THE UNIVERSITY OF NEWCASTLE UPON TYNE.

COMPUTING LABORATORY

R E P O R T O F T H E D I R E C T O R

1964/1965.

1/3, Kensington Terrace, Newcastle upon Tyne, 2.

S T A F F

Director

Ewan Stafford Page, M.A., Ph.D. Cantab., B.Sc. Lond.

Senior Lecturer

Hubert Ian Scoins, M.A., D.Phil. Oxon.

Lecturers

James Eve, B.Sc., Ph.D., Dunelm.
Michael John Elphick, M.Sc., Manc.
John Stevenson Clowes, B.Sc., Dunelm.
Kenneth Wright, M.A., D.Phil., Oxon.
Leslie Blackett Wilson, B.Sc., Dunelm.

Research Assistants

Brian James Duke, M.A., D.Phil., Oxon., A.R.I.C.
Michael Dines Poole, M.A., Cantab., D.Phil., Oxon.

Senior Computer Operator

Elizabeth Dick Barraclough, B.Sc., Manc., M.Sc., N'cle.

Computer Operators

Margaret Grace Robson, B.Sc., Lond.
Mary Frances Tabrett, B.Sc., Dunelm.
Gillian Hardie, B.Sc., Edin.
Diploma in N.A. & A.C. Dunelm.
Ian Nicholson, B.Sc., N'cle.
Diploma in N.A. & A.C. N'cle.
Brian Jones, B.Sc., Wales.
Diploma in N.A. & A.C. N'cle.

Part-time Computer Operators

Dorothy Jean Murchison, B.Sc., Dunelm.
Pauline Margaret Porter, B.Sc., Birm.

Junior Computer Operators

Susan Mary Cawood
Dorothy Edna Jackson
Joyce Kitchin

Senior Research Associates

John Paul Goy Roper, B.Sc., Dunelm.
Nigel Shaun Maturin Cox, M.A., Cantab.
Diploma in N.A. & A.C. Dunelm.
Ian Muir Leitch, B.Sc., Nott., M.Sc., N'cle.

Computer Engineers

Roderick William Walker, A.M.Brit.I.R.E.
Leslie Mitchell.

Secretary

Ella Barrett.

Clerical

Ann Laybourn.
Carole Anne Waugh.
Josephine Knapper.

THE UNIVERSITY OF NEWCASTLE UPON TYNE.

COMPUTING LABORATORY

ANNUAL REPORT, 1964/1965.

1. General.

During the year there have been many public statements, both official and unofficial, of the national importance of computers and of the magnitude of the training task that is presented. It is becoming realised that modern large-scale computing equipment is necessary for the teaching of advanced techniques of computer use, for their application to areas already explored and for research into new methods and applications. Work of all these types proceeds in a large University and demands considerable machine time; even one year after the installation of the KDF9 computer in this Laboratory the demand for machine time is as great as that four years after the installation of its first computer, the much slower Pegasus. An increase in staff has permitted the commencement of teaching of Computing in the General Degree with Honours and an acceptance of increased numbers in the various postgraduate courses. The negotiation of several research contracts or grants has enabled us to begin or continue work of interest and to have additional colleagues whose special knowledge has been valuable to many using the laboratory. It is hardly surprising that the increased activity causes us to look forward eagerly to the completion of our new laboratory now under construction and in the meantime to making use of whatever nearby temporary accommodation there is available. The demands for computing services, for instruction in many types of computer use and, not least, for research in a rapidly developing field continue to increase and are likely to do so in the foreseeable future.

2. Staff.

We have welcomed Dr. B. J. Duke, Dr. M. D. Poole and Mr. L. B. Wilson to the staff during the year and Miss J. Kitchin and Mr. I. M. Leitch to posts supported by research contracts. Miss Barraclough commenced work in March on the MEDLARS Information Retrieval system and her duties as Senior Computer Operator have been shared by Miss M. G. Robson and Mr. J. P. G. Roper. Mr. I. Nicholson and Mr. B. Jones have been appointed as Computer Operators, the former to replace Mr. J. Taylor who took a post in industry. Mrs. D. J. Murchison and Mrs. P. M. Porter have undertaken the operation of the computer from 6.0 p.m. to 10.0 p.m. each evening.

