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

1963/1964.

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, B.A., Oxon., A.R.I.C.
Michael Dines Poole, B.A., Cantab.

Senior Computer Operator

Elizabeth Dick Barraclough, B.Sc., Manc.

Computer Operators

Margaret Grace Robson, B.Sc., Lond.
Mary Frances Tabrett, B.Sc., Dunelm.
John Taylor, B.Sc., Manc.
Gillian Hardie, B.Sc., Edin.
Diploma in N.A. & A.C. Dunelm.

Junior Computer Operators

Susan Mary Cawood
Dorothy Edna Jackson

Senior Research Associates

John Paul Goy Roper, B.Sc., Dunelm.
Nigel Shaun Maturin Cox, B.A., Cantab.
Diploma in N.A. & A.C. Dunelm.

Computer Engineers

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

Secretary

Ella Barrett.

Clerical

Ann Laybourn.
Josephine Knapper.

THE UNIVERSITY OF NEWCASTLE UPON TYNE.

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ANNUAL REPORT, 1963/1964.

1. General.

The year in which a new computer is installed is likely to be one of inconvenience, frustration, excitement and intense activity for the staff of the Laboratory and other machine users. Given ample space, time and patience, some of the emotions might have been avoided; situated as we have been, all have been experienced. Shortly after the beginning of the academic year builders completed the new computer room, which had been formed in areas previously used for postgraduate students and tape-editing equipment. The students were displaced into a different building and the tape-editing equipment into whatever rooms in the Laboratory could be made available. The department of Agricultural Chemistry vacated No. 3, Kensington Terrace at the turn of the year and, although conversion work continued into the Epiphany Term, students and equipment occupied their more permanent accommodation in January, 1964. The English Electric KDF.9 computer was delivered at the end of April and handed over in May. Both the new machine and the Pegasus were operated until the latter was switched off on 31st July. As this report is being prepared, the Pegasus is being disconnected ready for its departure from the University. In many ways this departure marks the end of another stage of the development of automatic computing in the University; the Pegasus has been replaced not because it has become unreliable or too expensive to maintain, but because the growth of computing needs has demanded a much faster machine. The departure coincides with the introduction of extensive undergraduate teaching and the appearance of numerical analysis and automatic computing as an integral part of several postgraduate courses in the Faculty of Applied Science. To these new courses can be added the Diploma course in Data Processing in Business Administration

which is being offered with the assistance of colleagues in the Department of Economics, and the still increasing demand for introductory courses for graduates and undergraduates from many departments.

It is my belief that many desirable applications of an automatic computer have been postponed during the last few years because of the heavy demands on the Pegasus; similarly, new courses offered in conjunction with other departments have awaited the appointment of additional staff. Now that some of the deficiencies no longer exist, we look forward to providing more satisfactory computing facilities both for the University and for our industrial users.

2. Staff.

At the beginning of the new session, Mr. L. B. Wilson joins the staff as lecturer and Mr. B. J. Duke and Mr. M. D. Poole as research assistants. During the year two new posts of Junior Computer Operator were created in order to assist with the "closed shop" operation of the KDF.9; Miss S. M. Cawood and Miss D. E. Jackson were appointed to them.

Dr. K. Wright relinquished his post as research assistant upon assuming that of lecturer.

Members of staff have attended several conferences during the year. Dr. Page spent two days at the University of Edinburgh while the structure of undergraduate courses in Computer Science were discussed and contributed to a conference on "Computers in Medicine" arranged by the Medical Research Council at Balliol College, Oxford. He read a paper on "Computers and Congestion Problems" to a Symposium on Congestion Theory held in Chapel Hill, sponsored by the University of North Carolina and the United States Office of Naval Research. Dr. Page and Dr. Scoins went to the National Physical Laboratory for a three-day seminar on the "Iterative solution of linear equations".

