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UNIVERSITY OF EDINBURGH
AGRICULTURAL RESEARCH COUNCIL

EDINBURGH REGIONAL
COMPUTING CENTRE



Third Annual Report
(1st August 1968 to 31st July 1969)

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Senior Staff of the Edinburgh Regional Computing Centre

(at 1st August 1969)

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|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Director | G. E. THOMAS, B.SC., M.SC., PH.D., M.I.E.E. |
| Principal Consultant | Mrs M. M. BARRITT |
| Applications 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.
P. E. WILLIAMS, B.SC. |
| System Analyst | F. E. J. BARRATT
J. ELLENBY, B.SC.
G. E. MILLARD, B.SC., A.R.C.S.
D. T. MUXWORTHY, M.A.
C. H. NICHOLAS, B.SC.
P. D. STEPHENS, B.A.
D. B. TAYLOR, B.SC., D.PHIL. |
| 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 | Miss A. FINCH, B.A.
Miss C. R. MARR, B.SC.
H. E. WOODMAN, B.SC.
J. K. YARWOOD, M.A., M.SC. |
| Programmer | Mrs L. D. AITKEN, B.SC.
M. J. AVIS, B.SC.
Miss M. M. FISHER, M.A.
N. HAMILTON-SMITH
Mrs J. R. E. HORNBY, B.A.
Mrs H. A. HUGHES, B.SC.
J. B. O. JAMIESON, B.SC.
R. B. JOHN, B.A.
Miss F. A. KELLY, M.A.
C. D. McARTHUR, B.SC.
A. McKENDRICK, B.SC., PH.D.
E. R. MANSION, B.SC.
N. K. MOOLJEE, B.SC.
J. M. MURISON, B.SC.
J. WEXLER, B.A. |
| Program Librarian | D. N. ALLUM, B.A. |
| Assistant Program Librarian | A. W. BANNERMAN, B.SC. |
| Executive Officer | J. ROBERTSON |
| System Engineer | R. K. McLEOD
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

THIRD ANNUAL REPORT
(1st August 1968 to 31st July 1969)

Introduction

By the end of the year under review, the third full year of operation, the Regional Centre was in control both of its long-promised ICL System 4-75 and of an IBM 360/50 rented as a further stop-gap in place of the KDF9. Both machines are housed in the machine room of the Regional Centre's new accommodation in the first phase of the Mathematics/Physics Institute on the University's King's Buildings site. The year 1968-69 therefore has undoubtedly been a year of tangible progress—not unfortunately a year in which the Centre's problems have all been dissolved, yet on the whole an encouraging one which has allowed the Centre and its staff to start making a more immediate impact on its main task, the provision of a comprehensive computing service to its many and various users.

This Report, adopting the same general pattern as previous Annual Reports, describes in greater detail progress with the installation of equipment and the provision of accommodation and facilities, and gives a review of the services now provided to users, before returning more briefly to some of the questions now facing the Regional Centre and the Executive Committee, and indeed the Computer Board and many of the organisations under the Board's benevolent care, with regard to the future development of computing facilities.

Installation of Equipment

Delivery of the Centre's ICL System 4-75 installation commenced in November 1968, and after completion of the site acceptance tests conducted by the Ministry of Technology's Technical Support Unit a system was made available on 1st January 1969 for systems software development work by the Regional Centre and Edinburgh Multi-Access Project teams. Early in January ICL delivered the multi-channel communication control unit which, after completion of the test procedure, was handed over at the beginning of March to the Regional Centre's engineering support team for connection to a preliminary network of G.P.O. circuits. The final item of the main configuration, the 700 megabyte fixed disc, arrived in July 1969, but has suffered from extended mechanical difficulties, and as a result the software development teams of the Multi-Access Project and the Regional Centre have not to date (October 1969) had at their local disposal a full complement of components on which to complete their development work.

In the first half of the year under review, the Computer Board accepted that extended rental of the KDF9 would be an insufficient answer to the quantitative needs of Edinburgh users for local facilities in the interim period before the System 4-75 came into full service, and that continued dependence on the KDF9, despite its efficiency in operation, would unreasonably delay the transition to the computing standards typified by the System 4 and 360 series. The Board agreed therefore that the rental of the KDF9 should be terminated by September 1969, or at the latest by December 1969,

and that in its stead an IBM 360/50 should be installed, again on a rental basis, for two years. This IBM 360/50, opportunely available after its release from the S.R.C. Daresbury Laboratory, was delivered to the Regional Centre in February 1969, and a general service in FORTRAN was mounted from mid-April. The Atlas Autocode compiler was introduced into service in August 1969, which allowed "Project Exodus"—the transfer of work from the KDF9 to the promised land of System 4 and 360 standards—to be brought into operation over the summer vacation.

