UNIVERSITY OF EDINBURGH

AGRICULTURAL RESEARCH COUNCIL

# EDINBURGH REGIONAL COMPUTING CENTRE

# Fourth Annual Report

(1st August 1969 to 31st July 1970)

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**Secretary to the Executive Committee**

R. SEATON, M.A., LL.B., Assistant Secretary, University of Edinburgh

## Senior Staff of the Edinburgh Regional Computing Centre

(at 1st August 1970)

| | |
|---|---|
| Director | G. E. THOMAS, B.SC., M.SC., PH.D., M.I.E.E. |
| Principal Consultant | Mrs M. M. BARRITT |
| Marketing Manager | R. E. DAY, B.SC. |
| Administrative Officer | D. B. MARSHALL, T.D., M.A., B.COM. |
| Senior System Analyst | W. AITKEN, B.SC. |
| | J. G. BURNS, B.SC., PH.D. |
| | G. E. MILLARD, B.SC., A.R.C.S. |
| | P. D. STEPHENS, B.A. |
| | P. E. WILLIAMS, B.SC. |
| System Analyst | F. E. J. BARRATT |
| | A. McKENDRICK, B.SC., PH.D. |
| | Miss C. R. MARR, B.SC. |
| | D. T. MUXWORTHY, M.A. |
| | C. H. NICHOLAS, B.SC. |
| Senior Applications Programmer | M. D. BROWN |
| | R. L. MIDDLETON, B.SC. |
| | H. M. MOORES, B.SC. |
| | D. D. M. OGILVIE, B.SC. |
| Senior Systems Programmer | M. J. AVIS, B.A. |
| | Miss A. FINCH, B.A. |
| | R. G. KIRSOPP, B.SC., PH.D. |
| | R. R. McLEOD |
| | E. R. MANSION, B.SC. |
| | H. R. REIGER |
| | J. B. A. WEXLER, B.A. |
| | H. E. WOODMAN, B.SC. |
| | J. K. YARWOOD, M.A., M.SC. |
| Programmer | Mrs L. D. AITKEN, B.SC. |
| | P. W. ALLAN |
| | Miss P. BALLAM, B.SC. |
| | Mrs H. P. DRUMMOND, B.A. |
| | Miss M. M. FISHER, M.A. |
| | N. HAMILTON-SMITH |
| | Mrs J. R. E. HORNBY, B.A. |
| | Mrs H. A. HUGHES, B.SC. |
| | I. M. HUNTER, B.SC. |
| | J. B. O. JAMIESON, B.SC. |
| | R. B. JOHN, B.A. |
| | Miss F. A. KELLY, M.A. |
| | C. D. McARTHUR, B.SC. |
| | Miss M. E. McLEOD, B.SC. |
| | N. K. MOOLJEE, B.SC. |

Mrs M. L. Murbach, b.s.
B. R. Murdoch, b.sc.
J. M. Murison, b.sc.
A. D. Nolan, b.sc.
D. J. W. Stone, m.sc.
G. C. Yarwood

| | |
|---|---|
| Program Librarian | A. W. Bannerman, b.sc. |
| Executive Officer | J. Robertson |
| System Engineer | R. Hunter |
| | W. Watson, b.sc., m.sc. |
| Engineer | R. Chisholm |
| | J. G. Fordyce |
| | A. B. Henderson |
| Alison House Services Manager | W. M. Gordon |
| Computer Room Manager | C. C. Davies |
| Operations Controller | D. O. Sturgess |
| | M. T. Sykes |
| Job Reception Controller | Mrs V. Laing |

## FOURTH ANNUAL REPORT
### (1st August 1969 to 31st July 1970)

### Introduction

The fourth full year of operation of the Centre has been notable not so much for the acquisition of major items of equipment or the occupation of new buildings, as for the continued development, by means of much detailed work by the Regional Centre staff, of a more efficient and increasingly comprehensive computing service for the Centre's varied community of users. Throughout the year, however, the Director and the Executive Committee have been anxiously trying to assess the likely effect on the Centre's projected development of changing prospects in the computer industry, in other universities, and in our own Multi-Access Project.

The greater part of this report is devoted to a description of the services offered to users throughout the year, but the later sections highlight the current and prospective problems facing the Executive Committee in its task of recommending the pattern of development of the Centre in the next few years.

### Computer Services

The Regional Centre has continued throughout the year 1969-70 to base its services on the 360/50 and System 4-75 computers located at King's Buildings and, by data link or courier service, on three off-site computers—the 360/67 at Newcastle University, the Chilton Atlas and the 1108 installation at the National Engineering Laboratory, East Kilbride. In addition, the Regional Centre has arranged access to commercial time-sharing services both for its own staff and for certain user departments.

The Third Annual Report included a description of Project Exodus, the transfer of users' work from the KDF9 to the 360/50. This exercise was successfully carried to completion, with the final category of work, programs requiring the use of the graph plotter, being transferred early in December. The three-year period of service of the KDF9 therefore came formally to an end on 24th December 1969, with a total throughput of 232,328 jobs for Regional Centre users. As the last five months saw fewer than 6,000 jobs on the KDF9, it has been considered unnecessary to include KDF9 usage in the statistics presented in detail in this Report and its appendices.

### 360/50

As the Table in Appendix A (i) shows, by far the greatest part of the general service to users was provided on the 360/50 in 1969-70. The 360/50 was accepted by the Centre at the beginning of April 1969 and began to provide a service about the middle of that month. From that date use of the machine increased steadily until in Spring 1970 a state of saturation was reached and the process of off-loading certain work to the 4-75 had to be seriously undertaken. During the first twelve months of the rental of the 360/50 considerable effort was devoted to trying to tune the operating system

to obtain maximum throughput. Although significant improvements were obtained, it became clear that relatively little further improvement would be possible and that from Spring 1970 the growth of demand would have to be met principally through increased use of the 4-75 and the off-site machines.

