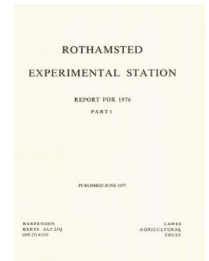




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<https://doi.org/10.23637/ERADOC-1-133>

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Introduction

Although the Department's activities remain centred around the development, maintenance and management of the central computing facility to Institutes of the Agricultural Research Service (ARS) in England and Wales, its responsibilities are changing in response to growing and varied demands for new facilities and services. Much of this demand for innovation and expansion comes from outside Rothamsted, and the Department is increasingly involved in these developments at both the policy and detailed execution level. One of the most difficult tasks during the past year has been to strike a

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balance between our present programme of work and the demands arising from the growing awareness of the role that computing now plays in agricultural research, both directly for the research worker and indirectly for the support and management services. Ways must be found for responding to these opportunities and for providing and managing implied additional resources. This situation can be illustrated with the following examples of ongoing activities whose future is still unresolved:

- (a) The Department proposed a scheme for collecting and summarising data from Mass Spectrometry (MS) equipment for direct transmission to the computing service for subsequent search and identification analysis. This could be a cheap yet effective alternative to equipping each MS site with its own local dedicated computer system. This proposal is now being discussed by the Panel of representatives from all Institutes with MS equipment. A corresponding departmental study group to examine the overall operational, programming and telecommunication aspects of the scheme is being made. The Panel and the Department largely agree about the relevance and advantages of this approach, and it is hoped that means will yet be found for implementing it.
- (b) Together with the Data Logging Service, National Institute of Agricultural Engineering, the Department is assessing centralised cross-assembler, emulation and similar techniques to ease the high cost of developing the otherwise trivially cheap but powerful microprocessor for research purposes. Such central facilities should yield overall cost benefits to the ARS and some Institutes are already turning to the Department for advice and support. This, however, implies a major extension to the Department's role for which further resources will be necessary.
- (c) Reports by Working Parties set up by the Computer Users' Group now confirm wide ranging user interest in database systems. However, the Department cannot support all available database packages. There are long-term implications in setting up database systems and without proper support the Department will have to set limits to the responsibilities it can assume on behalf of the user.
- (d) The Project Costing Scheme, the key to determining commissioned research costs, also appears to serve Institutes' needs at the administrative level. This has triggered interest in other management tasks; in some, immediate tangible savings could result and in others, timely and comprehensive information would be provided. However, under prevailing circumstances, progress will either be limited to feasibility studies or implementation over a long time scale.

The growth and changing nature of the computer service led to the proposal, made some three years ago, to enhance the service with an additional ICL System 4-72. Nevertheless, the speed with which pressures have built up, particularly in the past year, has been surprising. Users are now more articulate about their requirements, and it has become essential for the Department to channel these requests through more formal links with the Institutes. At my request, Directors have appointed Computer Liaison Officers for this purpose. The Officers have agreed to act as a Consultative Group to the Department and to offer views and opinions on matters of general concern. The Group has already urged that a second general programming language, better suited for non-numeric purposes, should be supported as an alternative to FORTRAN. They are keen to have a wide choice of application packages in the service, even if no central support could be offered. The Department has yet to respond to these suggestions which again demand resources.

It is unfortunate that these reasonable, and expected, requests should arise at a time of growing economic constraints. If, therefore, the substantial computing investment made for such purposes is to be exploited, it will become increasingly essential to look to the

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Institutes to contribute to the additional resources. This will certainly be considered in those situations where a request is specifically related to one Institute. It is not clear how this will be handled in other situations.

Joint ICL/RES System 4 Project. This Project was set up under the terms of the purchase contract of the ICL System 4-72. The Project is staffed jointly by the Computer Department and ICL and has been managed since January 1976 by Mr. Bernard G. Gold, who has been seconded by ICL for this purpose. The principal objective is to cater for the growth and demand for improved multiaccess and batch services by upgrading the present single 4-70 system into a twin System 4 configuration. The twin system will have dedicated and switchable shared peripherals, operating through an ICL inter-processor link for the transfer of work and files. Remote job entry (rje) users will be connected to the twin system through the Honeywell 716 front end processor (fep) which will eventually carry the multiaccess service. In this way developments to either the network or the central mainframe system can in principle be carried out independently because the interface between them is controlled by the Department.