The Computer Board has approved the purchase of a total of 96 teleprinter terminals and 4 video-display terminals, with the necessary associated equipment, to support the multi-access operation of the System 4-75—a total of 100 terminals being considered the full channel capacity of the single processor installation. At present an initial complement of 32 teleprinters and the 4 video-display terminals are in use for systems testing and evaluation by the Multi-Access Project and Regional Centre staff. By the end of the year under review the relevant committees on both the Research Council and the University sides had decided the initial allocations to user departments, to which the terminals will be transferred, it is hoped, from January 1970. To encourage the maximum utilisation of these terminals, a significant number will be retained, for the use of the general user, in Regional Centre accommodation at King's Buildings and in Alison House, and to a certain extent the University has accepted the principle of grouping terminals also in certain user departments.

Links of a different type, involving the installation of equipment both by the Regional Centre and by the user department, have been effected in relation to the 360/50. Using the experience gained over the last year in operating the card reader/line printer terminal in Alison House as a direct link to Newcastle University's 360/67, the Regional Centre is undertaking the connection to its own 360/50 of four small computers and two remote job entry terminals, most of which are housed in user departments—the IBM 1130 installations in the A.R.C. Unit of Statistics and the A.R.C. Animal Breeding Research Organisation, the PDP7 computer devoted to computer aided design research in the Department of Computer Science, and an IBM 2780 remote job entry terminal at the A.R.C.'s Rothamsted Station. The Regional Centre's own terminal in Alison House has also been upgraded to the more advanced 2780 model, and it will now allow communication either to the Newcastle 360/67 or to the 360/50. In addition a PDP8/L computer at the Regional Centre can be connected either to the 360/50 or the System 4-75 for the control of a Calcomp incremental plotter.

Buildings and Accommodation

The Regional Centre's permanent accommodation, designed as the first phase of the University's Mathematics/Physics Institute on the King's Buildings site, became available in the late summer of 1968, and its occupation was completed by the end of December, in parallel with the installation of the System 4-75. The main machine room, housing both the System 4-75 and

the 360/50 installations, and the adjacent on-line laboratories with a variety of other devices, now accommodate equipment to a value considerably exceeding £1 million.

Alison House has been further developed as the main Regional Centre focus of activity in the central area, its batteries of card punches, teletypes and flexowriters being now supplemented by very welcome facilities for lectures, seminars, and individual study. Continuation of the KDF9 service from Buccleuch Place has involved the retention of operating and support staff in the central area, but their numbers have steadily declined as the KDF9 service has been run down. In particular, towards the end of the year under review, it was decided to centralise the job reception activities for all machines at King's Buildings.

Staffing

Analysis of the current and projected establishment of the Centre shows the following figures:

GROUP	IN POST		GROUP (REVISED TITLES)	IN POST		PRO- JECTED 1969-70
	at 1st August 1966	at 1st August 1967		at 1st August 1968	at 1st August 1969	
Administration	8	56	Administrative Services	14	18	25
Software	1	12	Systems Evaluation and Operations	63	75	92
			Information and Applications	25	27	38
Consulting and Engineering	—	2	Consulting and Engineering	6	14	19
Total	9	70		108	134	174

Only minor amendments to the Groupings have been introduced during the year under review. The principal change, and, it is hoped, improvement, has been the identification of experienced and specialist staff as "consultants" either in the use of a particular computational technique or in the deployment of a category of resource available to the Regional Centre. Such consultants may on occasion supervise teams drawn from various parts of the Regional Centre's organisation. While they will normally carry complete responsibility for the particular functions with which they have been charged by the Director, they are bound also by the coordinating influence of the Principal Consultant (Mrs Barritt) whose role is essentially to further the development and use of consistent standards among the consultants and to advise on any imbalance in the service or development pattern of the Centre as a whole.

With the introduction of the System 4-75 and the 360/50 and the continuation, albeit on a reducing scale, of the KDF9 service, together with continued use by van or by data link of the various off-site computers, the management of computer operations has necessarily been allocated among several staff, rather than remain the responsibility of the Group Manager, and day-to-day control has to a considerable extent been delegated to relatively junior staff. It is a reflection on the current national difficulties of recruiting experienced operating staff, but also a matter of credit to the individuals concerned, that the Regional Centre has decided that this degree of responsibility can be satisfactorily shouldered by comparatively young staff whose training in computer operations in most cases has been gained largely within the Regional Centre.

With the advent of the 360/50 and its build up to three-shift operation, it was necessary to establish additional posts for computer operating staff. Otherwise only minor adjustments or regradings have been carried out in the Centre's establishment. As the table shows, there remains a considerable gap between the projected staff numbers for 1969-70 and the numbers in post at 1st August 1969. The latter figure of 134 also fell considerably short of the total of 152 previously projected for 1968-69. Proportionally the biggest deficiency is in the Information and Applications Group where there continues to be a serious dearth of experienced application programmers.

The device of joint appointments between the Regional Centre and academic departments has been mentioned with approbation in previous Annual Reports. While enthusiasm for this policy has remained undiluted, (and several proposals are currently being pursued), it has not in the last year proved possible to increase the present number, which are with either the Department of Computer Science or the Department of Physics. Moreover, the Regional Centre, having benefited greatly in the past twelve months from the temporary attachment of two senior workers from American universities with first-hand experience of the development of time-sharing systems and of the use of computers in the teaching of engineering students respectively, now finds itself again largely bereft of direct American experience. On systems development the lack is perhaps no longer a serious one, but there remains a feeling that the introduction of American experience might prove a useful catalyst in certain areas where the application of computers is poised for development. While the Regional Centre is not directly involved, the past year has also seen a further increase in the number of programming staff wholly employed within user departments or units—a necessary development and particularly welcome in view of the extreme demands being put upon the Centre's undermanned Applications Group.

