# Comments, Queries, and Debate

*Werner Buchholz, Editor*

This department offers an opportunity to comment on previously published articles, to correct or complete the historical record, to bring up topics not already covered, and to submit queries concerning historical events or facts. We expect that articles published in the *Annals*, which reflect the authors' views and historical perspectives, will generate debate. We welcome contributions to such debate that are relevant and in good taste. Opinions expressed are those of the writer and not necessarily those of the editor, IEEE, or the Computer Society.

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### Origin of the Term Software: Evidence from the JSTOR Electronic Journal Archive

The earliest use of the word *software* the *Oxford English Dictionary* recorded is dated 1960. The files of the Merriam-Webster Dictionaries also have no citations for this word prior to that year. Fiona McPherson of the *Oxford English Dictionary* staff told me that the files for the forthcoming edition include an 1850 occurrence of a very different, non-computer-related, meaning:

> Two other departments [among rubbish-tip pickers], called the "soft-ware" and the "hard-ware," are very important. The former includes all vegetable and animal matters—everything that will decompose.

I have been able to discover earlier usage of the computer term *software* by using an extraordinarily powerful research tool, namely, *JSTOR* (*Journal STORage*). *JSTOR* was conceived by William G. Bowen, president of the Andrew W. Mellon Foundation, as a response to a range of pressures libraries felt: escalating subscription costs for journals in the face of tighter budgets, rising library user expectations, limited stack space for long runs of journal back files, and preservation problems associated with storing paper volumes. *JSTOR*'s mission is to provide electronic access to back files of scholarly journals in many fields. Every issue of the included journals has been digitized into a database residing at the University of Michigan. The *JSTOR* database contains high-resolution, bitmapped images of each page linked to a text file created with optical character recognition software and hand-checked for accuracy. The text file is completely searchable.

The disciplines *JSTOR* covers are primarily in the social sciences and humanities, but some are in the natural sciences. At the time of this writing, these disciplines included African–American studies, anthropology, Asian studies, ecology, economics, education, finance, history, literature, mathematics, philosophy, political science, population studies, sociology, and statistics. The roster of individual journals on *JSTOR* includes some of the preeminent journals in their respective fields.

*JSTOR* is a gold mine for studying the terminology of the humanities, social sciences, and natural sciences. *JSTOR*'s coverage, described above, encompasses crucial and terminologically rich journals in multiple fields, with substantial chronological depth and with the ability to search the full text of those journals for occurrences of desired words or phrases and to sort the results by date. Therefore, *JSTOR* functions very well as a device for unearthing early occurrences of terms likely to appear within its covered journals. Although computer science is not one of the component disciplines, the database will, to some extent, be effective for research in the history of computer terminology, because among its journals are mathematics periodicals such as the *Mathematics of Computation*, statistics periodicals, and other titles that may treat computer-related subjects.

When searching for the word *software*, *JSTOR* indeed strikes pay dirt. The earliest "hit" is in an article by Princeton University statistics professor John W. Tukey entitled "The Teaching of Concrete Mathematics," published in the *American Mathematical Monthly* in January 1958.[1] Tukey wrote in this article:

> Today the "software" comprising the carefully planned interpretive routines, compilers, and other aspects of automative programming are at least as important to the modern electronic calculator as its "hardware" of tubes, transistors, wires, tapes, and the like.[1,p.2]

Two years prior to any other known example of the

term, this passage establishes Tukey as the presumptive coiner of *software*.

Tukey is a major figure in late 20th-century statistics. He introduced the fast Fourier transform algorithm and modern techniques for estimating spectra of time series, contributed substantially to the analysis of variance and the problem of making simultaneous inferences about a set of parameter values from a single experiment, and made many contributions to the philosophy of statistics and research. He served on important scientific commissions and was awarded the National Medal of Science.

