UNIVERSITY OF DUBLIN

TRINITY COLLEGE

COMPUTER LABORATORY

ANNUAL REPORT 1973/4

CONTENTS

Section 1 Introduction

The year just ended was a satisfactory but difficult one for the Computer Laboratory. It was marked by a series of major problems arising from shortages of paper, punched cards, ribbons, and power, accentuated by a sharp increase in the cost of almost everything. On the other hand, the newly installed Gothenburg Universities' Terminal System (GUTS) proved extremely satisfactory and spectacular success was achieved in the improvement of system performance both by tuning and by the addition of faster disc equipment. All major applications ran without the occurrence of major problems of the type experienced in previous years.

However, while the current position is very good thanks to the very high degree of optimisation which has been achieved, the future gives rise to growing concern as our present equipment, now obsolete, grows older and a major replacement, the delivery of which could take two years, is not yet in sight.

Section 2 Machine Utilisation

2.1 Computer Activity

The demand for computer service continued to grow and details of it are presented in Tables 2.1 to 2.4. Of these, Tables 2.2 and 2.3 show the relative use by different user sectors and it can be seen that the main feature of this had been a further sharp increase in the academic share together with a continuing drop in outside use.

Table 2.4 has not appeared in previous annual reports and shows the actual "CPU hours" used each month by the various user categories together with the corresponding total figures for the previous year. From these it can be seen that the total annual machine usage has increased by 53.5%. This was made possible by more effective operation resulting from the reorganisation of operating staff carried out at the beginning of the year and as a result of new disc storage, further software tuning, and the greater ease of access provided by the Gothenburg Universities Terminal System (GUTS). Furthermore, this increase in work throughput has been possible even though the total elapsed time that the system was in use fell from 5933.68 hours in 1972/73 to 5640.58 hours in 1973/74 due to such factors as the long closure at Christmas and less week-end working.

Tables 2.2 and 2.3 are based on the SMF usage recording program referred to in last years report. Use of this package so far has, of necessity, concentrated on analyses of the workload from from a technical performance evaluation rather than an administrative standpoint but it is planned to implement a revised version of it during 1974/75 which will incorporate more extensive "accounting" facilities and permit a more detailed level of management reporting from the beginning of the next academic year.

The continuance of computer operation at such a high level was seriously threatened during the year by a severe paper shortage and a sharp increase in stationery costs. However, reserve stocks built up in 1973 in anticipation of such a situation enabled normal operation to continue during the crisis period early in 1974 when paper was unavailable and a vigorous and extensive economy campaign made it possible to stay within budget. The shortage also affected supplies of other items such as punched cards and nylon printer ribbons.

Computer Activity

Total System Elapsed Hours

Month	Machine Use				Maint-enance	Total Activity
	GUTS & O.S.	OS Alone	Other	Total		
10/73	54.12	499.47	2.28	555.88	3.33	559.21
11/73	71.10	466.89	14.47	555.46	3.53	558.99
12/73	53.13	323.62	13.62	390.36	0.72	391.08
1/74	75.75	389.68	9.72	475.14	6.42	481.56
2/74	82.78	383.73	36.68	503.19	3.58	506.78
3/74	86.55	395.83	38.25	520.63	2.33	522.96
4/74	71.99	405.42	7.10	484.51	11.93	496.44
5/74	122.73	387.45	5.67	515.84	5.47	521.31
6/74	101.19	284.82	0.00	386.01	1.95	387.96
7/74	172.43	344.19	2.67	519.29	5.33	524.62
8/74	102.84	234.06	0.00	336.90	5.83	342.73
9/74	94.95	300.26	2.17	397.38	5.05	402.43
Totals	1089.56	4415.42	135.62	5640.58	55.48	5696.06

GUTS : Gothenburg Universities Terminal System

O.S. : Operating System /360. This is the main multi-programming control program in use.

Other: "Stand-alone" use of the system without the normal control program.

