Leo 2

In 1963 I was working in the Continuous Weld Office of Stewarts and Lloyds Tubeworks in Corby when the company offered the opportunity to all employees to take part in aptitude tests for computer programmers. I did not do well enough to be offered a programming job, but I was offered a position as a computer operator on the company's Leo 2 computer an offer which I accepted, and I stayed in this role until Leo was replaced in 1971.

Today when computers in one form or another are commonplace it is difficult to imagine just how important Leo was both for Stewarts and Lloyds and for the development of computing in British industry. It is a matter of some regret that I did not have the foresight to take some photos, or keep some mementos of Leo. It is more than 40 years since it was decommissioned and the following notes are made from memory, and I have no technical knowledge regarding components etc. so I would ask that any inaccuracies or errors that might emerge are forgiven.

The Leo 2 computer was installed in a custom built 2 storey office block, known as the Computing and Calculating Dept. (C.C.D for short) on the Corby site in 1958. Attached are my drawings of the floor plan of the building. The computer room occupied almost 1 side of the first floor. Its main function was the weekly calculation of payroll for all workers on the Corby site. Payroll for the Bilston Works in the West Midlands and for the Pipework Erection Dept. (P.E.D) was also done. In total, pay for approximately 12,000 employees was calculated every week. Despite what would now be considered the primitive technology involved, Leo never failed to deliver pay details for the various workforces on time, but on occasion there were problems. Sometimes the machine developed faults, or there were programme errors or wrong data input but everyone involved knew that they had to stay until matters were resolved. There were normally 2 shifts per day; from 07:00 to 15:00 and 15:00 to 23:00 with 2 operators and 2 – 3 engineers per shift. If there were problems those on the late shift drew the short straw and would on occasion work through to 07:00 on the following day to meet deadlines. Sometimes programmers were called out in the middle of the night.

In addition to payroll there were various other daily tasks for Leo to perform such as stores control, warehouse invoicing and stock control (for the 14 or so S&L warehouses around the country). One job that took priority no matter what was running was "the Mix". From the dozen or so quarries feeding Corby Steelworks ore samples would be received. The Mix programme worked out the best mix of ores from these various quarries to load up the furnaces. However payroll was the main job and it is the best example to use in trying to explain Leo's working.

The attached drawing shows the layout of the computer room. Data input was by punched card and paper tape on 3 input channels. There were 3 card readers and 2 tape readers. The combination of 3 input channels only allowed for 2 of the 3 card readers to be used for input at any one time. For the payroll runs for example input was made on 1 card reader and 2 tape readers. The card readers were electro mechanical and required regular maintenance so there was always 1 or 2 spare readers available.

Data output was by punched card and printer. There were 2 printers and 3 card punches. The combination of 3 output channels only allowed for 1 printer to be on-line and 2 card punches. This was the combination for payroll. The printer was electro mechanical with the facility to print a

maximum of 80 digits per line on a typewriter ribbon at a maximum speed of approximately 150 lines per minute maximum. As with the card readers there were always spare card punches available in case of breakdown.

The Wages Dept. including the Wages Hall occupied the greater part of the ground floor of the CCD. During the previous week data was transferred from clock cards on to computer input sheets by the wages clerks. On Monday completed input sheets would be passed to the punch room which was beside the computer room. Here some 30 – 40 ladies were employed to punch cards and paper tape. The wages information was punched in binary code on to tape and then passed through to the computer room. The payroll was done in the same order every week by section. Work usually began on Monday afternoon in the following order as the tapes became available.

Monday p.m Wagons Dept., Minerals, Steel Production, and Steel Maintenance and Repair.

It is difficult now to give an accurate figure for the manning levels for these sections, but I would estimate Wagons at less than 100, Minerals 600 – 700, with Steel Prod., and Steel M&R at approximately 2000 each making a total of about 5000 on the first day.

On Tuesday afternoon P.E.D. details became available. This dept. could be difficult to process. If I remember correctly this was an S&L subsidiary company that undertook steel construction work around the country. The employees were the biggest earners on the system, for in addition to their high rates of pay they were also entitled to "living out allowances" for board and lodgings and this boosted the value of their payslips significantly. This was to cause frequent problems in Leo's last few years of operation, but more of this later.

Next came the biggest section of all, Tube Works which had the same number of employees as Steel Prod. and M&R together a figure of about 4000. With P.E.D.'s 1000 or so this made for another 5000 payslips approximately. On Wednesday the Bilston payroll was run and this had around 2000 employees.

