little support for his estimates that "we are only a year or two away from highly effective, fully operational systems."

We would estimate that cost-feasible computer-managed instruction for general use is millions of dollars and hundreds of man years away under the most optimally arranged conditions. These figures could easily run to billions of dollars and thousands of man years under poorly arranged conditions. While the cost-utility ratio for developing and operating systems in which the computer is used to provide management information rather than full machine control is as favorable in education as in other computer applications, the development time and effort is still considerable.

We have found the problem areas Brudner whisks over lightly to be far from trivial. CMI technology requires the following capability: (i) stating instructional outcomes in observable terms; (ii) constructing criterion-referenced tests reflecting the outcomes; (iii) identifying and preparing instructional exercises referenced to the outcomes, or both; (iv) devising manageable logistical procedures for administering the tests under existing school conditions; (v) producing computer programs to perform the scoring, analysis, reporting, and file maintenance of the criterion-referenced tests; (vi) preparing "prescriptive" suggestions to the teacher, contingent upon designated levels of student performance with respect to each outcome; and (vii) developing training for teaching and administrative personnel to insure competent use of the system.

This technological capacity is currently available in at least a primitive form, but persons and organizations with competence to implement it are still few in number. Unless one is the kind of person who has purchased his ticket for a vacation on the moon, he would do well to hold his order for a computer-managed instruction system.

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Carbon Monoxide Controls

There is an arithmetic error in Goldsmith's and Landaw's article "Carbon monoxide and human health" (20 Dec., p. 1352). The authors state "Since motor vehicle use is expected to increase by 70 percent by 1980, even 70-percent control [of exhaust emission] —the goal of the existing program— would not produce an improvement over the present situation even if that goal were attained." An equivalent arithmetic statement would be $(1 + .7)(1 - .7) = 1$. Neither statement, of course, is correct. Under the conditions given, automobile carbon monoxide production in 1980 would be 51 percent of present levels—a significant lowering and a worthy interim goal.

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Hege is quite right. My face is appropriately cherry red. We intended to emphasize that control systems installed in new cars decline in effectiveness with use. This decline, along with an increase in the number of motor vehicles, could neutralize a control system which only applied to new cars.

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Inexorable Pollution

I would like to think that Katz in his letter, "Automobile engines: Pollution and power" (13 Dec.), was being ironic, but my impression was that he was quite serious. As a suffering resident of the Los Angeles basin I would hope for a better statement than "Therefore I doubt whether there is a truly practical solution to the pollution problem without inordinate costs to the car operator."

If this opinion is to be followed to its logical conclusion there is no solution to the problem except to allow pollution to rise to such a level that one-half of the car operators succumb to the effects of their free use of the highways. Then, with the number of automobiles reduced to the pre-smog level, air pollution will once again become insignificant until, of course, the car operators reproduce and the population increases again. Any discussion of pollution that admits defeat because of the unwillingness of the discussant to infringe upon the "freedom" of others is not only unrealistic, it is mad. . . .

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Regrets to Reprint Requests

The "reprint problem" has led to previous letters (17 Feb. 1967, 12 May 1967, 8 Sept. 1967, and 15 Mar. 1968) stimulated by the editorial of 7 Oct. 1966 which did not deal with the unanticipated impact of information services on reprint demand, but was concerned with the newer ways to deal with the "information explosion." The experience of Clark (17 Feb. 1967) is highly relevant because she reported objective evidence that at least two-thirds of the requests for reprints came from individuals who had not read her article but had seen the title listed by an information service. My own experience suggests that the information services plus the increase in the number of scientists who are crossing disciplinary boundaries has led to a reprint and "preprint" explosion that is self-defeating. For years I have refused to deal in mailing lists or to send out copies of preprints to a mailing list. Also I have sent out a postcard with "regrets" after our usual supply of 300 reprints was exhausted. Recently two of our papers in the *Journal of Molecular Biology* (1967) have resulted in some 1500 or more requests and we haven't been able to keep up with the regrets. After the initial flood of requests based on information services had depleted our supply, we began to receive requests from Europe and elsewhere which we were unable to fill.

Meanwhile I continue to receive reprints that I did not request and which I cannot begin to read. I have risked insulting my reprint donors by marking the envelopes "Return to Sender" but this is without effect in addition to being hazardous. My conclusions are simple: reprints should be paid for by the laboratory that requests them and not by the laboratory that generates them. I do not know what mechanism would be most efficient but somehow I feel that the problem is for publishers, not for scientists. My next publication will appear in *Cancer Research* in January and reprints will be very expensive. A footnote to the title will read, "We cannot undertake to supply reprints of this report." By the time this letter appears I should have some idea of how many people requested a reprint without reading the paper. To all of them I take this opportunity to offer my 'regrets' with the hope that some constructive suggestions will follow."

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