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AN ESSAY ON THE FUTURE DEVELOPMENT OF THE LABORATORY WITH  
SPECIAL REFERENCE TO THE ICT 1908

In recent discussions the question of obtaining more computing power within the laboratory, or/and deciding on a possible replacement for Atlas, has centred around a proposed extension of the ICT 1900 Series. This proposal seems to rest on three conditions:-

- (i) the computer or computers must be British built.
- (ii) the finance for such a development is thought to be available in 1969/70, but not in 1971/2.
- (iii) the Ministry of Technology are keen to support ICT in building an extension to their basic series.

It is significant that the conditions do not contain any reference to the function of the Laboratory and in addition does not attempt to learn from experience what is required of a new machine.

First, I would like to examine the case for a new machine of any kind. Given that it is the intention to establish the Laboratory as a permanent institution there are several views that could be put:-

- (a) the Laboratory should be equipped with the most advanced machines available in any say five year period. This would give it the status required of a "centre of excellence", which has been used in relation to the present Atlas Laboratory, and would provide a pace setter which could have a significant effect on the computing climate in this country. For this to be possible, it must be stated that this is the future policy of the Science Research Council and some thought should be given to the possibility that other centres of a like kind should be set up. The regional centres have been proposed but only Edinburgh so far shows any real signs of being established and this fact should be faced and the question asked whether this idea is in fact the best way of setting up expert centres of computing activity. Are the Universities capable of organising the centres in a proper way? Could S.R.C. do this more effectively? The Government Committee concerned with large expensive research tools for use by Universities seems to have backed down on this particular activity and left the situation to be resolved by the Flowers Committee and its ill defined notion that Regional Centres should be established. It is noted that there is always an implied assumption that the largest and fastest machine is necessary for future laboratories and centres and this will be discussed later.
- (b) The Laboratory should take its place alongside other developing organisations, not striving to lead the field in scientific applications or in providing a professional service for large groups of users. This involves taking careful assessment of the present demands for computing work and providing sufficient computing power to achieve a reasonable satisfaction of known needs. It is necessary in this case to be very clear about the demands that are to be satisfied and there must be no expectation that more than this is to be achieved. With this view it is clearly important to obtain the most reliable and well tried machines available at the time. This is a view typical of the computing organisations established for commercial work and some standard scientific work.

It does not provide an active environment for original work in computer applications, but this may not be required and the only interest is in providing service for standard activities. It is possible that the Atlas Laboratory could become one of the Regional Centres for the South and South Midlands Area and it could then only expect to advance with other Regional Centres as and when decisions are taken to buy new machines.

- (c) A further view is that the need for very large fast machines has passed and that large machines are not the best way of meeting the future computing needs of scientific research workers. The present interest in the USA for small cheap fast computers and the lack of such machines in this country adds emphasis to this thought. These machines are already comparable with Atlas in arithmetic speeds, but as we have established that arithmetic speeds are not as important as has been thought, the interaction of these machines with large fast access storage devices may be of more significance. It could be that we should encourage this kind of development involving advanced hardware design and useful functions for the programmer to experiment with. The work on multi-access use to which the Laboratory is already committed could be expanded and the aim could be to set up large storage systems to which a number of small machines were attached for various system and application experiments to be carried out. The function of the Laboratory would then not be to provide a general service, but to encourage the more advanced workers in the computer field to try out ideas. There is almost no development of this kind being carried out in this country and if we are to compete with other countries in the scientific as distinct from the technological applications of computers this could be a worthwhile direction for the Laboratory to take. This view is to some extent the complement of the case (a) above; both would encourage an active scientific atmosphere and further the prestige of the British Computer Industry, if computers of the right kind are made available.

Whichever view is taken it is clear that the Laboratory ought to take a significant role in any overall plans for furthering the use of computers in this country. The Laboratory is now established with an extremely good reputation and there is an urgency to establish what roles the various organisations should play in future work. For example, the centres at Manchester and Cambridge could be more fully supported to encourage research in their own topics of interest, the regional centres in London and Manchester could be got going rather more quickly. Associated with this question of "who does what"; there is the need to ask whether, in view of the general pressure to buy from and support the British computer industry, the machines it is capable of supplying will be adequate to satisfy the needs of scientific research, since the computers currently being sold are really intended for the small commercial firms, and any development which does not satisfy ICT's market will be considered as uneconomic, although vital for competitive scientific research with the States, ICT have yet to show that they can build the right kind of machine for the scientific users and the fact may be, as with Sigma 2, that machines are best obtained from the USA. If, however, the intention is to compete actively with the USA then a really serious attempt to do this must be made. It would appear that the only British machine which would have sold in the States, if it could have been produced well and at the right time, was the Atlas, and we should note carefully the reasons for this.