Services

The services provided by and through the Regional Centre have become even more multifarious. By mid-1969 the Centre was operating three local computers—the KDF9 in the central area of the University, and the 360/50 and System 4-75 at King's Buildings—and was feeding work by data link or

by courier service to three off-site computers—the 360/67 at Newcastle University, the Chilton Atlas, and the 1108 installation at the National Engineering Laboratory, East Kilbride. Access to the commercial time-sharing services operated by Systemshare Ltd., and G.E.I.S. Ltd. on General Electric machines was also being organised through the Regional Centre. Analyses of the usage of the three on-site and three off-site computers are given in Appendix A (i). In this section it is convenient to base the narrative as far as possible on each machine in turn, before covering the data preparation and other services provided by the Regional Centre to University and Research Council users.

In mid-1968 the KDF9 was being operated on a three-shift basis, Mondays to Fridays, with Saturday shifts being mounted either to meet special needs or to clear undesirably heavy backlogs of work. Every effort had been made to maximise its efficiency by the adoption of improved compilers and an editor system, but it was clear that the frustrations of saturation would become increasingly painful and could be only partially mitigated by increased use of off-site machines. In the Autumn of 1968 the Computer Board approved the proposal that the KDF9 should be replaced by an IBM 360/50, also as a rented, interim, machine, to cover the gap until the System 4-75 could be expected to give a full general service to users. This decision not only added impetus to the Regional Centre's attempts to encourage users to program in FORTRAN for processing on the Newcastle 360/67, but also depressed the development of new work on the KDF9. It is probable also, although no quantitative measurement could be made, that the introduction of the charging and allocation scheme for University users acted as a further restraint on demand in the University sector.

In the previous Annual Report an attempt was made to assess the annual growth factor by comparing KDF9 usage in March 1967 and March 1968. Appendix A includes a table which extends this comparison to March 1969. During the year an overall improvement of about 20 per cent. in job throughput on the KDF9 stemmed from several causes including the elimination of relatively inefficient Algol jobs (which Heriot-Watt University now largely handles on its 4130 installation or the similar installation at Stirling University), the improvement of the Atlas Autocode compilers, the batching of undergraduate jobs and a higher utilisation of peripheral equipment by means of multiple program operation.

Following the introduction into service of the 360/50 in April, and in particular the addition of the Atlas Autocode compiler in August, KDF9 users have been gradually transferred to the 360/50. Project Exodus, as this operation has been conveniently entitled, has required minute preparation and delicate public relations. The first phase, involving the checking of programs run in parallel on both machines, was satisfactorily completed by mid-August, and was immediately followed by the full transfer of the vast majority of relatively straightforward programs. The major difficulties then remaining related to sequential file handling and the graph plotting facilities, where hardware difficulties obtained, and the estimated dates for the transfer of work in these two categories are mid-October and early November

respectively. The Users Group, which throughout was kept closely in touch with the planning and conduct of Exodus, on the basis of progress reports approved in turn the reduction of the KDF9 service to two shifts in July 1969, and to one shift in early September, and the complete removal of the KDF9 in December 1969. The whole operation is proving a valuable exercise, in that both users and Regional Centre staff are gaining a better appreciation of the other's problems and concerns. Understandably there is fair unanimity that the exercise should not have to be repeated, and it has of course been a cardinal point of the Regional Centre's policy that from the 360/50 on there should, to the user at least, be a guaranteed painless progression of work through the present and projected machines operated by the Regional Centre.

The configuration of the Regional Centre's 360/50 installation is set out in Appendix B. As indicated above the preferred and fully supported languages on this installation are FORTRAN (FORTRAN IV as implemented on the G level compiler of IBM) and the specially written Atlas Autocode (called IMP(AA)), which has the longest continuous history in Edinburgh computing. By special arrangement other standard IBM software can be made available to users, but as the 360/50 was made available to the Regional Centre only as an interim machine with a scheduled release date of May 1971, it was not considered justifiable to devote Regional Centre staff and resources to the support of the very considerable range of IBM software available, at least until more was known of the performance of equivalent software on the System 4 range or any other machines which in the longer term may be designated as the future hardware provision for the Regional Centre.

By the end of the 1969 summer vacation the 360/50, multi-programmed for two user programs, was running at almost two full shifts, and handling 300-400 jobs per day. Its reliability, with regard both to hardware and to its operating system, has on the whole been good, although the connection and testing of the remote terminals referred to earlier in this Report have proved a more prolonged and time-consuming task than expected.