The University has created a chair in Computing and Data Processing and has appointed Dr. Page to fill it.

Members of staff have attended several conferences and seminars during the year. Professor Page contributed to the seminar on the Teaching of Computational Science at the University of Liverpool. Dr. Scoins, Dr. Poole and Mr. Cox attended a LISP programming course at Imperial College. Dr. Scoins joined a PERT seminar at Kidsgrove and the informal conference on Artificial Intelligence at Edinburgh. Dr. Poole and Miss Barraclough received grants to enable them to go to a N.A.T.O. Advanced Study Institute on the Evaluation of Information Retrieval systems held at The Hague. Mr. Roper attended a symposium on Simulation at the National Physical Laboratory. Dr. Duke was supported to enable him to take part in a N.A.T.O. Summer Institute at Menton on the Quantum Theory of Polyatomic Molecules. Miss Barraclough attended a symposium on survey analysis in Glasgow and Dr. Wright and Mr. Elphick one on the Numerical Solution of Differential Equations at St. Andrews.

Members of staff have been active in the British Computer Society. Dr. Eve completed his term of office as Chairman of the Newcastle Branch of the Society, Dr. Wright has been elected as Vice-

Chairman and Mr. Roper to the committee. Professor Page has represented the North-East Region on the Council of the British Computer Society.

Dr. Eve has represented the University in the KDF9 Users' Group meetings and Dr. Scoins in the Working Party on Operations Research. Dr. Duke has become the correspondent for the University with the Quantum Chemistry Program Exchange.

Professor Page has served on the I.U.C.C. and as Secretary of the Standing and Sub-Committees of Directors of Computing Laboratories and on the Committee for the Durham University Computer Unit. He contributed to the Working Party established by the Office of Scientific and Technical Information on ASLIB and to the 1966 Conference Committee of the British Computer Society.

3. Research Activities.

Mathematical Programming and Combinatorial Problems.

Professor Page has studied a problem connected with Ramsey's Theorem on partitions of sets and has continued work on scheduling problems. He delivered a colloquium on these topics at the University of Strathclyde. Dr. Scoins has directed the work of his research students, A. K. Obruca and M. R. Guy into graph theory and integer programming respectively and has continued his work on the transportation problem. Mr. Clowes has studied integer programming algorithms and has guided work on a combinatorial problem arising in the optimum design of logical circuits.

Numerical Analysis.

Dr. Wright has applied Chebychev collocation methods to problems occurring in hydrodynamical problems and has prepared a paper on "The oscillations of gas spheres" in collaboration with Professor P. Roberts of the Department of Mathematics and Dr. M. Harley of the University of Chicago. He has studied new modifications

of series methods for the solution of differential equations and for numerical quadrature. He lectured to the Edinburgh University Computer Unit colloquium on the Chebychev solution of differential equations and on initial value problems to the St. Andrews University symposium. Mr. Elphick has considered generalisations of divided difference algorithms for approximation problems and investigated procedures for the solution of elliptic partial differential equations in arbitrary regions.

Automatic Typesetting.

Work arising from the original D.S.I.R. grant to Professor Page and Mr. Duncan has been continued in conjunction with Dr. Molyneux of the Physics Department, Dr. Eve and Miss Robson. A KDF9 programme for the justified setting of plain text nears completion; in order to render the manipulation algorithms readily communicable, the main portions have been written in ALGOL. A new Ministry of Technology contract for £94,000 permits considerable development of this work and the purchase of a photocomposer for extended trials of computer setting. Under the contract Dr. J. L. Dolby from Stanford University will spend one year working in Newcastle; Miss B. Cooke and Mr. R. C. Saunders have been appointed as programmers for the project.

School Timetables.

