Early papers on the ORDVAC and the ILLIAC

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A number of papers, prepared during the time the ORDVAC and the ILLIAC were in operation, are reprinted here. The papers are of interest not only for their factual content, but also because they reflect the attitudes, the areas of concern, and the terminology of the early years, which often differ markedly from those of today.

The characteristics of the ORDVAC are given in the 1952 paper by Meagher and Nash. During the period between completion of the ORDVAC and the ILLIAC—almost a year—the experience gained from operation of the ORDVAC prior to its shipment to Aberdeen Proving Ground resulted in design changes of the ILLIAC. Other changes were suggested by David Wheeler, who arrived from Cambridge University shortly before the ORDVAC was completed. The number of bits assigned to specify an instruction was reduced from nine to eight, for better compatibility with a hexadecimal input. The memory circuits were also improved. Detailed specifications, such as the operation times in the ORDVAC paper, are a snapshot of conditions at the time the material was written and are subject to frequent changes in the early years of a computer's life.

In the early 1950s the need to achieve reliability affected every aspect of the design and operation of computers. Components were tested to ensure that they met specifications, circuits were designed to operate correctly under worst-case variations of component characteristics, and diagnostic programs were not only prepared to provide data to locate faults, but were also intended to detect malfunctions before user programs were affected. Careful logs were kept, and information about malfunctions was recorded at the time of occurrence. The 1953 paper by Wheeler and Robertson describes, among others, the diagnostic program called the leapfrog, which rapidly became the primary test to indicate whether the ILLIAC was sufficiently reliable for service use.

The 1953 paper by Williams reviews the operating experience with the ORDVAC after its installation at Aberdeen Proving Ground. This paper also indicates that a faster paper tape reader was installed, that card-handling equipment was added, and that improvements were made in the electrostatic memory.
The ILLIAC electrostatic memory, with a capacity of 1024 words, was later augmented by a magnetic drum memory, with a capacity of 12,800 words. Although the basic instructions involved a single word transfer, in practice a block of words was transferred under program control. The timing was such that this program was optimized if a transfer was requested at every fifth word recorded on the drum surface. The 1956 paper by Robertson describes the method of counting employed for this purpose. The paper initially describes the binary counter designed for the Institute for Advanced Study computer and copied for the ORDVAC and for the ILLIAC, and indicates that an up counter can be converted to a down counter by a simple rearrangement of wiring. It is next observed that $5 \times 13 = 65$, and that $65 \equiv 1 \pmod{64}$, so that a 6-bit counter that advances by 13 for each received count will advance by 1 for each 5 received counts. Finally, 13 can be represented as $16 - 4 + 1$, and advancing by 13 is achieved by simultaneously incrementing at digital positions of weights 1 and 16 and decrementing at weight 4. Alternating up and down counters in this manner has the advantage that a carry emerging from an up counter cancels the incoming down count of its neighbor to the left, and a borrow cancels the neighboring up count.

REFERENCES