The procedure began by feeding in the Wages Programme. This was a deck of binary punch cards about 6" thick. Programmes were always fed in on Channel 3. (It was estimated that there were approximately 120 cards to 1"). After the programme had been read, the employee cards were loaded. Each employee on the payroll had 2 binary punch cards identified by his or her clock number. The first card, the "Permanent Details" card held details that did not change from week to week e.g Tax Code, N.I. Reference, rate of weekly contributions to Savings Schemes etc. The second card recorded cumulative totals such as Pay to Date, Tax to Date, Accrued Holiday Pay etc. The card feed could take only about 500 cards at a time and this had to be topped up as the cards were read through. Tape reader 1 was loaded with a tape giving details of bonus rates for each dept. for whichever payroll was being run. When this had read Tape reader 1 was loaded with clock details for each employee for the previous week, i.e. hours worked, overtime hours, bonus rate codes etc. Loaded on tape reader 2 were details of changes to permanent details, new employees etc. All data was identified by clock number so it was critical that all information was in sequence on all 3 input channels. Pushing the "start" button set the machine running.

Each employee's card records were read and matched with the tape details. The machine would then print a 2 line payslip on output channel 3. In payroll mode the printer did about 80 lines per minute. At the same time on the card punch on output channel 1 updated cards were punched for each employee to be used in the following week's payroll run. On channel 2 a combination of decimal report cards detailing which cost centre the various wages would be charged to and also binary totals card by dept. that were used as input for the reconciliation run carried out after each

dept. payroll run had been completed. The computer had no memory as such and processed 1 transaction at a time, i.e. read one employee's details, output same employee's details, read next etc.

If the reconciliation balanced the payslips and other relevant details would be passed to the wages clerks along with various reports. The decimal report cards generated on each contained 3 fields of 10 digit account numbers and the charges to be debited against these accounts. There were 3 "Charges" runs for each dept. To prepare for the first charges run the cards had to be sorted into sequence on a separate card sorter. Each column of the 10 digit account number, starting with the lowest value column was fed through the sorter and the cards would sort into hoppers numbered 0 to 9. The other 9 columns were sorted in sequence in the same way. When the 10th column had been processed all the cards would be in sequence order by account number on field1. They would then be used as input on the first charges run on Leo. The process would then be repeated on field 2 and then field 3. The actual sorting of these cards was an unpopular task. The sorters could be temperamental and any cards that were out of sequence could lead to the process for the field concerned to be repeated. The information from these runs went to Accounts Depts.

In those days most workers were paid in cash. Payslips were rounded up to the nearest 10 shillings above, with the difference being included as a deduction in the next week's wage. The payroll reports told the Wages Dept. how much cash to order in total, broken down by the number of £20, £10, £5, £1 and 10 shilling notes. Securicor delivered the cash mid- week and the wages clerks would make up the brown wage packets accordingly. Estimates varied as to exactly how much money was sitting in the Wages Dept. each week, but it must have been between £200,000 and £300,000 by 1971. Payslips were available for workers to collect on Thursday at the windows in the Wages Hall which was in the front part of the building, returning on Friday to pick up their pay packets. In the latter years of Leo's operation employees were beginning to opt for payment to be made by bank transfer.

The maximum value of any single payslip that could be printed was £99-19s-11d. In the early years of Leo's working life this was more than adequate as wages were a long way short of the magical figure of £100 per week. But inflation caught up with Leo in its latter years, and whilst most workers' pay was still significantly below this figure P.E.D. workers, as mentioned previously, received expenses for travel and accommodation. When added to their weekly wage in some cases the total due exceeded the programmed print field which caused the system to crash. In such cases the data was amended to reduce the figure and the balance was probably paid manually with the required adjustments made on the following week's figures. Another factor was the imminent decimalisation of Sterling. This particular measure took effect nationally on the 15th of February 1971. To have amended the programmes, the continuous payslip stationery etc. would not have been worthwhile as new I.B.M machines were already being commissioned. In any case, such was the speed of development in computer technology, Leo was virtually obsolete from the day it was installed.

For those too young to have known Sterling before decimalisation the following might be useful. The value of £1 or 100p replaced the following.

£1 = 20 shillings, 1 shilling = 12 pence. Before the change therefore there were 240d (old pennies). to £1. (As a point of interest there were 2 coins of smaller value than the old penny. They were the farthing of which 4 = 1d, meaning that there were 960 to £1. This ceased to be legal tender in 1960. The other coin was the halfpenny and there were 480 to the £1. Neither of these values ever figured in Leo's calculations, but both were in current circulation when Leo was installed at Corby.) One

consequence of the pre decimal coinage and the old imperial measures of weight (ounces, pounds, stones etc.) was that everyone in the U.K. needed to be better at mental arithmetic than they are now.