The Joint Project Team is responsible for the software related to the twin ICL configuration which includes the interprocessor link and other operational aids. Other software developments, mainly relating to communication beyond the mainframe, remain the responsibility of the Operations and Telecommunications Sections. From the outset the Joint Project was based on an agreed definition which included a listing of the tasks to be undertaken. This was followed by the specification of the software necessary to achieve these objectives and from which forecasts were made about timescales, manpower and machine requirements. A full record of the resources used has been made and progress is reviewed quarterly by a Project Steering Committee. The planned requirements have been met and it is no fault of the Project Team that the implementation will be delayed. Regrettably, serious difficulties with the air conditioning plant have delayed the delivery of the System 4-72 by at least six months. It has therefore been impossible to develop and test the interprocessor software, and negotiations are taking place with Bath University for time and facilities to develop this phase of the system on their twin System 4 configuration. Present forecasts are that the initial phase of the twin System 4 service will be in service by July 1977.

Sections

This year Sectional Heads are largely responsible for their reports, which follow the pattern for previous years. No attempt is made to describe the work in detail, and any reader seeking more technical information about any aspect of these reports is invited to contact the Department.

Operations Section

This Section is responsible for the management and development of mainframe hardware, software and support services, and is headed by H. J. V. Gledhill.

The year began with hopes of delivery of the ICL 4-72 computer by the end of May and work was planned accordingly, but problems with the new air conditioning plant delayed delivery until January 1977. The Joint ICL RES 4-72 Project has been affected by the lack of a system for testing purposes and in particular of the link between the two processors, known as the DXC, which is to be delivered with the 4-72.

Without the 4-72, the existing 4-70 computer has had to carry the workload. Good hardware and reasonably good software performances kept the throughput up. However, increases in efficiency have been offset by higher overheads both in dealing with a larger number of on-line terminals and in core store reserved for service programs, e.g. the

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connection of the front end processor in February has meant an additional program resident in core to control its communications link.

The workload has increased, but to a lesser extent than in previous years. It is difficult to estimate to what extent this is due to lack of capacity. The multiaccess sessions have been almost fully utilised for the past two years, which has meant a poor response and turnaround for users. Several sites are waiting to have additional terminals connected, which means that some users are not able to obtain the service required and must wait for the 4-72 before connection is possible.

The 4-72 Project has strained the Section's programming resource, and as a result some work has had to be postponed. Multijob 1000, the last official release of the operating system by ICL, has now been incorporated in the system, but is by no means error free. Rothamsted developments include file transfers between the 4-70 and the fep, and now a further connection is being developed which deals with the messages to and from user consoles. When this work has been completed, the service will become independent of any one mainframe computer. Not only will this facilitate the operation of two System 4 computers, but it will also be an important milestone along the road to their replacement, which must eventually happen.

From April, users have been receiving statements of work done by the computer. Multijob does not provide all the information required, and over the last few years additions have been made to various parts of the system to obtain more information for internal management purposes, and this has now become the basis for the user's statement.

Systems performance. The multiaccess version of the system (day supervisor) runs from 08.00 to 18.00 h on weekdays. The night supervisor also permits terminal access, but not interactive working since the core store used for this in the day supervisor becomes part of a larger batch stream at night. Table 1 gives the 4-70 performance by usage for the year.

TABLE 1
4-70 Performance

	1975	1976
Productive time (%)		
Day supervisor	46.3	46.4
Night supervisor	22.8	27.3
housekeeping	15.5	11.6
system work	4.9	7.2
total productive time (%)	89.5	92.5
Non-productive time (%)		
failures (all causes)	3.3	1.3
routine maintenance	5.8	5.6
additional engineering and unaccounted time	1.4	0.6
total unproductive time (%)	10.5	7.5
	100.0	100.0
Operational time (hours)	5174	5195
Working days	252	250.5
Operational time per day (hours)	20.5	20.7

The night supervisor time has increased by 20%. Reductions in housekeeping time, lost time through failures, and additional engineering have meant that total productive time has increased by 4%.

