

UNIVERSITY OF EDINBURGH

EDINBURGH REGIONAL
COMPUTING CENTRE



Fifth Annual Report

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Note: The publication of this Report, which covers primarily the year 1st August 1970 to 31st July 1971, has been delayed, for several reasons, and the opportunity has therefore been taken to insert references to certain important developments in the period up to February 1972. The principal insertion has been printed in italics.

CONTENTS

Current Membership of the Executive Committee	4
Senior Staff of the Edinburgh Regional Computing Centre	5
Introduction	7
Hardware	8
Data Transmission and Program Transfer	9
Communications Division	9
Edinburgh Multi-Access System (EMAS)	11
Computer Services	13
Analysis of Usage	13
Charging and Allocation	15
Staffing and Organisation of the Regional Centre	15
Future Development	16

APPENDICES

A. Computers in the Edinburgh Research Council University Community (March 1972)	18
B. (i) Analysis of Usage 1970-71	21
(ii) List of User Departments	22
C. Financial Statement	24

EXECUTIVE COMMITTEE 1970-71

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M. M. SWANN, LL.D., F.R.S., Principal and Vice-Chancellor of the University of Edinburgh

Deputy Chairman

N. KEMMER, M.A., DR.PHIL., F.R.S., Professor of Mathematical Physics, University of Edinburgh (to 31st March 1971)

Director of the Regional Centre

G. E. THOMAS, B.SC., M.SC., PH.D., M.I.E.E. (*ex officio*)

P. VANDOME, M.A., Professor of Econometrics, University of Edinburgh

S. MICHAELSON, B.SC., A.R.C.S., Professor of Computer Science, University of Edinburgh

T. C. CARTER, O.B.E., M.A., PH.D., D.SC., F.R.S.E., Director, A.R.C. Poultry Research Centre (to 24th January 1971)

N. W. SIMMONDS, SC.D., A.I.C.T.A., F.R.S.E., F.I.BIOL., Director, Scottish Plant Breeding Station (from 25th January 1971)

H. P. DONALD, D.SC., PH.D., F.R.S.E., Director, A.R.C. Animal Breeding Research Organisation

G. M. BURNETT, D.SC., B.SC., PH.D., Professor of Chemistry, University of Aberdeen

A. BALFOUR, M.A., F.I.M.A., F.B.C.S., Professor of Computer Science, Heriot-Watt University

D. J. NEWELL, M.A., PH.D., Professor of Medical Statistics, University of Newcastle upon Tyne, and member of the Computer Board

J. B. SMITH, M.A., B.SC., Ferranti Ltd., Edinburgh

E. A. V. EBSWORTH, SC.D., M.A., PH.D., Professor of Chemistry, University of Edinburgh (from 1st April 1971)

Assessors

C. H. STEWART, O.B.E., J.P., M.A., LL.B., C.A., Secretary to the University of Edinburgh

SIR GORDON COX, K.B.E., T.D., D.SC., F.R.S., Secretary of the Agricultural Research Council

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 1971)

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. E. J. C. READ, B.SC., PH.D. P. D. STEPHENS, B.A. D. B. TAYLOR, B.SC., D.PHIL. 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. G. M. STACEY, B.SC., PH.D. J. K. YARWOOD, M.A., M.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. S. HAYES, B.A. R. B. JOHN, B.A. R. G. KIRSOPP, B.SC., PH.D. R. R. MCLEOD E. R. MANSION, B.SC. A. D. NOLAN, B.SC. H. R. REIGER J. B. A. WEXLER, B.A.
Programmer	Mrs L. D. AITKEN, B.SC. J. W. ALLAN, B.SC. P. W. ALLAN Miss P. BALLAM, B.SC. J. I. DAVIES, B.ENG. 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.

	Miss D. F. INGLIS
	J. B. O. JAMIESON, B.SC.
	Miss F. A. KELLY, M.A.
	C. D. MCARTHUR, B.SC.
	N. K. MOOLJEE, B.SC.
	Mrs M. L. MURBACH, B.S.
	B. R. MURDOCH, B.SC.
	J. M. MURISON, B.SC.
	N. H. SHELNESS, B.A.
	D. J. W. STONE, M.SC.
	T. C. WAUGH, B.SC.
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
User Liaison Officer	Mrs V. LAING

FIFTH ANNUAL REPORT

The final sentence of the Fourth Annual Report expressed the hope that it would be possible in this year's Annual Report to describe a pattern of development for the Regional Computing Centre for the next five to seven years which would be free of certain major question marks. Unfortunately, this hope has not been realised. In particular, the question of the replacement of the KDF9 computer at Glasgow University remains politically undecided and this is all the more regrettable in that considerable progress has been made in the past year towards the development of a wider regional computing organisation which would be responsible for providing the main computing services for Glasgow and Strathclyde Universities as well as for the present principal partners of the Edinburgh Regional Computing Centre, the University of Edinburgh and the Research Councils.