A significant feature of the 360/50 operation has been the growth of remote job entry facilities. On-line links have been maintained with IBM 1130 computers in the ARC Unit of Statistics and the A.R.C. Animal Breeding Research Organisation, and with IBM 2780 remote job entry terminals at the A.R.C.'s Rothamsted Station and in the Regional Centre's own accommodation at Alison House; in addition the Regional Centre's Calcomp incremental plotter previously serviced by the KDF9 is connected with the 360/50 via a specially developed PDP8/L computer. The most heavily used terminal is that in Alison House, in use all day and often until late in the evening, which carries much of the traffic from the central area of the University; on average 300 jobs a day are transmitted over this link of which about 200 are fairly short IMP or Watfor jobs using the batch compilers. Use of the link with Rothamsted grew rapidly more active, up to a level of 140 jobs a week. The 1130 connections are slightly less active with about 100 jobs each per week by the end of the year, but they are still highly valued by the Units.

Reliability of the 360/50 has on the whole been good, after a slightly shaky start which was probably partly attributable to the short notice at which the machine was supplied. The general pattern has been for the machine to run for several weeks with only minor faults, or no faults at all, and then to develop a more serious fault which sometimes, particularly if it occurred in the central processing unit, has proved difficult to isolate. Average downtime as a result of faults has been $11\frac{1}{2}$ hours per month—equivalent roughly to 3·5 per cent. of the total hours actually worked.

### System 4-75

It is a matter of great regret that 18 months after the delivery of the 4-75 hardware in January 1969, ordinary user departments are still receiving relatively little service through the 4-75, much less the long-awaited multi-access facilities. A later section of this Report describes in greater detail the position of the Edinburgh Multi-Access Project and of the operating system (EMAS) it has been developing for the 4-75. The repeated postponement of the date on which the Regional Centre could be sure of having a stable operating system on which to run a multi-access service understandably encouraged users to concentrate on the 360/50 for satisfaction of their main service requirements, and it was only the mounting congestion on the latter machine in the early months of 1970 that provided the incentive for a significant transfer of work to the 4-75, initially comprising mainly large programs of a few users which could be run on the night service when the Regional Centre compilers were available on the 7J operating system. Over the year, however, as the Table in Appendix A (i) shows, less than 6·5 per cent. of the 4-75 usage was in the name of non-specialist users. The rest of the time was split fairly evenly between the systems development work of the Multi-Access

Project and the systems and other work of the Regional Centre itself. (The statistics do not include the use that has been made of the special peripherals on the 4-75 for the conversion of data to and from the 9-track magnetic tape used as a means of communication with the 360/50).

### Newcastle University 360/67

Throughout the year the 360/67 at Newcastle University has been freely available to Edinburgh users by courier service and by means of the data link located in Alison House. In the middle of the year there was a three-month period when difficulties with the introduction of new communication equipment at Newcastle severely reduced the standard of service and many users reverted to the local 360/50, in spite of the more favourable performance characteristics of the 360/67. In the last few months of the year, however, re-establishment of satisfactory communication with the 360/67 and increasing congestion on the 360/50 combined to reverse the flow to some extent. Although even at the most active period of the year Edinburgh's use of the 360/67 did not come up to the level allowed for by the Computer Board's arrangements, assured access to a large 360 has continued to be a valued facility which the Executive Committee would be reluctant to lose.

### Univac 1108

This machine, located at the National Engineering Laboratory, East Kilbride, and the most powerful processor in Scotland available to the Scottish Universities, has been in regular use by the Regional Centre throughout the year, with an average load of 2 hours per week, representing almost double the load in 1968-69. To users requiring specific programs or merely high arithmetic performance, the 1108, with a performance ratio in relation to the 360/50 of the order of 6 : 1, can be a highly attractive proposition. If, as has been informally suggested, access for Regional Centre users will be restricted, or even completely removed, after May 1971, there will be a significant gap in the Regional Centre's range of facilities for its users unless a machine of comparable processing power becomes available elsewhere.

### Atlas

Use of the Atlas computer at the S.R.C.'s Chilton Laboratory, on the other hand, has continued to decline, with long-standing users with established programs forming almost the whole Edinburgh clientèle. Although the statistics in Appendix A (i) are not a comprehensive record of Edinburgh usage of the Atlas (as certain users are not obliged to submit their work through the Regional Centre), it is clear that the Chilton Atlas is no longer a significant element in the overall development of the Edinburgh computing scene.

### Commercial Time-sharing Services

To give some users an opportunity to gain experience of time-sharing systems, the Regional Centre arranged access, via Regional Centre equipment

to the commercial services operated by Systemshare Limited and G.E.I.S. Limited. This project was centred on a part-time introductory course organised by Mr W. Lutz of the Department of Social Medicine for medical staff and research students. The participants in this course were taught the elements of programming using the computer language BASIC which was provided on-line to the G.E.I.S. service. In his report on the project, Mr Lutz submerged isolated critical comments ("Putting oneself on-line proved surprisingly irritating" and "The response rate at times also proved to be very irritating, irrationally so, because the time lost by a sluggish response . . . to a command is negligible really") with a general flow of enthusiasm for on-line computing as a teaching vehicle. Several other departments and individual users were given similar access facilities to explore what value the systems offered to more sophisticated users. This experience evoked a similarly encouraging reaction, and it is clear that regular time-sharing facilities will be greatly welcomed by Edinburgh users both for teaching purposes and for program development. The Regional Centre also obtained from the project and from the participants' constructive comments, useful guidance on the relative desirability of particular system features and on some of the operational hazards encountered in running a conversational service. During the autumn usage of the commercial time-sharing services grew until in January 1970 over 100 hours of terminal time were used, through about 60 individual users. At this point it was necessary, for financial reasons, to curtail the experiment.