The concepts built into Atlas pioneered the way for all the current attempts to provide multi programming machines with more or less sophisticated

operating systems. There is a danger that with the attempts to link economic viability with advanced computer projects needed in this country, the experience of Atlas will not be used to the full. It is known that no critical study of Atlas both from the design and operating points of views, has been made and before proceeding to consider the next line of development this would appear to be an essential step. One of the difficult points to assess in providing computers is that given a basic set of machine orders anything is generally possible and more advanced hardware facilities have to be considered in relation to what is to be the purpose of the required machine. As an example of this consider a small University centre where the demand for computing is low and an IBM 1620 with disc and 20K character store is available, a simple operating system based on one language is adequate and users are quite content with this. If some more elaborate operating system is needed this can be done by taking up more space on disc and by taking up some more computing time to control the jobs, but there is time to spare and no one is very much concerned. On the other hand, consider the requirements of the Atlas Laboratory that have shown themselves to be of vital importance in the past two years:-

1. The operating system needs to be able to cope efficiently and quickly with a large number of small jobs.
2. The system must be readily understandable by a large number of users conversant with their own local systems, but wanting to know quickly what to do if their job has to be done at Chilton.
3. The machine has a larger core store than any of its customers' machines and this allows the unusual job for the local machine to be dealt with on Atlas.
4. The multiplicity of input/output devices allows links with a very great diversity of local University machines to be made.
5. The development of large special purpose programs can proceed without spending valuable expertise on costly exercises in programming optimally for small stores, or slow speed computers. An example here may be of interest: the survey package provided by ICT for the 1900s is rated as difficult to use, and very simple minded, whereas MVC, the survey program developed for Atlas, is comprehensive, easy to use and fast in execution.
6. The Atlas is relatively much faster than any of its customers' machines and the central processor use is high.
7. It has an extensive order code with a powerful set of extracodes provided independently of the user store.
8. The control and monitoring of jobs is more advanced than nearly any other machine that can be mentioned.
9. It has readily available nearly all compilers of any standing and some of the most advanced notions are already available, e.g. Compiler Compiler.

These features have contributed to the success that the Laboratory has undoubtedly achieved and when the choice of an eventual successor to Atlas has to be made these should be noted and if shown to be necessary included in the specification of the requirements.

Our experience with Atlas shows that there is an insatiable demand for short development work, which it is to be hoped will, to a large extent, be

met by the use of multi access consoles, and a demand for large amounts of computer time by a smaller group of users. For the first group, speed is necessary to satisfy the pressing demands for nearly immediate response, and for the second group speed is needed to make available computing power so that scientific projects are not held up waiting for results which are only at the moment becoming available relatively slowly. This last point raises some controversial questions concerning the need to spend large amounts of computer time on certain projects, but it would appear that until such times as we reach a ceiling in eventual computer speeds and a threshold for cost of computers that we try to satisfy these demands.

The proposal that the Laboratory be equipped with an ICT 1908 system in addition to Atlas has been discussed at length particularly in relation to the availability of funds and the intention of the Ministry of Technology to support such a project. It is not clear exactly what form the system will take since the original proposals have been superceded, but in general the aim is to provide faster versions of the 1904 and 1905 machines, the speed factors quoted are in terms of arithmetic and give virtually no guide to the real performance. The faster versions are then to be linked in a multi-processor complex to give an eventual gain in speed over Atlas of say 10. The overriding consideration is the financial one, that funds may be available in 1969/70 but not in 70/71, 71/72. If such funds are available is the admittedly indistinct 1908 a real advantage to the Laboratory. The first question that comes to mind is whether the delivery dates 69/70 are to be achieved. There is good evidence to suggest that ICT are not well advanced with the initial ideas and that the 1907 is not yet ready. This last is the largest of the 1900 series and it is not yet available for an assessment to be made of its performance. In addition the software for the smaller 1905's is not available and is not expected for some time. Given these facts it would appear to be extremely optimistic to expect the system to be available until well into 1971. At this stage the Laboratory would be concerned with a machine outclassed by its American competitors and in danger of not then being able to ask for more advanced machinery, if that is to be the function of the Laboratory, for say five years. It is also stated in support for the project that present 1904/1905 users would be able to update their machines to include the 1908 processors but it is questionable whether they would want to do this in sufficient numbers and in any case the continuation of a line over about 10 years at this stage of development of the computer industry seems undesirable. However given that the proposed date 1969/70 is in fact achievable, how well would the 1900 series meet our requirements. First of all there is the question of the operating system. Can ICT provide anything like the same comprehensive system we have at present? It will be useless to have a slight factor of speed over Atlas and then to throw a large factor away because the operating system is less efficient. There are no machines yet produced in the 1900 series which have anything like the present Atlas central processor usage and unless we are fully satisfied that such systems will be definitely available then we will not achieve very much. Secondly can the eventual 1908 complex provide the flexibility required to cope with the diversity of input/output shown to be necessary for our kind of service. Thirdly if the operating system is not to be of the same order as Atlas, how do ICT propose to cope with the problems of manual control of the system - through a typewriter? If the 1908 is to be a significant advance then we must be assured that there are well laid plans for making the system even better than at present. At the moment this could not be said to be encouraging; at the very least they should ask for comments on the deficiencies experienced, and this has not been done. Fourthly, the large amount of software built up for Atlas will have to be available and it should be remembered in this connection that our customers are spread throughout the country and minor adjustments to established program systems will not be easily made.

The only view of the function of the Laboratory which is consistent with acquiring a 1908 is the second view (b) above in which we have definite tasks to perform, but not including a service of the kind we now provide.

Because of the uncertainty of the ability of ICT to provide the hardware and software at the required time we would be unwise to endanger the prospects of a more advanced machine coming to the Laboratory in 1972/3 and it is strongly urged that this project is of greater importance to us than an indifferent prospect for 1971.

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