Glasgow University, at the Computer Board's invitation, first submitted proposals for the replacement of its KDF9 computer more than two years ago in 1969. The Computer Board, in line with its general policy to encourage regional groupings of universities, subsequently urged the Scottish universities, and in particular Glasgow, Strathclyde and Edinburgh, to give serious consideration to the advantages of a communal approach to the problems of providing a smoothly progressing computer service—an approach indeed that had attracted a wide measure of agreement among the Scottish universities even before the establishment of the Computer Board. Again there was general support for joint development with sympathetic recognition of the difficulties likely to be faced by the less central universities. The result of the discussion was a joint submission dated 31st December 1970 to the Computer Board from the Universities of Glasgow and Edinburgh, which proposed the establishment of a regional computing organisation whose computing resources would be based on two main foci, one at Edinburgh (the Edinburgh Regional Computing Centre) which in the short-term would be concentrated on the ICL System 4-75/PDP15 complex and in the longer-term would become an early operator of the ICL New Range, and one at Glasgow which it was recommended should as soon as possible be equipped with an IBM 370/165 at a cost of about £1.7 million, including significant linked equipment at Strathclyde. The Computer Board for its part approved this proposal at its meeting in January 1971, but final Government approval is still awaited.

The consequences of this delay have obviously been greatest in Glasgow and Strathclyde Universities, but the repercussions on the Edinburgh Regional Centre have also been significant. Although the Computer Board has willingly extended the rental of the 360/50 on a month by month basis, and although the 4-75 installation has made an increasing contribution towards meeting the general service needs of the user community, the Centre's computing resources are once again in a saturated condition and users are once again inhibited both in the short-term by the increasing delay in turn-round and in the longer term by the continuing uncertainty about future machine provision, with all the implications for project and program planning.

The Executive Committee for the Edinburgh Regional Computing Centre

has been very conscious that if Glasgow is not permitted to install the 370/165 but is required to accept equipment such as the ICL 1906A, which is essentially incompatible with the System 4-75, some alternative means will have to be found to plug the gap until the ICL New Range projected for Edinburgh can reasonably be expected to meet the computing needs of the Edinburgh user.

The uncertain delay in receiving the crucial Government decision on the 370/165 proposal has been the major reason for the late publication of this Report. After many months in which early resolution of the question was expected, the Executive Committee decided in January 1972 to submit to the Computer Board a proposal for the replacement of the Regional Centre's 360/50 by a rented 370/155 as an interim provision. The Computer Board, in the knowledge that further delay on the main proposal was inevitable, approved this proposal in February 1972, as a joint provision to cover the interim needs of Glasgow and, it was hoped, Strathclyde, as well as of the present partners in the Edinburgh Regional Centre. The 370/155 will be installed in August 1972 for a period of one year.

The progress of the Edinburgh Regional Computing Centre has, therefore, been retarded in the year under review but it has not been halted, and the remainder of this Report will try to describe more positively the Centre's continuing development.

Hardware

The major novel addition to the Regional Centre's capital resources in the year under review has been a PDP15/VT15 satellite and graphics system whose projected role was described in last year's Report. The delivery of equipment for the basic installation was completed in September 1971 with the delivery of the interface to the 4-75, although the link has not yet been fully commissioned. The emphasis will be on developing the PDP15 and the 4-75 as one complex, to provide an interactive graphic service where the user's program can in certain circumstances reside in the 4-75, as well as facilities for meeting the demanding real time requirements of analogue/digital conversion for which the PDP15 has a comprehensive range of equipment already under test by the first major user, the Seismological Unit of the Institute of Geological Sciences.

The third main function projected for the PDP15 Satellite processor, to facilitate fast transfers between the 4-75 and departmental computers, has been partially overtaken by further advances in the Regional Centre's plans for communications development. In terms of hardware this has stemmed from the role of the Modular One as a communications processor connecting the 4-75 to the 360/50, which the Computer Board approved in May 1970 and which was delivered in October 1970. The Computer Board subsequently invited the Regional Centre to present proposals for further development work on communications which would not only have specific relevance to the local Edinburgh or Central Scotland scene but would be likely to benefit other major computing centres or groupings.

Data Transmission and Program Transfer

The complexity of the computing environment at Edinburgh is remarkable in two respects—the number and variety of communication links that are now in operation or are projected, and the rate of migration of users, their programs and their data between systems of different design and manufacture. The Regional Centre has had to supplement substantially the provisions of the manufacturers and to introduce and enforce certain hardware and software standards irrespective of a particular manufacturer's current provision. One result of this has been that the Centre has assembled a substantial complement of uniquely qualified staff, and the Executive Committee has been concerned to see the continued deployment of their expertise not only to ease the local problems of Edinburgh, which will certainly be a "mixed machine" environment for some years yet, but also to produce results that will be of benefit to other centres.