Table 2.1

Analysis of Computer Use

Percent of Total Monthly Use per User Category

Month	User Category				
	Library	Academic	Admin.	Outside	Systems Support
10/73	10.70	47.66	31.24	4.53	5.87
11/73	8.93	52.20	22.00	4.95	11.92
12/73	18.86	49.98	16.34	3.48	11.34
1/74	4.93	65.05	15.59	4.05	11.38
2/74	7.76	55.90	22.27	2.26	11.81
3/74	10.82	56.37	18.63	2.96	11.22
4/74	10.87	62.42	13.75	2.47	10.49
5/74	7.40	57.70	18.26	3.80	12.84
6/74	12.40	45.74	20.71	4.75	16.40
7/74	12.58	52.45	10.19	6.17	18.61
8/74	7.72	61.65	12.90	2.98	14.75
9/74	5.74	60.24	16.40	3.72	13.90
Overall	9.75	55.57	17.71	3.97	13.00

- "Systems Support" includes time required for central software maintenance, central systems software operation; and "housekeeping" activities. In addition, approximately half of it is comprised of certain GUTS usage, by Library, Academic and Administrative applications, which it is not feasible to analyse further.

- The percentages in this table are based on the CPU Times shown in Table 2.4.

Table 2.2

Analysis of Academic Use

by Department

Department	Percent of Total Academic Use	Percent of Total Computer Use
Computer Science	33.82	18.79
Engineering	24.44	13.58
Statistics	20.54	11.41
Physics	6.04	3.36
Grad. School of Engineering	2.51	1.39
Economics	2.09	1.16
Pure Mathematics	1.79	0.99
Chemistry	1.60	0.89
Genetics	1.51	0.84
Geography	1.27	0.71
Education	1.01	0.56
Applied Mathematics	0.79	0.44
Geology	0.42	0.25
Botany	0.36	0.20
Pharmacology	0.30	0.17
Zoology	0.27	0.15
French	0.12	0.07
Biochemistry	0.11	0.06
Others (under 0.10% each)	0.33	0.18
General Academic Use (not specifically allocated)	0.68	0.37
	100.00	55.57

The percentages in this table are based on CPU time.

Table 2.3

Analysis of Computer Use

Total Monthly CPU hours per User Category

Month	User Category				
	Library	Academic	Admin.	Outside	Systems Support
10/73	12.5015	55.6995	36.5125	5.2896	6.8566
11/73	10.8232	63.2797	26.6745	5.9953	14.4556
12/73	13.6249	36.0905	11.8053	2.5152	8.1924
1/74	4.5514	59.1132	14.3903	3.7404	10.5055
2/74	7.6941	55.3976	22.0754	2.2417	11.7102
3/74	15.0175	78.2595	25.8689	4.1053	15.5803
4/74	13.9931	80.3893	17.7081	3.1768	13.5128
5/74	12.9740	101.1879	32.0292	6.6561	22.5126
6/74	16.3916	60.4881	27.3797	6.2804	21.6808
7/74	25.5212	106.3940	20.6630	12.5189	37.7437
8/74	10.5994	84.6860	17.7150	4.0932	20.2570
9/74	7.8677	82.6320	22.4898	5.1039	19.0690
Overall	151.5596 (112.4080)	863.6173 (486.8116)	275.3117 (217.0347)	61.7168 (126.2745)	202.0765 (70.1626)

- This table shows the total demand on the Central Processing Unit, the main component of the system. It must always be a fraction of the elapsed time but is an accurate and easily obtained measure of activity.
- Corresponding totals for 1972/73 are shown in brackets.
- "Systems Support" includes central software maintenance, etc, and 102.3461 CPU hours of GUTS usage, which it is not feasible to analyse, by Library, Academic and Administrative users.

Table 2.4

2.2 Ancilliary Equipment

Keypunching activities continued as before but at an increased level. The bottleneck in this area from an academic user's standpoint still continued but it is believed that the extensive use of the GUTS system prevented it reaching even more serious proportions. The Laboratory's limited data preparation staff were again almost totally committed to administrative and library punching and due to a number of vacancies in this section during the year it was again necessary to sub-contract work to some outside agencies. Details of punching are shown in Table 2.5.