As indicated earlier in the Report, System 4-75 hardware was made available in January 1969 for systems software development work by the Multi-Access Project and by the Regional Centre. The Regional Centre has been largely concerned to date with the operation of the various hardware components of the 4-75 configuration (which are listed in Appendix B) under the control of a local version of the ICL 7J operating system, which of course is appropriate only to the 4-70 or 4-50 models of the System 4 range. The standard ICL compilers and application packages contained in 7J do not adequately match up to the standard of software architecture required by the Centre for the transfer of work to the 4-75 or to the 360 operating system, and it has not therefore been considered expedient to introduce these facilities for general service use. During 1969 therefore the service role of the 4-75 will continue to be restricted to supplementing in limited areas the services provided on the 360/50 and the 360/67. For example, a media conversion service which exploits the variety of paper tape, card and magnetic tape peripherals of the 4-75 configuration is being satisfactorily operated. Otherwise the 4-75 will be devoted to systems development work whose progress

is summarised later in the Report. (The Edinburgh Corporation System 4-50 was similarly restricted to use for systems development in the second half of 1968.)

The use of the various off-site machines, however vital to Edinburgh users, can be described more briefly. Guaranteed access to the Newcastle University 360/67 was part of the rescue operation mounted by the Computer Board in substituting the 360/50 for the KDF9. In the event the Regional Centre and its users did not take up the guaranteed time at the rate allowed for by the Computer Board's arrangements. Particularly in the months preceding the installation of the 360/50, however, the Regional Centre staff found ready access to the 360/67 indispensable for their preparatory work. With the 360/50 in full operation, the role of the 360/67 in relation to Edinburgh will be primarily to cater for jobs which require central processor time in excess of what can be conveniently scheduled on the local 360/50. Hitherto only FORTRAN IV programming has been supported by the Regional Centre, but there are plans to mount an IMP (AA) compiler at Newcastle early in 1970.

The Regional Centre has continued to submit significant quantities of work to the Chilton Atlas and to the Univac 1108 installation at the National Engineering Laboratory, East Kilbride. The relevance of the latter to the Scottish Universities has been reinforced by the Computer Board's success in arranging with the Ministry of Technology and the Science Research Council's Atlas Computer Laboratory for the latter to administer access to the 1108 installation, which remains the most powerful central processor available to the Scottish Universities. The assurance of continuity of this service for at least another two years has been a welcome bonus to the Regional Centre this year.

The Chilton Atlas itself has continued, on a reduced level as far as Edinburgh is concerned, to provide an overflow service for universities and Research Councils. A subsidiary service exploiting an SC4020 microfilm plotter is now operated by the Atlas Laboratory which is of considerable interest to the Regional Centre. Systems trials of the micro-film plotter are being conducted by the Regional Centre, and it is hoped that Edinburgh users will shortly be enabled to use the Atlas service via IBM 7-track tape generated on the 4-75.

The steady development of the data preparation service based on Alison House has been a matter of considerable satisfaction. By October 1969, there will be available between the "closed shop" and "do-it-yourself" service, 8 Flexowriters, 14 Teletypes (at present off-line, but to be partially replaced by on-line terminals to the 4-75), and between 55 and 60 card punches (some provided by the Department of Computer Science for undergraduate use), together with other supporting equipment. As Alison House also houses the link to the 360 machines at Newcastle and King's Buildings, acts as a reception point for work being submitted to all machines, and now has lecture and tutorial accommodation for Regional Centre seminars (not to mention the Music Library and practice rooms), it is a centre of much activity in the Edinburgh computing scene. The data preparation area

originally incorporated in the design of the Regional Centre's building at King's Buildings was later sacrificed in favour of additional open-plan accommodation for programming staff, but attempts are now being revived to develop, on a limited scale, a general data preparation area for the benefit of King's Buildings users.

Partly from the shortage of staff and partly from the sheer complexity of the computing situation in Edinburgh, the scope of the Information and Applications Group activities has had to be concentrated to a greater extent than earlier envisaged. The application programmers have devoted much of their effort to developing and testing the applications programs and packages which will constitute the Regional Centre's permanent library, and, in the latter half of the year, particularly to the improvement and the transfer to the 360/50 of the most valuable among the very numerous routines accumulated on the KDF9. The Program Library, with a professionally qualified Librarian and Assistant Librarian, is housed in special purpose accommodation in the new building. A limited collection of literature has been placed in a sub-library in Alison House as part of the struggle to ensure that information is adequately disseminated. Indeed, the improvement of Regional Centre documentation in content, appearance and timeliness has continued to receive much attention and effort, as this is a matter of cardinal importance if the full computing potential of the equipment now available is to be realised. The formal advisory service to the general user has been constrained recently, partly as a consequence of the emergence of systems consultants, and while retraining of the advisory staff in the new systems being introduced has been in progress.

The necessity for more intense user education has led to an increase in the number of lectures, seminars and short courses organised under the aegis of the Regional Centre—many of them devoted to the development of FORTRAN and IMP (AA) as the two major Edinburgh languages, to the progress and promise of the Multi-Access Project, or to areas where a wide spread of advanced work has emerged in the Edinburgh environment, such as computer graphics.