### Analysis of Usage

Appendix A(i) summarises the usage statistics for the full year 1969-70 for each of the five computers covered in the preceding section. This is supplemented by Appendix A(ii) which continues the practice of previous Annual Reports of comparing the figures for March each year as a rough indication of growth rates for the various categories of user. March 1970 was the first year in which the KDF9 was not the principal supply of computing time for Regional Centre users and for this and for other reasons the validity of this method of comparison is now more dubious. The total of measured computing hours is in fact marginally lower for March 1970 than for March 1969. It is difficult to be precise about the relative value of an hour of computing time measured on the KDF9 and an hour measured on the 360/50, as the nature of the calculation involved in each job, its file handling requirements and the volumes of input and output, all affect the position. It seems a reasonable assumption, however, that the increase in the number of jobs handled provides on average a fairly close indication of the increase in the amount of effective computing obtained by users. On this basis, excluding the Regional Centre's own use of the machines in each year, the increase was of the order of 21 per cent. (if Regional Centre use is included the overall increase was very nearly 50 per cent.—in other words, the use the Regional Centre staff made of the 360/50 for systems development and applications work in March 1970 was far greater than the use made of the

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KDF9 for this purpose in March 1969). Of the principal categories of users, the Research Councils, with a 42 per cent. increase, at first sight appear to have fared best. The average length of Research Council job, however, dropped from about 6 minutes on the KDF9 in March 1969 to less than 2·5 minutes on the 360/50 in March 1970. This apparent fall in the amount of computing done for Research Council users, even when allowance is made for the assumed 1·5 improvement in performance, has been an important consideration in the minds of the Executive Committee in its review of the future development, and in particular future recurrent financing, of the Regional Centre.

University use, on the March totals of jobs, has increased by about 20 per cent. Over the full year 1969-70, however, if all machines are taken into account, the increase in the number of research jobs has been minimal (5·4 per cent.) and in undergraduate teaching there would appear to have been a not insignificant decrease in the number of jobs handled. This decrease in undergraduate teaching jobs, is, however, illusory—the consequence of a four-month time lag in adapting the accounting program to account for individual jobs within a batch following the introduction of a new batch compiler on the 360/50 in November 1969. (This defect in the 1969-70 statistics relates only to numbers of jobs and is significant only for Category 2 —undergraduate teaching.) Within the University the balance between research and teaching is perhaps not so crucial now that the Computer Board has formally within its remit the use of computers in universities for undergraduate teaching. In fact there has been a slight swing back towards research as the following table on the relative shares of Regional Centre resources of time (including off-site machines, but excluding KDF9) shows:

| | 1967-68 | 1968-69 | 1969-70 |
|---|---|---|---|
| | % | % | % |
| 1. University of Edinburgh (excluding undergraduate teaching) | 66·9 | 58·8 | 65·9 |
| 2. University of Edinburgh (undergraduate teaching) | 9·0 | 10·0 | 10·2 |
| 3. Other Universities | 5·3 | 0·8 | 0·2 |
| 4. Research Councils | 16·3 | 27·1 | 19·9 |
| 5. Other Treasury-funded users | 1·6 | 2·2 | 2·3 |
| 6. Commercial users | 0·9 | 1·1 | 1·5 |
| Total—Groups 1-6 | 100 | 100 | 100 |

This table of course is based on computing time and incorporates rough conversion factors for the machines other than the KDF9 (in 1967-68, 1968-69) and the 360/50 (in 1969-70), but it is considered to give a reasonably accurate picture of the relative proportions of computing time provided through the Regional Centre. The totals of "360/50" hours on this converted

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basis achieved over the full year 1969-70 by the three main categories were:

|  | 1969-70 | 1968-69 | Increase % |
|---|---|---|---|
| 1. University of Edinburgh (excluding under-graduate teaching) . . . . | 2794 | 1770 | 58 |
| 2. University of Edinburgh (undergraduate teaching) . . . . . | 413 | 290 | 42 |
| 4. Research Councils . . . . . | 924 | 741 | 25 |
| Total (for categories 1, 2 and 4) . . | 4131 | 2801 | 47·5 |

This average growth rate of approaching 1·5 between 1968-69 and 1969-70 will, it is hoped, be attained also in 1970-71.

The growth in the number of registered users has continued in most categories. In the two main categories, the increases have been from 494 to 524 among University users, and from 129 to 229 among Research Council users.

Appendix A(iii) lists the user departments in each sector. There were six newcomers among University departments, though four departments which had been small users in 1968-69 made no calls on the Regional Centre in 1969-70. The total number of active University Departments in 1969-70 therefore rose by 2 to 58. In the Research Council sector there are 4 additions to the list—the NERC British Antarctic Survey Unit (which was transferred from the University to the aegis of NERC in October 1969), the M.R.C. Brain Metabolism Unit (associated with the University Department of Pharmacology), the A.R.C. Scottish Horticultural Research Institute in Dundee, and the A.R.C. Rothamsted Experimental Station (which as explained earlier in the Report has now an active direct link to the Regional Centre's 360/50). There were, therefore, 19 separate institutes or units making up the Research Council sector in 1969-70. The Research Council Users Committee, under the chairmanship of Dr Carter, also has a representative from the College of Agriculture. This is a convenient arrangement in view of the similarity of interests and problems, but the usage of this organisation is separately recorded within the category "Other Treasury-funded users".