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Routine maintenance is scheduled for a total of 6 h per week on two days after 18.00 h. An increasing amount of routine engineering maintenance as well as fault diagnosis and correction has been carried out during normal operation. This results in a much more efficient use of machine time. The engineering staff of ICL have been encouraged to reduce the time when the 4-70 is reserved for maintenance, and to deploy their own terminal for testing devices within a working system.

The system was reserved for development work between 12.30 and 13.30 h and after 18.00 h, with most work being done in the latter period. Such use has been greater this year because of the needs of the Joint ICL/RES 4-72 Project, although greater efficiency in non-Project work has kept the increase down.

The number of total failures (Table 2) has fallen markedly, attributed almost equally to improved reliability of ICL hardware and software. Problems with the electricity supply still exist, and it has not been possible to connect the motor alternator owing to the delay of the 4-72 room completion. It is hoped that the 4-70's alternator will be connected early in 1977.

TABLE 2
System failure distribution

	1975	1976
Software		
ICL	151	92
RES	23	20
Total	174	112
Hardware		
ICL	178	99
RES	4	3
Other	15	14
Total	197	116
Total (all causes)	371	228
Total hours lost	173	70

A total failure or 'crash' is not the only type of fault possible in the system. Other hardware errors can and do occur in devices and their connections to the processor, but redundancy in the equipment permits the system as a whole to continue and be repaired with no effect for most users. Software faults also occur but the estimation of the total numbers of occurrences is difficult. Any failure is serious to the users and it is good practice to keep the system updated. All errors reported are logged and investigated, and lists maintained of current ones.

During the year, there were 126 failure free days including periods of ten, nine and eight days. The longest period of consecutive working days without a hardware crash was 25, and without a software crash was 18. These figures are encouraging, especially since much of the hardware was installed in 1970.

Throughput (Table 3) has been measured in the past in elapsed time units (ETU). This unit is adequate for annual comparison, but another unit—the work unit—will be introduced for accounting purposes in the future. User work, which is all work excluding that of the Computer Department, has increased by 15%. This has been achieved by increases in efficiency in the system and in its use by the Department, with only 0.2% (approximately 10 min) of extra time per day. Work done in the day supervisor is up by approximately 7% on last year's total. The job management system has diverted the larger jobs to overnight running, making more day time available for some additional

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TABLE 3
Distribution of work by Institutes

	ETUs		Job units	
	1975 3 562 835 %	1976 3 596 238 %	1975 233 268 %	1976 253 883 %
Total				
Rothamsted Experimental Station				
Computer Department				
Systems work	21.3	16.4	11.1	8.6
Other work	17.6	13.9	16.3	17.9
Total Computer Department	38.9	30.3	27.4	26.5
Rothamsted Experimental Station				
Statistics Department	15.9	17.8	11.1	11.3
Other Departments	5.5	9.6	4.8	6.3
National Institute of Agricultural Engineering	11.8	11.5	16.9	16.2
Grassland Research Institute	5.2	6.6	7.2	7.8
National Vegetable Research Station	5.3	5.2	13.6	11.3
East Malling Research Station	5.2	3.7	6.0	4.4
National Institute of Agricultural Botany	4.1	3.5	1.5	1.3
Letcombe Laboratory	1.4	2.6	1.4	2.0
National Institute for Research in Dairying	1.8	2.2	3.4	3.5
Meat Research Institute	0.5	1.4	0.6	1.2
Long Ashton Research Station	0.8	1.3	0.8	0.8
Glasshouse Crops Research Institute	1.2	1.3	1.4	1.6
Welsh Plant Breeding Station	0.6	1.0	1.1	1.3
Others	1.8	2.0	2.8	4.5
	100.0	100.0	100.0	100.0
Per day	14 138	14 356	926	1013

user work. There is a considerable amount of variation from one year to the next in any one site's workload, and although the same Institutes are in the top four, one increased and one decreased by approximately 30% compared with last year.

