work is also well advanced on the following:

Image data tablet. This is a technique which will enable spatial data to be tracked by a handheld 'pen' and the results transmitted to a local microsystem. This promises to be particularly useful in laboratory situations.

Printers. A single program has been written which will deal flexibly with problems which arise when matching a range of printers to a given configuration.

Flat bed plotting. A system has been designed and partially written to provide an interface between a high level language and a local plotter. It is expected that some of the existing System 4 routines may eventually be mounted on a microsystem.

The 5·25 in. and 8 in. diameter discs are increasingly used for 'off-line' data capture. This data must eventually be transferred to the mainframe and a system has been designed which will route such data to the System 4 via the Prime.

Another system will capture a store image of either of the network processors and be transferred to a microsystem. This will enable error diagnostics to be carried out off-line thus allowing a rapid restoration of the service.

The next phase. There are still many development opportunities ahead for these systems. The widespread interest was confirmed by the attendance of over 200 actual and potential users to the demonstrations which had been arranged for Rothamsted and ARC staff. One immediate result has been the purchase of CP/M Midas systems by Entomology and Soil Microbiology Departments where they are to be used to gather and organise experimental data directly.

These systems can also play an important role in meeting general application computing needs and will be particularly valuable when the experimenter wishes to perform an interactive analysis of the data. The availability of larger backing store systems opens up new opportunities for personal or laboratory databases. The emergence of

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network protocols will enable data to flow freely between linked systems. However, all CP/M systems suffer from the limitation of a maximum of 64 kilobyte memory and this, more than anything else, constrains their usefulness to modest FORTRAN application packages.

Larger memory systems ranging from at least one to 16 megabytes will be available in the new range of microsystems already beginning to appear on the market. Such systems may be sufficiently powerful to serve several independent users simultaneously; alternatively they could be cheap enough to become used as powerful personal computing work stations dedicated to a research team.

Telecommunications. Although microsystems have been given pride of place in the Report, the Section has also devoted considerable effort to finishing outstanding developments and incorporating new equipment on the established network. For most practical purposes the operational responsibility for the network has now been transferred to Operations but with support from the Section if a major problem arises.

Batch front-end processor. The outstanding work enabling files to be transferred from remote card, cartridge and paper tape readers was completed. This work, began in 1979, suffered badly through staff changes and the system was completed finally by the third programmer to undertake the task.

Work was also carried out to improve the performance and to remove many of the residual errors; a more comprehensive message system was devised and introduced.

Interactive front-end processor. All three remote concentrator systems are now in service and have proved to be extremely reliable. These were designed around and implemented on an early microsystem no longer in production. The established principles and lessons of this technique could be carried forward into contemporary systems but the need would have to be justified by future developments in the network. Improvements were made to the performance and operational convenience of the software.

Network. The backlog of equipment together with this year's purchases have been installed and no further significant changes are envisaged. The following is a list of peripherals permanently attached to the network: 68 hard-copy terminals, 21 at 30 characters s^{-1}, 47 at ten characters s^{-1}; 42 VDUs at 60 characters s^{-1}; ten serial printers; seven RJE stations having line printers; two letter quality printers; six paper tape readers; two card readers; four cartridge readers; seven drum plotters; and two microcomputer systems (connected via Prime 550).

Although the number of devices connected to the network has more than doubled since 1976, the average daily occupancy of 14 keyboard terminals fell by about an hour to 2·5 h day^{-1}. Whilst the work throughput of the system has increased the rate of increase of demand, experienced in the early years of the service, has not been maintained. Despite the increase in the number of devices users confirm that the system response has not been degraded and that lack of facilities and difficulties of access are no longer an impediment to growth. There have been several important changes in the service which have led to better utilisation of the facilities and these, in some sense, concealed the true increase in demand. Nevertheless the services seem to be on a plateau and the additional network investment has not apparently tapped new sources of work.

