DOCUMENT A.

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

1965/1966

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

S T A F F

Director and Professor of Computing and Data Processing

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.

Honorary Lecturer

Antony John Harley, B.Sc., Ph.D., Leeds.

Research Assistants

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

I.C.I. Fellow

John Oliver, B.Sc., Dunelm., Ph.D., Cantab.

Senior Computer Operator

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

Computer Operators

Margaret Grace Robson, B.Sc., Lond.
John Paul Goy Roper, 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.
Alan Keith Binks, B.Sc., N'cle.

Part-time Computer Operators

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

S T A F F

Junior Computer Operators

Susan Mary Cawood
Dorothy Edna Jackson
Joyce Kitchin
Margaret Cameron

Part-time Keypunch Operator

Brenda Clark

Senior Research Associates

Nigel Shaun Maturin Cox, M.A., Cantab.
Diploma in N.A. & A.C. Dunelm.
Ian Muir Leitch, B.Sc., Nott., M.Sc., N'cle.
Robert Edward Berry, B.Sc., Leic., M.Sc., N'cle.

Assistant Librarian to MEDLARS

Marjorie King, B.Sc., Sheff.

Computer Typesetting Research Project

James Louis Dolby, M.A., Wesleyan, Ph.D., Stanford.
Rodney Colin Saunders, M.Sc., S'ton.
Brenda Cooke, B.Sc., N'cle.
Diploma in N.A. & A.C. N'cle.

Computer Engineers

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

Secretary

Ella Barrett

Clerical

Ann Laybourn
Carole Anne Waugh (resigned 6.6.1966.)
Margaret Marshall (commenced 27.6.1966.)
Josephine Knapper

THE UNIVERSITY OF NEWCASTLE UPON TYNE

COMPUTING LABORATORY

ANNUAL REPORT, 1965/1966.

1. General.

In January, 1966, the report of a Joint Working Party on Computers for Research - in the "Flowers' Committee" - was presented to Parliament and promptly accepted by the Government. This report and government decision are clearly of first importance both for the national interest and for the individual Universities and research establishments concerned. In case, however, there is a feeling that all is now bound to be well in University Computing a few warnings should be voiced. More than six months elapsed between the date on the report and its presentation to Parliament; the total sum recommended by the Committee for capital and recurrent expenditure on computing in research over five years must be stretched to cover six years because of the National economic position. The Computer Board charged with reviewing, revising and implementing the committee's recommendations has been established more than twelve months after the completion of the report, although a valuable start has been made by an interim body. The early termination of the Working Party permitted them to take only partial account of the impact that multiple access computing is beginning to have in Universities. Worries about delays, scale and direction still exist. What some thought to be too little is in danger of becoming too little, too late, too slowly.

It must also be remembered that the Flowers' committee was concerned with computers for research; the teaching in Universities

of computing science in its various aspects and to the different groups of students was purposely not considered and the sums of money necessary to perform this teaching must come from the normal University recurrent grants. There is substantial evidence both in the report itself and outside it that all these dangers are realised by members of the Computer Panel and new Computer Board; they need also to be realised and the warnings heeded by all those involved both beyond and below these bodies.

Amid its general responsibilities the Computer Board has a particular one of great concern to this University, the capital grant for the new computing system to be installed in the building under construction for the Computing Laboratory. We hope to meet the Board soon and seek their approval for our proposals of co-operation with our colleagues in Durham in the early purchase and operation of a multiple access computing system to serve both Universities. Our plans are of a different kind from those in other Universities and research centres and if we are enabled to realise them promptly we believe that they may form a pattern for much University computing in the next few years.

Many detailed discussions about the new building have been held with the architects and their consultants; we are particularly grateful to the installation engineers of the computer firms with whom we are working for their advice and comments on the different designs proposed. We hope to move in a little under a year's time.

