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# The ATLAS Computer Laboratory

Draft of paper to be submitted to the Governing Board of the National Institute, by Sir William Penney and Dr. T. G. Pickavance.

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15 March 1961

## 1. INTRODUCTION AND BRIEF HISTORY OF THE PROJECT

The proposal to instal a Ferranti ATLAS computer at Harwell originated in the Atomic Energy Authority as a result of discussions in the Authority's Computer Policy Committee during 1959-60. The final proposal (Dec. 1960) that use of the computer should be available to the Universities, the National Institute and Government scientific Establishments, was considered by the Minister for Science, who asked the Governing Board of the National Institute if they would be willing to accept formal ownership and responsibility for management of the installation. The Board agreed (January 1961) on the assumptions:-

(i) no charge should be made to Universities for any of the services provided

(ii) cases would be made in the future for other large computers, which should, whenever possible, be located in the Universities.

The Board agreed that the computer should be located at the Rutherford High Energy Laboratory at Harwell and that it would be operated by the A.E.A. on behalf of the Institute. It appointed (March, 1961) a Computer Committee which will manage the installation on the authority of the Board.

## 2. THE ATLAS COMPUTER

Atlas is made by Ferranti Ltd., and is based on the work of Professor Kilburn and his collaborators in the Computing Machine Laboratory of the University of Manchester; the first machine of this type will be installed in the Manchester Laboratory at the end of 1961. The name refers really to a computing system, in which a central computer is surrounded by a variable number of peripheral devices for information storage, input and output; the circuits provide logical and arithmetical operations at a very high operating speed - the times for addition and multiplication, for example, are about 1 and 3½ microseconds respectively, whilst the system design allows an installation to be built up to virtually any desired size. The specification decided on in the A.E.A. discussions is for as big an installation as could be thought justifiable and should allow computation on a very large scale to be carried through efficiently. Details are given in Appendix A; briefly, the machine will have immediate-access storage for 48000 numbers on magnetic cores, 128,000 on magnetic drums, 16 magnetic tape units and ample input-output equipment; it will cost £2½ million and should be delivered in mid-1963. Apart from the STRETCH computer at A.W.R.E., Aldermaston, it will be the most powerful machine in Europe.

## 3. OBJECTIVES

The Laboratory is being set up with the Atlas computer as its main equipment, with which it is to provide a computing service for a number of bodies; as at present agreed, these are:-

1. The Atomic Energy Authority
2. The National Institute
3. The British Universities
4. Government Scientific Establishments, of which only the Meteorological Office has asked specifically for this service.

Apart from the A.E.A., whose special needs are considered in § 4, it can be assumed that these bodies will use the Atlas only for work needing the very high speed of this machine and will do their smaller-scale work on their own local computers. The Laboratory is intended to supplement the users' local facilities.

For efficiency, the Laboratory must provide a complete service for data preparation for input to the machine and for operation of the machine; it can be assumed that most users will write their own programs but the Laboratory must provide an agreed set of programming languages and input systems and give instructions in the use of these. It must also be equipped to give mathematical advice and assistance to the users, especially in numerical analysis, and must keep in the forefront of knowledge of programming and computational techniques, computer applications and developments and numerical mathematics. It should be built and organised so that users needing to do so can work in the Laboratory for extended periods.

## 4. SPECIAL NEEDS OF THE A.E.A.

Unlike the other users, the A.E.A. (meaning almost exclusively the Research Group) will depend upon the Atlas for possibly the whole of its computation and will require from the Laboratory the services it now gets from the Harwell Computing Group. This means that there must be a group of people in the Laboratory on which the A.E.A. has first call, or even the sole call; the size and composition of this group is considered along with the rest of the Laboratory staff in § 5. The needs of the A.E.A., apart from time on the computer and use of the associated services, are day-to-day help for its scientific staff writing programs, the actual writing of programs, including much work on a large scale, and collaboration of mathematicians and programmers in the formulation and development of problems being studied by its scientists.