Applications Section

System 4. Although work for System 4 has perceptibly slackened during the latter part of this year, it remains our only general service machine.

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The GHOST system was adopted as our standard graphics package on System 4 before the period under review. It has been enhanced by the provision of high level routines to mimic some of the facilities of the old CIL package and to provide new facilities, the latter particularly in the field of three-dimensional representation. The performance of the Benson plotter has been improved. (Bicknell, Barrett and Summerfield, with Williams, Operations Section)

The GRASP data management system has been enhanced and two courses given. (Clarke, Lessells and Crouch)

Enhancements have been made to the standard editor EE and a new guide produced; minor improvements have also been made to the local implementations of the taxonomic information retrieval program TAXIR and the bibliographic retrieval program FAMULUS. (Hersom)

An attempt was made to mount the statistical program MINITAB but encountered technical difficulties. It was ultimately decided to await improvements in the system software which will allow the worst of these difficulties to be bypassed. This work is expected to be resumed in the New Year. (Hersom and Summerfield)

Improvements have been made to the system for handling the ARCMET database of historical meteorological data, and work started on systems to handle current meteorological data. (Clarke, Crouch and Beasley, with Ford, Management Services Section)

Prime 550. Although the Prime 550 is not a general service machine, some work has been done on it both as a matter of general familiarisation and in the interests of specific customers.

The GHOST-80 and SURFACE II graphics packages have been implemented on the Prime. (Bicknell, Barrett and Summerfield)

The database management systems GRASP and INFO have been made available on the Prime (the latter being mounted by the suppliers) and assistance given to NVRS, who have been using INFO for a trial project. (Clarke, Crouch and Lessells)

Microcomputers. All members of the Section have become involved with microcomputers during the year.

Although much of this work was in the nature of general familiarisation, some specific comparative investigations were made: of the performance of the standard FORTRAN program DECODE (used by the Soil Survey to produce readable text from coded field records) on System 4 and the micros, and of the data management systems SELECTOR and dBASE II. The Section also assisted with the Microsystems demonstrations. (Lessells, Crouch and Clarke)

Training and Advisory Services. Although the Training team has been at half strength throughout the year, every effort has been made to give an adequate service to users and the good reputation which this team has acquired over the years appears to have been maintained.

The video tapes of the standard two-day course 'Introduction to Multijob' course were updated. This course was given four times and the standard UCL three-day introductory FORTRAN course also on video tape, was given three times, both of these exclusive of occasional presentations to individual recruits. There can be no doubt that the decision to use video tape for these courses has proved justified, though it is still necessary for training staff to be in attendance to answer questions and to supervise the practical sessions. The tapes are particularly valuable in enabling new recruits to be trained individually on arrival without imposing an undue burden on the training staff. The standard two-day SNOBOL course was also given once and a new one-day course 'Introduction to Microcomputers Using CP/M' twice.

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The Programming Advisory Service has continued to do valuable work, handling over 300 enquiries throughout the year. Typical activities including debugging user programs, advising on the use of library packages and routines, advising on program design, and writing simple programs to assist users' work (e.g. by rearranging their data into a more suitable format). This important but unglamorous work has long been regarded as one of the strengths of the Department. (Thomas, Barrett and Crouch). There were six issues of the *Newsletter*, amounting in total to 148 pages of text, including several contributions from Institutes. (Thomas)

Miscellaneous Investigations. A new plotting phase was written for the simulation program CSMP. (Bicknell)

An extensive investigation was made to find a suitable data management system for an NVRS Gene Bank Project. This ultimately recommended the purchase of the INFO system mentioned previously. (Clarke, with Mr J. Gilchrist and Dr D. Astley, NVRS)

An active role has been taken in the FORTRAN Specialist Group of the British Computer Society. In particular, this has involved drafting work in connection with possible future FORTRAN standards. (Clarke)

