CC/NUMBER 43
OCTOBER 28, 1985

This Week's Citation Classic®

Bell C G & Newell A. *Computer structures: readings and examples.* New York: McGraw-Hill, 1971. 668 p.
[Carnegie-Mellon University, Pittsburgh, PA]

This is a textbook on computer architecture that is used at both undergraduate and graduate levels. It is built around descriptions of some 40 different actual computer systems, mostly reprints from the literature, but with much original material that organizes them within a common notation. [The *CompuMath Citation Index®*, the *Science Citation Index®*, and the *Social Sciences Citation Index®* indicate that this book has been cited in over 145 publications since 1971.]

Allen Newell
Department of Computer Science
Carnegie-Mellon University
Pittsburgh, PA 15213

April 19, 1984

I am the right one to write this micro-essay, although it is really Gordon's book. Simply put, although Gordon's writing leaves something to be desired, he can organize anything that breathes. I was drawn into the enterprise of his book just by helping a newly arrived fellow faculty member clean up his prose.

Gordon is a computer designer. He came to Carnegie-Mellon University in 1967 from Digital Equipment Corporation, having designed many of Digital's computers. He brought with him some great prejudices concerning what was important about computers and wanted to tell it to the world. Detail was important—computers are complex and their complexity must be understood by the computer engineer. Actual computer designs formed a space that had to be understood empirically. We likened ourselves to botanists and wanted to title the book "Computer Botany," until talked out of it by publisher and friends. Gordon set out simply to produce an edited collection of reprints on significant computers. However, 40 such papers between two covers produced such a mishmash of notations and detail that we invented a computer-design space within which to locate them and a common notation with which to express their structure. The "readings" became a textbook.

Three ingredients lift the book to a contribution to the art and perhaps account for its high citation rate. First, detailing real computers made it a repository for the computer professional. Textbooks of its time devoted themselves largely to basics of logic circuits. Second, the book appeared just as computer architectures exploded in diversity. It gave voice to the organization of computer systems into levels (especially the register-transfer level) and the dimensions within which design took place. In engineering design, practice evolves in advance of theory, and the book captured practice in coherent conceptual terms. Third, the two new notations were a genuine technical (and joint) contribution. Interestingly, the more novel (PMS, which describes the configuration level of processors, memories, and switches) has received little attention subsequently, whereas the less novel (ISP, which describes the instruction set at the register-transfer level) has been highly successful, evolving into the only language actually used to describe full-scale computers.

I like to think two other ingredients have been significant—a small one for me and a large one for Gordon. For me, perhaps the book's writing has a modicum of style. Engineering texts are seldom graceful and I fantasize the style of this one helped it to stand out. For Gordon, the book is informed throughout by his deep insight into the nature of computers. Few major computer designers have written books about their art, much less textbooks; in ways both large and small the book rings true to the technology it describes.

The book is now dated, especially with its focus on real systems, none of which (of course) postdates 1970. A new edition of the text now exists, which is sufficiently revised to be a new book.[1]

1. **Siewiorek D P, Bell C G & Newell A.** *Computer structures: principles and examples.* New York: McGraw-Hill. 1982. 926 p.