Communications Division

In communications development, the Centre has formed a close liaison with Computer Technology Limited. The fruits of this liaison became evident in September 1971 when the Computer Board approved a proposal from the Centre for the purchase of two Satellite One Model 10 remote job entry terminals, one for installation in Alison House, the Centre's data preparation and job submission unit in the central area of the University, and the other for installation in Glasgow University. In the case of Alison House this equipment is the culmination of a series of rented remote job entry terminals serviced by the Newcastle University 360/67 as well as the local 360/50. The Centre is now satisfied, however, that the Satellite One range can be looked upon as a permanent provision capable of progressive expansion into more comprehensive terminals; moreover, it is capable of responding to ICL, IBM or CDC communications protocol, and the installation is therefore to this extent machine independent. Although in cost performance terms, the Model 10 system is undoubtedly inferior in the Edinburgh environment to specially assembled PDP8 or PDP11 configurations, the Centre (and presumably the Computer Board) looks upon this as an excellent opportunity to support and assist a British company which is attempting to develop a comprehensive range of satellite facilities and then to provide the necessary full manufacturer support. In the long term this product should be of relevance and benefit to other universities and research institutes in similar situations where the means of local access to a remote service is provided by the Computer Board.

The immediate aim is to expand the Alison House Satellite One to combine remote job entry facilities with the ability to construct and edit files held on local disk storage to provide a type of conversational remote job entry system. The central concept now adopted by the Centre's communications team recognises the essentially distributed nature of future computer networks and is aimed at the design and provision of a communications processor which can be used at a number of "nodes" in a network of dissimilar computers. As such it would aim to provide users of any computer or terminal in the network

with ready access to any of a number of attached computers, both host and satellite. This would give users a range of facilities far greater than they could hope to obtain from a single central machine and would permit the concentration of specialised services on a Regional or National basis. The intended implementation does not demand any special hardware or software in any machine installed in the network, but will make use of each machine's standard communications hardware and software. The advantage of this system is that it requires modest expenditure and provides considerable flexibility of interconnection. It enables the problems of networking to be examined while still providing many of the fruits. It follows, however, that the facilities available to the user of the network are restricted to those which are provided through the communication software of the machines he is accessing and are further limited (though probably not very seriously) by any character set incompatibilities. These are in most cases not very serious limitations and are likely gradually to disappear as facilities and character sets become more standardised between machines. The implementation will not be concerned with the production of any "front-end" processors intimately connected to a main computer, a development which, however, would have many similarities and would certainly not be incompatible.

The node processor project is a logical development of the current project to concentrate via a communications concentrator the medium speed network now connected to the 360/50 and later to be routed to the interim 370/155 installation and to connect to the 4-75. It envisages the phased development of a node processor based, like the communications concentrator, on a Modular One computer, and again the Centre is happy to be actively collaborating with Computer Technology Ltd. in a significant and potentially fruitful development.

The preceding paragraphs have concentrated on the new communications directions in which the Centre is anxious to embark. Of more immediate significance to users are the projects currently in progress. As mentioned above, the communications concentrator project has been active throughout the period of review and will be completed with the installation of the 370/155. It has provided illuminating experience in the use of a high level language for system software on a small machine, and has yielded the IBM 2780 simulator package for the Modular One, which is of interest to Computer Technology Limited, and was first used by the MRC Cytogenetics Unit on its Satellite One installation in Edinburgh. The Centre's synchronous communications interface, originally designed for the PDP8, has been adapted for ICL 4100 series computers and successfully used to attach the ICL 4120 at Napier College of Science and Technology as a remote job entry terminal to the Centre's 360/50. Six production versions of the communications interface have been constructed by a local company and are in use on departmental PDP8's, including soon the Department of Physiology at Glasgow University. Progress has also been made with the development of a unit to provide automatic answering facilities for teletypes on the System 4-75. Production versions, engineered for economical construction in modest numbers will be produced for all the Datel 200 buffers on the 4-75. The Communications Division is also required from time to time to interface special pieces of equip-

ment, usually to small computers being used as terminals—two recent examples have been an IBM Selectric typewriter (required for documentation) and a mark-sense reader (for multiple choice examination papers and survey questionnaires).

In many of these activities it is expected that benefit will accrue to users outside the Edinburgh area. It is perhaps worth emphasising, however, the present scale of the Edinburgh computing community which has already come to rely heavily on communications facilities. Appendix A lists the computers and remote job entry equipment presently installed in University departments and Research Council institutes associated with the Edinburgh Regional Centre. Of the total of 52 existing installations, 18 currently have the facility to intercommunicate via medium or high speed interconnections. Appendix A also includes diagrams indicating the present basis of the Edinburgh network and the revised network that will result from the successful completion of the Modular One project following the installation of the 370/155.

Edinburgh Multi-Access System (EMAS)

The year under review may be divided into two main periods. In the first, which ended in January 1971, development of the supervisor and its file system was continued by members of the Department of Computer Science and of the Regional Centre, while, in parallel, an evaluation was conducted to decide whether to continue the attempt to provide a reliable service under EMAS. The evaluation confirmed that the supervisor and general structure of the system were capable of providing a reliable and sophisticated service and the decision to proceed was taken against a background of reservation as to hardware reliability.

The remainder of the year saw continued development with the target, as projected in the last report, of providing a user service by October 1971. The performance of the fixed disk, discussed in detail elsewhere, proved the main hurdle in achieving this objective, but by the end of the period a multi-access service was being provided and was expanding steadily in both numbers of accredited users and in hours of service time.