## 5. STAFF AND ORGANISATION

The following types of staff will be needed:

(i) Engineers for maintenance of the computer and ancillary equipment; these will be Ferranti staff, working for the Laboratory under a maintenance contract.

(ii) Operators (for the computer and the data-preparation equipment) and any clerical staff needed for the efficient running of the machine service.

(iii) Program-advisory staff for day-to-day services

(iv) Expert program-advisory staff, able to deal with the most sophisticated and large-scale problems.

(v) Mathematicians, including some of very high grade; most of these should be interested in numerical aspects, some could, with advantage, be mathematical logicians.

Also in the Laboratory there should be:-

(vi) Scientists working on their own problems and using the Laboratory's facilities; these would be mostly on short-term attachment, say 1 to 3 years.

(vii) Visitors: members of user organisations, who want to spend up to a few months near the machine to develop and test a big program.

The organisation suggested is: that there should be a Director to be generally responsible for the Laboratory and that the staff should be organised into functional Groups, each under a Group Leader, as follows:

(a) Machine Group: Responsible for the actual running of the computer, data-preparation, operation of any data-transmission links which may be installed, record-keeping, provisioning the installation. The maintenance engineers would be responsible to the head of this Group.

(b) Computing Service Group: Responsible for providing and modifying, when necessary, the programming schemes (e.g. a FORTRAN compiler) and operating systems and the educational and advisory services; any writing of programs for customers would be done in this Group, which would be specially responsible for meeting the needs of the A.E.A.

(c) Mathematics Group: This Group would provide a pool of mathematical knowledge to be drawn on by the members of the Computing Service Group and by the users of the Laboratory generally. It would concern

itself with advanced mathematical studies relevant to numerical processes and applications of the computer and should have a good deal of freedom.

The visitors and attached research scientists would not need to be formally responsible to a Group Leader but would often associate naturally with one or other of (b) or (c).

It is assumed that, apart from day-to-day clerical, typing and secretarial services, the general administrative needs of the Laboratory would be met by the Rutherford Laboratory's organisation.

Numbers of Staff Required

The following estimates take into account the special responsibilities of the Laboratory towards the A.E.A.

Senior Members: Director and 3 Group Leaders

Machine Group: Most of the staff will be non-professional, in the Machine Operator class, although it would probably be an advantage to have a few in the E.O. class.

For the day shift, 3 to run the computer + 4 for data-preparation + 3 to operate data-transmission links: 10, of which 2 could be of E.O. class and the rest M.O.

For the evening and night shifts (when run), at least 3 to run the computer, possibly 3 more for the other tasks; allowing 1 E.O. for each of these shifts, we have the limits for the total operating staff for 3-shift work:-

12 M.O. + 4 E.O. to 18 M.O. + 4 E.O.

There will probably be 3-4 engineers per shift, who will be Ferranti staff; 1 clerk will be needed.

Computing Group : All scientific staff, either S.O., E.O., S.A.:

| | | |
|---|---|---|
| Day-to-day service | 6 - 8 | |
| Statistics and Data-Processing | 8 | |
| Advanced programming | 8 - 10 | 22 - 26 |

Mathematics Group:

| | | |
|---|---|---|
| Fellows and Associates | 4 - 6 | |
| S.O.'s | 4 - 6 | 8 - 12 |

Visitors and attached staff would not be on the Laboratory complement; these should be accommodation for about 8 at any one time.

In addition, there should be 2 secretaries (one for the Division Head, one

## 6. CONTROL AND MANAGEMENT OF THE LABORATORY

It is already agreed that the ultimate control of the Laboratory shall rest with the Computer Committee of the National Institute, which will exercise in this context the authority of the Board of the Institute. The Committee will be concerned with general policy and will instruct the Director, who should therefore be on the staff of the Institute, he could, of course, be seconded from the A. E.A. or some other body.

