# Oxford University Computing Laboratory – an informal prehistory

Today we mark the 50th anniversary of the opening of the Computing Lab; our Lab; one of the foremost Computing Science Departments in the world. It opened for business in 1957 under the direction of Leslie Fox.

Even if we could ever agree on what a scientific history of the Lab should be, it's probably too early to write it. But the early organisational history of the Lab is itself fascinating, and sheds light on the complex interactions between the complex personalities involved. Fox kept a huge archive of the relevant papers – dating from well before its foundation right up to his retirement. Before his death he had himself been planning to use this material to write a history of the Lab.

The main champion of the idea of a specialized Computing Lab at Oxford was Charles Coulson FRS, Rouse Ball Professor of Applied Mathematics. He campaigned for it starting from about 1951 – backed up by Dorothy Hodgkin in Crystallography -- yet to win her Nobel Prize -- and other Oxford scientists and statisticians.

The documents from this period make compelling reading, for it was by no means clear to all from the start that the stored-program electronic digital computer would become the dominant computational workhorse it eventually became, and there were serious worries about the huge costs involved.

The original plan, hatched at a meeting of scientists held in December 1952, seems to have been to establish a Laboratory based on programmable mechanical tabulating machines:

> *Mrs Hodgkin said that Chemical Crystallography [needed] a Reproducer, Collater, and direct-subtraction tabulator.*

existing stored-program machines such as EDSAC in Cambridge *[512 17-bit words, implemented as mercury delay lines]*, and the Manchester Baby machine were thought to be too small, and the analogue machines being used by a handful of the scientists were thought to be inappropriate:

> *Mrs Hodgkin thought that EDSAC had too small a memory [and] found it useful to have actual numerical totals as given by [the tabulators]. Dr Lydall thought that the demand for simple commercial [tabulators] would not be eliminated by the development of large electronic computers.*

It seems that crystallographic Fourier syntheses could be done efficiently without a multiplier, but that one was certainly needed for structure factor calculations

> Coulson to Secretary of Faculties: 19th June 1952:
> *I was in Cambridge earlier this week [and talked to] Wilkes, the man in charge of their Mathematical Laboratory. He was very definite that it was no use at all setting up a laboratory [...] unless we could have a multiplier.*

> Registrar's notes of an equipment meeting on 17th September 1952. Equipment required:
> *Punch, Sorter, Collater, Reproducer, Verifier, MULTIPLIER. A multiplier was essential for the laboratory and the BTM company did not yet provide an up-to-date multiplier as did the American company. (IBM)*

(Incidentally, the BTM company machines could do sterling arithmetic – whereas the IBM machines could work only in decimal).

More important were the arguments that were to be used to encourage the BTM company to co-operate in setting up the Lab:

> *The use of the machines for research purposes would provide further stimulus for further development to cope with varying needs. This [in contrast] to their use in commercial firms where [...] novel demands were not made on them.*

*Mrs Hodgkin suggested that a further development of the Lab might be to encourage BTM to develop expertise with electronic computers.*

For the next couple of years the people here seem to have made do with a bunch of second hand tabulators, and by buying time on outside computers. A 1954 bid to Whitehall to fund a 3 year computing scheme seems to have failed because the University didn't put any of its own money up.

Meanwhile the speed, capacity, and reliability of stored-program machines continued to improve, and Coulson continued to try to get the University to commit money as part of a new bid. Significantly, his campaign broadened, and we see (for the first time) an explicit reference to the potential of non-numerical computing. In a letter to Palmer, the Professor of Linguistics, in July 1955 he writes:

*I myself know a little about translation machines and [have seen] a couple of scientific articles translated from the Russian*

From this vantage point it's hard to imagine what the structure of the translation program was, or how accurate the translations were. Later in the same letter he writes:

*I have also seen the use of computing machines -- though of a rather simpler kind -- in working out the change in vocabulary and form of expression of a writer as his age increased; and to test whether certain parts of a longer work (for example, the book of Isiah) were the responsibility of two or more writers.*

and

*I have seen the power of these machines to write original letters by combining ideas and phrases in random ways – and the letters are perfectly understandable.*

He's probably talking about letters composed by Christopher Strachey's 1952 program for the Manchester "Baby" machine. This is one of them:

```
Darling Sweetheart
You are my avid fellow feeling.
My affection curiously clings to your passionate wish.
My liking yearns for your heart.
You are my wistful sympathy: my tender liking.
Yours beautifully
M. U. C.
```

Now let's fast-forward to 1957. The University has finally gotten capital for its Lab from the UGC. Both tabulators and electronic machines were to be funded. The post of Director has been established at Professorial level, Leslie Fox has been appointed, and there are established posts for

*a suitable number of non-graduate (girl) computers*

and two graduates. One we'd now call a numerical analyst; the other we'd now call a programmer. Interestingly the idea of "programming" had to be spelled out for the benefit of Whitehall

*By programming we mean the necessary manipulative adjustments of the machines, the most efficient sequence of operation, the sorting of cards, the coding of the electronic calculator – what is often referred to as "know-how".*

The budget covered the Lab's first big electronic computer, a Ferranti Mercury, which was eventually to be delivered in 1959. Meanwhile Fox's first task on his appointment seems to have been to organise the installation of an embarrassingly-obsolete HEC2 computer donated by the BTM company. Nobody really

wanted it. David Mayers later described it to me as "some sort of monster in the cellar". In December 1957 Fox is writing:

> *BTM don't worry a bit about what we do with the machine. If after 6 months or a year we hand it over to the Electrical Engineers as scrap they would not take offence.*
>
> *Meantime the idea is for people [to] see programmes being worked out on a machine and get the feel of an electronic computer without wasting time on the expensive Mercury*

Mercury was certainly expensive (I can't find out what was paid for the Oxford machine, but the much bigger machine that Shell installed at its Fawley refinery seems to have cost around £1m at around the same time).