Miss Barraclough completed her investigation into methods of construction of school timetables by computer and performed trials on a few schools with encouraging success. Her results were presented in a thesis for the M.Sc. degree and prepared for publication before her departure for America. Mr. Cox has reviewed the requirements of many schools and has devised methods of their specification; presentations of these methods by Professor Page and Mr. Cox were made in a two-day conference in Newcastle for ten head teachers and a similar one of one day for about fifty held in London. Several schools have served as preliminary trials of the specification and

will shortly be used in the final testing stages of the manipulation programme. The sponsorship of the Incorporated Association of Head Masters and the Association of Head Mistresses and the Department of Education and Science is gratefully acknowledged, together with the active help of the steering committee of their representatives; our thanks are due, too, to the Durham County Federation of Head Teachers' Association for their gift of twenty-five guineas towards additional expenses of the project and to the County of Durham Education Authority for their offer of co-operation and assistance in the proving stages of the methods which have been developed.

Terrain Geometry.

The Defence Operational Analysis Establishment of the Ministry of Defence has placed a contract under the direction of Professor Page for a study of representations of terrain suitable for computer processing. Mr. I. M. Leitch has commenced this work from which has arisen algorithms for the efficient searching of weighted trees and programs for the input and plotting of contour maps using the Pen Follower and Incremental Plotter recently delivered to the Laboratory.

Naval Architecture.

Mr. Roper has continued his work supported by the British Ship Research Association into the preparation of programs for ship design calculations and has operated the service for many shipbuilding companies in co-operation with Mr. Glover of the Department of Naval Architecture. Recently Mr. Roper has studied the programmes for PERT calculations and has performed them for several shipyards.

MEDLARS.

A contract has been obtained from the Department of Education and Science to develop computer programs for a Demand Search service for medical research workers using abstracted and indexed

material provided by the United States National Library of Medicine in Bethesda, Maryland. Miss E. D. Barraclough has been seconded to this project and has spent three months in the United States investigating the work involved, visiting the National Library of Medicine, the University of California, Los Angeles, and the Massachusetts Institute of Technology. Since her return several of the necessary programs have been written and tested. Dr. A. J. Harley of the National Lending Library will spend considerable time in the Laboratory training an Assistant Librarian to work in Newcastle on the formulation of searches and arranging courses for other librarians and for users of the system. Important though the siting of this nation-wide service in Newcastle, it is of greater significance that there will be available here a large body of indexed material in a form readable by a computer and so will permit research work in methods of Information Retrieval. Assessment of the MEDLARS system itself is one of the most urgent tasks.

Documentation and Retrieval.

Mr. Cox and Mr. Dewes of the Institute of Education have continued their work on the application of computers to library functions and have produced and maintained the Union list of periodicals held by all Institutes of Education. Preliminary studies have been made of the tasks involved in handling archive material; the willing co-operation of the Northumberland County Archivist, Mr. H. Taylor and of staff of the Public Records Office is gratefully acknowledged.

Mr. Cox has developed a number of programmes for handling linked data and has applied them to long runs of Parish records, using material from the Northumberland village of Alwinton. Work of this type has considerable interest to social historians and geographers and several groups from other Universities hope to process their own material by the techniques being developed.

Business Games.

Two business games have been constructed by Mr. A. Ismail under the guidance of Dr. Poole and Mr. Airth; the first comprised a simple manufacturing and selling situation while the second introduced a much greater realism and complexity. Staff and students of both the Computing Laboratory and the Department of Economics have taken part in the games with pleasure and profit, although the managements of some of the companies involved would hardly have merited the approval of the shareholders.

Other Topics.

Dr. Eve has considered several questions related to the Heisenberg problem with Professor G. S. Rushbrooke and Dr. P. J. Wood and, among other calculations, has enumerated lattice configurations of a variety of types.

Mr. Wilson has continued earlier work on the elastic and plastic deformation of shells and has prepared for publication a paper "The elastic analysis of a circular cylindrical shell supported by equally spaced circular ring frames under uniform pressure". He is now studying the buckling of general combinations of beams and plates.

Dr. Duke has worked on topics in Quantum Chemistry including developments of the extended Huckel method for large polyatomic systems and the evaluation of one-electron molecular integrals for the determination of molecular properties dependent on one-electron operations. He delivered a colloquium to the Department of Inorganic Chemistry on "The kinetics of reactions of diborane and the structure of ions related to diborane" and has prepared a note on the latter subject for publication.