**Charging and Allocation**

The Regional Centre was established in 1966 to provide computing services to the University of Edinburgh and to Research Council establishments in the region. The provisional division of interest and funding agreed in 1966 was 60 per cent. University, 40 per cent. Research Council, the Research Council funding being channelled through the Agricultural Research Council which operated a particularly large number of institutes in the Edinburgh area. The Executive Committee has kept this 60/40 ratio under review in the intervening four years. On the basis of statistics of past usage and the best estimates that could be formulated of the pattern of future usage,

the Executive Committee has decided that it would be appropriate to revise the University/Research Council ratio to 80/20 from 1st August 1970. This revised ratio is to operate for the remaining two years of the Quinquennium (to July 1972) when it would be subject to review, with the proviso however that if a substantial new Research Council-sponsored computing activity arose in the interim in the Edinburgh area the Regional Centre would be expected, if at all possible, to satisfy the requirements outwith the 20 per cent. share and with appropriate additional funding. With this possible exception, the Research Council sector hopes to continue to operate on a "block allocation" basis, without extending detailed charging or allocation procedures to individual institutes or units.

As explained in previous Annual Reports the University felt it necessary, particularly in view of the pressure on the Regional Centre resources available to University users, to operate some form of charging and allocation scheme. A first scheme, based on weekly allocations of time to each user department, was introduced in August 1968 and has been operated for two full years. It has served to make a start in alerting departments to the costs of computing and in bringing home to them the need for some rationing or control of this expensive resource. It operated, however, almost entirely through notional earmarked computing grants which could not be used for other kinds of expenditure, and therefore failed to present departments with a real economic choice. Indeed there is some evidence that departments have been using computers in ways in which they would not choose had they to bear the costs involved. Quite apart from the financial aspects, it would have become increasingly difficult to operate the allocation element of the scheme as facilities became multi-access and possibly multi-machine. The Executive Committee therefore accepted the proposals of its Charging and Allocation Sub-Committee that a revised charging scheme for computing time and services provided by the Regional Centre to University departments (for both teaching and research purposes) be brought into operation in 1970-71. This revised scheme will include a limited "real money" element—computer time will have to be paid for by departments but in 1970-71 the charges will be subject to a discount of 80 per cent. The intention for future years is to reduce this discount by stages to nil. Most other services, including data preparation, will from the outset be charged at full rates without discount. Other main elements in the scheme are:

(a) each department will have an initial free allowance of about £600 (a provision which will reduce the administrative overheads and will remove a possible disincentive to prospective new user departments);

(b) the detailed disbursement of funds to departments will be carried out by Faculties and not by the Charging and Allocation Sub-Committee;

(c) as an innovation a "standby" rate will be introduced for work submitted by users on the clear understanding that it will be handled only if the computers would otherwise be idle. The standby rate has been set at £6 per hour—the calculated marginal cost of keeping the machines switched on—and will not be subject to discount.

The scheme has been worked out in considerable detail and has also carried significant implications with regard to accounting procedures and the provision to departments of information for control purposes. Besides giving departments a choice in the deployment of their resources a "real money" scheme will, in the longer term, also provide more reliable indicators both to the University and to the financing bodies, the Computer Board and the University Grants Committee, on the demand for computing services and in particular on the rate of expansion of the Regional Centre. Nationally, a Working Party of the Computer Board has now begun to study the whole question of charging, both in Regional Centres and in the university system generally (and there would appear to be difficulties in introducing comprehensive charging arrangements only in the former). The Director of the Edinburgh Regional Centre is a member of this Working Party on which Research Councils are also represented; the problems raised by Edinburgh (and mentioned at some length in previous Annual Reports) should now receive adequate ventilation, and possibly our experience in operating the first charging and allocation scheme will also be of assistance to the Working Party in carrying out its study.

**Staffing and Organisation of the Regional Centre**

It is convenient to describe the other services and activities of the Regional Centre in 1969-70 in relation to the staffing and organisational structure. As the Centre has developed, its organisation has become more complex and it no longer seems sufficient to summarise its staffing in relation to only the 3 or 4 broad groups used in previous Annual Reports. The total numbers of staff in post at the beginning of each year have been:

| | |
|---|---|
| 1st August 1966 . . . . . | 9 |
| 1st August 1967 . . . . . | 70 |
| 1st August 1968 . . . . . | 108 |
| 1st August 1969 . . . . . | 134 |
| 1st August 1970 . . . . . | 150 |

