Overall view of calculator built to do commercial clerical work:

Only high speed automatic calculator anywhere designed expressly for doing general clerical work for industry and commerce. The machine was built by Lyons to do its own clerical work. Other high speed calculating machines have been built, but for mathematical and scientific work. The machines work at very high speeds doing a thousand or more arithmetical operations in a second. The machines built to do mathematical and scientific work have to wait while the data is fed in and while the results are printed, so that they are unsuitable for repetitive commercial clerical work where the volume of information to be fed in is very great, and the volume of information which has to be recorded is very considerable. LEO has special facilities so that, while one batch of data is being fed in, the calculator is working on the previous batch, and the results for the batch before that are being printed.

Show payslips being printed on continuous stationery:

The calculator is already being used for preparing the payroll for 1,700 staff in the Cadby Hall Bakeries. Payslips prepared on continuous stationery, one copy for the employee and one for the office printed simultaneously side by side on continuous stationery.

Preparation of punched tape for showing the hours worked, bonuses and allowances due, sickness and holiday information:

This information is received from the Bakery Office on a written attendance record. A bunch of sheets is handed to an operator who uses a keyboard perforator to produce a punched tape, one row of holes on the tape for each digit of information. When this has been checked it is ready so that the payroll job can start on the calculator.

Feeding in programme of instructions:

Before the calculator can do the job, complete instructions have to be fed into the store of the calculator. These instructions cover all the possible calculations that may be required, and are contained on punched cards which can be fed into the store in less than half a minute. The calculator is then ready to do the payroll for one employee after another.

Feeding in data tapes:

The tapes giving information about the hours worked, who has been away sick, and who is on holiday, are fixed on tape readers which feed the information from the tapes into the calculator. The employee's rate of pay and his P.A.Y.E. and National Insurance code numbers and similar fixed information are fed into the calculator from a punched card, one card for each employee. On this same card is the total pay and tax deducted for the tax year up to the end of the previous week. This card is automatically punched each week for the next week. The information is fed from it into the calculator at the same time as are the hours worked, etc., from the punched tape.

General view of Operating Floor:

Once the data tapes are loaded on the tape readers and the cards for the employees are on the card feed, the calculator is set in motion and is then completely automatic. One employee is dealt with in about 1½ seconds. Operators are only required for putting on new tapes and batches of cards when previous ones have been completed.

Completion of the payslips:

The payslips are taken from the tabulator. The employee's copy is detached from the office copy and the slips for individual employees are separated and sent to the Treasury to make up the pay packets.

Hands seen putting notes and coins into packet corresponding to net pay on slip:

Pay envelopes being given to Bakery staff. Envelope opened and slip taken out to check cash.

Chief Dept.   Mr Simmons
    Deputy   Mr Thompson
Engineer   Dr. Pinkerton
Programmer   Mr Camener
Maintenance   Mr. Lenaerts

LEO

LYONS' ELECTRONIC OFFICE

LEO - that is the name, appropriately
enough, from the initials of Lyons Electronic
Office - is the basic factor behind a bloodless
revolution.   For LEO is the new way of tackling
industrial and commercial clerical work of all
kinds and LEO may well lead the way towards a
brighter future for clerical workers, who will have
a vast amount of arithmetical drudgery removed from
their path by the advent of this "Machine".

WHAT IS LEO?

LEO, you will, therefore, gather is a
high-speed electronic calculating machine, but with
a difference.   Those electronic calculating machines
which have been built so far have all been designed
to handle mathematical and scientific problems.
For this type of work the amount of data which needs
to be fed into the machine is relatively small and,
although the number of individual calculations to be
performed on that data may be colossal, the volume
of results ultimately to be recorded may well be
relatively small - as little possibly as a couple of
lines of figures on a single sheet of paper.

LEO'S IMPROVEMENTS ON NORMAL CALCULATORS.