A sample of the punch cards used On Leo is not available unfortunately. On the attached sheets are descriptions with approximate dimensions. As can be seen there were 80 columns per card. On decimal cards the position of the punch hole gave the value on that column. For binary cards every second column was used making a total of 40 available columns. Depending on the type of information on each field of the card the format could either be straight binary or binary decimal. This is illustrated on the sheets attached.

On the payroll cards the Sterling values of the various fields were expressed in pennies in straight binary, i.e. every punch hole doubled in value. I assume that it was simpler to manage the various calculations in pennies than try to cope with the convoluted calculation in the old pounds, shillings and pence. One down side was that converting a string of punched digits to a sterling value was time consuming. Fortunately this was only necessary on those occasions when there might be problems, but the following is an illustration of how this was done. A field on a card might appear as follows with 1 representing a punch hole.

1 _ 1 1 1 _ _ _ 1 _ _ 1 1

This would interpret as	1
	4
	8
	16
	256
	2048
	4096
Total	6429

Divide 6429 by 12 to convert value to shillings = 535 with a remainder of 9 which is 9d

Divide 535 by 20 to convert to pounds = £26 with reminder of 15 which is 15 shillings

So the value shown above is £26 – 15 – 9.

This is a quite a small figure but some of the larger cumulative totals would run into tens of thousands of pounds. Sometimes a stray punch hole on a card would cause a discrepancy in a reconciliation, but experienced personnel could identify a figure in Sterling as a stray binary digit.

For example £34,952-10-8 = 524288p which is binary digit 20. That was the easy part. Identifying what caused this stray digit was the problem.

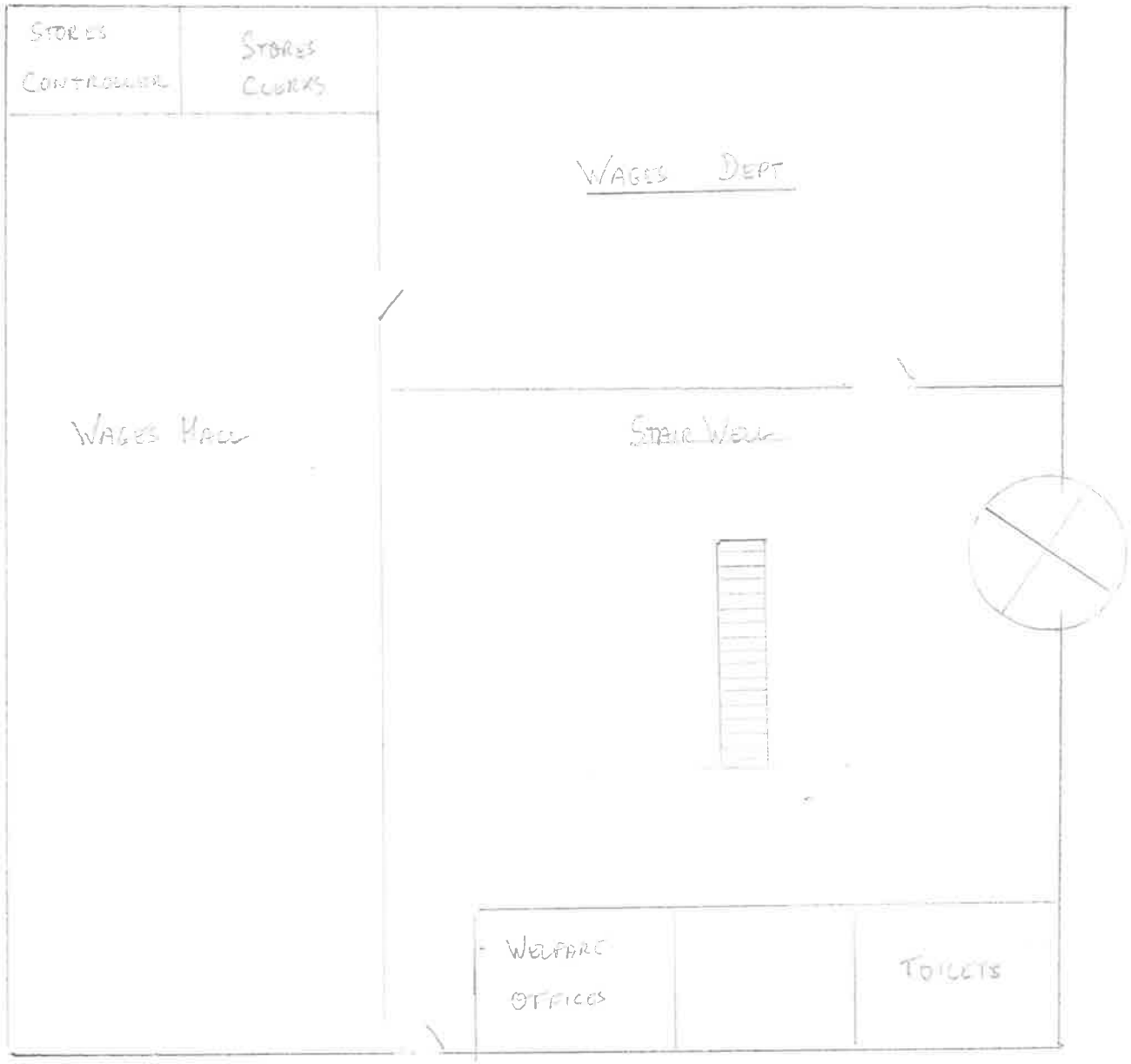
Also attached are drawings of the floor plan of the computer room and the control console. In the Heritage Centre there is a photograph of a Leo console with a gentleman sitting in front of it. It was unusual for anyone to sit there when the machine was working. Operators were usually on the floor making sure that the printer digits were aligned properly, that the printer ribbon did not