With the introduction of GUTS, terminals have assumed increased popularity and at the beginning of the year three of the twelve machines located in the Laboratory were relocated in user areas in the Faculty of Natural Sciences and the Schools of Engineering and Mathematics, to operate on a similar basis to the two machines already located for some years in the Department of Statistics. Activity on these machines is under constant review to ensure maximum utilisation and in line with this it was decided to move one of them to the Library as soon as data transmission lines could be made available. Experience, so far, has indicated that the terminals located centrally in the Laboratory itself are the most heavily utilised ones.

Data Preparation

Cards punched by Laboratory staff for:	
- Academic Users	10800
- The Library	63300
- The Administration	177000
- Outside Users	20000
Cards punched by outside agencies:	14900
Cards punched by Users themselves:	648000
Cards punched automatically by the Computer:	324000

Table 2.5

3.1 Library

The principal new development in Library data processing was the completion of the sub-system for the local generation of machine readable catalogue records. This sub-system permits the inclusion of non-copyright acquisitions in the computer-based catalogue and also plays an important role in the maintenence of the existing computer catalogue file. The original implementation of this sub-system was based on the use of an optical character reader to prepare automatically magnetic tapes, suitable for computer processing, from documents typed in the Library. It was soon realised, however, that the new GUTS system offered considerable advantages for this work and revised programs were prepared to permit direct entry of this material by Library staff using a terminal. This revision became operational towards the end of the year using one of the terminals in the Laboratory and has proved very satisfactory by eliminating most of the delays involved and significantly reducing the error rate.

During the year, the British National Bibliography announced the availability of machine readable cataloguing records covering books published before 1969, the date from which the existing microfilm catalogue begins. An extensive systems study was undertaken jointly by the Library, the Computer Laboratory and IBM to examine the feasibility of using this as a basis for incorporating books from the present card catalogue into the microfilm system. As a result of this, it was eventually decided that such a move was not appropriate at this time. The study aroused considerable interest outside and it is planned that the Library will publish its report in the near future.

The existing catalogue production application operated satisfactorally during the year. It has benefitted from the central equipment and software improvements but to avail of the full potential which these offer it is necessary to make a number of major revisions to the library programs and this will be a major task during the coming year.

3.2 Academic

Academic use continues to grow both for research and for teaching purposes and is still so large as to absorb virtually all the time that can be made available to it. This can be seen from Table 2.4, which reinforces the experience of previous years in this respect. The full potential demand in this sector is impossible to assess and such use tends to be self-regulating since saturation of the computer system increases the work "turn-around" time resulting automatically in a reduction of the rate of input, since most jobs are re-cycled several times.

The distribution of academic use among the various user departments has not changed significantly from previous years. In the case of this work the Laboratory service is, of necessity, limited to the actual operation of the computer itself and the provision of an advisory service to users who must therefore write their own programs or use an existing program package, if one is available. This tends to favour those departments which already possess computer skills and makes access more difficult for those which do not and it seems probable that low use in some areas, such as medicine, which are very active in other computer centres, is a result of this. As before, research applications cover a wide range of activities from pavement design to greyhound genetics. One area in which college is currently prominent is the development and evaluation of computer teaching facilities in secondary schools and work involving co-operation between staff from the Computer Science Department and School of Education has aroused considerable outside interest.

3.3 Administration

The new student record system referred to in last years report is still under development by the inter-university Joint Working Group on Information Systems established at the initiative of Trinity and University College, Cork. The project is progressing on schedule and it is planned that the main components of the new system will be gradually brought into regular operation during the first half of 1975. The new procedures use much of the experience gained in the library and will eventually make student record data available on computer produced microfiche which will be regularly updated from the central file. The system will also extend into the area of archival records and in this respect discussions have been held with the TCD Association to ensure that the future system will meet their requirements.

The new salary and wages system, UNIPAY, went into regular operation early in 1974 and after a number of initial difficulties is now working satisfactorily. Its implementation required more manpower than was originally anticipated due to the complexity of the package and the support available at the time from the supplier. However, it is now operating well and it has already proved its worth in such areas as the implementation of pay-related social welfare deductions and the frequent pay rounds. In this latter area, also, programs have been developed to assist the Staff Office in the determination of new scales and in the complex process of calculating arrears.