A substantial new programming task for Registration has been undertaken by Miss Dalchin of the Registrar's department and Mrs. Hardie, who has also programmed calculations for analyses of departmental expenditure for the Finance Officer.

Publications.

Elizabeth D. Barraclough:	The Application of a digital computer to the construction of timetables. Computer Journal, (1965), Vol. 8., No. 2, p. 136-146.
A. K. Obruca:	MINTREE: a procedure to find the minimum cost tree in a complete graph. Computer Bulletin, (1964), 8, 66.
E. S. Page:	Monte Carlo Methods in Congestion Problems: I: Searching for an Optimum in Discrete Situations: J. Oper. Res. Soc. Amer., (1965), 13, 291-299. II. Simulation of Queueing Systems: J. Oper. Res. Soc. Amer., (1965), 13, 300-305.
	The Comparison of Process Inspection Schemes: Industrial Quality Control, (1965), Nov., 245-249.
	Review of "Automatic Programming", Ed. E. R. Goodman, J. Roy. Statist. Soc. A., 128, 309.
	Review of "Monte Carlo Methods", by J. M. Hammersley & D. C. Handscomb. J. Roy. Statist. Soc. A., 127, (1964), 570-571.
	Performance and Cost Records for a Pegasus Computer. Computer Bulletin, (1964), 8, 133-134.
M. D. Poole with C. A. Coulson:	The Stability of Naphthocyclobutadienes. Tetrahedron, (1964), 20, 1859.
	Calculations of the formation energy of Vacancies in Graphite Crystals. Carbon, (1964), 2, 275.
M. D. Poole with C. A. Coulson, A. Streitwieser, Jr., and J. I. Brauman:	Dictionary of π-Electron Calculations. Pergamon, (1965).

4. Use of the Computer.

The KDF9 is many times faster than the Pegasus that it replaced; some of this increase in speed can be often gainfully sacrificed to make the machine easier to use by employing more powerful languages for the solution of problems. It is, however, remarkable that the first full year of operation of the KDF9 should have seen it engaged on University Computing for about the same time as the Pegasus was during its most heavily worked later years. This represents a large rise in the total amount of University Computing and provides support for our previously noted suspicion that worth while computing projects were being postponed until the arrival of the KDF9. The machine has been reliable with less than one hundred faults of any kind needing unscheduled maintenance in the year; recently the machine efficiency has been exceeding 99 per cent. regularly. A fourth magnetic tape deck and buffer was delivered during the year. A feature of the analysis of computer machine time is the increase in time required by courses; the new option in the General Degree with Honours has attracted a much larger class than had been expected and larger postgraduate courses for Engineers and in Automatic Computing itself have together contributed many hundreds of training programs. Although each such program occupies the central processor of the computer for only a few seconds, delays on peripheral units and handling tasks extend the time significantly. Dr. Eve has modified the Whetstone Algol compiler to reduce the amount of monitor printing and so achieve an improvement of over fifty per cent. for short programs. This version has been passed to other Universities for use on their KDF9 computers. Mr. Cox has produced systems programs which allow the inclusion of subroutines from a standard library tape more quickly than in previous sytems. About 240 hours have been spent on work for other Universities which either have no computer or only a machine too small for their calculations.

Requests of this kind are likely to increase in the immediate future and we shall do our utmost to grant them, although any extension of our operating hours is bound to present difficulties for the laboratory staff. We are grateful to Imperial Chemical Industries Limited for permission to use their compiler for Mercury Autocode, a facility which has been of substantial benefit to several University users. Appendices II and III give details of machine usage.

A D-Mac Pen Follower for punching on paper tape the co-ordinates of points indicated by a stylus has been installed, together with a Benson-Lehner Incremental Graph Plotter. A converter, designed by Dr. Eve and Dr. Molyneux, has been built in the laboratory by Mr. R. W. Walker to enable the plotter to record two increments for each character output by the computer punch. The Pen Follower has been bought in connection with the investigation into Terrain Geometry and the Plotter jointly with the Newcastle Regional Hospital Board. Mr. Givens of the Department of Psychological Medicine and Dr. Molyneux have investigated the input directly to the computer of information recorded on audio tape and the appropriate equipment is under construction. Dr. Molyneux has also considered the operation off-line of a variety of equipment from KDF9 magnetic tape.