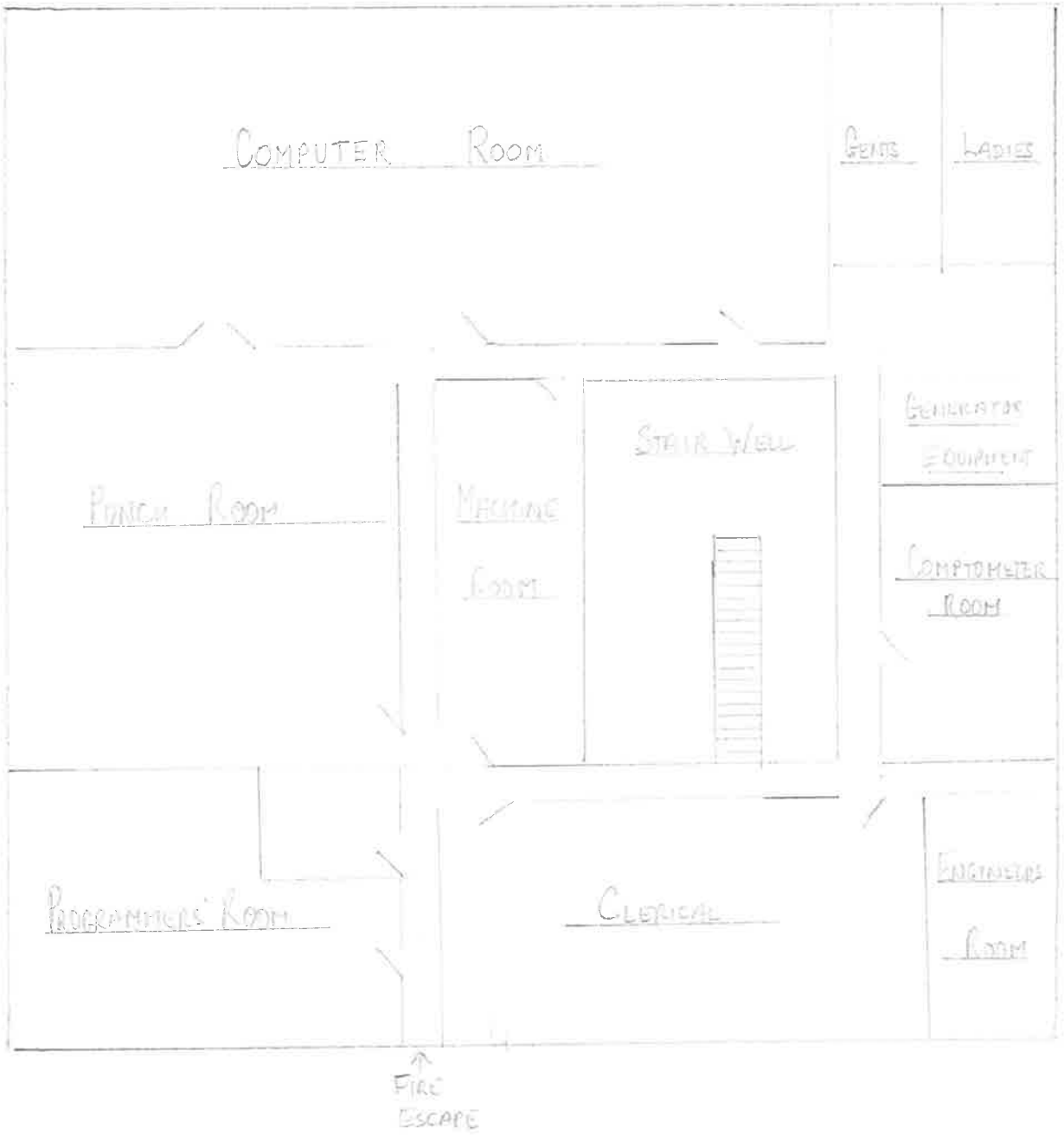
need replacing, that the paper tapes were fed in without delay, that card readers and card punches were topped up. If cards ran out the machine made a continuous howling noise until the feed was restored. I stress that all of the above is from memory, and there might be other sources that could give more detail.