It is hoped that the facilities of the GUTS system can be introduced into certain administrative application areas during the coming year to permit the direct entry of certain accounting transaction data by the Accountant's staff and it is planned to undertake some tests in this area in the near future.

Section 4 Central Service Development

4.1 Equipment

By far the most significant development in this area was the introduction of additional disc storage in May. The main advantage of this equipment is the fact that it makes possible more intensive use of the central processor by making both programs and data more readily accessible by the latter machine and it is believed that it has been the main factor in increasing central processor utilisation, i.e. the ratio of "CPU time" to total operational time, from 17.1% in 1972/73 to 27.6% in 1973/74. These discs are second-hand equipment and have been leased. This has proved to be the most economic method of acquisition in view of the age of the college computer and has made possible the installation of 60% more storage capacity than would have been financially possible were such units rented directly from the manufacturer. A substantial financial saving was also made during the year by discontinuing the rental of two smaller disc units and purchasing two second-hand machines of the same type to replace them.

The "dial-up" teletype entry port into the system went into operation at the begining of 1974 and has proved very successful. It is currently used by both college departments and outside users who own terminals and who compete for access. Since some of these terminals are equipped with punched paper tape facilities, it has provided a method whereby the small number of users who already have data on this medium can be accommodated.

Another significant development was the acquisition of a Burroughs B1700 system. This machine has been located in the Department of Computer Science as a research and teaching processor and will eliminate the need for time-consuming "hands-on" use of the central system for such work. Eventually, it is hoped to link it to the central machine.

4.2 Software

The GUTS system went into regular use at the beginning of the academic year and was very well received by users. Terminal activity, which fell off very sharply when the Remote Access Computing System (RAX) was discontinued in 1972, has recovered completely and can be expected to grow steadily in all spheres of operation. Unlike the RAX system, GUTS and Operating System /360 which is used for most batch work are fully compatible and, with a few restrictions, capable of simultaneous operation. This means that the hours of terminal service availability can be more readily extended.

Considerable emphasis was placed on promoting the use of fast batch compliers which are generally suitable for a large proportion of the work, particularly student programs, but which do not carry the high processing time overhead associated with the official IBM ones. Among those in regular use are WATFIV, PL/C and Assembler G, (ASMG), which offer fast compilation facilities for subsets of FORTRAN, PL/I and 360 Assembler Language, the three most widely used programming languages in the installation.

During the year the Department of Statistics continued its policy of acquiring programs for the Statistical Laboratory. The new facilities include:

SPSS (Statistical package for the Social Sciences, designed for social survey data);
MINITAB (A statistical teaching package available for use under GUTS);
RADASS (Radioimmunoassay interpolation program used in biological and medical work);
ECTA (Everyone's Contingency table analysis);
MALAMUTE (Multivariate and Univariate Analysis of Variance);

These programs are available to users of the Computer Laboratory and consultation on their use is available from the Statistics Department.

Section 5 Other Activities

5.1 Teaching and Publications

The distribution of the first part of the new Computer Laboratory Users' Guide was made in November 1973. The Computer Laboratory Newsletter, introduced in 1972/73 has proved very valuable in keeping users aware of the current status of the service and eight issues were published during 1973/74 and circulation extended to active graduate student users. To supplement the newsletter, a "Hot News" facility for urgent announcements was introduced whereby short messages can be inserted in an otherwise unused portion of each users computer printout.

As in former years, Mr. A. Tucker, Systems Analyst, lectured on advanced PL/I programming to M.Sc. students and was also invited to speak to a British Library/ASLIB seminar in London. The Director lectured on Data Processing to M.Sc. students for three terms and to the MBA class during Trinity term.

5.2 Sale of Computer Services

Revenue from outside sales has fallen from £9851 in 1972/73 to £6520 in 1973/74. The real position is considerably worse than this because of the reduced proportion of gross revenue repayable to IBM under the terms of their educational allowance scheme and from Table 2.4.it can be seen that the total CPU time sold in 1973/74 was 61.7168 hours compared to 126.2745 hours in 1972/73. This is due to a number of factors including the acquisition of their own equipment by outside users, the increasing pressures of internal use, and the active commercial competition in this field.