Dr. Scoins contributed a paper on "Trees and the Transportation Problem" to an International Conference on Mathematical Programming in London, which Mr. Clowes also attended. Dr. Scoins received a grant from N.A.T.O. to enable him to accept an invitation to a conference with

a similar title held in Menton. Dr. Scoins and Dr. Wright joined a day's discussion on the teaching of Algol at the English Electric Company, Kidsgrove.

Dr. Eve was invited to an IBM Scientific Computer Users' Seminar lasting three days at Sanderstead, Surrey.

Mr. Elphick was the guest of the Computing Section of Imperial Chemical Industries, Wilton, at a one-day colloquium on "Surface Fitting and Interpolation".

Miss Robson attended the Computer Typesetting Conference of the Institute of Printing to assist in the presentation of the joint paper read by Mr. C. J. Duncan.

Miss Barraclough attended a conference of the British Computer Society on "Practical Experience with Commercial Autocodes".

Dr. Page has represented the University on the Inter-Universities Committee on Computing and has been appointed secretary of the Sub-Committee of the Directors of Computing Laboratories and its Standing Committee. Dr. Eve has attended meetings of the KDF.9 Users' Group, representing the Laboratory.

Members of staff have been active in the British Computer Society. Dr. Eve has served as Chairman and Dr. Wright as Committee member of the Newcastle group. Dr. Page has represented the North-East region on Council and has visited the Middlesbrough group to assist with their planning.

Dr. Page lectured at colloquia at the University of Leeds on "The Chain Monte Carlo Method" and at the University of Edinburgh on "Permutation Problems". Miss Barraclough lectured on "Student Registration by Computer" and on "The Compilation of School Timetables by Computer" at seminars of the University of Durham. Mr. Cox read a paper on "The Computer as an aid to Archive Administration and Historical Research" to the Annual Conference of the Society of Archivists. Drs. Scoins and Eve presented papers to our own colloquia on "Trees and Lists" and "The Evaluation of Polynomials" respectively.

3. Research Activities.

Preparations for the transfer from Pegasus to KDF.9 have occupied much time during the year. Dr. Eve completed his Pegasus Simulation programme shortly after the arrival of the KDF.9 and so made possible extended testing of Pegasus programmes as they would need to be run following the withdrawal of the Pegasus computer. The scope of the simulation programme was increased by Dr. Eve in conjunction with Mrs. G. Pettit and Mr. A. Wren of Leeds University so that programmes using the Pegasus Magnetic Tape equipment could also be operated. These Pegasus Programmes run on KDF.9 at between twice and three times their speed on the smaller machine; although this gain is a welcome one, any such operation is hardly efficient use of the much greater speed of the KDF.9. This work has nevertheless been invaluable in making easy the transfer of work from one machine to the other while programmes were being rewritten in other languages. The details of the Pegasus Simulation programme have been released to the University of Leeds, The Admiralty Research Laboratories and the Hawker Siddeley Aviation Company who are about to face similar problems.

Miss Barraclough has planned the reprogramming for the registration of students and has incorporated routines written by Mrs. Hardie, Mr. Taylor and those of Miss Balchin, recently appointed to the Registrar's Department. The programmes for design calculations on ships are being rewritten and augmented by Mr. Roper. This work is made possible by grants from the British Ship Research Association.

Dr. Page has continued working on permutation problems and Monte Carlo methods and has collaborated with Dr. Eve, Miss Robson, Mr. Duncan and Dr. Molyneux in the application of computers to printing. The methods which have been demonstrated by setting several articles using the Pegasus computer with experimental programmes are now being written in a more comprehensive form for the KDF.9 by Miss Robson. The progress of this work, which is supported by a D.S.I.R. grant,

was described in a paper read to the Computer Typesetting Conference in July, 1964.

An article on Quality Control has been contributed by Dr. Page to the Encyclopedia of the Social Sciences and one on the comparison of quality control schemes is in press for the American Society for Quality Control.