But in large scale repetitive clerical
work, which is the kind of thing with which Lyons is
concerned, the number of calculations which need to
be performed is likewise colossal, but, and this is

the key to the phenomena of LEO, the volume of
data and the volume of results are colossal too.
To take a pay roll as a working example:- the
number of calculations necessary to compute pay
for one man are comparatively small, but multiply
that for 33,000 people employed by Lyons and that
task assumes gigantic proportions.   The job is,
therefore, one suitable for high-speed automatic
methods - but the existing types of electronic
calculator were not sufficient.   Means had to be
found of feeding them with data fast enough to
keep them busily employed and means also had to
be found of recording results fast enough to
prevent the calculator from getting cluttered up.

Means also had to be found of ensuring
that the machine was thoroughly reliable for
regular commercial usage.   A man's pay, for example,
cannot wait, whereas if the scientist gets the
answers to his problems next week or next month
instead of next year or the year after he will be
well satisfied. But Bill Jones wants his money on
his regular pay-day.   So LEO must not let him down.
It would be ridiculous to claim that LEO never breaks
down, for with over 5,000 valves there is always that
possibility, but breakdowns are quite infrequent now
and when they do occur the Lyons engineers have so
developed their technique that a fault can usually
be put right within a matter of minutes.

HOW IT ALL STARTED.

Lyons have always been noted for the way in which they have more than kept pace with the times and it was about six years ago that they first began to investigate the possibilities of using electronic calculators for commercial purposes. News had been received that an electronic calculator was then in process of construction at Cambridge University and accordingly representatives went there to examine the situation. It was decided that all the possibilities were there and LEO's own basic calculator was in fact based very largely on the Cambridge experimental machine.

So Lyons Electronic Office was born; there was nothing else in existence which could be brought in for the purpose. The company reckoned, with every justification, that they knew as much as anybody about clerical work and LEO was developed to their own re-quirements. That in itself was a notable thing. So often in the past have machines been made by commercial undertakings and then clerical work has subsequently had to be adapted to suit the machine. This time it was the other way round. A sound, logical survey was carried out to show exactly what was required from clerical work and then the machine was built to satisfy those requirements.

And so the first all-purpose commercial electronic high speed calculator ever built anywhere in the world, slowly came into existence. There were 5,000 valves in one machine can be expected to develop teething troubles naturally.... characteristics entirely their own. But all those troubles were steadily overcome. Means were perfected of feeding the machine

with information and instructions at a pace which
was in keeping with the speed at which the calculator
can operate and then further means were perfected of
recording results at similar speeds both in normal
printed form and in punched card form.   With these
essentials completed the remainder became merely a
question of time .... it became an exciting if sometimes
frustrating path .... then LEO became reality.

HOW LEO WORKS.

How exactly does LEO function?   First there
must be a store in which the numbers and orders which
have been fed in can be held until required.   Then there
must be a means of input to get them there.   Next
comes an arithmetic unit to perform the necessary
calculations and an output unit for recording the
results as fast as they are produced.   And finally,
there must be a kind of brain, a co-ordinating unit,
which interprets the orders as to what calculations
are to take place and when.

Perhaps we can take a payroll job as a
working example, as most people make a habit of knowing
how to work out what effects them most.   But let it be
said right away that this is not the only kind of clerical
work that LEO will perform ... all types of clerical
work involving repetitive calculation are within its
scope, e.g.   ledger keeping, stores control, invoicing
and cost accounting, to mention a few.

And besides the purely clerical work, LEO can do all
types of scientific and mathmatical calculations.
It has, in fact, already done a great deal of work
for other organisations:- calculations on the
trajectories of shells fired from guns; calculations
on the behaviour of guided missiles; calculations
to study the practicability of numerical weather
forecasting; calculations to determine the cost of
joint life and last survivor annuities; and calcul-
ations to determine the positions of atoms in crystals.
On one job it was said that by normal methods, calcul-
ations would have taken several years, but LEO was able
to complete the job in four months.

But to return to the payroll task. Calcul-
ations for this fall into two sections:-

(Take in here Chart 3)

To perform these calculations the machine must have the
individual information concerning each man and this
information in turn can be split into three sections:-

1. certain basic information which normally remains invariable.