5.3 External Contacts

Regular contact was maintained with all the NUI colleges and the HEA through the Joint Working Group on Information Systems. Systems Programming and Operations staff also co-operated closely with computer personnel in UCD and UCC on many common problems and Mr. Doherty, the Assistant Director, continued to participate in the planning of the proposed centralised admissions unit. The Laboratory is an active member of the newly formed UNIPAY users' group which was set up to share information and experience among the growing number of users of this package.

The Director continued to serve as a member of the Executive Board of the SHARE European Association (SEAS), an international computer users group, and retired as editor of its bi-monthly newsletter, in October, to concentrate on planning its main annual conference, SEAS 75, to be held in College next September. Through SEAS regular contact was maintained with several European computer centres and in particular with the Gothenburg Universities' Computer Centre.

Section 6 Future Developments

6.1 Short Term Development

Since no major increase in finance will be available during 1974/75, developments will be restricted to such changes as are possible within the limits of the existing rental budget or which can be achieved by system programming or organisational changes. In particular, recent developments in the data transmission area suggest that existing rented control equipment may be replaced by a more modern unit which will handle more terminals of a faster type at no extra cost. This is under investigation and it is likely that action will be taken before the end of 1974. Experience with the "dial-up" entry port has been satisfactory and it appears that an extension of this mode of operation will make it possible to support more terminals without increasing the number of entry ports so the replacement of some of the rented terminals by a greater number of cheaper "dial-up" machines is being examined. Following the Library's successful use of a terminal for data preparation, the possibility of extending this idea to the administrative area is being considered. This would both offer administrative users better control of certain activities, and would release some punching capacity in the Laboratory for academic purposes. It is also planned to extend the hours during which GUTS is available. This will offer a better service to users and may ease the keypunch bottleneck slightly. There is still scope for increasing the throughput of the central system by additional "tuning". It has not yet been possible to identify, let alone implement, all the potential improvements which the faster disc units offer and work will continue in this area.

In conclusion, the present healthy state of the system together with the marginal improvements outlined above and the diversion of much Computer Science work to the research and teaching processor should ensure that capacity is available at least for 1974/75.

6.2 Long Term Growth

Reference has been made frequently in the past to the enormous potential computer requirement of the academic sector which is difficult to assess from recorded usage since demand has always exceeded supply. This has again been demonstrated by 1973/74 results which show that 70% of the very substantial increase in processor time was readily absorbed by academic work.

In mid 1973, the Computer Management Committee presented plans to the Board to enable this demand to be met over a five year period from 1974/75 onwards and the basis on which these were made has been strongly reinforced by subsequent experience. Apart from the research and teaching processor, none of these plans have materialised and we are now entering the five year period with no prospect of change. While short-term needs can be met reasonably well, it must be pointed out that the existing machine has now been obsolete for four years and that maintenance and the availability of spare parts will become a problem within the next few years. Maintenance of the main control software, Operating System /360, is currently being phased out and we have been advised that no further updated "releases" will be made available. Since major new equipment will be subject to delivery delays of one or two years and since considerable time may be needed to transfer all existing applications to a new machine, it is essential that a decision be taken soon.

Another aspect of such obsolesence is the growing awareness of Laboratory staff of being technically "left behind" and there has been considerable comment on the decreasing relevance in College of much published material and conference discussion, as corresponding centres elsewhere move to the current generation of equipment.

APPENDIX A

EQUIPMENT

The specifications of the equipment currently installed are as follows:

1 x IBM 2044 Model H Central Processing Unit with 262,144 bytes (256K) of core storage and with

- One Multiplexor Channel
- Two high speed multiplexor channels
- Single disk storage drive in CPU
- Store and fetch protection
- Floating point arithmetic
- Console printer keyboard
- Interval timer
- Commercial Feature (full 360 instruction set)
- High Speed General Registers

1 x IBM 2841 Model 1 Storage Control with

- File Scan
  and
- Record Overflow

1 x IBM 2415 Model 4, Magnetic Tape Unit and Control (2 drives) with 9-track compatibility, i.e., 800 b.p.i. tape at 15000 b.p.s. or 1600 b.p.i. tape or 30000 b.p.s.

