

## Science & Technology

### CONNECTED KNOWLEDGE: *Science, Philosophy, and Education.*

By Alan Cromer. Oxford University Press. 221 pp. \$25

If heeded, this book could do more to improve science instruction, and American education in general, than a hundred educational summits. In a little more than 200 pages, Cromer, a professor of physics at Northeastern University, surveys human prehistory, the history of education, the meaning of “intelligence,” and the philosophy of science—all as prelude to proposals for serious pedagogical reform.

Cromer’s thesis is that learning is shaped by certain biocultural realities which are ignored by current educational theory and practice.

“Most educational reformers accept, at some level, the Rousseauian belief in an ideal natural state in which human beings were once freer and less constrained than they are in organized society,” he writes. “This has led to repeated attempts at progressive, naturalistic, and holistic education, all of which inevitably failed. There never was a time when human beings didn’t live in hierarchical groups, and reading, writing, science, and mathematics aren’t natural.”

Cromer’s particular focus is the educational philosophy of “constructivism.” Based on “the remarkable influence” of Thomas Kuhn’s *Structure of Scientific Revolutions* (1962), constructivism exaggerates the extent to which scientific knowledge is tentative, socially constructed, and subject to radical revision. Arguing that constructivism is “deeply embedded in many educational institutions in the United States,” Cromer quotes a 1991 document from the National Academy of Sciences in which educators were urged to adopt national standards reflecting “the postmodern view of science,” which “questions the objectivity of observations and the truth of scientific knowledge.” The language was modified after “protest from the scientific community,” but constructivist methods still pervade classrooms.

For instance, it is now common for science teachers to ask students to “construct” an explanation for buoyancy by fooling around with a tank of water and various floating and

sinking objects. Yet Archimedes’ principle—that a body immersed in a fluid is buoyed up by a force equal to the weight of the fluid it displaces—is not so easily rediscovered. Difficult nonintuitive concepts such as density must be grasped beforehand if the exercise is not to end in futility. Tellingly, Cromer cites a National Science Foundation study in which 24 middle-school teachers were themselves taught by both constructivist and traditional methods. When asked to compare the two, they showed a marked preference for the latter. As one commented, the experience “made me reevaluate my own use of inquiry-based teaching. I am going to change to much more content with a little constructivism thrown in.”

Cromer paints a depressingly familiar scenario: cognitively gifted students manage to learn despite misguided teaching, while the majority learn little, and those most in need of skilled instruction learn nothing. He does not need to prove the case; the data, including the declining test scores of American stu-

dents, are plain to see. But he does not stop where most experts do, wringing his hands and demanding more spending, a PC on every desk, and a chicken in every pot. He makes concrete proposals for a concept-ordered curriculum. He recommends specific textbooks, such as Seymour Rosen’s inexpensive and concise middle-school science texts, and urges that students be allowed to keep them. He shows why specific tests, such as the General Educational Development (GED), should be the universal minimal standard and why the animus against “teaching the test” is misplaced. He musters evidence that his concrete proposals work, even in unpromising venues such as prisons. And he argues that their implementation would cost no more, and probably less, than preserving the status quo.

Cromer’s approach differs sharply from the nostrums of both the cultural Left (self-esteem) and the cultural Right (family values). His book has no politics. It merely explains what is *known* about learning and what can be done, here and now, to revitalize the West’s great experiment in public education.

—Paul R. Gross