There have been more terminals in use at peak times than ever before, with a maximum of 36 recorded. This is a larger number than the system can accommodate without increasing response time, and under such a load, response has been poor. Interactive usage is also increasing despite the slow turnaround, and so also are users' criticisms. The poor system response is the result of an overloaded system. The 4-70 computer is not sufficiently fast to meet the full multiaccess demands made of it, and as a result user work, which has been steadily increasing since the service began, is still below its maximum potential. New applications and 30 new users this year, including a new Institute, the Animal Virus Research Institute, are still coming forward, and some of the smaller sites in terms of computer workload are about to increase their demand significantly.

Disc space is now uncomfortably full, and the additional discs and the 4-72 computer expected to be in service by mid-summer next year should provide the much needed capacity to permit expansion to continue.

Programming. This work divides into three approximately equal parts; system support, software development, and Joint ICL/RES 4-72 Project software. Because of the commitment to the 4-72 Project, other enhancements to the system have been limited. It has not been possible to provide more conveniently useable facilities because other longer term developments have been given precedence. Nevertheless, improvements have been made, several of which have been acquired from other Multijob users including the Universities of Aberdeen, Bath, Bristol, Cardiff and Exeter, the Transport and Road

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Research Laboratory, the Culham Laboratory (UKAEA), the European Space Agency in Holland and Germany, and the Post Office.

System support. Rothamsted was the first Multijob user to implement the full MJ1000 release in the Spring. (Thomson and Newbould) With the anticipated arrival of the 4-72 computer in early summer it was desirable to establish an up-to-date software base. This was accomplished with the Rothamsted Release 6 in June, which included a new ICL release of the Communications Control Program tested by ICL on the RES Multijob system in May. Considerable extra effort was required in dealing with errors in the manufacturer's released software which prevented its speedy implementation.

The operating system consists of programs—software—and many different files including libraries, compilers, utility programs, and catalogues, etc. These have been reorganised to speed up certain lengthy procedures thus reducing the time required for reserved use of the computer. As much work as possible is being done within the service system during normal working hours, but some work has to be done out of hours when the users do not have access.

The Rothamsted editor program REDIT has been re-released on a trial basis following a major error clearance. (Thomson) Again commitments relating to the 4-72 delayed this work.

Software development. MEDINF, a control program for the System 4 end of the 4-70-fep interprocessor link, was brought into service. This receives file and job input from the fep and transmits both punch and printer files over a 48K bits s⁻¹ link for output at remote sites. (Coombs and Latin)

Message Multiplexing software is being written for terminal traffic between the two System 4 processors and the fep, and will use 2400 and 4800 bits s⁻¹ lines. (Coombs) This software is a further step in making the user network independent of System 4 and provides greater flexibility now as well as easing the transition to a future mainframe computer.

Input programs for cards and paper tape and a paper tape punch program compatible with MEDINF have been implemented. These use common code together with the JOBINPUT program, and it is planned that commands will become generally available regardless of the input device. (Sharma, Malcolm, Latin and Bishop)

Multijob does not provide a suitable mechanism for controlling the use of magnetic tapes. Programming to deal with this problem has had to be postponed during the year, but is now being tackled. The second stage of the job management system has also had to be shelved during the year, and included procedures for more adequate usage and control of private disc volumes (PVOLS) which, though improved by the first stage, needs further work. Use of PVOLS is expected to increase as demands for sizeable databases have to be met.

Many minor improvements as well as error corrections have been implemented during the year. Where possible the emphasis has been on more convenient user facilities, e.g. considerable use is now being made of the user's journal file for reporting actions completed or errors encountered to him. This is important since most of the development work has been in areas not visible to the individual user, though all will benefit from the work.

ICL/RES 4-72 Project. This is dealt with elsewhere in the Departmental Report but some of the software produced by the Project has already been put into service. File protection details are now dealt with more adequately; and the operators have better control over users and their work when closing the system. One requirement when run-

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ning the twin System 4 computers is to be able to move discs from one system to the other. Changes to Multijob permit this. (Sharma, Coombs, Malcolm and Latin)

Applications Section

This Section is concerned with supporting, training and advising users with scientific programming needs, and is headed by J. D. Beasley.