The current deployment of these staff and of established posts which may be filled in 1970-71, is shown in the organisational chart on the following page.
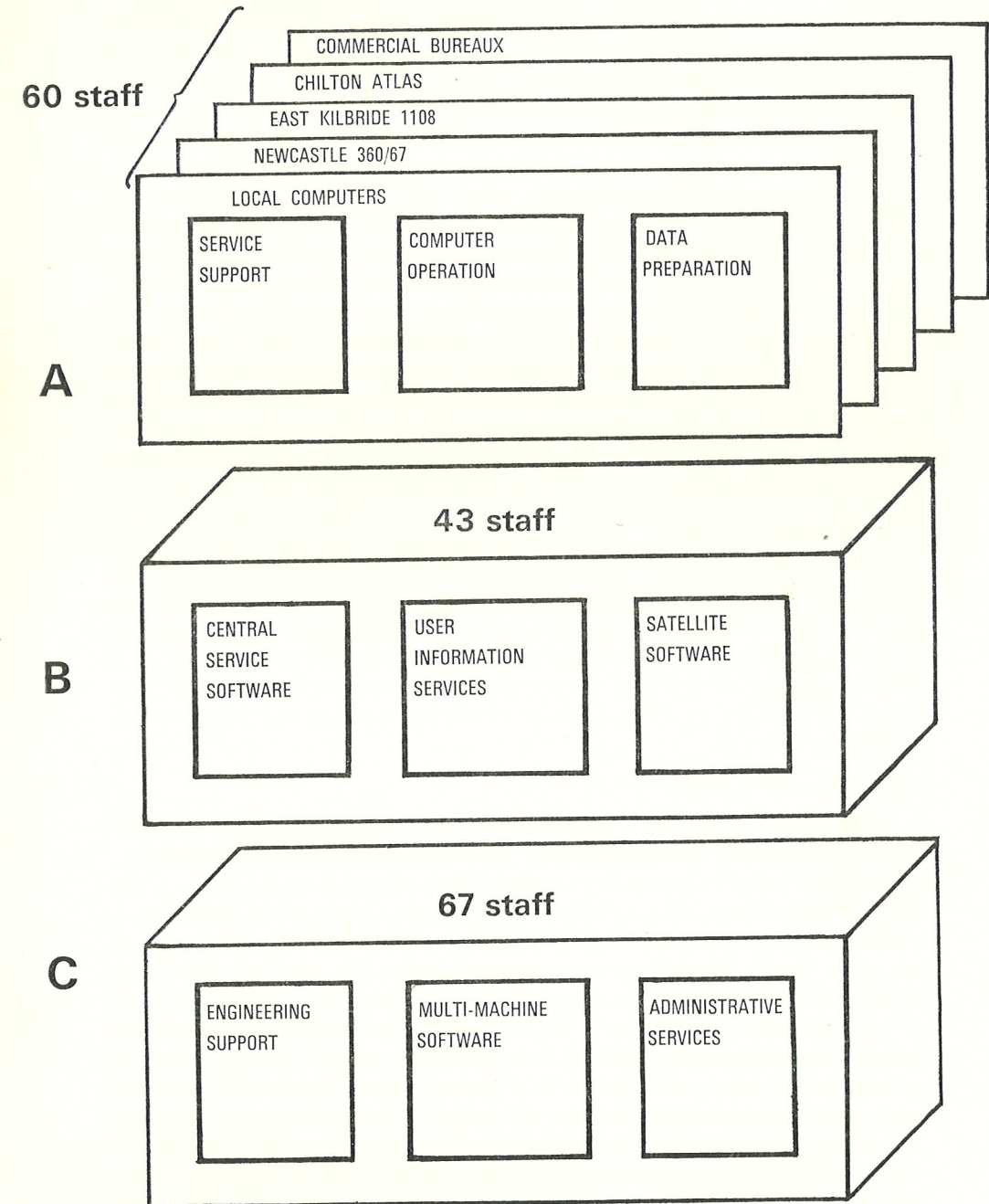
*Computer Operation*

The central and numerically greatest, block in Group A comprises the operating staff directly involved in running, or assembling work for, the local computers on a 3 or 4 shift basis; their functions are clear and further explanation of their role is unnecessary.

*Data Preparation*

The data preparation section has continued to operate both a full service and "do-it-yourself" facilities. This is based on Alison House, which also accommodates the 2780 terminal to the 360/50 or 360/67 and teletype terminals

## REGIONAL CENTRE STRUCTURE



60 staff

COMMERCIAL BUREAUX
CHILTON ATLAS
EAST KILBRIDE 1108
NEWCASTLE 360/67
LOCAL COMPUTERS

A

| SERVICE SUPPORT | COMPUTER OPERATION | DATA PREPARATION |

43 staff

B

| CENTRAL SERVICE SOFTWARE | USER INFORMATION SERVICES | SATELLITE SOFTWARE |

67 staff

C

| ENGINEERING SUPPORT | MULTI-MACHINE SOFTWARE | ADMINISTRATIVE SERVICES |

to the 4-75 and commercial time-sharing services, and house seminars and training courses. For 1970-71 a small pool of 10 card punches at King's Buildings will also be supervised by the Regional Centre. This equipment, which will be used primarily by undergraduate students, has been provided from University funds. Under the revised charging scheme users will have to pay for data preparation service or facilities at the full rates, and it is expected that this will be the first element of Regional Centre service where it will be reasonable to accept purely commercial arguments for extension or reduction.

### Service Support

The role of one part of this unit is to provide routine support in the handling of software and data in regular service use on the Regional Centre's machines. This includes the execution of routine tasks in the maintenance of software, in the transfer and archiving of data, and in the production of management records both for other units in the Centre and for users in general. The rapid resolution of technical problems that arise in the initial phases of using domestic software on the main service computers is the key aim of the three-man systems analyst/programmer team which forms the other part of this unit.

### User Information Services

This section covers not only the training courses run by the Regional Centre, and the administration of the library and software documentation, but also user support both in the general sense of assisting users to apply library programs to their own needs or advising users with difficulties on the local service compilers, and in the more specific sense of supporting special projects where users cannot do without a substantial programming contribution from the Regional Centre.

### Central Service Software

This section, under the direction of Mr P. E. Williams, has had responsibility for the use of IBM software on the 360/50 and for the development of communications software related to the remote terminals now on-line to the 360/50. This remit is now being widened to embrace similar functions in relation to the System 4-75. It is hoped that staff of ICL, of the manufacturers concerned with communication equipment, and of University departments will, where appropriate, engage in joint programming activities with the Regional Centre staff. In addition to the tuning and maintenance of the operating systems currently in use, which is engaging the attention of up to 6 programmers, this section is staffed to afford substantial support to users in the development and use of complete problem-solving packages. The aspect of the section's activities which requires greatest elaboration here is the research and development work on communications software which will involve a team of 3 programmers who will also be involved in the specifically communication aspects of the multi-machine or satellite software development work described later in the Report.

