Letters

"Polywater" Is Hard To Swallow

Proponents of polywater in the pages of *Science* and elsewhere may be interested to learn why some of us find their product hard to swallow. One reason is that we are skeptical about the contents of a container whose label bears a novel name but no clear description of the contents. Another is that we are suspicious of the nature of an allegedly pure liquid that can be prepared only by certain persons in such a strange way. We choke on the explanation that glass can catalyze water into a more stable phase. Water and silica have been in intimate contact in vast amounts for millions of years; if a more stable kind of water were possible, it is hard to understand why any ordinary water should be left.

There is another and, I think, much more plausible role for the necessary glass. Water and silica interact in wonderful variety, as may be read in a fascinating book by Ralph K. Iler, *The Colloid Chemistry of Silica and Silicates* (Cornell University Press, Ithaca, N.Y., 1955). It is easy to see why a spectroscopist might be excited by the term "polywater" to try to design new ways for water to polymerize which nature had overlooked, but I think that a chemist who feels curious about what is in those glass capillaries would have more success if he assumes that he is dealing with a system of two components.

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Panic in the Marketplace

One of the most disturbing aspects of the current brouhaha over food additives and pesticides is the steady erosion in the credibility of the Food and Drug Administration. The current view of the general populace is that the FDA is an irascible, irresponsible, and dictatorial giant who periodically decides to remove certain items from the marketplace. Witness the rush to purchase cyclamates, and the unprecedented increases in sales of DDT. Very likely a similar rush to buy 2,4-D and 2,4,5-T will occur if present plans to phase out these materials are implemented.

Common sense quite obviously tells the ordinary citizen as well as the biological scientist that injecting astronomically high doses into animal organs does not provide reliable data on the effects of small amounts of a chemical consumed in an ordinary way and passed through the digestive system. The real danger that we face is that one of these days the FDA may indeed find a toxic substance. Will its announcement trigger a rush of buyers to accumulate supplies of this material also?

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CAI: Technological Misconceptions

The PLATO system is indisputably a signal achievement in the hardware development of computer-assisted instruction, allowing many impressive instructional intuitions to be explored. It is unfortunate and ironic that Alpert and Bitzer in pinpointing some misconceptions about CAI are in danger of perpetuating others ("Advances in computer-based education," 20 Mar., p. 1582). Here are four:

Misconception 1. Simply mentioning that learning strategy research exists means that solid, empirical data are available. Researchers in CAI concluded that this extremely important topic was in great need of sound theoretical and experimental development (*1*).

Misconception 2. A system consists of only the hardware and software for CAI. Although Alpert and Bitzer focus on the marvels of the hardware and the software's easy accomplishment of any teaching problems, giving documentation and illustrations, they neglect to discuss or document solid learning strategies. The PLATO approach apparently ignores the fact that "CAI" is only a technological label for valid operating instructional processes or models. The latter seem to be taken for granted, rather than to be viewed as the primary and fundamental problem whose continuing solution must progressively guide hardware and software design (*2*).

The computer per se offers the feasibility of vast and refined data analysis and unprecedented control and feedback potential. It does not *automatically* supply the valid algorithms linking instructional data input to output, nor guarantee any sensible decision rules for mapping input into output. These technological developments must be evolved systematically.

The authors state: "In the absence of a fully developed educational model or a widely accepted evaluative procedure, even for conventional educational methods, it is not possible from such relatively small samples [the authors' limited research study] to derive broad generalizations." Despite this, they conclude that "computer-based education is a plausible approach to improve individualized instruction. . . ." What is the true value of a *plausible* statement?

Misconception 3. Ignoring economics evaluations means that they do not exist. The authors' own figures concerning the economics of CAI overlook information in the published literature (*3, 4*). The study cited in addition to their own, the Booz-Allen economics analysis (*5*), based on the assumption of equivalence between CAI and production of text materials, ignores the difference between the costs of a total technology and the cost of a single portion of an educational system, the textbook. Alpert and Bitzer also seem to play down the development costs of authoring, particularly in Bitzer-Skaperdas (*6*) where author's costs seem to be identified only as royalties.

The discussion confuses developmental and operational economics. While operational costs for the PLATO III system are mentioned, this is a developmental item being put into operat*ing* use and cannot be used to estimate opera*tional* costs of the fully developed system with mass-produced components. Also, the costs of instructional material and the time needed to generate it are not agreed upon by people whose experiences derive from projects with different conceptual approaches.

Misconception 4. "If there has been informed skepticism or concern about *the potentiality of computer-assisted instruction, it has largely been addressed to the issue of economics."* The authors cite Oettinger's *Run, Computer, Run* as support for their statement. But is Oettinger informed only when he is skeptical about the economics of CAI? To quote Oettinger further: "The basic needs . . . common to most enterprises [are] better ideas, better people, and more money. . . . Every attempt to introduce technological change into education has revealed [that] we know precious little about the psychology of learning, and what we know is more relevant to the laboratory than to the classroom" (*7*). We wholeheartedly share his concern and skepticism, especially with respect to the helter-skelter attempts to incorporate the computer in a conventional educational environment without defining a cohesive instructional model for the individual (*8, 9, 10*).