It is now projected that during the year 1971-72 there will be a progressive move towards a 24-hour EMAS service, a target which should be substantially achieved by October 1972. However, although considerable effort has been and is being devoted to recovery, diagnostic and test procedures, the unreliability of the hardware, despite intensive efforts by ICL, remains a major disquiet. In any multi-access system the console user is conscious of, and disrupted by, any unscheduled break in the service and the present situation with a mean time of only 5 hours between hardware crashes, compared with 40 hours for software, is barely tenable.

Multi-Machine Software, Program Library Provision and Service

Now that the work involved in establishing a full user service on the EMAS multi-access system on the System 4-75 has been substantially completed, the multi-machine systems group (which previously held responsibilities for

operational development and subsystem provision for the various stages of user transfer from the KDF9, through IBM 360 machines, to the 4-75) has been re-aligned for the next quinquennium. The head of the group, Mrs Barritt, supported by a nucleus of six senior staff concerned with computing methods, has reverted to concentrating on standard program library material and services and is now directing a Program Library Unit as a focus for this work. The remainder of the group is supporting Dr Burns on the EMAS supervisor and IMP compiler, and on subsystems to provide continuity through to standard IBM operating systems for FORTRAN programs and data files; subsystem designers are also assigned to investigation of ICL New Range and other facilities.

The Program Library Unit has completed the cataloguing and registration of the original work (software and algorithms) and support, which constitutes the current ERCC Library provision and service on the 4-75 and 360/50 (PLU Report 1). This covers about 700 items or facilities from packages, programs or subroutine libraries. Two reference rooms for advisory services and publications are supported, one at King's Buildings and one in the Adam Ferguson Building, George Square, particularly related to the needs of the Faculty of Social Sciences.

In a wider context, liaison has been established with the Working Party of the six London Colleges on the London Computer Index, and with Bristol and the South-West Universities, for the purposes of producing a national catalogue of University Program Library material. A simple disk-based system provides this information on access through remote job entry to the 360/50 in Edinburgh.

Extension of the existing service and of the Program Library content is dependent on approval by the Computer Board of a subsidy to increase the available resources. Discussions have taken place through the year with members of the Board and with the Secretary to the Board and also with other Library Groups, such as the Nottingham Algorithm Group, and with other Universities. In this connection, the Edinburgh Group, which includes members from Glasgow and Rothamsted, is concentrating on packages which support teaching and research in fields of which the members of the Group already have experience. A Program Package Working Party, set up with a view to building on past experience and for direct liaison with ICL on New Range characteristics, is endeavouring to establish in service certain U.K. packages (originating in Rothamsted, Edinburgh, Strathclyde or Glasgow) both on presently available machines and, where required, on other machines and systems, including ICL New Range. In regard to subroutine libraries, the main effort lies in collaborative working with Cambridge and others to produce a byte version of the NAG subroutine library, initially on IBM machines and thence on the System 4 and ICL New Range. Using this basic work as a focus locally, the Unit is concentrating on workshops and seminars and other support to teaching computer applications which particularly serve the needs of the Edinburgh Research Council institutes and the Faculty of Social Sciences, where interdisciplinary needs linked with new or large computer packages are most likely to arise.

Computer Services

The main computing services have continued to be provided by the 360/50 and the System 4-75. A little extra throughput has been squeezed out of the 360/50, by means of minor organisational or system changes and much increased weekend working, but for reasons set out in last year's Annual Report there remained only limited scope in this respect, and the larger share in meeting the growth in demand has had to be taken by the 4-75. As the statistics in Appendix B show, although a very substantial portion of the 4-75 was again diverted to development work, the time consumed by general users was slightly in excess of 2,000 hours over the year, and at a significantly higher annual rate in the latter part of the year. This increase was despite periods of hardware breakdowns (which were however mostly related to the large fixed disc and therefore hindered multi-access development work more than the batch processing service). The reliability of the 360/50 was more consistent, with average downtime as a result of hardware faults being possibly slightly less than the 3.5 per cent of total hours worked quoted in last year's Report. At its best, however, the 4-75 achieved a comparable performance except in relation to the large fixed disc and the replaceable disk units. The viability of the 4-75 as a service machine devoted primarily to on-line computing will however depend heavily on the reliability of the large fixed disc, and it is clear that the resolution of this major hardware issue and the general problem of achieving adequate system reliability will continue to concern the Regional Centre, ICL and the Computer Board for at least the next year.

Of the three off-site machines regularly used by the Regional Centre, the Univac 1108 operated by the National Engineering Laboratory at East Kilbride has been the most heavily used. An average load of 2 hours per week on this powerful processor is of particular value to those users with heavy demands for C.P.U. time. If for financial reasons rather than lack of physical capacity, the Regional Centre and other Scottish universities are during 1971-72 debarred from continued use of this facility, there will be a considerable gap to make good. The most promising replacement, at least for some major users, will be the 370/195 installation at the Science Research Council's Rutherford Laboratory. The Regional Centre's use of Newcastle University's 360/67 has again decreased but the link remains a valued one. The use of the Chilton Atlas has reduced to internal use by the staff of the Regional Centre only.

