FERRANTI MERCURY AT THE NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT

T. William Olle

T. William Olle Associates, 2 Ashley Park Road, Walton on Thames, Surrey KT12 1JU, England; BillOlle@aol.com

Abstract: This paper presents the author's experience in using what was probably the first commercially available stored program electronic digital computer used in the Nordic countries, namely the Ferranti Mercury installed at NDRE in August 1957. It describes the computer hardware and what came much later to be called the system software.

Key words: Ferranti Mercury, Norwegian Defence Research Establishment, machine language programming, Jan Garwick, SHAPE Air Defence Technical Centre

1. PERSONAL BACKGROUND

I started work at the SHAPE Air Defence Technical Centre (SADTC) in The Hague in The Netherlands in July 1957. The advertisement for the post in the well-known monthly magazine "Nature" in February 1957 stipulated a requirement for a postgraduate degree and experience in programming a digital computer. There were not too many people around at thee time who could meet that requirement.

Dr. Jan V. Garwick conducted the interview for this post. Garwick was on loan to SADTC from the Norwegian Defence Research Establishment (NDRE) and spending six months with SADTC, prior to the delivery to NDRE of the Ferranti Mercury. By the time I started at SADTC, Jan Garwick had returned to NDRE in order to be there when they delivered the Ferranti Mercury. Although Ferranti had promised delivery much earlier, delays in those days were very typical.

My four years of programming experience had taken place at Manchester University using the Ferranti Mark 1 computer, which was a forerunner of the Ferranti Mercury and which claimed to be the first commercially available computer delivered in the world when it was installed at the University in 1951. Only two Mark 1 computers were made (the other went to the University of Toronto in Canada, which I also used in connection with a summer vacation job in 1955). The upgrade, referred to as the Mark 1*, was in fact sold to seven customers, two of which were exported from the UK.

SADTC did not have its own computer in 1957, or indeed until 1959. The first two programming jobs, which I undertook after joining SADTC, used the Ferranti Mark 1 at Manchester University. When Jan Garwick returned for another period in The Hague starting some time during 1958, it was for two years. I remember that he and I did an informal evaluation of computer resources in the Netherlands, which could be used for SADTC's scientific work that was often highly classified. The results of this evaluation turned out to be disappointing. There were indeed computers in use in the Netherlands, but these were mainly commercial machines. (In those days, there was a very clear distinction between scientific and commercial computers. This lasted until the seminal announcement of the IBM360 series in March 1964.)

Against the background of this informal evaluation, Jan Garwick did no difficulty in convincing the SADTC management that any computing work that we did should be done on the Ferranti Mercury at Kjeller, near Lillestrøm about 25 kilometers east of Oslo. Even though Kjeller was a difficult journey from The Hague, the machine was obviously superior and machine time was readily available. NDRE was anxious to sell time and the all-important security facilities were well in place.

2. MERCURY HARDWARE

Manchester University and Ferranti Ltd (which were also based in Manchester) built on their experience with the Mark 1 and Mark 1*. As described by Simon Lavington in his excellent book on *Early British Computers* written in 1980, development started at Manchester University in 1951 on a prototype called MEG (megacycle engine). We should note that the MEG used cathode ray tube storage (widely known as the Williams tube after the inventor). The MEG ran its first program in May 1954.

The Ferranti Mercury was announced in late 1954. It had a number of significant improvements over its two predecessors, namely the Mark 1 and Mark 1*, the most important of which was floating-point arithmetic. It has

frequently been asserted in Manchester that the Mercury was the first machine in the world to provide floating-point arithmetic. Having personally struggled for four years with the fixed-point arithmetic of the Mark 1, floating-point arithmetic was much appreciated.

The high speed memory was based on magnetic core technology rather than the cathode ray tube based technology of the Mark 1, Mark 1* and MEG. The Mercury had a very much-increased speed. It was generally claimed to be 20 times faster than the Mark 1 and consumed half as much electrical power, even though it was still a "valve" machine.

Jan Garwick had taken the bold step in 1954 of persuading NDRE to order a Ferranti Mercury based on its paper specifications. This was what came to be known subsequently as a "paper machine". The machine that Garwick ordered was to be the first machine off the production line. It is not clear what the delivery date promised for the machine was at the time it was ordered, but it was not delivered until August 1957.

To get some indication of the development between 1951 and 1957, it is interesting to compare some of the technical specifications of the Ferranti Mercury with those of its predecessor the Mark 1. [1, 5] Both had a 40-bit word length. However, the Mercury 40-bit word was divided into a 10-bit exponent and a 30-bit mantissa.

Both used a 5-bit character code that went with the five-channel paper tape input that many computers of the time inherited from the telex code and equipment. Both used a magnetic drum as what was then called "backing store". (In those days, the English used the word "store" and Americans used "memory").