Dr. Scoins has studied methods of solution of the transportation problem with particular reference to the use of trees. Interesting problems in permutations and partitions have arisen. Under his supervision Mr. Obruca has examined certain combinatorial problems in trees and both he and Mr. Clowes have worked on the travelling salesman problem.

Papers by Dr. Eve on the evaluation of polynomials and of square roots were completed. He has worked also on the Heisenberg model in statistical mechanics with Professor Rushbrooke.

Dr. Wright has investigated the use of different types of series, methods of extrapolation and their application to quadrature and the solution of differential equations.

Mr. Elphick has continued work on partial differential equations and on general divided difference algorithms.

Mr. Cox has made further progress on the application of computers to the construction of timetables, research which is supported by grants from the Department of Education and Science and the Associations of Headmasters and Headmistresses. He has produced also a group of list processing routines primarily for use in the timetable work and for the analysis of data on parish records.

The following publications have appeared:-

J. S. Clowes and E. S. Page:	Assignment problems. Computer Journal (1963), 6, 304-7.
J. Eve:	Starting approximations for the iterative calculation of square roots. Computer Journal (1963), 6, 274-6.

J. Eve:	The evaluation of polynomials. Numerische Mathematik (1964), 6, 17-21.
E. S. Page:	A note on assignment problems. Computer Journal (1963), 6, 241-3.
E. S. Page:	Review of "Proceedings of a Harvard Symposium on Digital Computers and their applications". Computer Journal (1963), 6, 270.
E. S. Page:	Quality control abstracts. New York (1963).
K. Wright:	Chebyshev collocation methods for ordinary differential equations. Computer Journal (1964), 6, 358-365.
K. Wright, with C. T. H. Baker, L. Fox and D. F. Mayers (Oxford University Computing Laboratory):	Numerical Solution of Fredholm Integral Equations of the first kind. Computer Journal (1964), 7, 141-148.

4. Use of the Computers.

For the first time in the annual report the title of this section contains the plural "Computers". Until its final switch off, the Pegasus was in heavy use even though work was being increasingly transferred to the KDF.9. Pegasus was again switched on for more than four thousand hours in the year. Engineers were present for one shift after which the computer was handed over to an experienced user charged to close down if trouble occurred. Even in the seventh year of its life and operating under the care of only one of the two maintenance engineers for about three-quarters of the period, its efficiency reached 94.6 per cent. Such a record, I believe, reflects much to the credit of the designers, manufacturers and, not least, to the maintenance engineers, Mr. R. W. Walker and Mr. L. Mitchell. Over its life Pegasus has yielded some 19,000 hours of productive computing and by any reasonable method of accounting has repaid its purchase and running costs many times; it has served well this University, the University of Durham, friends in other Universities and colleges and many firms. It has given

way to the larger and faster machine we have needed for some time but we are pleased that it has gone to join a similar model at a company in Newcastle upon Tyne and hope that it may continue its useful life.

After the University of Durham installed its own computer, work on Pegasus for them decreased, as did that for the Computing Laboratory itself as the new machine became available. A significant feature has been the increase in the use for the School of Medicine which has now joined the "traditional" large users in requiring several hundred hours in the year.

The KDF.9 machine was handed over for regular operation in May, 1964. In spite of certain doubts about the immediate availability of all the peripheral devices the whole installation as originally ordered and later supplemented was delivered together; the system thus comprised 8,192 words of core store, two paper tape readers, one punch, three magnetic tape decks and a 1,000 lines per minute printer. Shortly after its arrival negotiations were completed with the English Electric Company for a further 8,192 words of store in return for some computing services. I am particularly grateful to the computer operators and other members of staff who have willingly consented to undertake this extra work. The enlargement of the fast store has already made a great difference to the range of problems readily soluble. All operation of the KDF.9 is by laboratory staff assisted in some cases by computing staff from other departments.