In addition to the well-established data preparation services operated by the Regional Centre both at Alison House and at King's Buildings, and various support services described in some detail in the last Report, the Centre during the year under review commenced services on the PDP15, initially as a stand-alone machine but prospectively as a satellite to the System 4-75. Interactive graphics and the conversion to digital form of data recorded on analogue magnetic tape have been the primary objectives.

Analysis of Usage

Appendix B (i) summarises the usage statistics for the full year 1970-71 for the 360/50 and the 4-75, and for the two main off-site computers, the

Newcastle University 360/67 and the National Engineering Laboratory Univac 1108.

By the use of rough conversion factors for the off-site machines, it is possible to calculate that in total users of the Regional Centre enjoyed in 1970-71 an increase of 70 per cent in the computing time consumed in comparison with 1969-70. The analysis by category of user produces the following table (which incorporates comparative figures for the preceding three years):

	1967-68	1968-69	1969-70	1970-71
	%	%	%	%
1. University of Edinburgh (excluding undergraduate teaching)	66.9	58.8	65.9	65.0
2. University of Edinburgh (undergraduate teaching)	9.0	10.0	10.2	7.9
3. Other universities	5.3	0.8	0.2	2.5
4. Research Councils	16.3	27.1	19.9	20.8
5. Other Treasury-funded users	1.6	2.2	2.3	2.7
6. Commercial users	0.9	1.1	1.5	1.1
Totals—Groups 1-6	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

The relative proportions of computing time provided through the Regional Centre to the main categories of users are, it will be seen, only marginally altered, with a slight decrease in the University of Edinburgh usage being almost counterbalanced by the increase in use by other universities. It is already clear that in the year 1971-72 Category 3 will show a further substantial rise, as a result of the continued delay over the Glasgow decision and the Executive Committee's deliberate decision to make available considerable quantities of time to both Glasgow and Strathclyde Universities—an offer of which both are availing themselves. The Research Council share has risen slightly above the estimate of 20 per cent adopted by the Executive Committee in determining the division of recurrent costs for the last two years of the quinquennium, but it remains to be seen whether this is a decided rising trend or a minor fluctuation.

Most categories have shown a further rise in the number of registered users—most strikingly in Category 3, where the total rose from 19 in 1969-70 to 132 in 1970-71, of whom 106 were from Glasgow University. The Research Councils also showed a substantial increase from 229 to 284, while other Treasury-funded users, Category 5, rose from 27 to 43. The figure for training supported by the Regional Centre (Category 9) is greatly swollen this year by the accretion of 1,630 users under the aegis of Moray House College of Education. The College's programme of work, in which the Regional Centre, at least temporarily, has been collaborating, has involved widespread use of Regional Centre facilities by school children—who on average, however, ran 4.5 jobs totalling 42 seconds of 360/50 time.

Appendix B (ii) lists the user departments in Category 1 (University of Edinburgh) and Category 4 (Research Councils), and the principal other universities in Category 3.

Charging and Allocation

The limited real money charging scheme for University users outlined in the previous Annual Report was put into operation in December 1970 and its operation was reviewed in May 1971. The scheme worked well and after the initial period of operation there was general agreement on the merits of such a scheme. The estimates of usage proved remarkably accurate considering it was only the first period of operation. In addition to the actual invoicing programs it was found necessary to introduce a variety of reporting programs to keep users up to date with their use of resources.

In the review of the scheme after the first four months of operation it was decided for the second year of operation to extend the charging to cover consultancy and programming though normal advisory services remained free. Various aspects of the scheme had proved complicated to administer and in particular the "free" undiscounted allowance to each department was abandoned at the end of the financial year. It was felt that the funding of departments commencing computing could in future be adequately met from reserves held by the Faculties. It was agreed that the rate of discount for the year 1971-72 would not be altered as the amount of real money in the scheme would be significantly increased by virtue of the allowances covering twelve instead of only seven months and by an average 50 per cent increase to cater for growth in demand.

Staffing and Organisation of the Regional Centre

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
1st August 1971	158

The figure of 158 staff in post at the end of the year under review represents a reduction of 12 in the projections made in the last Annual Report. For the period August 1971 to July 1972 no increase in staff numbers has been recommended and in the event of the transfer of the 360 operations and system programming staff to Glasgow a significant reduction in the residual establishment at Edinburgh was projected.

The organisation of the Regional Centre was realigned during the year to reflect the intention to provide services on both the local System 4-75 and on the IBM 360 Systems which were expected to sustain the main regional growth in the immediate future. The work on program libraries and on communications has been described in earlier sections and in each case more discrete groupings of staff dedicated to each of these areas of interest have been established.

The implications of more comprehensive regional operations on the longer term organisation of service staff at Edinburgh and elsewhere have been the subject of continuous study but plans cannot be crystallised until the nature of the next round of investment at the Universities of Glasgow and Strathclyde has been determined.

Future Development

The future as we look ahead in March 1972 is no clearer than at the time of composition of our last Annual Report in September 1970. It is now imperative that the deadlock that has existed at Government level concerning the role of the British Computer Industry and the computing needs of regional groupings of the Universities in the United Kingdom should be quickly resolved.

