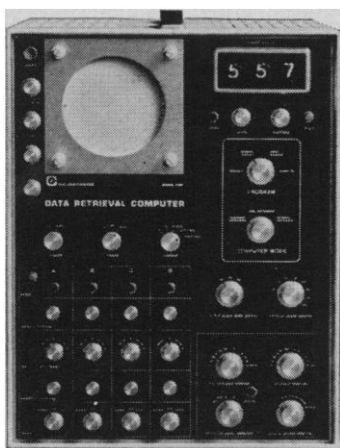


What price signal averaging?

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Will you pay for less than total versatility? You will in any averager that doesn't have the built-in capability—without add-on options—for interval- and time-histogram analysis, as well as transient-averaging. The DRC will operate in *any* of these three modes, which are selected on a front-panel switch.

Will you pay for less than maximum input sensitivity? You will in an averager that needs a pre-amplifier to accept low-amplitude input signals. The DRC has 20-millivolt input sensitivity. So, most of the time, the DRC requires *no* added pre-amps.

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varied, complex, rich. It remains only to answer the objections posed by many skeptics.

Objection 1. Only natural phenomena breed sciences, but computers are artificial, hence are whatever they are made to be, hence obey no invariable laws, hence cannot be described and explained. **Answer.** 1. The objection is patently false, since computers and computer programs are being described and explained daily. 2. The objection would equally rule out of science large portions of organic chemistry (substitute "silicones" for "computers"), physics (substitute "superconductivity" for "computers"), and even zoology (substitute "hybrid corn" for "computers"). The objection would certainly rule out mathematics, but in any event its status as a natural science is idiosyncratic.

Objection 2. The term "computer" is not well defined, and its meaning will change with new developments, hence computer science does not have a well-defined subject matter. **Answer.** The phenomena of all sciences change over time; the process of understanding assures that this will be the case. Astronomy did not originally include the study of interstellar gases; physics did not include radioactivity; psychology did not include the study of animal behavior. Mathematics was once defined as the "science of quantity."

Objection 3. Computer science is the study of algorithms (or programs), not computers. **Answer.** 1. Showing deeper insight than they are sometimes credited with, the founders of the chief professional organization for computer science named it the Association for Computing Machinery. 2. In the definition, "computers" means "living computers"—the hardware, their programs or algorithms, and all that goes with them. Computer science is the study of the phenomena surrounding computers. "Computers plus algorithms," "living computers," or simply "computers" all come to the same thing—the same phenomena.

Objection 4. Computers, like thermometers, are instruments, not phenomena. Instruments lead away to their user sciences; the behaviors of instruments are subsumed as special topics in other sciences (not always the user sciences—electron microscopy belongs to physics, not biology). **Answer.** The computer is such a novel and complex instrument that its behavior is subsumed under no other science; its study does not lead away to user sci-

ences, but to further study of computers. Hence, the computer is not just an instrument but a phenomenon as well, requiring description and explanation.

Objection 5. Computer science is a branch of electronics (or mathematics, psychology, and so forth). **Answer.** To study computers, one may need to study some or all of these. Phenomena define the focus of a science, not its boundaries. Many of the phenomena of computers are also phenomena of some other science. The existence of biochemistry denies neither the existence of biology nor of chemistry. But all of the phenomena of computers are not subsumed under any one existing science.

Objection 6. Computers belong to engineering, not science. **Answer.** They belong to both, like electricity (physics and electrical engineering) or plants (botany and agriculture). Time will tell what professional specialization is desirable between analysis and synthesis, and between the pure study of computers and their application.

Computer scientists will often join hands with colleagues from other disciplines in common endeavor. Mostly, computer scientists will study living computers with the same passion that others have studied plants, stars, glaciers, dyestuffs, and magnetism; and with the same confidence that intelligent, persistent curiosity will yield interesting and perhaps useful knowledge.

ALLEN NEWELL

ALAN J. PERLIS

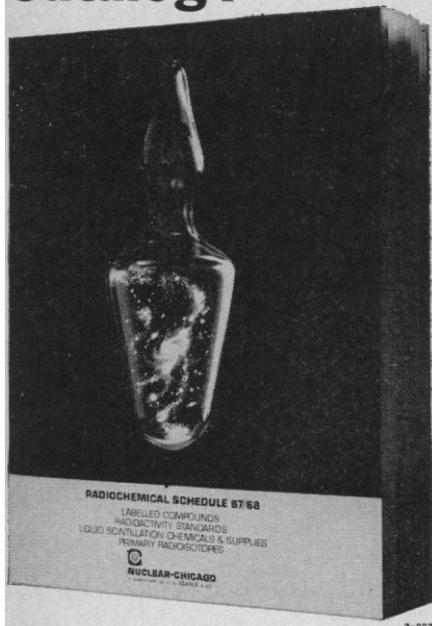
HERBERT A. SIMON

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"The Big Trouble with Scientific Writing . . ."

When I see articles, as I frequently do these days, exhorting authors to greater simplicity and clarity (*1*), I think of the first little scientific note I wrote, when I was an idealistic graduate student. I wrote it as simply and directly as I could. It began, "The big trouble with diffusion cloud chambers is low radiation resistance," and it went on in the same vein. My co-workers thought it needed a little more work. Secretly I did not agree, so I decided to attempt to make it into a parody of

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scientific writing. I borrowed impressive but empty phrases from *The Review of Scientific Instruments*. Each sentence and each idea was made unnecessarily complicated, without being too obvious about it. The result began, "The principal difficulty encountered in the operation of an ordinary high-pressure hydrogen cloud chamber is inferior radiation resistance." I failed in my attempt, for now everyone thought it read fine, and it appeared in its complicated form in *The Review* (2).

My point is not that scientific writing cannot be parodied, but rather that scientific writing is the way it is because its readers actually prefer it that way. People's actions do not always correspond to their words. Everyone is against sin and bad writing, unless given a free choice.

ROBERT H. GOOD

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State College, Hayward 94542

Reference

1. J. P. Woodruff, *Science* **156**, 743 (1967);
Letters, *ibid.* **157**, 6 (1967).
2. R. H. Good, *Rev. Sci. Instr.* **28**, 472 (1957).

Role of Intuition

In much recent writing about science and scientific discovery a strong distinction is purported to exist between intuition and ostensive logical argument. Some authors attribute to intuition a special quality giving its results a status almost as though *ex cathedra*. In their view, intuition is such that scientific advance is made only on intuitive process while the exercise of intelligence and logic are pedestrian activities of which the result is merely a confirmation of that which was in the first instance accessible only to intuition.

Wilder's article, "The role of intuition" (5 May, p. 605), establishes a more reasonable perspective. His argument that "mathematical intuition, like intelligence, is a psychological quality which stems possibly from a hereditarily derived faculty, but which is, at any given time, principally an accumulation of attitudes derived from one's mathematical experience," supports a view that intuition is logical process unobserved.

In brief, intuition is an act of the mind, in nonverbal apprehension of significant relation. The quality of such acts is a function of the quality of

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