We recommend that there should be a Users' Committee to advise the Director on all matters concerning the provision of the Laboratory services. There should should be some members common to the two committees. The Users' Committee would report periodically to the governing committee and could appeal to that body to resolve any dispute between itself and the Director. This committee would consist of members of the user organisations of senior standing who were closely connected with the needs for the Laboratory's services; it should be set up well in advance of the delivery of the computer so that agreement could be reached on the allocations of machine time and the precise way in which the users would get the services they needed. It would of course review these topics at regular intervals.

The relation of the Laboratory to the Rutherford High Energy Laboratory need be simply an administrative one; the Director of the Rutherford Laboratory will be on the governing committee of the Computer Laboratory and the general services such as administration and finance should be provided by the Rutherford Laboratory.

## 7. THE LABORATORY AND THE A.E.A.

Settling the formal relations between the Laboratory and the A.E.A. presents a difficult problem. As was said in §4, the Authority will be a large user of the computer and has demands in programming and mathematics which must be met; the problem is to ensure that these needs will be met without weakening the Laboratory's unity by too much division of responsibility and control - some seems unavoidable.

The question of the amount of machine the Authority is to have is important but straightforward and can be settled by decree; the Machine Group will do the work just as it does that of the other users. The services of the other groups will be needed by all users and the division of the time of programmers and mathematicians is a far more complex matter than that for operators. We can see no satisfactory solution other than that some members of the Computing Service and Mathematics Groups should be A.E.A. staff working in the Laboratory. We do not recommend that there be two separate Computing Groups, one working solely for the A.E.A; the senior programming experts will play very important parts in the functioning of the Laboratory, through their contributions to the programming and operating systems, the division would lead to disagreement and inefficiency. We feel that there is much to be gained by having few and strong groups, even with composite membership, and that the system of control suggested in §6 should ensure that the obligations are met. It should be one of the first tasks of the Director, when appointed, to get the A.E.A.'s agreement on the numbers and grades of staff it will require to work in the Laboratory; this will show what appointments are to be made by the Institute.

## 8. ACCOMMODATION

A new building will be needed to house the computer, with its ancillary services, and the Laboratory staff. The amount and type of accommodation needed is as follows:

| | | | |
|---|---|---|---|
| (i) | **Computer** | | |
| | Machine room | 2000sq.ft. | air-conditioned |
| | Data preparation | 1000 sq.ft. | " |
| | Card & tape store | 300 sq.ft. | " |
| | Power supply | 400 sq.ft. | |
| | Maintenance engineers | 500 sq.ft. | |
| | | | 4200 |
| (ii) | **Operator staff** | | |
| | Operator's office (for 4) | 250 sq.ft. | |
| | Chief Operator | 150 sq.ft. | |
| | Clerk, records | 150 sq.ft. | |
| | | | 550 |
| (iii) | **Scientific staff, including visitors** | | |
| | Say, 60 at 120 sq.ft. each | | 7200 |
| (iv) | **Conference room** | | 1000 |
| | | Total .. .. .. .. | 12950 sq.ft. |

Allowing for corridors, toilet accommodation and so on, the area needed will be about 15,000 sq.ft.

Provision has been made for this in the estimates of costs given to the Treasury.

for the Group Leaders) and 2 typists for mathematical and general typing, also a D.A.O. - who might, however, be shared with another Division or a part of the Institute. The totals are, for 3-shift operation:

| | Division Head | Machine Group | Computing Service | Mathematics | Totals |
|---|---|---|---|---|---|
| Scientific | 1 | 5 | 23 - 27 | 9 - 13 | 38 - 46 |
| Clerical and Admin. | 5 | - | - | - | 5 |
| Operator | - | 12 - 18 | - | - | 12 - 18 |
| | 6 | 17 - 23 | 23 - 27 | 9 - 13 | 55 - 69 + up to 8 visitors |

For comparison, the present complement of the Harwell Computing Group is 26 Scientific + 10 Operator Staff and 1 Secretary.