The number of trained persons needed in the computing field in Britain is large and the task of training presents a challenge, part of which must be accepted by Universities. A broad training in any discipline requires staff of varied interests

and makes heavy demands upon staff time. It is unlikely that any but the larger and longer established computing departments will be able to contribute significantly to the training programme necessary; unfortunately, these departments are to be found in the universities which are fearing the severest restrictions on increases in their student numbers over the next quinquennium. We have, however, taken the necessary steps to make us ready to play what part we can. Regulations for an Honours degree in Computing Science have been approved and can take effect from the academic year 1966/67. The first small group of students coming from the Mathematics Honours intake will thus become the principal responsibility of the Computing Laboratory in October, 1967, at the commencement of their two final years. This new teaching coupled with requests for additional courses from other subjects and the still increasing need of computer users for assistance are bound to bring heavy burdens on the staff of the laboratory. Computing and related subjects seem to be high in the priorities of those planning their courses, deservedly so, we believe; we shall do what we can, as soon as we can, to satisfy these reasonable requests.

The growth of computing, both as a service and as a subject of its own, has been very rapid and all the problems of such an expansion have been and are still being encountered. Plans formed even two years ago are inadequate for present requirements; the pace of growth has not perceptibly slackened and the only safe forecast is that the problems will remain beyond the present planning horizon.

2. Staff Changes.

At the beginning of the year we welcomed Dr. J. Dolby and have recently bid "Au revoir" to him after a year's work on the Computer Typesetting Project; the injection of his ideas and energy from America has been both enjoyable and valuable and we look forward to maintaining

regular contact with him. Newcomers working on the same project and continuing in their posts have been Miss B. Cooke and Mr. R. C. Saunders. Miss M. King has been supported on the MEDLARS Research Contract and Mr. R. E. Berry by another research grant. Dr. J. Oliver was awarded an I.C.I. Fellowship to pursue research in the Computing Laboratory. Miss M. Cameron joined the staff as Junior Computer Operator and Mrs. B. Clark as a Keyboard Operator. Mr. Roper has transferred to the established staff as Computer Operator on the termination of the research grant from the British Ship Research Association.

Dr. B. J. Duke has left the laboratory after two years to become lecturer in Chemistry at the University of Lancaster and Mrs. P. M. Porter has ceased operating duties on returning to a teaching post. In the Office Miss M. Marshall has replaced Miss C. Waugh.

In the new session we look forward to greeting Dr. R. B. Hunter as lecturer, Mr. C. R. Snow as demonstrator and Mr. A. K. Binks as computer operator. The regular assistance part-time of several other graduates will be valuable for operating the computer during the extended hours required.

Dr. J. Eve spends the coming academic year on study leave in the Computing Science department of the Carnegie Institute of Technology, while Dr. B. Shaw, whose appointment as lecturer has been delayed until August, 1967, will be working until then at the University of Texas.

Those leaving the laboratory take with them our good wishes; those joining are most welcome and we hope, that in spite of crowding, they will find conditions helpful for their work.

3. Research Activities.

Mathematical Programming and Combinatorial Problems.

Professor Page has continued work on permutation problems

with applications to scheduling and on the generation of pseudo-random elements. A paper on the latter topic was presented to the N.A.T.O. conference on "The Role of Digital Simulation in Operational Research" in Hamburg and at the International Symposium on Simulation at Brunel College of Advanced Technology. He acted as rapporteur for a session on combinatorial problems at the British Joint Computer Conference.

Applications of graph theory have continued to occupy Dr. Scoins and his research students; A. K. Obruca completed his doctoral dissertation entitled: "The manipulation of trees and linear graphs within a computer and some applications"; M. R. Guy is working on the convergence of integer programming algorithms.

Dr. Scoins attended a seminar at the International Computer Centre, Rome, on Graph Theory and took part in a Machine intelligence workshop in Edinburgh. He read a paper on "The Classificiation of Initial Problems of the Transportation Type" at a symposium on Mathematical Programming at Birmingham and gave a colloquium at Manchester University on "Trees and the transportation problem".

Different application of "backtrack" procedures have been studied by L. Waller under Professor Page's direction and by Mr. Wilson.

Mr. Berry has been employed on a research contract to study with Professor Page different methods of scheduling landing and departing aircraft at a given airport. The co-operation with the Royal Aircraft Research Establishment, Malvern, has been valuable and the joint results show promise of improvements within the physical and safety constraints.