1 x IBM 2821 Model 2 Control Unit (for 1403 printer)

1 x IBM 1403 Model 2 Printer with Universal Character Set feature and interchangeable Chain Cartridge adapter
Print Positions: 132
Maximum Rated Speed: 600 lines/minute
Chains: Normal - PN3
Also Available: TN modified for Library use QN2.

1 x IBM 2502 Model B2 Card Reader with Card Image Feature

1 x IBM 1442 Model N2 Card Punch with Card Image Feature
Speed: 91 to 256 cards/minute depending on number of colums punched

8 x IBM 2260 Display Stations Model 1 with alphameric keyboards

1 x IBM 1053 Model 4 Printer with pin-feed platen and accelerated carriage return

4 x IBM 2311 Model 1 Direct Access Storage Units

1 x IBM 2314, 2312 & 2313 Model A1 Direct Access Storage Facility (5 spindles)

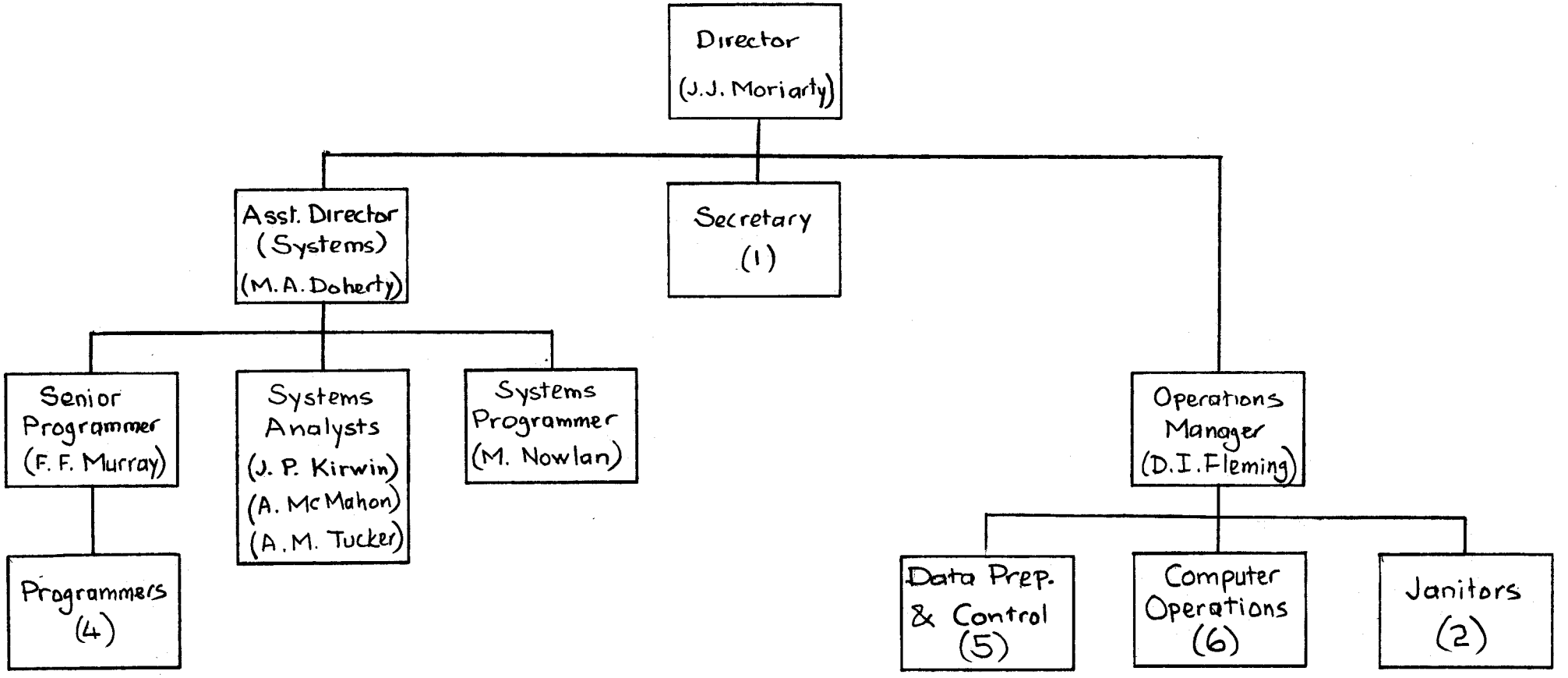
1 x IBM 2702 Transmission Control Unit

1 x ASR 33 Teletype Terminal in a user location

6 x IBM 2741 Terminals in the Laboratory and user locations

Computer operation is performed by Operators who are organised into teams of two people, one of whom is shift leader. Operators work permanently on a shift rota.

Janitors work on permanent night shift and are responsible for general security.



C O M P U T E R L A B O R A T O R Y

O R G A N I S A T I O N

Figure B.1.

APPENDIX B

STAFF

The Laboratory has a staff of 26 organised as shown in Figure 3.1. The functions of the main groups are as follows:

DEVELOPMENT STAFF

This section is responsible for the development of new applications, as follows:-

Systems Analysts study the requirements of new systems in the library and administrative fields and design computer based procedures to implement them.

Programmers write and test the computer programs called for by the Systems Analysts' designs. They also act as advisors to academic users who do their own programming.

Systems Programmer. The Systems Programmer is responsible for the generation and maintenance of internal control programs needed to run the computer.

OPERATIONS STAFF

This section is responsible for the day-to-day operation of the Laboratory and duties are as follows:-

Data preparation and control is performed by Data Processing Assistants and consists of card punching and verification, reception and dispatch of work, and control of the magnetic disc and tape library and of documents in process.