The activities of the Applications Section remain many and varied, but with a gradual change of emphasis away from purely numerical work towards general data handling.

Information storage and retrieval. This heading covers the storage, management and reading of substantial bodies of data. These bodies may be experimental records, lists of information on plant types, library catalogues and almost any other information which has previously been kept in books. Several programs have been mounted or investigated with a view to determining their suitability for some of this work; those on which there is now local knowledge include the TAXIR taxonomic information retrieval program and the FAMULUS program for bibliographic information (Hersom), the G-EXEC Data Management system (Lessells), the Aberdeen University FORTRAN database programming system (Clarke), and the FILETAB program from the National Computing Centre (Verrier). Also conveniently summarised under this head is our work on the application of the computer to mass spectrometry. (Clarke)

The library programs for the sorting of data on magnetic tape or disc have been made a little more efficient and their use considerably simplified. (Hersom) The use of magnetic tape on the Rothamsted 4-70 is not particularly convenient, owing both to incompatibility between FORTRAN formats and other tape formats and to inefficiencies within FORTRAN. Various programs have been written to assist users through some of the resulting difficulties. (Barrett and Hersom)

Numerical work. The Section has continued to give substantial assistance to Dr. F. Yates in the development of the Rothamsted General Survey Program. Most of the work this year has related to the production of a Master Source version of the program, which can be used to produce versions suitable for running on any relevant machine. Versions of the program have been sent during the year to Queen Mary College London, Manchester University, Edinburgh Regional Computing Centre and Service in Informatics and Analysis Ltd. (Dr. F. Yates and Barrett)

Work has also taken place on two projects in conjunction with the Statistics Department. The first of these concerns the production early in the year of a version of GENSTAT which would occupy less core space but at the small cost of more transfers from the backing store, and would be more suitable for the running of small jobs during the day. Recent figures suggest that about 35% of GENSTAT jobs (measured by number of jobs) now use this small version. Work has also started on the production of a program to perform the analysis of variance in a framework similar to that of the generalised linear model fitting program GLIM. This work is being done at the request of the Numerical Algorithms Group and under the auspices of the Working Party on Statistical Computing of the Royal Statistical Society. The work falls into three stages: the extraction of the reading and calculating algorithms from GLIM, the extraction of the present algorithm for the analysis of variance from GENSTAT and its incorporation into an environment suitable for GLIM, and the production of new printing routines. Our work lies in the middle section. (Beasley)

Computer graphics. Work has continued on the program DRAW which was originally developed for drawing chemical structures but has proved to have a wide range of

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application. (Bicknell and Thomas) Some other applications involving graphical work are reported on briefly in the section on Miscellaneous Programming below.

Computing languages. Although the main computing language of the service is FORTRAN, several other languages have been the subject of implementation, development or study during the year. The symbol manipulation language compiler SNOBOL4 is gradually becoming available through the medium of the compiler SPITBOL; the licensing difficulties concerning this compiler have now been sorted out only to be succeeded by technical difficulties in its local implementation, but many of these have now been overcome. (Bicknell and Barrett) The language BASIC continues to be of interest to users and a comparative report has been written discussing the standard form of the language and the various versions available on our machines. (Lessells)

One of our members (Clarke) is the Secretary of British Computer Society FORTRAN Specialist Group. This group is currently active in discussing and making proposals concerning the proposed new International Standard for FORTRAN. Various programs relating to FORTRAN and its use have been brought into the Department as a result of the activities of this group. A study has also been made of the initial proposals of the CODASYL FORTRAN Database Manipulation Language Committee. (Clarke) Work has also been done on certain pre-processor programs to elucidate obscure error conditions occurring in FORTRAN programs. (Barrett)

Miscellaneous programs. As usual, the Section has spent some time on the production of miscellaneous programs. Among the more substantial examples have been programs to draw outline maps of counties or countries with internal shading dependent on the value of some attribute, to accumulate and present graphically values of temperature and rainfall, and to prepare soil profiles from coded field data. (Bicknell, Dunkley and Lessells)