The Computer Board in May 1970 approved a grant of about £33,000 for the purchase of a peripheral processor for attachment to the 4-75 to provide additional communication facilities. The equipment finally selected for this function—after lengthy consideration of what was available both in the United Kingdom and the United States—was a Modular 1 manufactured by the British Company, Computer Technology Limited. The idea of peripheral processors for communications is not new, and there are already several installations in the United Kingdom relying on this method, usually where there is a need to support a large number of simple terminals or several fairly sophisticated terminals. The more normal communications multiplexor, such as the one ICL produce for the System 4 range, was considered too rigid in design, so that the later attachment of other types of terminal or the use of new methods of transmission were likely to prove both difficult and expensive; in addition, though a basic multiplexor is relatively cheap, the addition of each terminal is relatively expensive, so that in any but a small installation the cost of a communications multiplexor is roughly proportional to the number of terminals it can support. In contrast, the outstanding virtues of a peripheral processor are its great flexibility (essentially because it does many things by means of software which a multiplexor does by means of hardware), and the ease and cheapness of attaching new types of terminals or adopting new methods of transmission; by suitable design of interfaces and programming of the peripheral processor, it should be possible to attach even a completely novel type of terminal without affecting the system communications routines of the main computer. The Modular 1, which will initially have a configuration capable of permitting the attachment of up to 6 synchronous terminals, 4 Datel 600 terminals and 16 Datel 200 terminals, was delivered on schedule in October 1970, and its acquisition will be an important factor in planning and effecting the transfer of departmental satellites from the 360/50 to the 4-75.

### Satellite Software

Another significant capital addition to the Regional Centre's equipment is a general-purpose satellite processor, approved in principle by the Computer Board in December 1969. It took, however, several months to agree the exact specification of this equipment, particularly in view of the considerable advantages which, in the Regional Centre's opinion, would accrue from the installation of American equipment. Finally a PDP15/VT15 satellite and graphics system from the American manufacturer, Digital Equipment Corporation, was ordered, at a total cost of about £80,000, for delivery to Edinburgh in December 1970. A British Standard Interface unit has been ordered from ICL to effect the connection of the satellite processor to the 4-75.

Essentially the role of the satellite processor will be to cater for several areas requiring much faster response from the 4-75 than can sensibly be provided solely by the use of the high-speed data channels of the 4-75 itself. Firstly there is an increasing number of real-time peripheral devices recording

continuously varying (analogue) signals on magnetic tape where a guaranteed response time from a digital computer is essential. Secondly, for interactive graphics work rapid transfers are needed to maintain a conventional cathode-ray tube display and to handle associated graphical output, and even in less demanding graphics work using storage cathode-ray tubes the availability of the 4-75 as a back-up facility will be highly valuable. Thirdly the satellite processor will have an important role to play in facilitating fast transfers between the 4-75 and departmental computers.

Dr J. G. Burns, as head of the satellite software section, will have responsibility for the development of software and services on the graphics/analogue to digital satellite and in this he will have a team of about 8 programmers. Wherever possible the software developed and experience obtained will be exploited in similar installations in user departments. Dr Burns himself holds his appointment jointly in the Regional Centre and in the Department of Physics, which itself is planning a similar PDP15 installation to serve a variety of intradepartmental needs.

### Engineering Support

This section of engineers and technicians under the direction of Mr F. E. J. Barratt undertakes the local development and maintenance of equipment which is not readily provided, or supported, by the computer and communications industries. Where locally developed equipment is required in quantity arrangements will be made for contracting out the routine production processes and for the sale of manufacturing rights to local industry.

The potential value of both hardware and software developed by the Regional Centre—which has already devoted very substantial staffing resources to research and development work, and hopes to continue to do so—has been considered sufficiently great to justify the deployment of a senior member of staff, Mr R. E. Day, as marketing manager primarily concerned with the commercial exploitation of the resources and products of the Centre which are applicable to similar computing installations elsewhere. It is envisaged also that support may be available through Mr Day for local users wishing to exploit related products.

### Administrative Services

An essential part of the infrastructure of the Regional Centre is formed by the administrative services. In the past year the reprographic facilities have been considerably improved and these, and to some extent other services, are likely to be developed further in the near future to meet the needs of the whole Physics/Mathematics Institute, of which the Regional Centre occupies the first, and relatively small, phase.

### Multi-machine Software

The Edinburgh Regional Centre was identified in the original Flowers Report as a suitable location for the development of advanced systems software. The most immediate result of this recommendation was the establishment in 1966 of the Edinburgh Multi-Access Project, as a collaborative

exercise of ICL and the University (with Ministry of Technology support) to produce an advanced multi-access system for use on the Regional Centre's 4-75. In parallel with the Project (the progress of which is reported in the next section) the Regional Centre has itself devoted very substantial effort and resources to the development of systems software. The Regional Centre has always had before it the task of assimilating the EMAP software components into a service environment, and throughout the progression of machines available to it since 1966—that is, the KDF9, 360/50, 4-75 and in prospect the "new range" of ICL machines—a main aim has been to produce as smooth transitions as possible for the users. The schedule of software development now embarked upon to exploit to the full the potential of the 4-75 and to ease the progression to the ICL "new range", is a substantial one and this is not the place to elaborate upon its content. If Regional Centres have a special role to play in the developing structure of university computing services it is probably to be found in this ability to concentrate resources on major development problems, the successful solution of which should be beneficial to other installations, in this case both other System 4 users and users of IBM 360 systems. Organisationally, Mrs Barritt as Principal Consultant has the task of co-ordinating the work of three identifiable sub-sections of the multi-machine software group covering (1) supervisors, new range software and IMP-type languages; (2) operating systems packages and Fortran-type languages; (3) software architecture generally, the last to a large extent drawing together staff from the other subsections; in total about 15 senior staff are likely to be committed to this work plus, it is hoped, some ICL staff based on the new ICL establishment at Dalkeith.