Is the plasma display panel the key to an expensive student console? For the large quantity price of $1800 per console or terminal, existing engineering technology can provide a TV quality image with color and 3-D, speech recognition and speech output, plus a light pen for identifying any aspect of the display. This terminal could store all text centrally, rather than in each student's console, providing distributed costs for centrally located terminal capabilities, facile updating, flexibility in operation, and in "library" management.

Alpert and Bitzer's opening assertion that CAI is a "medium of instruction is later followed by "the introduction of the major new technology into the educational process. . . ." The latter properly negates their characterization of CAI and stands as a direct contradiction. Resolving this inconsistency would alleviate some of the remaining misconceptions.

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References and Notes

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We believe Seidel *et al.* present little evidence to substantiate the "four misconceptions" which they list as a consequence of reading our article. For example, they assert that in our paper "valid instructional processes or models . . . seem to be taken for granted, rather than . . . viewed as the primary and fundamental problem whose continuing solution must progressively guide hardware and software design." This conclusion is antithetical to our approach. If there is a feature which uniquely characterizes the PLATO program, it is that the designs of hardware and technological software are defined by the educational objectives rather than by the availability of existing commercial technology. With this in mind, the PLATO system was designed for maximum adaptability, not only to accommodate teaching strategies, formulated in accordance with a variety of educational theories, but also to encourage research and development leading to the systematic establishment of valid educational models.

Further, Seidel *et al.* assert that we have ignored the economic evaluation of CAI by other agencies, in particular the economic evaluation of lesson preparation. This is immediately contradicted by their citing our reference to the study of the Committee for Economic Development (*1*), a study which did not include the PLATO system in its analysis of the economics of computer-assisted instruction. We stated that the cost of lesson material preparation using the PLATO III system is much lower (by at least a factor of 10) than for the systems evaluated by the CED. Our data cover the preparation of almost 1000 hours of completed lesson material in a wide variety of subjects. Assuming the economic validity of both analyses, and we see no reason to question either, a logical conclusion is that the PLATO III system is far more flexible and more economical than others in the preparation of lesson materials.

After several other criticisms, the authors proceed to the following assertion: "For the large quantity price of $1800 per console or terminal, existing engineering technology can provide a TV quality image with color and 3-D, speech recognition and speech output . . . [and] could store all text centrally. . . ." This unsupported statement which implies that new technology is not needed to make CAI economically feasible is, in itself, a technological misconception. This particular misconception has, in the past, limited rather than encouraged the development of computer-based education.

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Reference

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U.S. Radio Astronomy in Decline

American astronomers and physicists recently attended an inaugural symposium in Groningen, Netherlands, for the Westerbork Synthesis Radio Telescope, a major new facility for research in radio astronomy. In a few months another major facility, the 100-meter telescope near Bonn, Germany, will begin operation.

Radio astronomy in the United States was almost nonexistent in the decade following World War II, but in the late 1950's and early 1960's it moved rapidly to the forefront after the completion of several powerful instruments. However, it is inevitable that radio astronomy in our country will deteriorate again since no new instrumental facilities are presently under construction. Our instruments of the 1950's cannot compete with the new ones now coming into use in other countries. A number of ambitious American proposals for new instruments have been made in the past decade, but none has been funded.

The strength of the American economy and our leading position in the world are based upon excellence in technological and scientific disciplines. Radio astronomy is one of the most exciting and rapidly developing fields of science and one which demands—and contributes to—the most advanced technology. We urge that the present stalemate on radio astronomy facilities be broken and that construction of some of the proposed instruments be undertaken. This is necessary if the United States is again to play an important role in this field.

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Marital Success of Scientists

Robert Graves's comments on scientists' wives ("The human toll of science," 3 Apr., p. 96) are unfair to scientists and, I think, statistically unsound. As a scientist's wife, I know many more cases of satisfactory marriages among our colleagues than unsatisfactory or broken ones. Of these, half a dozen have celebrated their golden anniversaries and a great many have passed 20 years of marriage. We talk of the broken marriages, thus publicizing them out of proportion to their numbers.

Graves says that scientists "cannot communicate with their wives about their work in the way open to most husbands." There he pinpoints the problem in most unsatisfactory marriages: lack of communication. A scientist is no more to blame than is a poet or historian who doesn't talk to his wife.

Successful wives of scientists have made one of several choices: they have studied some science before or during marriage, or through conversation they have acquired a superficial knowledge of the field in which the husband works, or they have held up the social and stimulating side of the partnership, or they have developed an interest of their own in which they can communicate. Most scientists marry college-educated women. Science is a major part of daily life, and no woman—or poet—has a right to consider that scientists "live in an exclusive world in which things are viewed in a strange and different way."

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