Leo's design predated the invention of printed circuits, and as can be seen from the unit exhibited in the Heritage Centre its works consisted mainly of electrical glass valves. The 4 racks on the drawing of the computer room were packed with these units. As might be expected quite a lot of heat was generated. This was not a problem usually, but on warm summer days if the internal temperature of the machine rose above 106 degrees Fahrenheit it had to be switched off until the heat went out of the day. A critical part of the machine was something called the "mercury delay tube" which I think had something to do with controlling the speed of electrical pulses somewhere in the system. As the temperature rose the mercury expanded and became unstable causing malfunctions. The unlucky staff on the late shift would have to stay till the small hours of the following day to complete the work. In an attempt to cool the computer room down a system of water sprinklers was installed to spray cold water on the external surfaces of the windows, but this measure did not work very well and was seldom used.

Cotterer & Calculating Dept.

Ground Floor



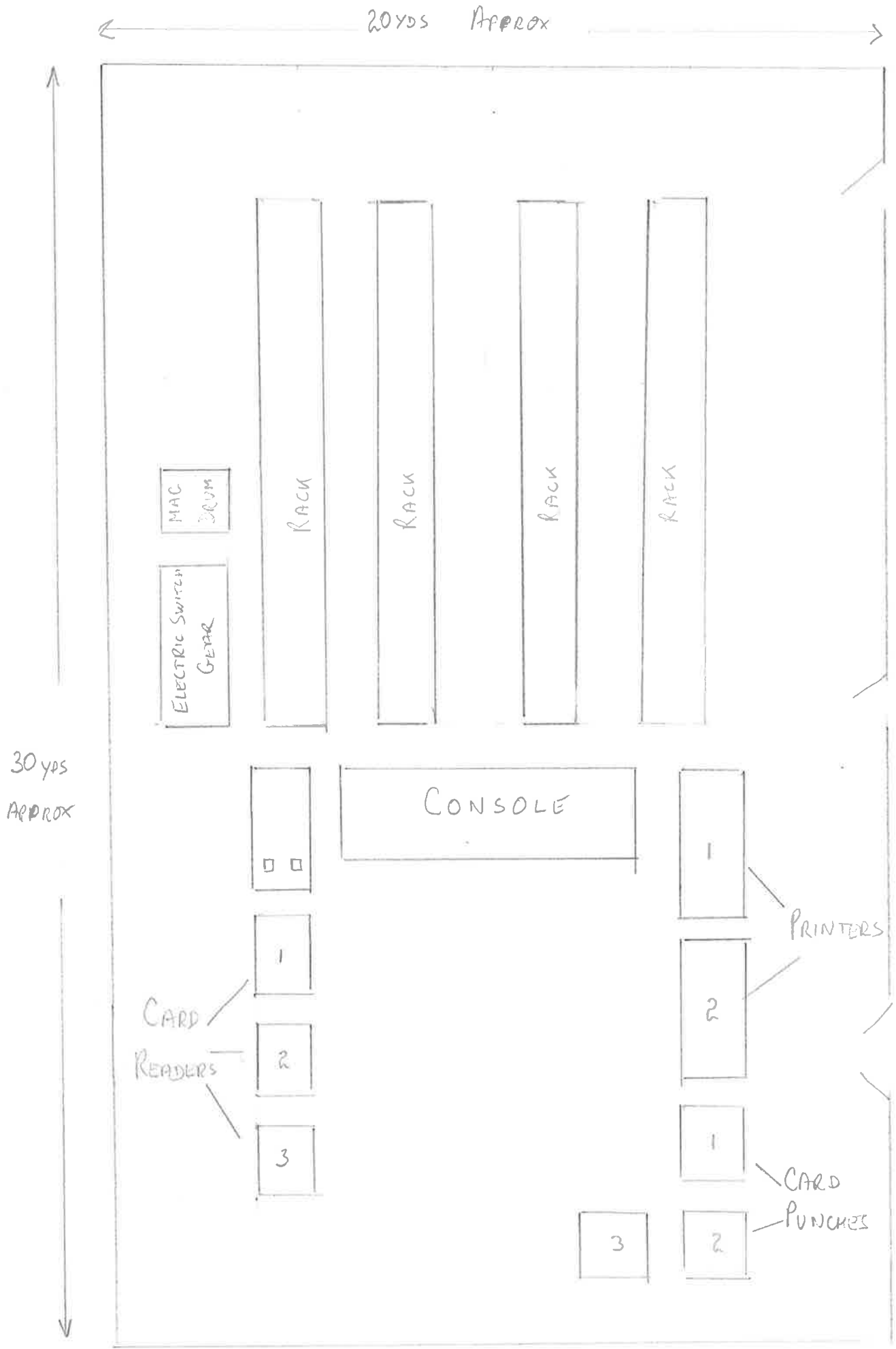


COMPUTER & CALCULATING DEPT

1ST FLOOR

(NOT TO SCALE)

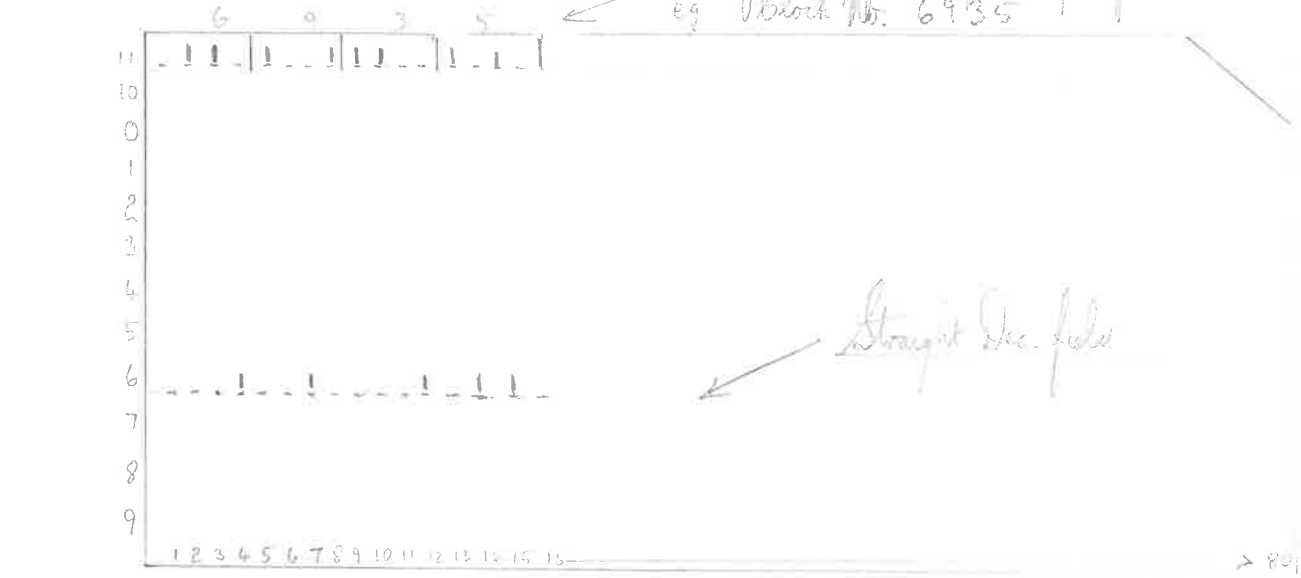
COMPUTER ROOM LAYOUT (NOT TO SCALE)



Decimal Card

eg Columns 1-4 = Year 1971
Column 5 : £69-14-10p

Binary Card



8
64
2048
8192
16384
26696