And it was big, and it was astonishingly fast. With 1024x40-bit words of 40$\mu$sec core and 16k words of much slower drum store it could do about 3000 integer additions per second and 300 floating point multiplications per second.

And its maintenance and running costs were enormous because it was built from thermionic valves. At a time when television sets had about 30 valves in them, Mercury had hundreds, if not thousands. Fox was made responsible for earning the costs from external sources so of necessaity the tone was set early for the tradition of collaboration with industry that continues to this day.

By the time Mercury was decommissioned in 1964 the cumulative income from industry and commerce had reached £250k — enough to pay for the maintenance, to pay £15k back to the UGC and to pay £75k towards the cost of Mercury's successor, an English-Electric KDF9.

By 1960 the Lab was running courses and summer schools on scientific computing and a computing service for the whole University; it had also become a leading centre for research in numerical analysis and scientific computation.

But as we've already seen, Coulson's vision had extended way beyond numeric computation, and Fox was soon to take up the challenge of implementing it. After a short public controversy with Christopher Strachey and Stan Gill, Fox had clarified his earlier position – which many had wrongly interpreted as opposition to the very idea of non-numerical programming. He organised a summer school in 1963 at which many of the key pioneers of non-numerical computing gave lectures.

> Stan Gill – introduced "automatic computing"
> Mike Woodward – introduced "list programming"
> David Barron and Christopher Strachey gave an introduction to CPL
> *This was an ambitious language -- some of whose features were, after a few generations of language design, to find their way back into mainstream programming languages.*
> Mike Foster – discussed the Chomsky hierarchy and parsing technique.
> David Cooper presented work on theorem proving
> Roger Needham presented work on information retrieval
> Donald Michie presented work on game playing and game learning automata.
> Peter Landin presented his work on lambda calculus and applicative expressions.

Soon after the summer school, we see Fox advocating the formation of a new "experimental programming unit" to investigate programming languages, operating systems, and computer architecture. The unit was to be led by Christopher Strachey, with whom Fox collaborated in writing an initial 2-year funding proposal to Whitehall, called "General Theory of Information Processing". David Park (then at Cambridge) was the first person to be hired by Strachey. The proposal was successful, and a unit was established and called the Programming Research Group. Strachey spent 1965 at MIT before taking up his post, and Fox seems to have spent much of that year campaigning for a college Fellowship for Strachey. Fox's correspondence with and about Strachey at this time is also compelling reading, as are the references he conjures for Strachey from key government figures. These two paragraphs from the Earl of Halsbury are not untypical:

*If you are to assess Strachey for a Fellowship you will have to start straight from the admission that he is an unusual kind of person who does not fit into any kind of formal classification. ...To say that he has not got the formal qualifications for a fellowship is merely to decline to discuss the question.*

*Strachey has not got a higher degree for the simple reason that he has been too busy developing the pioneer phase of a completely new technique, and his work has issued in practical forms which do not lend themselves to publication as scientific papers.*

None of the Colleges took the hint, however, and it was not until considerably later that Strachey became a Fellow of Wolfson College. In consoling Strachey, Fox wrote that nobody in the Lab apart from himself had a college fellowship, and that he himself had had to wait 6 years before being appointed to one.

Under his direction, the PRG quickly won considerable renown. Among the theoretically minded the renown was for work on the semantics of programming languages. Among the practically minded the renown came for designing, building, and publishing the code of one of the earliest operating systems written in a high-level programming language: something nearly unheard of at the time. Much of the work on the operating system was done by Joe Stoy, a young physics graduate who (in his own words) "spent far too much time hanging around computers."

Dana Scott, who had been attracted to Oxford by Strachey's work on semantics, became Professor of Mathematical Logic in 1972.

Strachey was granted an *ad hominem* Chair in 1971, but with his early death in 1975 Joe Stoy, then a Research Officer, was left as the only academic staff member of the PRG, and for a while it seemed that the Professorship might die with Strachey. But Fox, Scott, and Stoy soon persuaded the University to establish a permanent Chair in Computation. This was filled by Tony Hoare, who joined Oxford from Belfast in 1977.

Tony will speak for himself, but it's fair to say that under his leadership the PRG began to grow at a rate that has only recently been surpassed. Several major collaborative projects with industry had begun by 1986, and among other achievements these led to two Queen's Awards for Technological Achievement in 1990 and 1992, and to the foundation of the Software Engineering Programme of in-service, part-time education that still thrives.

If I had to summarise the history of the Lab in one sentence, I'd say that right from its foundation it has been a place where the theory and practice of computing inform, challenge, and enrich each other, and where teaching and research go hand in hand. It's clear from today's proceedings that that's going to continue.

Bernard Sufrin, June 2007