Training and advisory services. The appointment at the end of last year of a Training and Advisory Officer has made possible a considerable extension of these services. We normally rely upon Universities for basic courses in FORTRAN, but courses in the local operating system have to be given from our own resources. Four such courses were given this year. Some video tape equipment was purchased during the year and has been used for a substantial part of this introductory course. This makes it possible to give courses for single recruits and to keep copies of them at Institutes with compatible equipment. Other courses will be recorded next year. The presence of a Training and Advisory Officer has also made possible a substantial and in some cases long overdue improvement in the quality of documentation supplied to users. (Verrier and Thomas)

Computer study groups. During the year the ARS Computer Users' Group set up a number of study groups. The Section is involved in three of these: the Computer Graphics Study Group, the Scientific Data Management Study Group, and the Textual Data Handling Study Group. These groups cover areas where interest is expected to increase, and they are likely to play a significant role in influencing the future activities of the Section.

Rothamsted general survey program (RGSP). A few minor improvements were made to RGSP in response to requests, and the *Introductory Guide to RGSP* by Mrs. Linda D. Aitken (Inter-University/Research Councils Series Report No. 27, July 1976), Program Library Unit, Edinburgh University, has been published. As stated earlier, the Master Source enables versions of RGSP to be generated for various machine types. This includes the current working version of RGSP at Rothamsted which appears to be satisfactorily

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free from errors. This process does not guarantee the full portability of the program and detailed testing is necessary for a local working version. Such versions are now in operation on CSIRO's CDC 7600 and CDC 6400 computers in Australia, and a new working version suitable for IBM installations has been completed by Mrs. Linda D. Aitken (PLU, Edinburgh University). Dr. F. Yates has also been working on a new edition of his book *Sampling Methods for Censuses and Surveys* (Charles Griffin & Co. Ltd.).

Telecommunications Section

The Section, headed by I. M. Richmond, is responsible for all aspects of telecommunications and includes the development and maintenance of the network and its associated terminal equipment. Staff with experience and knowledge of these techniques are in great demand, and the Section has been below strength for much of the year. For this reason the maintenance of the front end processor software, which is essential now that it is carrying the remote job entry (rje) traffic, has been borne by the development programming staff at the expense of other aspects of the total Section programme. A certain amount of reassignment has taken place, which has not affected the primary tasks too seriously, but has minimised progress on some secondary ones.

Operations

Network equipment. The network consists of all terminals and the associated telecommunication links. The ARC, for the first time, provided central funds for enhancements to the network in the 1976-77 departmental budget. Previously Institutes had funded their own terminal equipment purchases, often under guidance from the Department, but this led to planning difficulties and the new arrangement is welcomed.

The eight telegraph and four high speed buffers which were added to the system were in full operation by June and further expansion was deferred until the installation of the System 4-72. This applies even to those items purchased in this year's budget which will not be operational until the System 4-72 is in full service. A summary of the terminal position as at the close of the 1976-77 financial year is given in Table 4.

TABLE 4
Summary of terminal and buffer facilities

	Installed	On order	Total
Buffers			
Leased lines	12	3	15
Dial up	5	0	5
Terminals			
Teletypes	41	2	43
Visual display units	11	7	18
Serial printers	4	4	8
Remote job entry	4	0	4
Card readers	1	0	1
Paper tape readers	0	1	1

This table reveals another aspect of the growth in the service now being provided to ARS Institutes. The expansion seems likely to continue because enquiries have already been received for further substantial enhancements in the coming financial year. This growth is very much in line with the prediction made some years ago and which, together with other factors, led to the recommendation to purchase an additional mainframe computer.

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Network performance. Overall performance is not discussed because the staffing situation has inhibited the collection of data for meaningful analysis. There have been difficulties with the introduction of the rje service and the Institutes have shown forbearance. The programming staff, however, have minimised the interference with service by working non-standard hours. A simple count of incidents on the network is summarised in Table 5.

