Tom Kilburn

Born August 11, 1921, Dewsbury, Yorkshire, England; early worker on the Manchester Mark I who collaborated with Frederick Williams to develop the CRT memory and the first truly multiprocessor system-ATLAS.

Education: BA and MA, mathematics, Cambridge University, 1940-1942; PhD, computer research, Manchester University, 1948; DSc, computer research, Manchester University, 1953.

Professional Experience: scientific officer, Telecommunications Research Establishment, Malvern, 1942-1946; outside duty at Manchester University computer research, 1946-1948; University of Manchester: lecturer, 1948-1951, senior lecturer, 1951-1955, reader in electronics, 1955, professor of computer engineering (first chair in computers in UK), 1960-1964; professor of computer science (first university computer department in UK), 1964-1981; professor emeritus, 1981-present.

Honors and Awards: fellow, IEEE, 1954; fellow, Royal Society, 1965; DV (Hon.), Essex University, 1968; McDowell Award, IEEE, 1971; CBE, 1973; first recipient of the John Player Award, British Computer Society, 1973; distinguished fellow of the British Computer Society, 1974; FEng, founder member of the Fellowship of Engineering, 1976; DUniv (Hon.), Brunel University, 1977; Royal Medal of the Royal Society, 1978; DSc (Hon.), Bath University, 1979; foreign associate, US National Academy of Engineering, 1980; DTech (Hon.), Council for National Academic Awards, 1981; Computer Pioneer Award, IEEE Computer Society, 1982; Mancunian of the Year, Manchester Junior Chamber of Commerce, 1983; Eckert-Mauchly Award, ACM/IEEE Computer Society, 1983; honorary fellowship, University of Manchester Institute of Science and Technology, 1984.

Kilburn was involved in the field of computing since the mid-1940s, and built the first machine (the Manchester Mark I) that put programs and data in the same store (1948). He developed the cathode ray store in the early 1940s with Frederick Williams. Later he was central in the development of the ATLAS system, which was designed from the outset as a multi-programmed system based on virtual memory (paging) which exploited programmed operators (extracodes) residing either in read-only or alterable main store for extensibility, and which was expressly intended to run under control of a monitor system. The ATLAS was significant in influencing later thinking regarding computer systems throughout the world.

Mark I, 1946-1951

September 1942-December 1946: Kilburn worked on electronic circuits for radar in F.C. Williams' group at Telecommunications Research Establishment, Malvern. Towards the end of 1946, one binary digit was stored on a cathode ray tube by the “anticipation pulse” method.

December 1946-December 1947: Williams and Kilburn moved to Manchester University, the former to the chair of electrotechnics, and work continued on the cathode ray tube store. This work resulted in the

“anticipation pulse” method being abandoned to be replaced by the dot-dash, defocus-focus, and so on, methods, and later formed the substance of Kilburn's PhD thesis. By autumn 1947, 2046 digits had been stored on a cathode ray tube by the preferred defocus-focus method, and this was the first electronic immediate access alterable store.

December 1947-June 1948: In December 1947, Kilburn wrote a report on the store which was circulated in the UK and the US. With the primary aim of testing the store as thoroughly as possible, a small computer was designed and built. The program that first ran on this machine on June 21, 1948, was the first computer program to run on the world's first alterable stored-program computer.

June 1948-April 1948: The small computer was enhanced to create a large machine by the spring of 1949. It had two especially interesting features-the inclusion of index registers (a Manchester invention) and a synchronized magnetic drum as a backing store for the cathode ray tube store.

April 1949-July 1951: The large machine was copied by Ferranti Ltd. and marketed as the Ferranti Mark I. The first of these machines was delivered to Manchester University in about February 1951, and vies with the Univac for consideration as the first commercial machine. An inaugural conference was held at the university in July 1951.

MEG, 1951-May 1954, and MERCURY, 1957-1962

MEG was a megacycle computer and Kilburn's design aim was an increase in speed of 30 over MARK I, with greater reliability. It used semiconductor diodes and miniature pentodes, and distributed electromagnetic delay lines for the internal registers. Floating point hardware was provided. It ran its first program in May 1954, and was perhaps the first floating point machine. Again, Ferranti produced a commercial machine, renaming the MEG as MERCURY. MERCURY differed from MEG only in its use of ferrite core instead of cathode ray tube store. Ferranti delivered a MERCURY to the university at the end of 1957.

The Transistorized Computer, November 1953-April 1955

In parallel with the MEG project, Kilburn started a transistor computer project, using the transistors then available, namely germanium point-contact devices. These were more unreliable than valves, but semiconductors held out a promise of great reliability in the future, and experience of their use would therefore prove useful. The machine was to be economic and had only a magnetic drum store. Registers were made by placing read-write heads at suitable distances along the drum surface. A pseudo two-address instruction format was used. A small transistor computer ran its first program in November 1953, and is believed to be the first transistor computer. A larger version using 200 point-contact transistors and 1300 point-contact diodes, with a power consumption of 150 watts, was completed in April 1955. This design was adopted by Metropolitan Vickers (later AEI and now GEC) and produced in 1956 using junction transistors.

MUSE and ATLAS, December 1962-September 1971

It was apparent to Kilburn in 1956 that it would be possible to build a junction transistor computer 80 times more powerful than MEG/MERCURY (2400 x MARK I), thus approaching 1 μsec per order. Responsibility for the computing service to the university and industry on Mark I had also made Kilburn realize that the use of the computer was inefficient, and that, if suitably designed, the computer could itself make its own use more efficient. Simultaneous operation of large numbers of input and output equipment would be arranged, and (apparently) simultaneous running of many programs would also occur. The irritation and cost to users of different levels of storage would be removed. Everything would be controlled by an internal program. To make these and other improvements, a number of inventions were required and these were made over the period 1956-1959. They resulted in techniques now known as multiprogramming, job scheduling, spooling, the supervisor or operating system, virtual storage, paging and the one-level store, read-only memory, interrupts, and so on. The learning program in the one-level store program was the first use of AI in a conventional computer. In 1959 Ferranti joined the project, which hitherto was known as MUSE, and it was rechristened ATLAS. Kilburn's team increased from 20 to 40, large compared with two on the prototype Mark I. The Atlas was inaugurated in December 1962 and provided computing service to many universities and industry until September 1971.

Department of Computer Science

In 1964 the computer group within Electrical Engineering became the Department of Computer Science-a separate department, and undergraduates were accepted into a three-year honors degree course in October 1965 for the first time in a UK university.

MU5, 1966-1979

In 1966 work was started on a multicomputer system MU5. The principal design aims were a speed approaching 20 times that of ATLAS, and an architecture capable of running high-level language programs efficiently, extendable to a family of machines. A segmented virtual store with variable-sized pages would facilitate a multiprogramming environment. Associative storage would hold “names.” The Ferranti computer department had been taken over by ICL, which now collaborated with the computer group in providing the hardware for the university. The university team of 16 staff and 25 research students was increased by 19 engineers from ICL in 1971. By October 1974 the MU5 multicomputer system was available for use by the department and remained so until 1979. The architectural concepts of the ICL 2900 series were derived in large measure from those of MU5.

QUOTATION

“I obviously over coached him since he got his FRS[1] two years before I did.” James Wilkinson, Kilburn's supervisor at Cambridge University)

[1] Fellow of the Royal Society.

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UPDATES

Tom Kilburn died January 17, 2001 (MRW 2012)

Portrait inserted (MRW, 2013)