2. certain information carried forward from one week to
   the next.

3. certain information which applies specifically to the
   week for which the pay is being worked out.

(Take in Chart 5)

Items 1 and 2 are held in the form of a punched card (one
card for each employee) produced by the calculator as the
result of the previous week's work, but item 3 is
prepared in the form of punched tape from current
information supplied.

As soon as the punched tape has been prepared,
everything is ready for the payroll job, but before the
calculator can start, all the orders necessary to do the
job must be fed into the store of the calculator. These

orders are contained on punched cards and once there
the calculator is able to deal with one employee after
another ad infinitum.   It draws in the information
from the punched cards and the punched tape simultaneously
and, while it is doing the calculations for one man, draws
information ready for the next.   As soon as it has got
the answers, it sends them out for printing, and while
the printing is taking place for one man the calculations
are in hand for the next.   The calculator only takes
about a second to do all the calculations and the payslips
are printed simultaneously.   It does not matter how
variable are the circumstances for different men.   The
orders are arranged so that the calculator only carries
out those that apply and skips the rest.

CHART 3.   PAYROLL TASKS

1. BASE PAY

2. SICK PAY

3. HOLIDAY PAY

4. GROSS PAY (INCLUDING BONUS, ALLOWANCES, ETC.)

5. GROSS PAY TO DATE

6. P.A.Y.E. TAX TO DATE AND THIS WEEK

7. NATIONAL INSURANCE

8. NATIONAL INSURANCE STAMP RECORD

9. PENSION DEDUCTION

10. PENSION CONTRIBUTION TO DATE

11. NATIONAL SAVINGS DEDUCTION

12. NATIONAL SAVINGS TOTAL TO DATE

13. LOAN REPAYMENT

14. LOAN BALANCE OUTSTANDING

15. HOSPITAL SATURDAY FUND
                           CONTRIBUTION

16. CLUB CONTRIBUTION

17. OTHER DEDUCTIONS

18. TOTAL DEDUCTIONS

19. NET PAY

20. NOTES AND COINS FOR NET PAY

RUNNING TOTALS FOR GROUPS OF EMPLOYEES

AMOUNTS OF EACH NOTE AND COIN

NUMBERS OF EACH NATIONAL INSURANCE STAMP

MAINTAIN RUNNING TOTAL FOR ALL EMPLOYEES IN DEPARTMENT IN RESPECT OF
                                                    ALL ITEMS

CHART 5.   DATA FOR EACH EMPLOYEE

PARTICULARS NORMALLY UNALTERED	BROUGHT FORWARD FROM PREVIOUS WEEK	APPLYING TO THIS WEEK ONLY
IDENTIFICATION NUMBER	IDENTIFICATION NUMBER	IDENTIFICATION NUMBER
BAKERY NUMBER	BAKERY NUMBER	BAKERY NUMBER
WAGE RATE	GROSS PAY TO DATE	HOURS TO PAY
TAX BASIS AND ALLOWANCES	TAX TO DATE	PREMIUM BONUS, ETC.
NATIONAL INSURANCE CODE ETC.	NATIONAL INSURANCE STAMPS TO DATE	SICKNESS DETAILS
PENSION PARTICULARS	PENSION CONTRIBUTION TO DATE	HOLIDAY DETAILS
NATIONAL SAVINGS PARTICULARS	NATIONAL SAVINGS TO DATE	
LOAN REPAYMENT	LOAN BALANCE OUTSTANDING	
OTHER DEDUCTIONS	HOLIDAY INDICATORS	

Wiring Units

The machine consists of 220 removable units.   Here are two being wired up to the circuit diagram.   Before use in the machine they must be carefully inspected and tested.

Testing Units

All units are tested in this test rack.   Faulty units removed from the calculator are also tested here.   The engineers are looking for a tricky fault.

Valve Testing

All valves are tested before being put into the machine, and again at regular intervals throughout life.   The valve is being tapped to see if there are any short circuits inside.