Obituary

# Tom Kilburn (1921–2001)

By 1947 the theory of general-purpose, stored-program computers was familiar to several research groups on both sides of the Atlantic. However, the lack of suitable high-speed memory devices stopped them turning theory into practice. To quote Nathaniel Rochester of IBM, writing in the premier US electronics journal (*Proc. IRE*, p. 374; April 1950): "The most difficult problem in the construction of large-scale digital computers continues to be the question of how to build a memory, and the few papers written do not reflect the greatness of the effort which is being exerted." It was in this context that Tom Kilburn began working for his PhD at the University of Manchester. His task was to perfect a new form of digital memory. The starting point was an observation by F. C. Williams of the stored patterns of electrostatic charge inside a cathode-ray tube.

By the autumn of 1947 Kilburn had constructed a practical random-access memory device, later known as the Williams–Kilburn tube. Williams and Kilburn decided to incorporate the tube into a small-scale experimental computer, "to subject the memory system to the most searching tests possible". This small-scale computer, sometimes called the 'Baby', first ran a program on the morning of Monday 21 June 1948. The event was described in a letter to *Nature* published later that year (162, 487; 1948).

The 1948 Manchester computer contained only a few words (128 bytes) of storage. It was built from war-surplus electronic components, the rudimentary input being via push-buttons recycled from the radio-channel selector panels of Spitfire aircraft. Yet this small machine provided the first convincing demonstration of the stored-program principle, which is the basis of every modern computer. From this prototype, the British company Ferranti Ltd developed the world's first commercially available computer, known as the Ferranti Mark I. The first production model was delivered in February 1951, marginally ahead of the much larger UNIVAC 1 computer developed by Eckert and Mauchley in the United States.

Designing and building computers is a team activity combining hardware and software skills. When Williams moved on to other things, Kilburn built up a research team at the University of Manchester that completed a total of five increasingly powerful computers between

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Designer of the first stored-program computer

1948 and 1975. The fourth of these, Atlas, was the world's most powerful computer when it came into operation in December 1962. Although this pre-eminence lasted but a few months, several innovative concepts that remain in use today were pioneered in Atlas, including virtual memory. Kilburn (seen here at the keyboard of Atlas) was particularly proud that all five designs led to industrial derivatives. Fruitful links with companies such as Ferranti and ICL meant that only one of the projects required an initial injection of public funding from Britain's Science Research Council. In 1964 the Manchester group evolved into the department of computer science, with Kilburn at its head.

But what of the man himself? Born in the no-nonsense county of Yorkshire, Kilburn was christened plain 'Tom' (not Thomas). Encouraged at school by an outstanding mathematics teacher, Kilburn won a scholarship to the University of Cambridge in 1940. He graduated with first-class honours in a two-year wartime mathematics course, and was given a quick introduction to electronics in London and sent to work at the Telecommunications Research Establishment, Malvern. Here he joined Williams, who headed a special engineering group solving electronic circuit problems for radar applications. Although originally a mathematician, Kilburn soon came to regard himself as an engineer. As with many young British scientists at this time, his wartime experience in radar made him determined to see projects through to completion. Kilburn's enthusiasm for implementation became the hallmark of computer science at Manchester. Kilburn was accorded the scientific accolade of fellowship of the Royal Society in 1965.

Kilburn was a modest individual who actively shunned publicity. In 1968 he was asked why computer science textbooks seldom mentioned the early pioneering work at Manchester. Kilburn paused, and then replied mysteriously: "Because those who need to know, do know." Such isolationism was sometimes the despair of his more gregarious colleagues, but Kilburn's ability to remain focused on a problem enabled him to lead his team from the front.

In a field of scientific endeavour characterized by transitory, ad hoc developments, it is not easy to explain in simple terms the contributions to computer design made at Manchester between 1948 and 1975. If there was an underlying theme, it was the pursuit of hardware assistance for efficient scientific computation. Although some of Kilburn's engineering innovations were soon made obsolescent by subsequent technologies (the advent of semiconductors, for instance), other ideas have stood the test of time. Among them are hardware assistance for accessing structured data such as arrays (the index register, 1949); hardware implementation of floating-point arithmetic (1954); hardware management of heterogeneous storage systems (associative page-address translation, 1962); and hardware management of local scalars in block-structured high-level languages (the name store, 1974).

In June 1948, the information revolution took its first tentative steps. By the end of 1949 there were probably still only four prototype computers coming into hesitant operation anywhere in the world — two in Britain (at the universities of Cambridge and Manchester), one in the United States (at the Eckert–Mauchley Computer Corporation, Philadelphia) and one in Australia (at the Commonwealth Scientific and Industrial Research Organisation, Sydney). Like its designer, the first Manchester computer was a creation of few words in a new world. Kilburn died on 17 January, aged 79, but his 'few words' will continue to resonate widely.

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