INTRODUCTORY REMARKS TO THE CONFERENCE ON DATA PROCESSING AND AUTOMATIC COMPUTING MACHINES

by

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LADIES AND GENTLEMEN:

We propose this morning to describe and demonstrate to you the two calculating machines we have in this Establishment, but before you break into groups for this inspection, I feel it would be useful if I told you a little of the work we do here at Weapons Research Establishment, and perhaps give some indication of why we have these machines.

The Weapons Research Establishment (W.R.E.) consists basically of two Wings - one, the Weapons Research and Development Wing, is concerned with Research and Development in the fields of Electronics, Aerodynamics and Propulsion, and their work is largely related to Australian Defence Projects The other, the Trials and Instrumentation Wing, who operate the two machines you will be seeing, are concerned with the trials of guided weapons and have their indoor laboratories here at Salisbury, and their outdoor laboratory is, of course, at Woomera. The majority of the weapons tested are developed in the United Kingdom, and this Wing operates under the terms of a Joint Project Agreement between U.K. and Australia.

Within this latter Wing, there is a Division concerned with the planning and execution of trials and the reduction of the data arising from them. WREDAC, the digital computer, forms part of the data reduction system. Two other Divisions are concerned with the development of instrumentation and data reduction equipment for use in the laboratories here and on the Range. The fourth Division is engaged in the assessment of guided weapons, and AGWAC, the analogue machine, is in use in this Division.

Guided missile trials have one outstanding characteristic. They are most expensive. Perhaps the greatest economy measure which could be introduced would be to restrict the number of trials, and in fact we do use AGWAC to simulate on the ground the behaviour of guided missiles in flight, and we are quite convinced that extensions of this technique will reduce the number of trials we have been asked to undertake.

However, once a trial has been accepted, it is difficult to reduce the actual instrumentation required, but there are opportunities for making considerable economies by mechanising the analysis of the huge quantity of data which is obtained from each firing, and it is here that WREDAC is making a real contribution.

AGWAC, the analogue computer, started its life in 1951 when a requirement arose for a special purpose simulator for a particular test vehicle. An interim computer, ARTUS, was completed in 1953, but by that time we had realised that it would be advantageous to have a more general purpose computer. The specification for AGWAC was modified and the machine manufactured by Elliott Brothers. It was installed in Salisbury in 1954, and has since been used to solve a wide variety of problems mainly concerned with missiles and with target aircraft. As a result of our experience over the last two years, AGWAC is now entering its second developmental phase and, like many middle-aged machines, is getting a little bulkier and is also producing a

number of vigorous children. The children are rather simple special purpose machines which will enable us to relieve the load on AGWAC, and the girth consists of the addition of units which will allow us to feed in actual trials data from real firings. This development is quite interesting, as we now think it probable, in several years time, that we will adopt a similar procedure with the digital machine and produce small simple digital units which will relieve the load on WREDAC.

As I said earlier, WREDAC, the digital machine, forms part of our data reduction system. When we first assessed the reduction and computing problem in 1951 when all our information was recorded on photographic film, it appeared that, if we had continued on with the methods in use at that time, we would now require about 200 computers to cope with the trials load. This was quite unacceptable, and on further studying the problem it was seen that 70% of that time would be spent in obtaining numbers from the photographic film and only 30% of the time would be spent on actual computation. There was therefore little point in installing a fast computer until we had devised some scheme for getting the numbers more quickly.

The United States Ranges had had the same problems and had developed semi-automatic methods for reading films, recording data on punch cards and computing by means of a Hollerith or similar machine. We took advantage of this work and procured some of the equipment, which enabled us to handle the trials load without any great increases in staff for a period of several years, but it was quite apparent that the digital computer, with its capacity for handling masses of data, would be used in the eventual solution. It was equally apparent that there was little point in putting this machine in until the data could be fed in and read out at a rate that would fully load the computer.

We realised that photographic film was a very poor writing medium. It is, of course, expensive, cumbersome, cannot be re-used, and the data in general must be read off by the human eye (which unfortunately is associated with the human being). A new recording medium was obviously required, preferably one which was acceptable to the computer. We found, in fact, that much of our data existed in the form of a frequency variation which could be recorded on magnetic tape and the specification for our input equipment became clearer, that is, we would record as much as possible on magnetic tape, but we required equipment that would scan this information and convert it into digital numbers. We could not eliminate photographic film completely, but we did require that the output from the film readers should be either paper or magnetic tape rather than the slow and rather expensive punch cards.

On the output side, the conventional teletype machine was obviously too slow, and we required there a printer, preferably of the line type, which could print out several hundreds of characters per second. We did not think that a tabular display of information was really what our customers wanted, and so some form of graphical display capable of plotting 30 to 40 points a second was required to keep pace with the printer and, of course, with the digital machine.

It was now possible to write a fairly precise specification for the computer, whose primary function was to correct the raw data, do comparatively simple calculations, and pass this information on the output units. We decided that we would develop and manufacture the input converters and let contracts for the main machine and the output units. This has now been done and the Contractor for these latter units was again Elliott Bros. The

system, then, which we will show you later in the day, accepts either photographic film or magnetic tape from the Range. It converts the photographic material into punch paper tape by means of semi-automatic readers. It converts the raw frequency data on tape into a series of digital numbers on a secondary magnetic tape. Both the magnetic and the paper tapes are then fed into the machine, which carries out the necessary computations and produces the final information on a tertiary magnetic tape which is fed into the high speed printer and the graphing machines. This system will be described and demonstrated to you later in the morning by Mr. White and his staff, while Mr. Keats and his staff will be describing and showing you AGWAC.

But before I close, I would like to refer briefly to Session III - the Application of these Machines to Business Methods. When we originally thought of holding this Conference, we intended concentrating on two technical sessions. However, it was pretty obvious that many of the problems that we had run into in solving our own data reduction problems were similar in principle to those which would occur in office automation. In particular, the actual calculations done on trials data or in office accounting such as payroll preparation, etc. are comparatively simple and machines such as digital machines can do these extremely quickly, but the real bottleneck is in converting the initial data such as time clock cards, invoices, etc. into a form that the machine can use. Our equivalent problem, of course, was reading photographic film. We came to the conclusion that the essential thing in any system was to record the data at the source in a form that the machine could immediately accept, and in our work we were able to use magnetic and paper tape. In office work, however, paper tape is probably the only suitable medium. We or, at any rate I, feel that punch cards are an inappropriate writing medium either in our system or in an office accounting system. We, of course, were very fortunate in not having any great invested capital in punch card equipment, so we were able to adopt what we consider the ideal form for recording and transferring data. These thoughts and the fact that this is the only machine in use in the Commonwealth Public Service stimulated us to think that it would be worth while having a third session related to office automation, and to make the session a little more realistic and perhaps to show that our ideas had some foundation in fact, we are proposing to demonstrate on Friday a payroll of several hundred employees and a system of inventory control on the digital machine.