The machine usage is shown in Appendix 1.

5. Lecture Courses.

The postponement of the arrival of the KDF.9 from December, 1963 to April, 1964, had a serious effect on certain parts of our teaching plans. In order to avoid the task and additional difficulty to students of teaching several programming languages it was decided to teach Algol and use it for examples on the Pegasus computer. The

slowness of the object programme and the tedium of using a five-channel paper tape code thus placed a severe limitation on the amount of computation that could be undertaken.

The postgraduate courses for the M.Sc. degree and Diploma in Numerical Analysis and Automatic Computing were again offered. Five students received D.S.I.R. Advanced Studentships for the M.Sc. course, four of whom will soon submit their dissertations; of the five diploma students two were supported by grants from their Local Education Authority, one by the British Council: two diplomas were awarded. Although these results represent a tiny sample they reinforce our view that mathematical ability - measured, at any rate, by the class or type of first degree - is an unsure predictor of performance at automatic computing in its varied aspects. Unfortunately, there is little better to use and for the present will have to be relied upon for these courses with their substantial mathematical content.

For the first time instruction in Numerical Analysis and Automatic Computing was given as part of an M.Sc. course in Chemical Engineering. Next year the course is being extended for similar students and those in Mechanical Engineering.

Short introductory courses for the Algol language have been offered several times in the year, always with an embarrassingly large response; a waiting list has occasionally filled a course before its announcement. We are striving to improve this situation by borrowing larger lecture rooms and pressing all staff and graduate students into service. A fundamental difficulty remains: as long as these courses remain optional, timetable congestion forces them to the beginning and end of terms or into the vacations with all the attendant limitations. Next year the course in the General Degree with Honours will include the Algol instruction during its allotted hours.

A list of the courses is shown in Appendix II.

6. Colloquia.

Colloquia arranged by Mr. Elphick have been held at approx-

imately 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. H. H. Robertson, Imperial Chemical Industries, Wilton.	"Digital Filters and Computer Control".
Mr. G. R. Symm, National Physical Laboratory.	"The Use of Integral Equations for the solution of Potential Problems".
Dr. R. Fletcher, University of Leeds.	"Some Recent Developments in Optimisation Methods".
Dr. D. Michie, University of Edinburgh.	"Games, Puzzles and Computers".
Dr. J. Eve, University of Newcastle upon Tyne, Computing Laboratory.	"The Evaluation of Polynomials".
Mr. D. E. Bagley, English Electric-Leo Computers Ltd.	"Use of Computers by Librarians".
Dr. H. I. Scoins, University of Newcastle upon Tyne, Computing Laboratory.	"Trees and Lists".
Dr. J. Walsh, University of Manchester.	"Numerical Treatment of Singularities in Elliptic Equations".
Dr. R. D. James, Manchester College of Science & Technology.	"Numerical Investigation of the Structure of Rotating Polytropes".
Professor W. L. Smith, University of North Carolina, Chapel Hill, N.C. U.S.A.	"On Some Recent Work in the Theory of Queues".
Dr. S. C. R. Dennis, University of Sheffield.	"Eigenvalues of Differential Equations using Finite-Difference Methods".
Dr. D. F. Mayers, University of Oxford.	"The Deferred Approach to the Limit in Ordinary Differential Equations - Some Singular Cases".

7. Conclusion.

The arrival of our new machine has provided a new impetus to the study and application to many fields of automatic computers. Already the demand for machine time is more than twice what had been reasonably estimated. It is clear that there is much growth of demand still to be expected from other departments in the University, quite apart from the increased requirements for teaching and research by the Computing Laboratory itself. The task of satisfying these demands is bound to be a difficult one and may place an even heavier burden on the operating staff.