Covering problems connected with the automatic design of switching circuits have been considered by Mr. Clowes.

Numerical Analysis.

Dr. Wright has extended previous work on collocation methods for the solution of differential equations and has studied methods of

quadrature using series. A joint investigation with Professor Roberts and Dr. Harley has applied some of the methods developed. He has spoken about his work in a colloquium entitled "Chebyshev collocation methods for ordinary differential equations: some extensions and practical examples", held at the Atomic Energy Research Establishment, Harwell, and at the Edinburgh symposium on Chebyshev Approximation in November, 1965, in which Dr. Oliver also took part. Both Dr. Wright and Mr. Wilson attended the Oxford Summer School on Numerical Approximation.

Several methods for solving numerically the initial value problem for linear recurrence relations have been developed and analysed by Dr. Oliver. He has also investigated the mathematical problems arising in general purpose programs for electrical network analysis. Three papers on different aspects of this work have been prepared, the first of which: "Relative error propagation in the recursive solution of linear recurrence relations" will appear in Numerische Mathematik.

Mr. Wilson is writing a paper on the plastic collapse of stiffened shells and completing a stage of his work on the buckling of general combinations of beams and plates under end thrust. The latter study has involved an investigation of the general eigenvalue problem and has produced useful modifications of the iterative methods of Michaelson and Osborne.

A series of informal seminars on Numerical Analysis topics of current research interest have been held; the introductory talks have been given by Mr. Elphick, Mr. Lane, Dr. Oliver, Mr. Wilson and Dr. Wright.

Computer Typesetting Project.

Work supported by the Ministry of Technology research grant of £94,000 has commenced and continues and extends that performed

under the original D.S.I.R. grant by Professor Page, Mr. Duncan, Dr. Eve, Miss Robson and Dr. Molyneux. A KDF9 program for the justified setting of plain text has been completed by Miss Robson and has been used for a number of trials including Professor Page's inaugural lecture. Several extensions to this program have been made or are in progress. Miss Cooke has added optional unjustified setting, Dr. Poole has commenced the Editing suite of programs, while Dr. H. B. Cortius, on a two month visit from the Mathematische Centrum, Amsterdam, has worked on a page layout section and on the setting of mathematical formulae. Under Dr. Dolby's direction a number of studies of printing practice have been carried out. Mr. Saunders has programmed input and analysis routines for tape converted from T.T.S. format by equipment designed and built by Dr. Molyneux's group. Mr. Saunders is now working on methods of estimating the cast-off and assessing their value from material deposited by a number of printing houses. Arrangements have been made to install a Monophoto typesetting machine in the laboratory to permit prompt trials and a Potter line printer will be attached to the KDF9 via a slow magnetic tape deck by Dr. Molyneux for use at the intermediate editing stage. Several of those involved in the project attended the Computer Typesetting Conference held at the University of Sussex in July and presented papers on their work.

School Timetables.

Mr. Cox has designed methods of specification of a wide range of the requirements encountered in timetabling in schools and has completed a suite of programs enabling them to be accepted by the computer and a timetable formed as far as possible. The programs are intended to be used both for extended trials of the manipulation algorithms incorporated and for comparisons of other possible algorithms. A steering committee on which have been

represented two head teachers' associations and the Department of Education and Science has given valuable assistance, particularly in ensuring close contact with the intended ultimate users of the work. The financial support of these bodies has been much appreciated; now that the initial research phase of the work is complete, other arrangements are being sought to enable more extended trials to be conducted. Mr. Cox has talked about the work to a group of the Institute of Mathematics and its Applications, the Northumberland Training College and at a session of the British Joint Computer Conference. Miss Barraclough spoke on the construction of timetables at a seminar in the Edinburgh University Computer Unit.

Terrain Geometry.

Mr. Leitch has continued his work on the representation of terrain suitable for computer processing in consultation with Professor Page and Dr. Scoins. As an incidental to his main study, he has produced general purpose routines permitting easy use of both the Pen Follower and Incremental Plotter within the Algol systems available. Mr. Leitch attended a seminar on terrain intervisibility arranged by the French Ministry of Defence in Paris in February.