5. Lecture Courses.

Candidates for the General Degree with Honours have been able this year to select a course in Numerical Analysis and Automatic Computing exclusively and so to spend one quarter of their time on these subjects. An embarrassingly large number of students enrolled for the first year and will present a problem as the majority of them continue for a second year and a new class enters.

The course in Numerical Analysis and Automatic Computing for the M.Sc. in Chemical Engineering which began in 1963, was

enlarged to accept a total of twenty students from this department and from Mechanical Engineering. Our own postgraduate courses have again been offered. In October, 1964, four candidates were awarded the M.Sc. degree by the Advanced Course in Numerical Analysis and Automatic Computing; this year there were initially ten candidates, eight of whom will soon submit their dissertations. Out of six registered for the Diploma in the same subjects, one withdrew early in the course; four diplomas were awarded.

The first year of the Diploma in Data Processing in Business Administration suffered from late publication of its availability; the sole candidate failed to reach the standard required. This year the nucleus of a class has been registered and will be instructed by colleagues from the Department of Economics and the laboratory staff.

Introductory courses in Algol have again been well attended; our own lecture room is filled several times each year and larger numbers accommodated elsewhere whenever sufficient demonstrator assistance was avilable. For the first time a course for mathematics students in local Teacher Training Colleges was offered; fifty-one attended. A further new type of course was one on the programming of survey analysis in Algol directed primarily at Medical Research Workers; many colleagues from the Medical School joined the course together with workers from other Universities. Next year courses of two kinds will be arranged for undergraduates from the Department of Economics and an undertaking has been given to provide instruction in computing for the new Honours degree in Agricultural Engineering.

A list of courses is shown in Appendix I.

6. Colloquia.

Colloquia arranged by Mr. Elphick have been held at approximately fortnightly intervals during term. The topics have

ranged from specialist ones on the speaker's recent research to general descriptions of the applications of automatic computers in particular fields. There have been large attendances at the Colloquia and many departments of the University and industrial and research organisations have been represented. We are grateful to all the speakers for their interesting papers and the stimulating discussions that they provoked.

Dr. F. Hartley, University Mathematical Laboratory, Cambridge.	"Some Features of the Design of the CPL Language".
Mr. J. H. Cadwell, Royal Aircraft Establishment, Farnborough.	"Curve and Surface Fitting".
Mr. N. E. Wiseman, University Mathematical Laboratory, Cambridge.	"Some Objectives of Design Automation".
Professor P. Henrici, Eidgenoessische Technische Hochschule, Zurich.	"Some Applications of the Quotient-Difference Algorithm".
Mr. A. D. McLaren, University Statistical Laboratory, Cambridge.	"Techniques for Numerical Integration on a Sphere".
Dr. H. Coblans, A.S.L.I.B., London.	"The Use of Computers in Documentation".
Mr. N. S. Makower, University of Edinburgh.	"Operational Research: A Manager's Tool".
Mr. A. d'Agapeyeff, Computer Analysts and Programmers, London.	"Some Software Implications of the new time-sharing Computers".
Dr. M. R. Osborne, University of Edinburgh.	"Numerical Solution of the Orr-Somner feld equation".
Dr. K. D. Tocher, United Steel Companies Ltd., Sheffield.	"The General Simulation Program (Mark III) Language!"

Professor G. Dahlquist, Royal Institute of Technology, Stockholm.	"Convergence acceleration from the point of view of Linear Programming".
Dr. V. Ptak, University of Prague.	"Applications of Matrix Theory to Spectral Problems".
	"Applications of Matrix Theory to the Rate of Convergence of Iterative Procedures".