TABLE 5
Incidents on network

	Number	%
1. rje (fep supported)*		
(a) software	96	85.0
(b) hardware	17	15.0
Total	113	100.0
2. Terminals (non-fep supported)		
(a) Teletypes	21	17.9
(b) Visual display units	12	10.3
(c) Serial printers	35	29.9
(d) Links	49	41.9
Total	117	100.0

* 1st July–31st December 1976

This table clearly points to the rje service software as the major problem. The data of Tables 4 and 5 shows that there are on average two incidents per year on teletypes, and one for the visual display units, which would seem to be entirely acceptable. Problems still remain with the serial printers, although the actual performance is an improvement over the situation in 1975, mainly due to the new maintenance contract. Nevertheless, they continue to be used more intensively than the manufacturer's rating permits, and the only long-term solution will be to replace them.

FEP/RJE system. The centre of the Section's programming activities has again been the fep/rje system. User trials were started in January and as the system became more robust these gradually merged into an operational service. Considerable effort is being concentrated on improving the system and although problems still exist, a more resilient package for the fep should be operational by the close of the year. (Moore and Morton)

During the latter part of the year the system has been carrying a full operational workload. This has revealed several problems. The most significant is ill-formatted files being passed for transfer by the System 4. Information is being collected on the problem and a solution is expected early in 1977. Errors in the rje 2780 emulator package were also evident but these remain Honeywell's responsibility.

Developments. Development tasks within the Section are designated as either primary or secondary. The former are those on which a commitment has been given to the users. The latter are those which will provide desired facilities but are not demanded by immediate operational requirements. This division is mainly a management tool to facilitate the sharing of the tasks between staff.

Primary developments

Interactive traffic. The development phase of the software for the fep to carry all terminal traffic was completed by July. It is planned that the support on the mainframe will be available when the 4-72 is operational.

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This development will considerably improve the flexibility of the system enabling a wider range of peripherals to be supported.

Microprocessor based terminals. The major new project started during the year has been the development of a remote terminal concentrator based on the Honeywell MTS 7500. This system will be located at the National Institute for Research in Dairying, and will serve a dual function. In a foreground mode it will concentrate on to the telecommunications link all the terminal devices. This will improve throughput and flexibility over the existing technique of Time Division Multiplexing (TDM). On a background basis local file creation and editing will be carried out. The software for this system has been under development during the latter part of the year. A program has been completed for the MTS 7500 which will enable the testing of other programs to be carried out. The detailed design for the system is at present being undertaken. (Moore)

Batch terminals. A rise in user demand for batch facilities led to a search of the peripheral market for devices that could be supported directly on TDM equipment. Such a peripheral needs to provide a measure of security for the data during transmission without incurring the cost of a rje. Suitable equipment was identified. A common protocol for the fep/peripheral dialogue was defined and has been specified for the equipment on order. The increased use of microprocessors in peripheral equipment has meant that the definition of a special protocol has not incurred a cost penalty. However, the task of supporting these devices is significantly reduced. A card reader destined for Meat Research Institute has been purchased and the support software will be implemented in the early part of 1977.

MS study. A study was carried out to ascertain the feasibility of providing a data acquisition service to the MS users at remote sites. The outcome of this study was the acceptance by the MS Panel of a system which could meet the users' needs without extensive equipment at each site. Plans are being formulated to build a trial system. (Richmond)

Secondary developments

High quality printers. A hardware interface was developed and testing of the system awaits the completion of the support software for the fep. (Bojtos, G. W. Storer—Industrial Training Student)

Experimental Packet Switching Service (EPSS). The Department joined the experiment in June. The development of the software falls into three phases. Phase one, the line protocol software to enable the fep to accept and transmit packets. Phase two, the call protocol to enable machine to machine conversations, and phase three, the job transfer protocol. Phase one has been written and will be tested in conjunction with the Post Office. The initial design for phase two is being carried out and the software is to be written in a high level language, CORAL 66. Phase three awaits the definition of the protocol by the Post Office. Delays caused by staff shortage have not been a problem as the Post Office part of the experiment is running a year late. In spite of the delays the experience gained is proving of value. (Moore)

Graphics. The initial design for the remote support of plotting devices has been prepared. It is expected that work will recommence during 1977 and a plotter will be tested at the National Institute of Agricultural Engineering.