Information Retrieval and Documentation.

Miss Barraclough completed programs enabling MEDLARS searches to be started on 1st April, 1966, just one year after commencement of the system study. We are pleased that Dr. Harley of the National Lending Library has accepted an honorary lectureship in the laboratory to mark the close co-operation of the National Lending Library and the University in the provision of the MEDLARS service for the United Kingdom. Dr. Harley has arranged several courses for both Medical Research workers and medical librarians in the best use of MEDLARS, one of which was held in Newcastle. Miss M. King has been appointed

as Assistant Librarian working on the project in the Laboratory and in the University Library; she has assisted in one of the users' courses and has given particular attention to discussions with Newcastle medical workers about their search requests and the formulation of them. The effect of having a librarian fully conversant with the system and the interest shown by those in the School of Medicine have certainly been large; only recently has the number of searches for Newcastle staff been exceeded by those from all the rest of the country. Naturally, the total Newcastle usage will be rapidly outstripped by the remainder, especially as Dr. Harley's further courses enlarge the body of potential users, but the proportionate use is likely still to be high and to reflect the advantages of personal attention by the formulator of the searches - given good communications, the siting of the computer is, of course, of no great consequence. Additional search possibilities are being added, together with the capability for regular "current awareness" reports. A vital step in the operation of the service is the conversion of the magnetic tapes received from the National Library of Medicine to KDF9 format and we are particularly grateful for the facilities made available by Imperial Chemical Industries Limited at Wilton.

Comments on the citations retrieved are being used to study the quality of the searching while a research student, W. L. Miller, is developing and applying clumping techniques to the retrieved citations. Another student, W. A. Gray, also working with Professor Page, is using the citation file to consider semi-automatic methods of indexing and alternative retrieval strategies. Professor Page described the Newcastle operation of MEDLARS to a one-day meeting on Information Retrieval under the auspices of the Royal Society.

Professor Page, Dr. Dolby and Mr. Cox, together with Mr. Line and Mr. Dews from the University and Institute of Education

Libraries, attended the Anglo-American Conference on the Mechanisation of Library Services at Oxford. Various library applications of computers are in progress in Newcastle. The preparation of the Union List of periodicals in Institute of Education Libraries, programmed by Mr. Cox and Mr. Dews, is undertaken regularly. The ordering and accession system devised by the University Library and Mr. B. Jones has completed its trial period of double running. A catalogue of recently acquired volumes is being created on magnetic tape. Preliminary studies of the problems of recording existing catalogues and eliminating errors and deficiencies automatically have been made using some seminar libraries as examples and were reported by Mr. Cox and Dr. Dolby at the Institute of Printing Typesetting Conference. The extension of this work to the University Library is being considered.

A course of six lectures to Senior Librarians on "The Role of the Computer in the Organisation and Handling of Information in Libraries" has been given by Mr. Cox, Mr. Dews and Dr. Dolby and the material subsequently published in monograph form.

Mr. Cox has continued work on the application of computers to archives and to the analysis of parish records. A research grant has been received from the Science Research Council to support work into methods for handling such linked records and applications will be made to data accumulated by the Cambridge group for the History of Population and Social Structure.

Naval Architecture.

The research grant from the British Ship Research Association which has supported programming work on ship design calculation has now terminated and Mr. J. P. G. Roper has prepared a final report. The service performing these calculations and those for the PERT management aid will be continued for the substantial number of shipbuilding

companies who request them.

Other topics.

Dr. Duke has continued work in Quantum chemistry and has in preparation papers on "The Numerical estimation of Mossbauer spectra parameters" and "The extended Huckel method self-consistent on charges". Another paper on "The Structure of Diborane and Diborohydride Ion" will appear in the Transactions of the Faraday Society. He is about to submit two programs for the computation of Huckel Molecular Orbitals to the Quantum Chemistry Program Exchange. He described some of his work to the Mossbauer Group of the Chemical Society.

Dr. Eve has again collaborated with Professor Rushbrooke and others on combinatorial problems in Statistical Mechanics. One paper has appeared and another is in press.