Also within the Multi-Machine Software Group is a scientific software section, whose remit is to complement Departments such as Computer Science and Mathematics and Research Council units such as the A.R.C. Unit of Statistics, by offering limited services in numerical computing, providing a focus for the collection of numerical library programs and routines and pursuing research and development in selected fields pertinent to achieving these aims. Again, the general philosophy will be to produce software designed for fluent transfer across System 4-75 and IBM 360 and ICL "new range" installations, which should be of benefit outside the Regional Centre.

## Edinburgh Multi-Access System (EMAS)

After 4 years the Edinburgh Multi-Access Project, located in the Department of Computer Science, came formally to an end on 30th September 1970. As a major collaborative exercise between the University and the manufacturer, ICL, it has been an illuminating venture, and undoubtedly both sides have derived benefits. From the narrow point of view of providing a multi-access service on the 4-75, however, it is disappointing to have to report that the end-product of the Project still requires a substantial further amount of development work on the paged supervisor and its file system before the Regional Centre can be expected to offer a secure multi-access service on it.

Although the teaching staff of the Department of Computer Science who have been on secondment to the Project will continue the development of the supervisor as part of their research work, and within the limited allocation of time that can be made available on the 4-75, it is improbable that a reliable multi-access service based on EMAS can be mounted by the Regional Centre before October 1971.

**Future Development**

General question marks continue to hang over the future of the Regional Centre. The relevance and timing of the ICL new range are little clearer than they were a year ago. The replacement of the KDF9 at Glasgow University has been engaging the attention of the Computer Board for many months, and the outcome of this issue will carry significant, and possibly overwhelming, implications for Edinburgh. The Executive Committee supports the need for major developments in Glasgow to complement the Edinburgh Regional Centre and has expressed its willingness to consider even radical redefinition of the Regional Centre's role and scale of development, if computing services for the Scottish Universities and Research Council establishments can thereby be more effectively provided. In the next Annual Report it is hoped it will at least be possible to describe a pattern of development for the Regional Centre for the ensuing 5-7 years which will be free from such major question marks.

**APPENDICES**

ANALYSIS OF

USAGE 1969-70

| Category of user | No. of registered users | 360/50 | | 4-75 | | (Newcastle University) 360/67 | | (Chilton) Atlas | | (National Engineering Laboratory) 1108 | | Data Preparation Service | | Access to Data preparation equipment | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins | No. of jobs | Time used hrs/mins |
| Total—Groups 1-6 | 2,349 | 81,666 | 3147:53 | 1,454 | 215:32 | 1,496 | 39:24 | 12 | 0:59 | 891 | 81:15 | 4,746 | 5849:58 | 28,984 | 18057:10 |
| Total—Groups 1-9 | 2,833 | 114,739 | 4049:24 | 26,686 | 3408:33 | 2,047 | 59:20 | 163 | 5:07 | 1331 | 96:37 | 5,124 | 6268:38 | 31,652 | 19245:00 |
| 1. University of Edinburgh (excluding undergraduate teaching) | 524 | 33,550 | 1901:20 | 716 | 146:03 | 1,000 | 27:05 | 5 | 0:33 | 877 | 80:51 | 2,734 | 3645:37 | 3,249 | 2361:36 |
| 2. University of Edinburgh—undergraduate teaching | 1,411 | 25,738 | 382:36 | 397 | 23:44 | 77 | 0:24 | — | — | — | — | 171 | 111:50 | 24,202 | 13739:41 |
| 3. Other Universities | 19 | 658 | 5:23 | — | — | 21 | 0:03 | — | — | — | — | 573 | 562:26 | 452 | 612:45 |
| 4. Research Councils | 229 | 18,529 | 759:34 | 300 | 36:07 | 21 | 0:04 | 7 | 0:25 | 14 | 0:24 | 927 | 1184:57 | 494 | 609:17 |
| 5. Other Treasury funded users | 27 | 2,057 | 50:16 | 12 | 0:22 | 377 | 11:48 | — | — | — | — | 177 | 211:45 | 347 | 557:38 |
| 6. Commercial users | 29 | 1,134 | 48:44 | 29 | 9:16 | — | — | — | — | — | — | 164 | 133:23 | 240 | 176:13 |
| 7. Multi-Access Project | 32 | 43 | 0:31 | 8,797 | 1420:14 | — | — | — | — | — | — | 6 | 19:55 | — | — |
| 8. Regional Centre Staff | 151 | 29,011 | 878:32 | 16,435 | 1772:47 | 545 | 19:55 | 151 | 4:09 | 440 | 15:22 | 305 | 357:20 | 59 | 25:15 |
| 9. Training supported by Regional Centre | 301 | 4,019 | 22:28 | — | — | 6 | 0:01 | — | — | — | — | 67 | 41:25 | 2,609 | 1162:35 |

*Note:* Time used is expressed in each case in hours/minutes as recorded on the particular machine.