Programming Languages and Operating Systems

(i) Edinburgh Multi-Access Project (EMAP)

As projected in the previous Annual Report, the Project was formally allowed to extend its remit so as to incorporate the large fixed disc in the system. The consequent three-month extension in period gave an estimated completion date for the Project of 31st December 1969. In practice the numerical strength of the Project team, especially on the University side, was expected to be considerably reduced from September 1969—mainly because of the inability of the Project to guarantee employment throughout the academic year 1969-70. By September 1969, a preliminary system was substantially complete, providing about a dozen virtual machines which could be used for batch processing or simple console use once they were primed with the relevant programs. Regional Centre staff are developing a

background batch processing system to run in such a virtual machine which will provide for the compilation and execution of FORTRAN and IMP programs. It is expected that the 7J system hitherto used to support the software development process on the System 4 will be relegated to night-shift operation during the period January to March 1970—which will then allow Project and Regional Centre staff to carry out further development and testing in parallel with service activity. The basic permanent system with drum paging, large disc and a file system is now scheduled for December 1969, with evolution of the system and subsystems continuing in varying degrees throughout 1970.

As indicated earlier in the Report, the allocation of terminals to user departments in both the University and Research Council sectors is now being carried out, with projected installation dates in the first quarter of 1970. Only at that stage will it be possible for the Regional Centre to begin to assess comprehensively the efficacy of the multi-access system.

(ii) Regional Centre Software Development

For the past two years Mr G. E. Millard has been leading a team of Regional Centre systems programmers on the development of FORTRAN compilers which are now under test on the System 4 and IBM 360 machines. His major concern at the date of writing lies in the development of suitable software interface components (modelled on those of the EMAP system and written largely in IMP) to allow Regional Centre and other specially written compilers to be attached to either the 7J or the EMAP operating systems. Mr P. D. Stephens has equally been concerned with the development of compilers for Atlas Autocode and its successor IMP, which have to date been successfully mounted on both the 360/50 and the 4-75 and are in regular service use on the respective machines. To ensure future mobility of users' work written either in IMP or FORTRAN, it is necessary to define and provide certain standard facilities for handling files and in this connection Mr K. Yarwood has been concerned to date with the deployment of a controlled set of IMP 360 operating system facilities which Mr Millard is now reproducing with his interface components for use with either 7J or EMAP on the 4-75.

The results of this work are relevant not only to Edinburgh but to those other System 4 installations which require ready transferability of programs with the IBM 360 community of users. The FORTRAN and IMP compilers have been issued to Universities with 4-50 installations and, in spite of the limited core storage they currently possess, have been put into effective operation.

Analysis of Usage

An analysis of the usage of the seven machines, and of the off-line usage of the KDF9 (that is, plotting work, spooling, etc., which is costed at one-fifth of the normal rate for KDF9 time), is set out in Appendix A (i). Use by Regional Centre staff has been included, but not the maintenance and other overheads whose inclusion in previous years has proved a source of confusion.

The table therefore presents the totals per machine of *useful* time, analysed by the 8 main categories of user. Appendix A (ii) continues for a third year the comparison of KDF9 usage in the month of March, and Appendix A (iii) lists the active user departments in the University and the Research Council sectors respectively.

With the multiplicity of machines now in service it is no longer possible to bring out in these tables the percentage shares of total computing resources taken up by each category of user. Certain trends however can be confirmed in several ways. The most significant one is the accelerating growth of the Research Council sector, for which the March comparisons in Appendix A (ii) indicate a growth factor of 2.6 between 1968 and 1969, as compared with about 2.3 between 1967 and 1968. This table of course covers only the KDF9, but by adopting rough conversion factors for the machines other than the KDF9, it is possible to estimate that the Research Council sector has almost exactly doubled its total usage over the year 1968-69, in comparison with the year 1967-68. The relative shares of Regional Centre resources of time (including off-site machines) on this basis of calculation are:

	1967-68	1968-69
	%	%
1. University of Edinburgh (excluding undergraduate teaching)	66.9	58.8
2. University of Edinburgh (undergraduate teaching)	9.0	10.0
3. Other Universities	5.3	0.8
4. Research Councils	16.3	27.1
5. Other Treasury-funded users	1.6	2.2
6. Commercial users	0.9	1.1
Total—Groups 1-6	100	100

The same basis of calculation suggests an overall growth rate of just under 1.2, a serious reduction from the 1.95 achieved the previous year and well short of the 1.8 per annum quoted in the Flowers Report as "not unreasonable". Such crude calculations, however, do not give the whole story, as in addition to the various factors which have depressed demand in Edinburgh in 1968-69 (and in particular the imminent change from the KDF9 to the 360/50), the Regional Centre has achieved considerable success in maximising the efficiency with which the available resources are used, both by the Centre itself introducing more efficient compilers and by the constant process of urging users to adapt library programs and routines or otherwise to improve the efficiency of their own programs. This improvement stands out most clearly in the undergraduate figures, where an increase of 63 per cent. in the number of jobs processed on the KDF9 was achieved at a cost of only about 16 per cent. extra time, but although more difficult to detect in the statistics for other categories, it should have been a significant factor across the whole user population. Speculations in the previous Annual Report on the basis of the average monthly usage of the KDF9 by a University research user and

a Research Council user seem confounded by the 1968-69 statistics. The figures for the three periods are:

	January- July 1967	1967-68	1968-69	
University research user	24.0	32.1	24.6	KDF9
Research Council user	37.0	32.5	53.0	mins. per month

The divergence, having been reduced almost to nothing in 1967-68, has increased dramatically in 1968-69, and the conclusion seems inescapable (at least for the next twelve months) that the Research Council user has very different needs from the typical University user. The pressure of the University's charging and allocation scheme in 1968-69 and the greater reliance of University users on the off-site machines are hardly sufficient to discount the difference in these figures.