Grading programs for the assessment by computer of some student exercises were devised and compared by Mr. Berry in his M.Sc. dissertation. A paper will appear in the Computer Journal.

Miss Barraclough presented a paper on Program development strategy to a symposium arranged by the KDF9 Users' Association. She attended the N.A.T.O. Summer School on Man Machine Interaction held in Edinburgh in July and August, and Dr. Eve the British Computer Society Symposium on Multi-access Computers at the National Physical Laboratory. Dr. Eve visited several laboratories in the United States of America to discuss multiple access machines.

Publications.

Elizabeth D. Barraclough and A. J. Harley:	MEDLARS: Information Retrieval in Britain. Postgraduate Medical Journal, (1966), Vol. 42, 69-73.
N. S. M. Cox, J. Dews and J. L. Dolby:	The Computer and the Library: 96 p. University of Newcastle upon Tyne Library, 1966.

Publications (continued).

N. S. M. Cox and J. L. Dolby:	Structured linguistic data and the automatic detection of errors. Proceedings: Institute of Printing, Computer Typesetting Conference, (1966), b, 9-13.
J. L. Dolby and B. Jones:	The measurement of composition practice. Proceedings: Institute of Printing, Computer Typesetting Conference, (1966), d, 29-34.
J. L. Dolby and R. C. Saunders:	The use of T.T.S. tapes in studies of computer typesetting practice. Proceedings: Institute of Printing, Computer Typesetting Conference, (1966), a, 58-62.
B. J. Duke:	Structure of Ions related to Diborane. Nature (1966), 209, 1234.
	Computation of rotational levels. Computer Journal (1966), 9, 210.
J. Eve with G. A. Baker, H. E. Gilbert and G. S. Rushbrooke:	On the Heisenberg Spin $\frac{1}{2}$ ferromagnetic models. Physics Letters 20 (1966), 146.
A. J. Harley:	U. K. Medlars Information Retrieval Service: A Handbook for Users. 64 p. National Lending Library for Science and Technology, July, 1966.
E. S. Page:	Computing: How, What and Where. Inaugural lecture, (1966), University of Newcastle upon Tyne.
	Computers and congestion problems: Proceedings: Symposium on Congestion Theory, University of North Carolina, (1965), 72-85.
L. B. Wilson:	The elastic deformation of a circular cylindrical shell supported by equally spaced circular ring frames under uniform external pressure. Quart. Trans. of Royal Institute of Naval Architects, (1966), 108, 63-72.
K. Wright:	Series methods of integration. Computer Journal (1966), 9, 191-198.
K. Wright with M. Hurley and P. H. Roberts:	The Oscillation of gas spheres. Astrophysical Journal (1966), 143, 535-551.

External Activities.

In addition to visits directly connected with their research activities, members of the laboratory staff have served on outside bodies. Professor Page is a member of the Science Research Council Atlas Computer Committee, the Committee for the University of Durham Computer Unit and the Office for Scientific and Technical Information Working Party on A.S.L.I.B. (Association of Special Library Information Bureaux). He is the University representative on the Inter-Universities Committee on Computing and Chairman of the Sub-Committee of Directors of University Computing Laboratories and of its Standing Committee. Dr. Eve has recently resigned from the Executive Committee of the KDF9 Users' Group in anticipation of his departure for one-year's study leave at the Carnegie Institute of Technology.

Dr. Wright is Vice-Chairman and Mr. Roper and Mr. Cox have both served on the committee of the Newcastle branch of the British Computer Society; Professor Page has completed his term of three years as Member of Council for the North-East region and has served on the British Joint Computer Conference Committee.

Professor Page has acted as external examiner for various degrees of the Universities of Belfast, Leeds and Liverpool and for the proposed University of Bradford.

Use of the Computer.

Last year the KDF9 was switched on for nearly 6,000 hours; difficulties in staffing all the night shifts for a period of the year caused some reduction in the usage. This heavy demand for machine time arose predominently from research requirements within the University while a substantial allocation of time was made to the University of Durham. The University of Edinburgh expects to install a KDF9 by the end of 1966 and until that time we are attempt-

ing to provide them with computing facilities, although the conflict between our internal demands and the desire to help is impossible to resolve with satisfaction to all. The total machine time used by students on formal courses has reached about seven per cent. of the useful time; the majority of this is taken by M.Sc. students while performing the work on which their dissertations are based. A slight increase in time for teaching is likely, but other constraints - time for practical work, congestion on editing equipment - will be encountered before it becomes an embarrassment to the demands of research computing.