## ANALYSIS OF KDF USAGE

### (March 1967, March 1968, March 1969) and 360/50 USAGE (March 1970)

| | KDF9 March 1967 | KDF9 March 1968 | % Increase | KDF9 March 1969 | % Increase over March 1968 | 360/50 March 1970 | % Increase over March 1969 |
|---|---|---|---|---|---|---|---|
| **Total—Groups 1-6:** | | | | | | | |
| No. of users | 273 | 663 | | 562 | | 595 | |
| No. of jobs | 3,417 | 7,518 | | 8,429 | | 10,199 | 21 |
| Time used (hrs/mins) | 152:52 | 349:32 | 129 | 410:52 | 17 | 369:17 | |
| **1. University of Edinburgh (excluding undergraduate teaching):** | | | | | | | |
| No. of users | 149 | 248 | | 161 | | 169 | |
| No. of jobs | 2,259 | 3,089 | | 3,281 | | 4,024 | 23 |
| Time used (hrs/mins) | 119:44 | 209:36 | 76 | 203:43 | −3 | 217:57 | |
| **2. University of Edinburgh—undergraduate teaching:** | | | | | | | |
| No. of users | 93 | 245 | | 334 | | 303 | |
| No. of jobs | 530 | 2,059 | | 3,465 | | 3,648 | 5 |
| Time used (hrs/mins) | 6:25 | 37:32 | 500 | 50:02 | 32 | 57:47 | |
| **3. Other Universities:** | | | | | | | |
| No. of users | — | 114 | | 1 | | 15 | |
| No. of jobs | — | 1,128 | | 4 | | 90 | >1000 |
| Time used (hrs/mins) | — | 35:37 | — | 0:06 | −100 | 1:11 | |
| **4. Research Councils:** | | | | | | | |
| No. of users | 26 | 47 | | 56 | | 90 | |
| No. of jobs | 553 | 1,046 | | 1,538 | | 2,178 | 42 |
| Time used (hrs/mins) | 25:06 | 57:30 | 130 | 149:34 | 159 | 85:08 | |
| **5. Other Treasury-funded users:** | | | | | | | |
| No. of users | 2 | 6 | | 6 | | 11 | |
| No. of jobs | 22 | 81 | | 115 | | 183 | 59 |
| Time used (hrs/mins) | 0:34 | 4:40 | 800 | 2:54 | −38 | 2:13 | |
| **6. Commercial users:** | | | | | | | |
| No. of users | 3 | 3 | | 4 | | 7 | |
| No. of jobs | 53 | 115 | | 26 | | 76 | 192 |
| Time used (hrs/mins) | 1:03 | 4:37 | 350 | 3:33 | −1 | 5:01 | |

## LIST OF USER DEPARTMENTS

(a) *University of Edinburgh*

Agriculture
Architecture
Astronomy
Bacteriology
Biochemistry
Botany
Business Studies
Centre of African Studies
Chemical Engineering
Chemistry
Child Life and Health
Chinese Studies
Civil Engineering
Computer Science
   Computer-Aided Design
Criminal Law and Criminology
Dictionary of the Older Scottish
   Tongue
Economics
Educational Sciences
Education Research Unit
Electrical Engineering
Forestry and Natural Resources
Genetics
Geography
Geology
Geophysics
Human Genetics
Linguistics
Machine Intelligence and Perception
Mathematical Physics

Mathematics
Mechanical Engineering
Medical Physics
Medicine (Royal Infirmary)
Medicine (Western General)
Metamathematics
Meteorology
New Testament Language
Ophthalmology
Pharmacology
Physical Education
Physics
Preventive Dentistry
Psychiatry
Psychology
   Applied Psychology Unit
Radiodiagnosis
Respiratory Diseases
Secretary's Office
Seismology
Social Anthropology
Social Medicine
Sociology
Statistics
Urban Design and Regional
   Planning
Veterinary Pathology
Veterinary Physiology
Zoology

(b) *Research Council Institutes*

ARC   Animal Breeding Research Organisation
ARC   Unit of Animal Genetics
ARC   Animal Diseases Research Association
ARC   Hill Farming Research Organisation
ARC   National Institute of Agricultural Engineering
ARC   Poultry Research Centre
ARC   Rothamsted Experimental Station
ARC   Scottish Horticultural Research Institute
ARC   Unit of Statistics
ARC   Scottish Plant Breeding Station
MRC   Unit for Research in the Epidemiology of Psychiatric Illness
MRC   Brain Metabolism Research Unit
MRC   Clinical and Population Cytogenetics Research Unit
MRC   Speech and Communication Research Unit
MRC   Clinical Endocrinology Research Unit
NERC   Oceanographic Laboratory of the Scottish Marine Biological Association
NERC   Institute of Geological Sciences
NERC   British Antarctic Survey Unit
SRC   Royal Observatory

## Financial Statement for the year 1st August 1969–31st July 1970

### Expenditure

| | £ | s. | d. |
|---|---|---|---|
| Salaries, National Insurance and Superannuation | £228,347 | 3 | 2 |
| Travel and Subsistence | 6,357 | 0 | 1 |
| Rental of IBM and ICL Equipment | 17,280 | 0 | 0 |
| Hire of Computer Time | 7,194 | 0 | 0 |
| General Expenses | 121,151 | 17 | 9 |
| University Fixed Charges | 27,400 | 0 | 0 |
| | £407,730 | 1 | 0 |

### Income

| | £ | s. | d. |
|---|---|---|---|
| Sale of Computer Time and Services | £118,381 | 15 | 6 |
| Sale of Materials | 20,200 | 0 | 2 |
| Balance of Expenditure over Income shared by: | | | |
| Agricultural Research Council | 107,659 | 6 | 2 |
| University of Edinburgh | 161,488 | 19 | 2 |
| | £407,730 | 1 | 0 |

*Note:* In addition the Computer Board provided grants to meet the rental costs for both the KDF9 and the 360/50.

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