APPENDICES

APPENDIX A

COMPUTERS IN THE EDINBURGH RESEARCH COUNCIL—UNIVERSITY COMMUNITY (March 1972)

ICL Installations

Clinical Chemistry (Royal Infirmary)	903
Computer Science (Heriot-Watt)	4130
ERCC	4-75*†
Machine Intelligence	4130
Mechanical Engineering (Heriot-Watt)	903
Napier College	4120
SRC/Royal Observatory	4130
Surgical Neurology (Western General)	905
Clinical Chemistry (Western General)	903

IBM Installations

Accounts (Edinburgh University)	1130
ARC/ABRO	1130*
ARC/Statistics	1130*
ERCC	360/50*

Computer Technology Installations

MRC/Cytogenetics	MOD 1†
	MOD 1†
	MOD 1†
	MOD 1†
	MOD 1†
	SAT 1*
ERCC	MOD 1*
	SAT 1*
Glasgow University	SAT 1*

Honeywell Installations

Electrical and Electronic Engineering (Heriot-Watt)	H 316
Machine Intelligence	H 316

Remote Job Entry Equipment

Secretary's Office	DATA 100*
ARC/Rothamsted	DCT 132*

DEC Installations

ARC/Poultry Research	PDP-8L
	PDP-8L
Chemistry	PDP-11
Chemical Engineering	PDP-8
Computer Science (Heriot-Watt)	PDP-8E
Computer Science	PDP-15†
	PDP-16
	PDP-9†
	PDP-8†
	PDP-11*†
(CAD Unit)	PDP-10†
	PDP-7†
Electrical Engineering	PDP-8
ERCC	PDP-15/40*†
	PDP-8E*
	PDP-8L*
	PDP-11*

Medical Faculty	
Medical Physics (Royal Infirmary)	PDP-12
Medicine (Royal Infirmary)	PDP-11
MRC/Cytogenetics	PDP-9†
ARC/N.I.A.E.	PDP-8L
Pharmacology	PDP-8L
Physics	PDP-8*
Psychology	LINC-8
Social Medicine	PDP-8*
Veterinary Physiology	PDP-12A

Projected DEC Installations

Electrical Engineering (Heriot-Watt)	PDP-11
ARC/N.I.A.E.	PDP-11*
Physics	PDP-11*
Physiology (Glasgow University)	PDP-8*
Radiotherapy (Western General)	PDP-8*
Strathclyde University	PDP-8*

Projected Computer Technology Installations

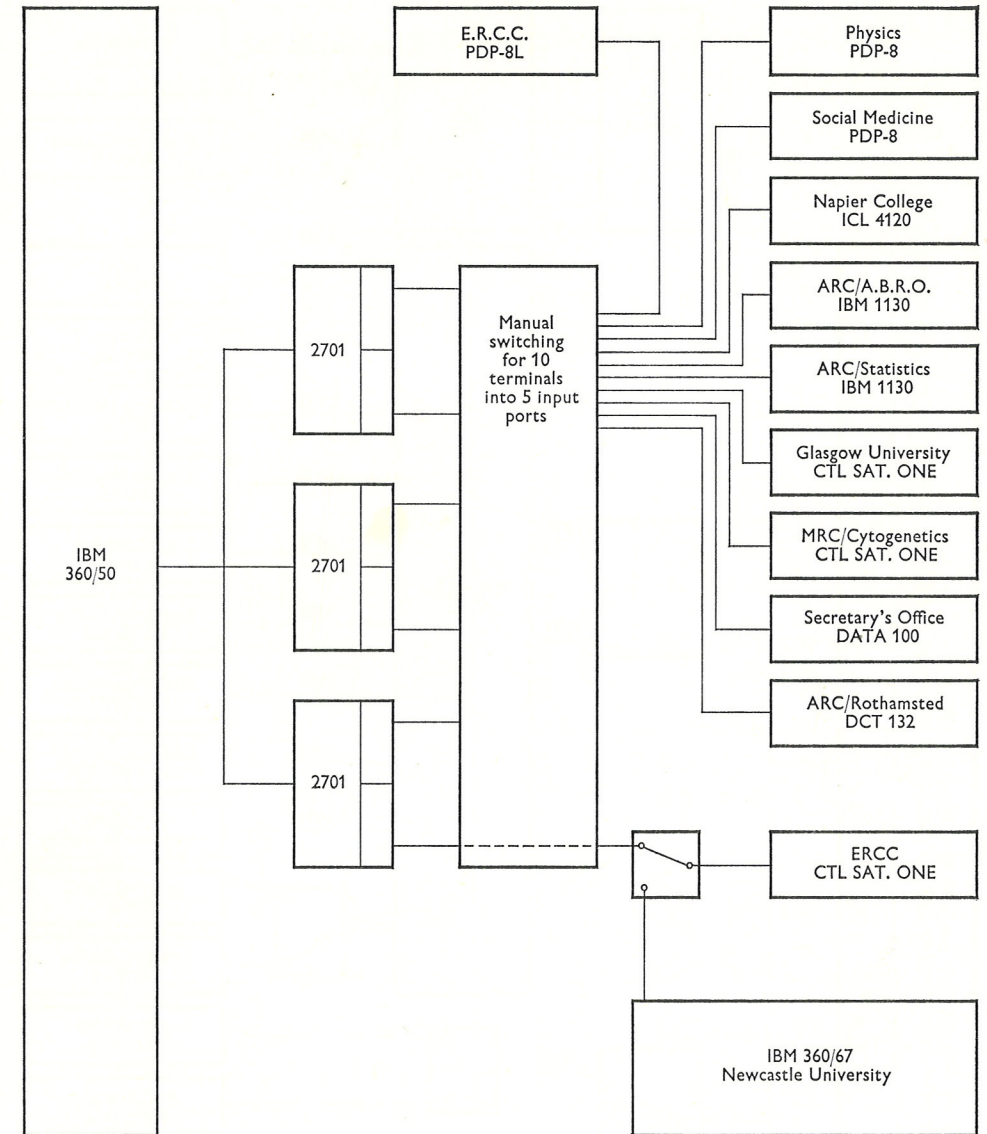
ERCC	MOD 1*
Strathclyde University	SAT 1*