The reliability of the computer has been very good even though the majority of the operation has been unmaintained. The scheduled maintenance has taken less than $1\frac{1}{4}$ hours in each 24-hour period and the unscheduled repair times amount to less than one hour a week. As in every installation difficulties occur; an elusive transient fault in late Summer was only removed after three separate borderline conditions in one section of the computer had been detected. The engineering team merit congratulations on the results of their efforts. Analysis of machine usage is given in Appendix II.

Mr. Givens of the Department of Psychological Medicine and Dr. Molyneux of the Physics Department have designed and constructed an input device accepting information recorded on audio-tape and Mr. Clowes has written a suitable suite of input programs. Dr. Molyneux is working upon equipment to operate a line printer with a larger character set than that attached to the KDF9.

5. Teaching.

The Automatic Computing option in Mathematics for the General Degree with Honours has proved popular and the size of classes in both second and final years has been large and presents

difficulties in the practical sessions.

In October and November, 1965, six candidates were awarded the M.Sc. degree by advanced course in Numerical Analysis and Automatic Computing. This year there are five candidates, in addition to seven for the Diploma, of whom five were successful in June. Three candidates gained the Diploma in Data Processing in Business Administration.

We have welcomed as visiting lecturers for these post-graduate courses, Dr. K. D. Tocher, United Steel Companies Limited and Mr. C. W. Cleverdon, The College of Aeronautics Library, who have given short series of lectures on Process Control and Information Retrieval respectively.

Teaching in computing for the M.Sc. in Chemical Engineering and in Mechanical Engineering has been continued and other courses for some Applied Science departments planned for implementation as staff becomes available.

A one-day seminar arranged by Dr. Scoins on Critical Path techniques was well attended by University staff and students and by managers from Industry. The value of the proceedings was enhanced by the contribution of the visiting speakers.

There have been many visits to the laboratory by interested groups and lectures to them and others have been given by different members of staff.

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. M. F. Lynch, University of Sheffield.	"Information Retrieval and its Role in Scientific Communication".
Dr. W. Saraga, A.E.I. Advanced Development Laboratories, Blackheath.	"Numerical Problems in Electrical Network Design".
Dr. J. L. Dolby, University of Newcastle upon Tyne.	"Some Problems of Computational Linguistics".
Mr. M. J. D. Powell, Atomic Energy Research Establishment, Harwell.	"A Comparison of Weighted Least Squares and Minimax Polynomial Approximations".
Mr. R. Popplestone, Experimental Programming Unit, Edinburgh.	"Theorem Proving by Computer".
Dr. J. Oliver, University Computing Laboratory.	"Recursive Solution of Linear Recurrence Relations".
Dr. E. Elcock, University Aberdeen.	"The Use of a Learning Component in the Design of a Game-Playing Program".
Dr. A. R. Meetham, Autonomics Division, National Physical Laboratory, Teddington.	"Graph Algorithms and Information Retrieval".
Mr. M. J. Elphick, University Computing Laboratory.	"Divided Difference Algorithms and Extensions".
Professor B. Galler, University of Michigan.	"Multiple Access Computing".
Dr. J. D. Lambert, University of Aberdeen.	"Numerical Solution of Ordinary Differential Equations by Methods Based on Non-Polynomial Interpolants".
Professor J. Bennett, University of Sydney.	"Inverses for all Occasions".

Conclusion.