COMPUTER DEPARTMENT

Development H716. The minimal development system purchased in 1975 was enhanced so that development of software could proceed satisfactorily. Hardware failures on the fep indicate that a standby system is necessary if long, but rare, periods of 2–3 days down time are to be avoided, and the necessary interfaces are being obtained. Thus one H716 will have the dual role of being a development tool and a cold standby to the system.

Management Services Section

This Section is headed by C. W. Fearne, and in addition to its broad supporting role to the computing service, is increasingly becoming involved in management tasks on behalf of outside bodies.

Project costing scheme. The year end analysis for the financial year 1975–76 was held up by the delay in the returns from one or two Institutes. After discussion with the Agricultural Research Council (ARC) a new schedule has been agreed which, if maintained, would provide them with the computer analysis output within two months of the end of the quarter. Reports for the first two quarters of the financial year 1976–77 were completed to this new schedule.

At the request of the ARC, several programming changes were made to the suite, including a revised allocation distribution and a 'rolling year' analysis. (Fearne, Proctor and Cooper)

The trial use of the scheme by the Department of Agriculture, Northern Ireland, was successfully completed for the financial year 1975/76 and we are awaiting their decision as to the future use of this service. The Sea Fisheries Research Laboratory, MAFF, Lowestoft, are also to make a trial use of the scheme for the coming financial year. (Fearne)

Centralised accounting. On behalf of the ARC Study Group on Financial Procedures, the Section carried out a joint investigation with Mr. J. C. F. Coles (Secretary, National Institute for Research in Dairying), into the feasibility of a pilot scheme for a centralised accounting system based at Rothamsted. This is in part a consequence of the growing use of accounting machines with punched paper tape output at the Institutes. These tapes could be used to consolidate information for both local and central purposes. There is no immediate commitment to this and the investigation will continue in a low key until more resources become available.

Seed store management. Following discussions with the staff of the Plant Breeding Institute, both a feasibility and design study were made of a computer based system for managing the movement of seed stock and associated records in their newly constructed central seed store. The study reports have been accepted by the Director, but other Institutes with a common interest in this technique have been invited to comment on these proposals before an implementation decision is made. (Fearne and Proctor)

Other services. There was a small increase in the number of punched and verified cards handled by the Section during the year and this service was employed by eleven Institutes and ARC. There was an improvement at the Edinburgh end of the link into the Edinburgh Regional Computing Centre which resulted in an increased availability from 73.3% in 1975 to 80.8% in 1976. This excluded the period when the terminal was being used for departmental development and other tasks such as dialling into the University of Cambridge Computer Service. In order to make the maximum use of this equipment it seems

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likely that more use will be made of the dial-up facility now reliably available on high speed links.

Staff and Visits

During the year A. J. Swan, J. G. Jackson and S. Riches, all Scientific Grade staff, resigned, as well as Mrs. Maxine Kerry and Rosemary Hearne, both Executive Officers. The following new staff were appointed. Anne Kiss and R. P. Morton, Scientific Grade, and Mrs. Mary Proctor and Mrs. Jane Spreull, Executive Officer Grades.

The Department continued to support all User Group activities and regularly attended many of the ICL User Association meetings. D. H. Rees resigned from the Council of this Association.

D. H. Rees visited the Taxometric Laboratory, University of Colorado, Boulder, Colorado, and attended the National Computer Conference, New York. He also visited the European Space Agency, Darmstadt, Western Germany. R. P. Sharma attended a Conference on Software Systems Engineering, Eurocomp.

Publications

GENERAL PAPERS

- 1 DAY, A. C., CLARKE, P. A., HILL, D. & REID, J. K. (1976) The proposed new standard for FORTRAN: A critical examination. *Computer Journal* **19**, 268–271.
- 2 YATES, F. (1976) Design of computer programs for survey analysis. *Biometrics* **32**, 700.

RESEARCH PAPERS

- 3 DYKE, G. V. & SHELLEY, C. F. (1976) Serial designs balanced for effects of neighbours on both sides. *Journal of Agricultural Science, Cambridge* **87**, 303–305.
- 4 WEBSTER, R., LESSELLS, C. M. & HODGSON, J. M. (1976) DECODE—a computer program for translating coded profile descriptions into text. *Journal of Soil Science* **27**, 218–226.