In addition to these substantive accomplishments, Tukey has been fascinated with originating new words and phrases. He is credited with being the first user of no less than seven terms in mathematical statistics.[2] In the computer field, his major neologism has been considered to be the word *bit*, which he invented in 1946.[3] Now *bit* is supplanted by the even more important term *software*, at least until earlier evidence of the latter's existence is brought forward.

I invite readers of the *Annals* to contribute any earlier documentation of *software* to this column. It should be kept in mind that "documentation" means dated written materials, not unsupported recollections. Etymological anecdotes are notoriously unreliable and belong in the realm of folklore, not history.[4]

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### The First Business Computer

I am either a nitpicker or a language purist; you pick. The *Annals* covers both digital and analog computer history and generally (and rightly) differentiates between them the majority (51 percent) of the time. Of course, it is proper to give more attention to the digital, but some references to computers completely ignore the analog when they say something like "the first multiplier" rather than "the first digital multiplier," etc. I would think historians, at least, would do better. The commercial world places too much emphasis on "first" and yet very often does not credit the real first.

As editors, you can do only so much to buck the trend. Certainly you are forced to accept the inevitable when someone writes a book titled *LEO: The Incredible Story of the World's First Business Computer* as reviewed on page 84 of vol. 21, no. 4. Finally, in the last sentence of the review, we find that the author was discussing electronic computers and not a balance for weighing articles for trade.

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### Architecture

A summary of IBM's Project Stretch in *Computer* (November 1999, page 36) mentions that the term *system architecture* was introduced in the context of that project. My purpose here is to add a recollection concerning the genesis of that term.

I joined the Machine Organization department of IBM's research establishment in November 1958, having previously worked on the following projects: Univac I, Serial No. 2, as project officer; an IBM 702 as Ford Motor Company's in-house technical consultant; and Univac II as Sperry Rand's programming manager for sort-merge generator, input-output-rerun generator, and various operator/debugger aids. At the time, of course, computer models were expected to look diverse to users; my new assignment was to digest information on interesting hardware and possibly edge closer to an understanding of how divergent designs might be rated on a user's "bang-for-the-buck" scale. IBM's Stretch supercomputer, then under development, clearly deserved attention. A programmer's manual existed, a surprising volume of technical reports had been written, and I attended divisional training sessions that designer Frederick P. Brooks, Jr., and others were conducting.

At length I drafted a report of about 30 pages that attempted to present the behavioral features of Stretch's richly endowed design. The introduction said my description was subordinating the detail of circuit and logic design and dealing with system "architectonics." The term seemed overwrought in typed form, and I changed it at once to "architecture," which was more familiar and expressed my meaning more

directly. As luck would have it, Brooks transferred to our department and agreed to read the improved document before publication. His review found no significant problems, to my relief, and the report was distributed as IBM-confidential research communication RC-160, "A Description of Stretch," 10 November 1959.

I was shunted to other work soon thereafter, and as far as I know, the term *architecture* languished until Brooks gave it wings.[5] In this acclaimed book by members of Project Stretch, only Brooks's Chapter 2 relies on the word *architecture.* But by 1962, the word was gaining currency in the System/360 development division, presumably at Brooks's behest.

One could speak of computer architecture (defined at the time as "what the programmer needs to know"), of architects, and of the architecture department. All in all, this was a striking improvement over the clumsy phrase *machine organization.* Interestingly, by holding the architecture constant in the IBM System/360, Brooks gave sales people their first convincing basis for evaluating computer models.

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[*Editor's Note: In the above-mentioned chapter, Brooks actually defined the term* architecture *as more than machine organization, putting emphasis on the user. He wrote: "Computer architecture, like other architecture, is the art of determining the needs of the user of a structure and then designing to meet those needs as effectively as possible within economic and technological constraints. Architecture must include engineering considerations, so that design will be economical and feasible; but the emphasis in architecture is upon the needs of the user, whereas in engineering the emphasis is upon the needs of the fabricator."*]

### References

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