Projected IBM Installation

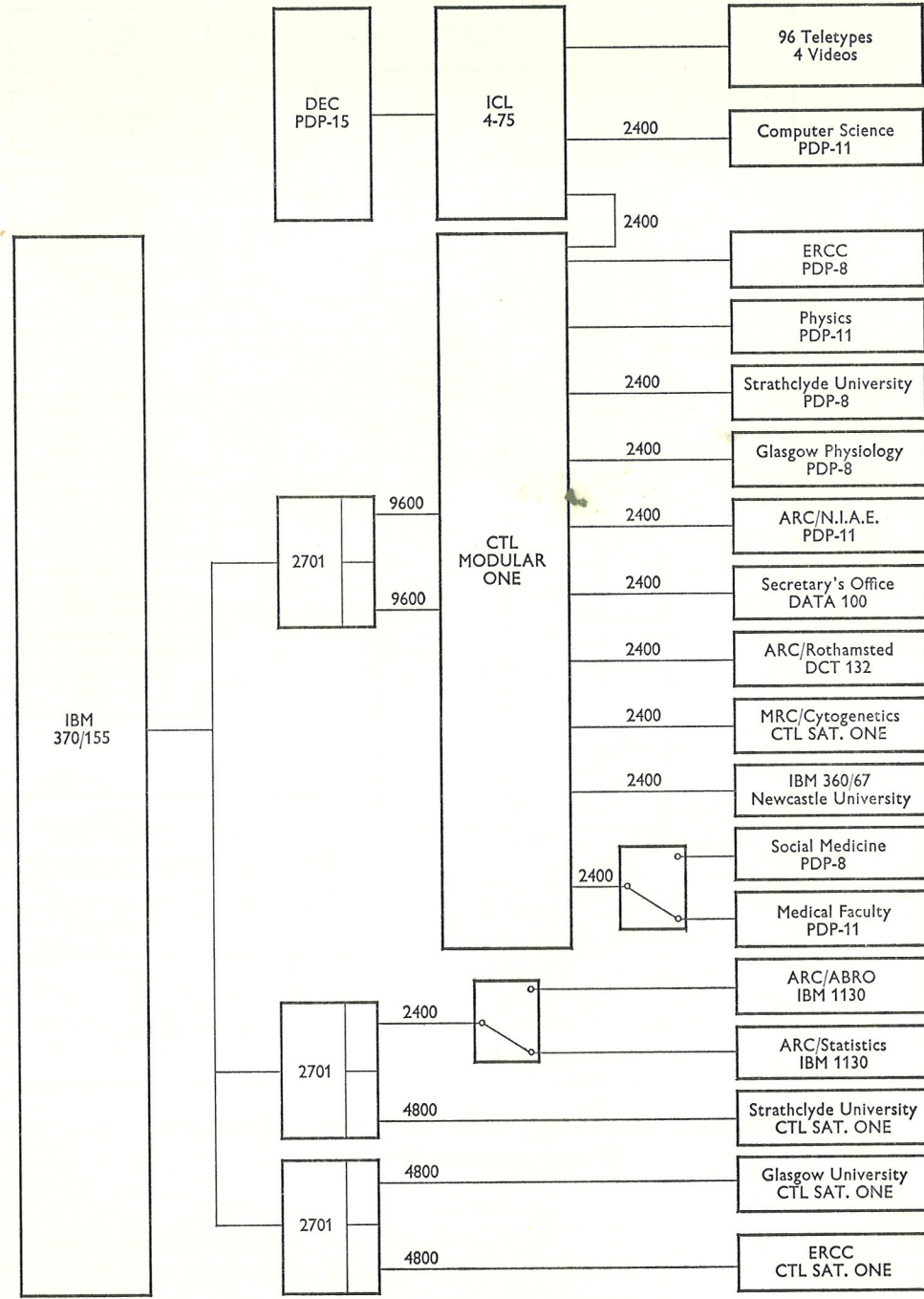
ERCC	370/155*
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*Equipped with remote job entry interconnection.