Both had cathode ray tubes on the console. Both provided a paper tape punch as well as a character printer for output. These devices were inherited from the world of telex communications. Another significant similarity was that both had index registers (referred to as B-registers on the Mark 1) which were used to modify the address to which an instruction referred. The Mark 1 was the first machine to provide this capability. In early 1950, the Cambridge EDSAC was the first machine in the world to provide a regular computing service and it did not have B-registers.

The two fundamental advances from the Mark 1 to the Mercury were the use of core storage and the floating-point arithmetic. The Mercury instruction set provided facilities for both fixed-point arithmetic and floating-point arithmetic. The average time for a fixed-point addition and multiplication on the Mark 1 were 0.67 and 6.00 milliseconds respectively. The corresponding times for the Mercury were 60 and 210 microseconds respectively. The Mercury's time for floating point addition was 180 microseconds and for multiplication 360 microseconds.

Before leaving the topic of hardware, it is useful to note that the physical size of the Mercury was about one-third the size of the Mark 1. This, of

course, was an important consideration for the amount of floor space that was needed and also the amount of air conditioning. Mercury consumed 12 kW of power compared with 25 kW for the Mark 1.

3. MERCURY SYSTEM SOFTWARE

The term "software" had not yet quite made it across the Atlantic by 1957. Concepts such as batch processing, supervisor programs, and operating systems had yet to evolve. Even the term "symbolic assembly language" had not quite arrived.

The term used in those days to refer to what was needed to input a program was "input routine". The established practice with Ferranti computers (such as the Mark 1 and Mark 1*) was for the organization purchasing the machine to develop its own input routine. For instance, Manchester University had its own input routine. The Ferranti Mark 1 at the University of Toronto in Canada had a different input routine. To run a Manchester program on the Toronto machine (as I did in the summer of 1955), it was necessary first to feed in the Manchester input routine and store in on the magnetic drum storage and then "booting" this input routine before feeding in the tapes containing the Manchester programs.

The term "bootstrap" was used for the few lines of code necessary to read the input routine from the drum into fast storage, so that it in turn could input other programs. "Bootstrap" and hence "booting" must be the oldest in computer terminology as it was always necessary to boot up the machine, which meant entering the input routine.

At Manchester University, the input routine for the Mark 1 did very little apart from reading the tapes into the machine and storing the blocks of code on to the drum. The fast store addresses to which an instruction referred would be machine addresses as used by the machine itself. However, the availability of B-registers meant that we could modify these addresses prior to execution by adding the content of the B-register to the address that was being referenced.

The task, which occupied Jan Garwick before the delivery of the Mercury to NDRE, was to develop an input routine, bearing in mind that this was the first Mercury delivered anywhere. Ole Johann Dahl ably assisted Garwick in this work and together they designed and implemented a system and wrote a handbook [2]

Since the NDRE Mercury was as indicated the first machine, he suggested to Ferranti's that the subsequent Mercury's could use the same input routine. For whatever reason, Ferranti did not accept this suggestion

and they produced an input routine [3] that was used on the remainder of the production line [4].

I personally never used the Ferranti input routine and am not in a position to compare the merits of the two. Garwick was certainly upset that Ferranti had not used the development by Dahl and himself. However, sometime later possibly around 1960 after Garwick had returned to NDRE from SADTC, SADTC discovered that there was more machine time available on the Ferranti Mercury at the University of London. I ran application programs there that had been developed in Norway using the Garwick and Dahl's input routine without any difficulty on the London machine. This was an early example of what we now call "portability"!

I had to learn how to use the so-called Norwegian input routine by studying (in The Hague) the handbook [2] written by Jan Garwick and Ole-Johan Dahl. The principles learned in over four years of experience with the machine code of the Mark 1 helped, but there were significant differences. For what was usually highly complex computation work, the floating-point arithmetic was a tremendous help.

Furthermore, it was no longer necessary to refer to machine level addresses in a program, as it was possible to create symbolic variables that the input routine would subsequently assign to a physical address. The programming was by no means equivalent to an Autocode or higher-level language, but it was much easier than working with physical addresses in the high-speed memory.

4. COMMERCIAL SUCCESS OF MERCURY

As previously indicated, the NDRE Mercury was the very first to be delivered. Even Manchester University, who had been responsible for the design of the prototype MEG, did not get their machine until three months later. One of the major scientific applications of the era was atomic energy work and indeed, one of the main users of the BDRE machine was the Norwegian Atomic Energy organization.

However, according to reference [4], atomic energy authorities in UK, France, Switzerland (CERN), Sweden, Belgium, and Venezuela followed the pioneering path of Norway by installing a Ferranti Mercury. In all, nineteen Ferranti Mercury machines were installed around the world. Reference [4] indicates that four of these (all outside the UK) were still in use as late as 1970. Reference [5] indicates that the Manchester University Mercury was in use until 1963. Reference [6] suggests that the motivation to develop Simula on a machine that was more widely used (namely the Univac 1100

series) lead to the acquisition of such a machine and possibly the end of the NDRE Ferranti Mercury.

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