A project has been undertaken to process the aphid data from the Rothamsted Insect Survey, to store and maintain it and to simplify the production of the weekly aphid bulletin. This work is initially being done on System 4 but will ultimately be transferred to a microcomputer. It is intended that it be operational for the 1982 season. (Barrett)

An attempt has been made to identify users' needs for the next range of ARS computers. (Beasley)

Rothamsted General Survey Program (RGSP). The current Mark 2 version of RGSP was released at the end of last year and the past twelve months has, therefore, been one of consolidation. Opportunities to exploit this package have been sharply limited by the small effort available on the project. Beasley returned to take charge of the Applications Section in late April and has acted in a consultative capacity since July with the assistance of Christine Lessells, a part-time worker. As a result only the present customers have been supported with no effort available for seeking out new customers for the current version.

Mark 2 has stood up reasonably well to a year of actual use, though inevitably a few errors have come to light and one or two of them have been rather difficult to locate and cure. Versions are now available for ICL System 4, CDC 7600, ICL 2900, Prime 550, IBM 370 and NCR B-series, and some work has been done on conversion for ICL 1900 and Data General Nova. These conversions have been done out of our control but in general appear to have been performed to a high standard.

The future of RGSP remains unclear and there is concern that the full value has not been obtained from the work already put in over past years. However, further development work, as distinct from the support of the existing program, would not be justified. The batch interface of RGSP is not attractive by modern standards and the provision of a conversational interface in the modern style would require extensive and probably complete re-writing of the program. To do this properly is beyond the resources presently available.

It is important that the lessons learned from RGSP are made known for the benefit of those writing and using survey programs in the future. A start has been made on this in papers which were invited for Dr F. Yates—Eightieth Birthday Issue of Utilitas Mathematica. (Beasley and Church, Statistics Department)

Paradoxically the cessation of development effort in RGSP might cause more notice to be taken of these lessons because in the competitive world of computer packages, com-

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ment by one producer on another's product is at least suspect even when it is objective and sensible.

The list of current RGSP customers is given in the Appendix 2.

Management Services

This seems likely to be the last full report of this Section because in 1982 the ARC Project Costing Scheme will cease, and be followed by the retirement of the Section Head, C. W. Fearne. Project Costing services to the Sea Fisheries Laboratory, MAFF and the Department of Agriculture and Northern Ireland will also cease. Pat Ford, the Data Controller for all these services is already being retrained to take up new duties as a Data Administrator of ARS databases beginning with the meteorological databank.

The Data Preparation team is now committed to a long term program of punching on behalf of the Soil Survey of England and Wales. This began in the summer and already accounts for a 12% increase in the number of cards punched and verified this year. The volume of data will increase further and is expected to double in the coming year. This additional load will be handled by the same staff through the improved productivity expected with new data entry systems which will replace the aged punched card machines. This team also continues to receive work from most Institutes and has received wide-spread praise for the accuracy and timeliness of their services.

Honorary Scientists

The Department enjoys the privilege of sharing its facilities with two Honorary Scientists —both former Deputy Directors of Rothamsted.

Dr F. Yates has devoted a considerable portion of his time to the design and development of the Rothamsted General Survey Program (RGSP) which has been a feature in the Annual Report for many years. (*See* Applications System)

Dr F. G. W. Jones, long an advocate for numeracy in biological research, has continued his modelling studies, using the computer to stimulate the spread of nematodes attacking root crops within fields, where their natural spread is modified by soil-moving harvesting machinery. The model is being extended to nematodes that attack above ground fodder crops such as lucerne.

Staff, conferences and other courses

W. Ip (ASO) left shortly after graduating in his 4 year, day release Studies in Computer Science. Christine Godfrey, Audio Typist and M. Driscoll and Leon Thompson, Data Processors, also resigned. Sandra Ellis for unavoidable reasons, resigned from the newly created post of Departmental Administrator, a post she only filled in January 1981. New staff included Dawn Johnson, Shorthand Typist, M. Hornby and Carol Stevens, Data Processors.