APPENDIX C

ACCOUNTS

COMPUTER LABORATORY

Year to 30th, September 1974.

	£
Cost of Staff	
- Salaried	70116
- Weekly Paid	3831
Rentals of Equipment	19681
Maintenance	10287
Consumable Supplies	7550
Cost of External Services	447
Miscellaneous Expenses	1435
Insurance Charges	571
Recurrent Cost for Period	118189
Amortisation of Cost of Computer	20000
Total Cost for Year	138189

Income from Sale of Computer Services: £6520

APPENDIX D

GLOSSARY

ASMG : Assembler Language G. A fast batch compiler for 360 Assembler Language produced by the University of Waterloo, Ontario.

CPU : Central Processing Unit. The major component of the computer system which in the college System /360 is an IBM 2044.

FORTRAN : FORMula TRANslation. A computer programming language for scientific applications.

GUTS : Gothenburg Universities Terminal System. A comprehensive set of control and service programs to permit the use of keyboard terminals for general computing purposes on an IBM system operating under O.S. with HASP.

HASP : The Houston Automatic Spooling Program. A control program to marshall the queue of incoming jobs, schedule them for processing, and release their results to the appropriate output device. It works in conjunction with O.S.

OS : IBM System /360 Operating System. This is the main complex of control programs and program libraries needed to run the machine.

PL/C : This is a fast batch compiler developed at Cornell University for the PL/I programming language.

PL/I : This is a general purpose programming language developed by IBM for both scientific and commercial programming.

RAX : Remote Access Computing System. The terminal control system originally used in College and now replaced by GUTS.

SEAS	:	The SHARE European Association. A European association of scientifically oriented users of large IBM computers.
SMF	:	Systems Management Facility. A program for the recording of computer usage.
SPSS	:	Statistical Program for the Social Sciences. An extensive program package for statistical computing.
UNIPAY	:	A program package for the processing of salaries and wages developed commercially in the United Kingdom and marketed in this country by CARA, the computing subsidiary of Aer Lingus.
WATFIV	:	A fast batch compiler, developed by the University of Waterloo, for the FORTRAN programming language.