In some respects this year has been one of consolidation; the existing computer has become fully used, the first candidates for the General Degree with Honours taking Computing as a substantial part of their course have graduated, the other previous courses have continued with numbers certainly as large as can be reasonably accepted. Rates of change in the computing field are such that it is not enough only to consolidate and time cannot be spared solely for consolidation. Some of us have spent much time with the architects and their consultants discussing the new Computing Laboratory, scheduled for completion within the next nine months; others have had the enjoyable task of examining in detail the new computing systems which might be purchased with the capital grant to us, while all have suffered suspense awaiting the permission to place the necessary order; the new Honours course in Computing Science, one of the first of its kind in a British University, is receiving much detailed study in its preparation; existing and new research projects are developing in interesting ways. The immediate future holds much to look forward to, and promises little as breathing space; I believe that few in the Computing Laboratory would really wish it to be different. I know, however, that the demands made this year upon all, in particular upon those on the "service" side of the activities, have been extremely heavy and this brief comment of appreciation for the response to those demands is far from adequate.

E. S. Page.

APPENDIX I.

LIST OF COURSES HELD.

Title	Lecturer	No. of Persons attending	
		University	Industry
POSTGRADUATE:			
M.Sc. and Diplomas in Computing.			
Michaelmas.			
Algol Language.	Dr. M. D. Poole.	16	
Approximation Theory.	Mr. M. J. Elphick.	15	
Computing Equipment.	Dr. J. Eve.	4	
Data Forms and Survey Analysis.	Dr. H. I. Scoins.	4	
Machine Languages and Communication.	Mr. J. S. Clowes.	12	
Monte Carlo Methods.	Prof. E. S. Page.	12	
Sorting.	Dr. J. Eve.	4	
Epiphany.			
Computer Languages.	Dr. M. D. Poole.	16	
Differential Equations.	Dr. J. Eve.	12	
Graphs and Mathematical Programming.	Dr. H. I. Scoins.	4	
Graph Theory.	Dr. H. I. Scoins.	12	
Linear Programming.	Dr. H. I. Scoins.	12	
Logical Design.	Dr. J. Eve.	14	
Quadrature.	Dr. K. Wright.	15	
Simulation.	Prof. E. S. Page.	3	
Easter.			
Case Studies.	Staff of the U.C.L.	4	
Partial Differential Equations.	Mr. M. J. Elphick.	12	
Sorting.	Prof. E. S. Page.	12	
M.Sc. in Chemical and Mechanical Engineering.			
Michaelmas, Epiphany and Easter.			
Numerical Methods.	Drs. Duke, Wright, and Mr. Wilson.	14	
UNDERGRADUATE:			
Michaelmas, Epiphany and Easter.			
Automatic Computing: 2GDH and 3G.	Mr. M. J. Elphick, and Mr. L. B. Wilson.	43	
Automatic Computing: 3GDH.	Mr. M. J. Elphick, Dr. J. Oliver and, Mr. L. B. Wilson.	23	
Numerical Mathematics, Level II.	Mr. J. S. Clowes.	24	
PROGRAMMING:			
Algol: 8 Courses during the year.	Staff of the U.C.L.	199	22
User Code: 1 Course: December - January.	Staff of the U.C.L.	19	1
PERT: December.	Dr. H. I. Scoins and Visiting Lecturers.	8	88

APPENDIX II.

DIVISION OF MACHINE USAGE.

	Hours
Useful Time (University and Industry):	5,170
Maintenance:	375
Idle:	168
Engineering:	89
Fault and Repair Time:	96
Total:	5,898

APPENDIX III.

DEPARTMENTAL ANALYSIS OF KDF9 MACHINE TIME USED.

	Hours
Agriculture	53
Chemistry	225
Computing Laboratory	
Courses:	403
Contracts:	353
Service and Research:	997
Economics	8
Education	14
Engineering	
Chemical:	19
Civil:	91
Electrical:	219
Mechanical:	92
Mining:	1
Geography	16
Geology	2
Mathematics	462
Medicine	
Child Health:) Industrial Health:) Obstetrics and Gynaecology:)... ... ... Psychological Medicine:)	233
Metallurgy	31
Naval Architecture	305
Philosophy	--
Physics	218
Psychology	10
Registrar and Bursar	196
Social Studies	3
Town and Country Planning	2
	3,953
University of Durham	274
University of Edinburgh	123
Queen's University, Belfast	2
English Electric-Leo-Marconi Computers Ltd.	645
Industry	173
	5,170