The growth in the number of users has continued. In the two main categories, the increases have been from about 350 to 494 among University users, and from about 90 to 129 among Research Council users.

Appendix A (iii) lists the user departments in each sector, and again there are few newcomers, as almost all the Research Council Institutes or Units in the Edinburgh area were already in 1967-68 making some use of the Regional Centre's services. Within the University, social science departments accounted for about 12 per cent. of the total University usage, thus maintaining the high growth rate identified in the last Annual Report.

The share of the facilities taken up by undergraduates has increased marginally in 1968-69 (although the increase is more than offset by the departure of the Heriot-Watt University undergraduates to the 4130 computers provided for both Heriot-Watt and Stirling Universities). The total of undergraduate users has not significantly increased on the KDF9, but there has been a startling increase in the number of jobs handled for undergraduates. In the simplest terms, a better turn-round has allowed an increase of more than 50 per cent. in the amount of practical work a student on a computing course can undertake, and in this respect 1968-69 has been a gratifying year. More generally, however, the past year has failed to be marked by any effective national recognition that the computing needs of undergraduates are a separate and substantial problem for universities. The First Report of the Computer Board (Paragraph 87), in noting that the exclusion from the Board's remit of the use of computers for teaching purposes was "largely accidental", and that the Board had in practice regarded postgraduate teaching as inseparable from research and therefore a proper use of computers provided by the Board, expressed concern at the lack of any specific agency for funding computers for teaching purposes, other than the annual equipment grants provided by the U.G.C. to universities to cover all equipment needs in new as well as existing buildings. The Board accepted that it would be difficult to perpetuate for much longer the fiction whereby teaching needs, as a relatively small component of total demand, could be absorbed in the Board's programme without specific recognition. As was indicated in the

Second Annual Report for the Regional Centre, the Computer Board therefore set up a Joint Working Party with the University Grants Committee to look into the question of computing requirements for teaching purposes "as an urgent matter". At the time of writing no public intimation has been received of the progress of the Working Party, and it therefore seems probable that for at least the year 1969-70 further provisional decisions will have to be taken, without clear knowledge of future developments, on the proportion of Regional Centre facilities that can reasonably be made available for teaching purposes.

Charging and Allocation Scheme

As explained in previous Annual Reports, the Executive Committee had agreed in principle that some form of charging or allocation scheme was necessary at an early stage of the Centre's development, at least for the University sector where the pressure on the available resources was particularly severe. Accordingly, a scheme devised by a University Sub-Committee under the convenership of Professor Black and subsequently blessed by the Executive Committee, the Committee on Educational Policy, and the University Court, was brought into operation on 1st August 1968. The scheme, based on weekly allocations of time to each user department, was intended to facilitate flexibility in operation and to assist the operating staff of the Regional Centre in monitoring the submission of work to the various computers without either abrupt curtailment of a Department's work or the need for constant reference back to the Sub-Committee for the revision of allocations. In the event, despite the low levels of allocations, especially in the first two terms of the year prior to the advent of the 360/50, it proved possible just to meet actual departmental demands without undue delay or hardship. How far the existence of the scheme depressed demand is difficult to quantify, and as indicated in the preceding section of the Report, University research users enjoyed in 1968-69 a depressingly small increase—about 5 per cent. measured in terms of computer time—a result to which, however, other, probably more dominant, factors obviously contributed.

It is difficult at this stage to present more than an interim report on the merits and demerits, the success or failure, of the scheme. In one respect it received an early setback which removed much of the value of the charging element. Despite some early, and admittedly informal, encouragement from individuals centrally involved in the deliberations of Research Councils, the attempt made in the scheme to have computing costs considered as an integral part of research grant applications by members of the University staff elicited a firm and collective negative from the Research Councils, and at least for the present the Executive Committee accepted that at the best members of staff should be advised to include computing costs as an item for information in grant applications to Government Research Councils. The argument of the Research Councils that computing costs are among the "reasonable overheads" which a university undertakes to bear may seem in a way a valid one, given the present methods of providing the recurrent finance for universities and Research Councils. The Computer Board, however, in paragraph 85 of