†Equipped with high-speed interconnection.



360/50 COMMUNICATIONS NETWORK (March 1972)
(All lines operate at 2400 bit/sec)



COMMUNICATIONS NETWORK (Projected September 1972)
(Line speeds are indicated in bits/sec)

APPENDIX B (i)
ANALYSIS OF USAGE 1970-71

Category of user	No. of registered users	360/50		4-75		(Newcastle University) 360/67		(National Engineering Laboratory) 1108	
		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	2,520	139,439	4300:02	26,690	2128:37	1,002	24:49	1,199	88:33
Total-Groups 1-9	4,496	187,186	5492:34	97,452	4019:40	1,044	25:23	1,466	104:52
1. University of Edinburgh (excluding undergraduate teaching)	532	42,775	2469:03	10,826	1587:38	200	15:31	1,199	88:33
2. University of Edinburgh (undergraduate teaching)	1,516	55,056	275:35	11,965	267:28	1	00:00	—	—
3. Other Universities—	106	8,262	128:49	—	—	—	—	—	—
(a) Glasgow	26	1,731	40:36	29	02:10	—	—	—	—
(b) Others	284	26,338	1186:34	3,312	241:55	—	—	—	—
4. Research Councils	43	3,751	142:35	144	7:14	801	9:18	—	—
5. Other Treasury funded users	13	1,526	56:50	414	22:12	—	—	—	—
6. Commercial users	177	33,040	1137:52	6,389	264:01	—	—	—	—
7. Multi-Access Project	—	—	—	64,121	1626:21	42	0:34	267	16:19
8. Regional Centre Staff	—	—	—	252	0:41	—	—	—	—
9. Training supported by Regional Centre	1,799	14,707	54:40	—	—	—	—	—	—

Note: Time used is expressed in each case in accounting hours-minutes as recorded on the particular machine, i.e., the 4-75 should yield 2-3 times that of the 360/50.

APPENDIX B (ii)
LIST OF USER DEPARTMENTS

- (a) *University of Edinburgh*
- | | |
|--|---------------------------------------|
| Agriculture | Mathematics |
| Anatomy | Mechanical Engineering |
| Archaeology | Medical Education |
| Architecture Research Unit | Medical Physics |
| Astronomy | Medicine (Royal Infirmary) |
| Bacteriology | Medicine (Western General Hospital) |
| Biochemistry | Meteorology |
| Botany | Molecular Biology |
| Business Studies | New Testament Language |
| Centre for Industrial Consultancy and Liaison | Obstetrics and Gynaecology |
| Chemical Engineering | Ophthalmology |
| Chemistry | Orthopaedic Surgery |
| Child Life and Health | Pharmacology |
| Christian Dogmatics | Physical Education |
| Christian Ethics and Practical Theology | Physics |
| Civil Engineering | Preventive Dentistry |
| Clinical Chemistry | Psychiatry |
| Computer Science | Psychology |
| Computer-Aided Design | Public Law |
| Criminal Law and Criminology | Radiodiagnosis |
| Dictionary of the Older Scottish Tongue | Radiotherapy |
| Economic History | Respiratory Diseases and Tuberculosis |
| Economics | Restorative Dentistry |
| Educational Sciences | Scots Law |
| Educational Studies | Secretary's Office |
| Electrical Engineering | Seismology |
| English Language | Social Administration |
| Forestry and Natural Resources | Social Anthropology |
| Genetics | Social Medicine |
| Geography | Sociology |
| Geology | Statistics |
| Geophysics | Surgery |
| Hebrew and Old Testament Studies | Therapeutics |
| Human Genetics | Urban Design and Regional Planning |
| Institute for Advanced Studies in the Humanities | Veterinary Anatomy |
| Linguistics | Veterinary Pathology |
| Machine Intelligence and Perception | Veterinary Pharmacology |
| | 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 | Molecular Genetics Research Unit |
| MRC | Clinical Endocrinology Research Unit |
| NERC | Oceanographic Laboratory of the Institute of Marine Environmental Research |
| NERC | Institute of Geological Sciences |
| NERC | British Antarctic Survey Unit |
| NERC | Nature Conservancy |
| NERC | Institute of Tree Biology |
| SRC | Royal Observatory |

(c) *Other Universities*

- | | |
|-------------|-------------|
| Aberdeen | |
| Glasgow | St Andrews |
| Heriot-Watt | Stirling |
| Newcastle | Strathclyde |

APPENDIX C

Financial Statement for the year 1st August 1970 to 31st July 1971

<i>Expenditure</i>		<i>Income</i>
Salaries	£276,663.55 £25,572.30
Travel and Subsistence	7,053.51	Balance of expenditure over income shared by:
Rental of Equipment }		Agricultural Research Council £84,482.72
Hire of Computer Time }	136,268.87	University of Edinburgh . 337,930.91
General Expenses	_____	422,413.63
University Fixed Charges	28,000.00	
	<u>£447,985.93</u>	<u>£447,985.93</u>

Note: In addition, the Computer Board provided a grant of £133,714 to meet the rental of the 360/50.