7. Conclusion.

The teaching duties of the Computing Laboratory continue to increase at both postgraduate and undergraduate levels. In the Computing field, forecasting seems beset with more than the usual difficulties; however, it seems safe to prophesy that the demands for teaching in undergraduate courses will increase very largely over the next few years and that the twin requirements of practical instruction and of productive computing in research work will saturate our present machine in a short time. In order to satisfy these needs further lecturing staff will need to be appointed. The type of computing system which we have proposed to the University Grants Committee involves multiple access consoles and would enable the different kinds of computing demand to be satisfied and at the same time permit research into the more advanced methods of computer use. Substantial expenses are bound to be incurred if these developments are to be made possible; the importance, nationally, of extensive training in the use of computers ensures that the money would be well spent and, accordingly, I hope that the University Grants Committee will be provided with the funds it needs to distribute for these purposes.

E. S. Page.

APPENDIX I.

LIST OF COURSES HELD.

Date	Title	Lecturer	No. of Persons Attending	
			University	Industry
1964				
Sept./Oct.	Algol.	Staff of the U.C.L.	54	4
October.	Algol.	Staff of the U.C.L.	65	4
Michaelmas.	Matrices.	Dr. H. I. Scoins.	18	
	Monte Carlo Methods and Operations Research.	Prof. E. S. Page.	18	
	Approximation Theory.	Mr. M. J. Elphick.	22	
	Machine Languages and Communication.	Mr. J. S. Clowes.	15	
	Computing Equipment.	Dr. J. Eve.	2	
	Sorting.	Dr. J. Eve.	2	
	Chemical and Mechanical Engineers.	Dr. K. Wright. Dr. B. J. Duke.	20	
	Numerical Methods, Level II	Mr. J. S. Clowes.	29	
	3 G and 2 GDH.	Mr. L. B. Wilson.	35	
December.	Algol.	Staff of the U.C.L.	26	
Dec. 1964 & Jan. 1965.	Programming.	Staff of the U.C.L.	21	2
1965				
January.	Algol.	Staff of the U.C.L.	33	3
Epiphany.	Linear Programming.	Dr. H. I. Scoins.	15	
	Theory of Algol.	Dr. H. I. Scoins.	15	
	Ordinary Differential Equations.	Dr. J. Eve.	15	
	Logical Design.	Dr. J. Eve.	40	
	Quadrature.	Dr. K. Wright.	19	
	Chemical and Mechanical Engineers.	Mr. L. B. Wilson. Dr. B. J. Duke. Mr. I. M. Leitch.	19	
	Numerical Methods, Level II	Mr. J. S. Clowes.	29	
	3 G and 2 GDH.	Mr. M. J. Elphick.	36	
	Computer Languages.	Dr. M. D. Poole.	8	
	Algol.	Staff of the U.C.L.	32	
	Pilot Experimental Course.	Mr. S. N. M. Cox.	50	
	Sorting.	Prof. E. S. Page.	15	

APPENDIX I CONTINUED.

Date	Title	Lecturer	No. of Persons Attending	
			University	Industry
1965				
Easter.	Partial Differential Equations.	Mr. M. J. Elphick.	13	
	A Simulation Language.	Mr. J. P. G. Roper.	17	
	Numerical Methods, Level II	Mr. J. S. Clowes.	29	
	3 G and 2 GDH.	Mr. M. J. Elphick.	36	
June.	Algol.	Staff of the U.C.L.	27	
	Algol.	Staff of the U.C.L.	32	
July.	Algol for Teachers' Training Course.	Staff of the U.C.L.		51
	Algol for Medical Research.	Staff of the U.C.L.	19	6

APPENDIX II.

DIVISION OF MACHINE USAGE.

	Hours
Useful Time (University and Industry):	3,331
Maintenance:	338
Idle:	141
Engineering:	106
Fault and Repair Time:	130
Total:	4,046

APPENDIX III.

DEPARTMENTAL ANALYSIS OF KDF9 MACHINE TIME USED.