its Report, describes the essential aim of any charging system as being "to try to ensure that computers are used efficiently . . . on worthwhile research projects". "Worthwhile research projects", it goes on to imply, are to be identified by the university department in the first instance, or at the university level if total demand exceeds supply and a rationing scheme is in operation. Edinburgh's argument, on the contrary, is that the bodies best qualified to judge whether research work is "worthwhile" are the Government Research Councils which are in a position to take a national conspectus of research in a particular field, and that at least for projects where computing costs form a significant proportion of total costs, the Research Councils should be presented with a full and undistorted estimate of the costs involved in undertaking a piece of research. A relatively junior research post in a University can be funded by a Research Council at a cost of little over £1,000 per annum, but the occupant of the post might wish to consume in computer time £1,000 per month. The Computer Board is clearly well aware of the complexity of devising a comprehensive system of charging for computer time (it instances, for example, the anomalous position of the Chilton Atlas Laboratory), and has expressed its intention to consider the question in depth once universities generally have gained experience in the operation of computing installations of reasonable size. In the circumstances, therefore, it has been decided at Edinburgh to retain in the meantime, in more or less their present form, both the allocation and the charging elements of the present scheme. There is the additional point that in any case the Computer Board is required by the financial arrangements under which it was appointed to apportion the costs of operation of regional centres among the user institutions "in the form of charges for computer time", and consequently, even if a national charging system is felt undesirable, some more limited scheme for financing the Regional Centre will presumably have to be introduced in place of the provisional basis of financing, whereby the University and the Research Councils respectively meet the net recurrent costs of the Centre by means of block grants in the ratio of 60:40.

Future Development

Once again the summer solstice has heralded new uncertainties for the longer term development of the Regional Centre. The continuing struggles of International Computers Limited to rationalise their product range, and in particular to avoid the wasteful duplication of the System 4 range and the 1900 series, elicit sympathy, but the latest reassessment at first sight, and insofar as it can be interpreted in the absence of any detailed public intimation, seems to threaten the Regional Centre in particular with an awkward gap in its development between 1971 and 1975. The means of ensuring a smooth progression from the System 4-75 to any new range of ICL equipment will have to be a matter of detailed discussion between ICL and the Regional Centre in the coming months, and in such discussion the duties of the Regional Centre as a *service* organisation will have to receive prime emphasis. After the tribulations of staff and users in the first three years of the Centre's existence, the maintenance of System 4—IBM360 standards and architecture

must be of paramount importance. Even without the imposition of a new product range, it seems unlikely that in the next few years sufficient capital can be injected into the Regional Centre to maintain, or rather restore, the 1.8 per annum growth rate.

The lack of substantial progress, or even a clear indication of direction, in the development of the use of computers in teaching is also a matter of concern to the University, but in other respects there is a feeling that a reasonably coordinated development of computing activity is now gathering a satisfactory momentum throughout the constituent bodies associated with the Edinburgh Regional Centre.

APPENDICES

APPEN
ANALYSIS OF

DIX A (i)
USAGE 1968-69

Category of user	No. of registered users	KDF9		360/50		4-75	
		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	1,695	74,052	3291:10	2,289	129:02	63	8:29
Total—Groups 1-8	1,824	87,639	4025:11	9,488	450:15	4,288	1637:01
1. University of Edinburgh (excluding undergraduate teaching)	494	27,801	1826:01	1,428	89:26	61	6:59
2. University of Edinburgh — undergraduate teaching	c.1,000	30,292	341:52	90	1:41	—	—
3. Other Universities	29	380	25:59	—	—	—	—
4. Research Councils	129	14,274	1037:10	361	18:59	—	—
5. Other Treasury-funded users	19	923	39:56	90	1:00	—	—
6. Commercial users	24	382	20:12	320	17:57	2	1:30
7. Multi-Access Project	29	3,492	280:41	17	0:21	1,943	665:54
8. Regional Centre staff	100	10,095	453:20	7,182	320:52	2,282	962:39

Note: Time used is expressed in each case in

(Edinburgh Corporation) 4-50		(Newcastle University) 360/67		(Chilton) Atlas		(National Engineering Laboratory) 1108		Off-line (KDF9)	
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.
64	25:08	6,094	85:51	190	19:02	802	34:12	1,156	445:00
1,545	368:50	13,171	189:07	438	30:08	1,590	54:26	1,266	475:11
64	25:08	4,143	67:35	92	6:13	707	29:42	439	146:28
—	—	1,356	11:51	—	—	51	2:45	86	15:56
—	—	26	0:09	—	—	7	1:06	—	—
—	—	305	5:05	24	1:23	37	0:38	598	266:16
—	—	142	0:29	74	11:26	—	—	—	—
—	—	122	0:41	—	—	—	—	33	16:20
449	137:09	5	0:04	—	—	—	—	59	19:24
1,032	206:32	7,072	103:13	248	11:05	788	20:14	51	10:47

hours/minutes as recorded on the particular machine.