It is tempting for a sceptic to invoke one of Parkinson's Laws to explain the observed use of our KDF.9. A closer examination suggests more cogent reasons. The saturation of the Pegasus for the last four years forced many computing projects to be postponed and even more important the deficiency in size and speed of the machine (and incidentally those in other British Universities) inhibited the development of whole areas of work which were being actively studied elsewhere. The arrival of the KDF.9 into several Universities advances the national position, but it would be naive to believe that the "computer gap" had been narrowed.

This year has been a particularly busy one and my warmest thanks to the staff of the laboratory for their support are well merited.

E. S. Page.

APPENDIX I.

DIVISION OF MACHINE USAGE.

KDF.9 Time: (up to 31st July, 1964).

	Hours
Useful Time (University and Industry):	453
Maintenance:	88
Idle:	29
Engineering:	22
Fault and Repair Time:	51
Total:	643

Pegasus:

Useful Time (University and Industry):	3,165
Maintenance:	580
Idle:	235
Engineering:	13
Fault and Repair Time:	193
Total:	4,186

APPENDIX II.

LIST OF COURSES HELD

DATE	TITLE	LECTURER	NO. OF PERSONS ATTENDING	
			UNIVERSITY	INDUSTRY
1963				
Sept./Oct.	Algol - Experienced Computer Users.	Staff of the U.C.L.	15	7
October.	Simplified Programming - Autocode and Algol.	Staff of the U.C.L.	28	1
Michaelmas.	Operations Research and Monte Carlo Methods.	Dr. E. S. Page.	10	
Michaelmas.	Matrix Methods.	Dr. H. I. Scoins.	10	
Michaelmas.	Numerical Analysis. (Chemical Engineers).	Dr. J. Eve.	15	
Michaelmas.	Approximation Theory.	Mr. M. J. Elphick.	10	
Michaelmas.	Numerical Methods. (Level II).	Mr. J. S. Clowes.	29	
Michaelmas.	Machine Languages and Communication.	Mr. J. S. Clowes.	10	
1964				
January.	Algol.	Staff of the U.C.L.	30	5
Epiphany.	KDF.9 User Code.	Mr. J. S. Clowes & Mr. M. J. Elphick.	18	
Epiphany.	Ordinary Differential Equations.	Dr. J. Eve.	9	
Epiphany.	Quadrature.	Dr. K. Wright.	9	
Epiphany.	Theory of Algol.	Dr. H. I. Scoins.	10	
Epiphany.	Linear Programming.	Dr. H. I. Scoins.	10	
Epiphany.	Logical Design.	Dr. J. Eve.	18	
Epiphany.	Chemical Engineering Applications.	Dr. J. Eve.	5	
Epiphany.	Introduction to Computers for Civil Engineers.	Mr. M. J. Elphick.	36	
Easter.	Algol.	Staff of the U.C.L.	29	5
Easter.	Partial Differential Equations.	Mr. M. J. Elphick.	9	
Easter.	Data Processing Methods.	Dr. E. S. Page.	9	
June.	Algol.	Staff of the U.C.L.	26	3
June.	Algol.	Staff of the U.C.L.	32	2
July.	Algol.	Staff of the U.C.L.	21	14

APPENDIX III.

DEPARTMENTAL ANALYSIS OF PEGASUS MACHINE TIME USED.

	Hrs.	Mins.
Agriculture	54	31
Chemistry	545	27
Computing Laboratory		
Courses	329	46
Contracts	76	28
Service and Research	384	00
Education	2	56
Chemical Engineering	8	56
Civil Engineering	86	09
Electrical Engineering	111	11
Mechanical Engineering	84	20
Mining Engineering	9	58
Geography	0	48
Geology	53	12
Mathematics	28	33
Metallurgy	0	33
Naval Architecture	42	11
Philosophy	61	25
Physics	374	28
Psychology	0	31
Child Health	112	37
Industrial Health	154	38
Obstetrics and Gynaecology	272	11
Psychological Medicine	47	52
	2,842	41
University of Durham	68	28
Industry	253	22
	3,164	31