H. J. V. Gledhill was appointed the Oxford, Reading and West Herts. Regional Representative on the Council of the British Computer Society. Eight staff attended general interest computer conferences and another ten, participated in more specialist ones. Eight attended one of several management training courses and five followed a course on aspects of computer education.

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Publications

General Papers

1 Finney, D. J. & Yates, F. (1981) Statistics and computing in agricultural research. In: *Agricultural Research 1931–1981* Ed. G. W. Cooke, London: Agricultural Research Council, pp. 219–236.

2 Jones, F. G. W. (1981) Management of potato nematodes. *IXth International Congress of Plant Protection, Washington, 1979*, **12**, 480–484.

3 Yates, F. (1981) Badgers guilty. *Nature, London* **289**, 218.

4 Yates, F. (1981) Badger debate. *Nature, London* **290**, 183–184.

Research Papers

5 Jones, F. G. W., Parrott, D. M. & Perry, J. N. (1981) The gene-for-gene relationship and its significance for potato cyst nematodes and their solanaceous hosts. In: *Plant parasitic nematodes*. Ed. B. M. Zuckerman & R. A. Rhode. New York: Academic Press, **3**, 23–36.

6 Perry, J. N. & Jones, F. G. W. (1981) Simulation of population models for cyst-nematodes, applications in agriculture. *Proceedings of AMS81, 1st IASTED Conference*, Vol. V. Lyon: AMSE, pp. 15–18.

7 Webley, D. P. & Jones, F. G. W. (1981) Observations of *Globodera pallida* and *G. rostochiensis* on early potatoes. *Plant Pathology* **30**, 217–224.

APPENDIX 1

Documents sent out 1981

Program Guides

PG/108	DEDPRT (in 1980 report but sent 2 February 1982)
PG/150/2	EE. An Editor
PG/157	TIGGER (restricted circulation)
PG/148/3	A Utility to provide information on the System
Brief EE Guide	RGSP guide

Program Manuals

RGSP ME II Part 1
RGSP 22
RGSP 25
RGSP 24
RGSP Mk II Qualifying document
NAG 8 Mini manual

System Guides

GSYS/29/2	Operators Guide to running the Online Benson Plotter
GSYS/33/2	Writing and Testing JOBINP MACROS
GSYS/23/17	Rewrite of Multijob Command list
GSYS/26/2	Amendment to Paper tape input/out utilities
GSYS/17/5	Amendment to SORT/MERGE program

6 Newsletters (total 148 pages)

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APPENDIX 2

Current RGSP Users

UK

Universities

Aberdeen
Bath
Edinburgh
Imperial College
Kent
Lancaster
London Computing Centre
Newcastle Upon Tyne
Reading
Sheffield
Southampton

Polytechnics and Colleges

Middlesex Polytechnic
Napier College of Commerce and Technology

Public Bodies

Hertfordshire County Council
Food Supply Analysis Group, Oxford
MAFF Computer Development Unit
Rutherford and Appleton Laboratory
West Midland County Council

Commercial Bodies

Barclays Bank Limited
NEGAS (British Gas Corporation)

Overseas

Australia

CSIRO
Department of Agriculture
University of Western Australia

Others

Statistical Institute for Asia and the Pacific (Japan)
University of Copenhagen
Data Processing Services (Fiji)
Data Processing Division (Hong Kong)

APPENDIX 3

Full title of Institute abreviations mentioned in the Report

EMRS	East Malling Research Station, Maidstone.
GRI	Grassland Research Institute, Maidenhead.
IRAD	Institute for Research on Animal Diseases, Newbury.
LARS	Long Ashton Research Station, Bristol.
NIAE	National Institute of Agricultural Engineering, Silsoe.
NVRS	National Vegetable Research Station, Wellesbourne.
SSEW	Soil Survey of England and Wales, Harpenden.

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