APPENDIX A (ii)

ANALYSIS OF KDF USAGE
MARCH 1967, MARCH 1968, MARCH 1969

	March 1967	March 1968	% Increase	March 1969	% Increase over March 1968
Total—Groups 1-6:					
No. of users	273	663		562	
No. of jobs	3,417	7,518		8,429	
Time used (hrs./mins.)	152:52	349:32	129%	410:52	17%
1. University of Edinburgh (ex- cluding undergraduate teach- ing):					
No. of users	149	248		161	
No. of jobs	2,259	3,089		3,281	
Time used (hrs./mins.)	119:44	209:36	76%	203:43	-3%
2. University of Edinburgh— undergraduate teaching:					
No. of users	93	245		334	
No. of jobs	530	2,059		3,465	
Time used (hrs./mins.)	6:25	37:32	500%	50:02	32%
3. Other Universities:					
No. of users	—	114		1	
No. of jobs	—	1,128		4	
Time used (hrs./mins.)	—	35:37	—	0:06	-100%
4. Research Councils:					
No. of users	26	47		56	
No. of jobs	553	1,046		1,538	
Time used (hrs./mins.)	25:06	57:30	130%	149:34	159%
5. Other Treasury-funded users:					
No. of users	2	6		6	
No. of jobs	22	81		115	
Time used (hrs./mins.)	0:34	4:40	800%	2:54	-38%
6. Commercial users:					
No. of users	3	3		4	
No. of jobs	53	115		26	
Time used (hrs./mins.)	1:03	4:37	350%	4:33	-1%

APPENDIX A (iii)

LIST OF USER DEPARTMENTS

(a) University of Edinburgh

- | | |
|--------------------------------------------|-----------------------------------------|
| Agriculture | Mathematics |
| Applied Linguistics | Mechanical Engineering |
| Architecture | Medical Physics |
| Astronomy | Medicine (Royal Infirmary) |
| Bacteriology | Medicine (Western General) |
| Biochemistry | Meteorology |
| Botany | New Testament Language |
| Business Studies | Pharmacology |
| Chemical Engineering | Phonetics and Linguistics |
| Chemistry | Physical Education |
| Civil Engineering | Physics |
| Clinical Surgery | Politics |
| Computer Science | Preventive Dentistry |
| Computer-Aided Design | Psychiatry |
| Metamathematics | Psychology |
| Criminal Law and Criminology | Applied Psychology Unit |
| Dictionary of the Older Scottish
Tongue | Radiodiagnosis |
| Economics | Secretary's Office |
| Educational Sciences | Seismology |
| Education Research Unit | Social Anthropology |
| Electrical Engineering | Social Medicine |
| English Language | Sociology |
| Forestry and Natural Resources | Statistics |
| Genetics | Surgical Science |
| Geography | Urban Design and Regional Plan-
ning |
| Geology | Veterinary Pathology |
| Human Genetics | Veterinary Physiology |
| Machine Intelligence and Perception | Zoology |
| Mathematical Physics | |

(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 | Unit of Statistics |
| ARC | Scottish Plant Breeding Station |
| MRC | Unit for Research in the Epidemiology of Psychiatric Illness |
| 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 |
| SRC | Royal Observatory and Seismological Research Centre |

APPENDIX B

CONFIGURATIONS OF THE ICL SYSTEM 4-75 AND IBM 360/50
INSTALLATIONS

(i) *ICL System 4-75*

- 448 Kb Core Store
- Control Typewriter
- 1 × Discfile, model 4442—700 mb
- 6 × Replaceable Disc units, model 4425—7.25 mb
- 2 × Magnetic Drums, model 4430—2 mb
- 4 × Magnetic Tape Units 9 Track, model 4453—TR 120Kb
- 1 × Magnetic Tape Unit 7 Track, model 4450—TR 60Kb
- 2 × Cardreaders Binary option, model 4513/1—Speed 800 cpm
- 2 × Lineprinters 132 columns, model 4561—Speed 750 lpm
- 2 × Papertape Readers, model 4580—Speed 1500 cps
- 1 × Cardpunch (Binary option), model 4520—Speed 100 cpm
- 1 × Papertape Punch, model 4585—Speed 150 cps

(ii) *IBM 360/50*

- 1 × Model 2050 C.P.U. with 512K bytes store (1 μs)
- 1 × 2540 Card Reader/Punch (Reads 100 cds/min. Punch 300 c/m)
- 1 × 1403 Line Printer (950 lines/min.)
- 8 × 2311 Replaceable Disk Units (7.25 million bytes/disk)
- 3 × 2400 Magnetic Tape Units (60Kc/sec.)—9 Track
- 2 × 2701 Data Adapter Units
- 1 × 2841 Disk Control Unit
- 1 × 2803 Magnetic Tape Control Unit
- 1 × 2821 Control Unit
- 1 × 1052 Model 7 Console Typewriter

APPENDIX C

Financial Statement for the year 1st August 1968-31st July 1969

<i>Expenditure</i>	<i>Income</i>
Salaries, National Insurance and Superannuation	£166,071
Travel and Subsistence	6,417
Rental of Equipment	13,696
Hire of Computer Time	28,566
General Expenses and Materials	90,457
University Fixed Charges	28,300
	<u>£333,507</u>
	Sale of Computer Time
	Sale of Materials
	Balance of Expenditure over Income shared by:
	Agricultural Research Council
	University Court
	<u>£74,069</u>
	<u>7,509</u>
	100,772
	151,157
	<u>£333,507</u>

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