	Hours
Agriculture	39
Chemistry	180
Computing Laboratory	
Courses:	456
Contracts:	221
Service and Research:	636
Education	18
Engineering	
Chemical:	14
Civil:	53
Electrical:	147
Mechanical:	100
Mining:	1
Geography	15
Geology	3
Mathematics	49
Medicine	
Child Health:) Industrial Health:) Obstetrics and Gynaecology:) ... ... Psychological Medicine:)	144
Metallurgy	2
Naval Architecture	98
Philosophy	1
Physics	343
Psychology	12
Registrar and Bursar	93
	2,625
University of Durham	154
University of Edinburgh	17
Queen's University, Belfast	71
English Electric-Leo-Marconi Computers Ltd., ...	407
Industry	57
	3,331

APPENDIX IV.

STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST JULY, 1965.

EXPENDITURE

Salaries, Superannuation, etc.

	£ s. d.	£ s. d.
Salaries, National Insurance & Graduated Pension of Teaching and Research Staff	29,734. 3. 1.	
Superannuation - do - - do -	3,075.16. 4.	
Student Demonstrators	393. 6. 3.	
Salaries, National Insurance, Graduated Pension and Scottish Widows' Fund Contributions in respect of Technical and Clerical Staff	6,934.13. 4.	40,137.19. 0.

DEPARTMENT & LABORATORY SUPPLIES

Printing, Postages, etc.	787. 1. 2.	
Travelling Expenses	423.16. 1.	
Laboratory Equipment	2,453. 6. 5.	
Computer Maintenance	9,042. 8. 7.	
Computer Running Costs - other than Power	2,505. 1. 4.	15,211.13. 7.
Library		305.11. 3.

MAINTENANCE OF PREMISES

Insurance	430. 9. 2.	
Heat, Light, Power and Water	1,305. 7. 8.	
Office Maintenance and Repairs	229.17. 9.	
Office Furniture and Equipment	199. 1. 7.	
Wages of Cleaners	1,300. 4. 3.	3,465. 0. 5.

MISCELLANEOUS EXPENDITURE

Hospitality	161.19. 8.
Removal Expenses	38. 3. 1.
	59,320. 7. 0.

STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST JULY, 1965.

INCOME

	£ s. d.
Grant from British Shipbuilding Research Association.	1,535. 0. 2.
Grant from the Department of Education and Science/ Association of Headmasters and Headmistresses.	1,196. 1. 8.
Grant from the Ministry of Defence.	888. 9. 8.
Grant from Science Research Council - (Miss Robson's salary, etc. to 31.1.65).	549. 5. 3.
Grant from Office for Scientific and Technical Information - Miss Barraclough's salary, etc. from 1.3.65).	782. 4. 4.
Fees (Programming Courses).	1,650.13. 9.
Contributions for Services rendered.	11,300. 3. 1.
	17,901.17.11.
S. R. C. - Supplementation to Departmental Grant - (Carried forward to 1965-66).	282. 9. 0.

PROVISION FOR RESERVE

Grant from the University (based on 98.25% of net expenditure less income from concessionary users).	50,375. 0. 0.
Income.	17,901.17.11.
	68,276.17.11.
LESS Expenditure.	59,320. 7. 0.
Surplus transferred to RESERVE for Equipment, Additions and Replacements.	8,956.10.11.

APPENDIX V

INCOME FROM SALE OF MACHINE TIME.

	£ s. d.	£ s. d.
Shipbuilders.		1,086. 1. 6.
British Ship Research Association.		1,976.10. 0.
Other Industrial Firms.		3,447.13. 9.
Universities.		2,377.13. 0.
Research Contracts:		
British Ship Research Association. Ship Design Calculations.	500. 0. 0.	
Department of Education and Science. School Timetables.	200. 0. 0.	
Ministry of Defence. Terrain Geometry.	291.13. 4.	
Office for Scientific and Technical Information. MEDLARS.	833. 6. 8.	1,825. 0. 0.
Industrial Programming Contracts.		600. 0. 0.
Royal College of Physicians, London.		455. 0. 0.
		11,767.18. 3.
LESS		
Charges against Income:	170.12. 5.	
Royalties:		
Key Punching - payments to operators:	23.15. 6.	
Print-out:	15.18. 0.	
Stores:	257. 9. 3.	467.15. 2.
		11,300. 3. 1.