stage of the game I am completely open-minded concerning anything which may be encountered when we finally arrive on the surface of Mars. It is quite reasonable to expect that many of our sciences, interdisciplinary and otherwise, will bloom forth in an almost unprecedented manner after this momentous event.

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Questions and Answers

A recent editorial [*Science* **136**, 231 (20 Apr. 1962)] offers some almost irresistible questions.

1) (Are scientists unfeeling or passionate?) Of course they have their feelings in perfect balance. You will probably get letters declaring this in passionate terms.

2) (Are political and scientific freedom related?) Scientists see red whenever freedom is mentioned, any kind. But don't let public opinion polls be used to demonstrate truth. Cupidity, curiosity, and/or love of power are more common than debates over freedom, in and out of science.

3) (What do laymen do when scientists disagree?) They decide. They have to. It occurs daily. Politicians disagree, so laymen select presidents. Doctors disagree, so laymen choose the path to follow. Scientists disagree, and laymen put their bets on one or the other. Players disagree, and a layman, the umpire, decides. Lawyers disagree, and jurists and juries declare answers.

4) (What is different about what a scientist does?) Not a thing, except that he polishes the brass "SCIENTIST" on his door before going to work. The idea that a scientist is something apart, or something to which to aspire, is a carefully nurtured illusion.

5) (Are scientists unusually moral?) Faking experiments is rare, but the facts around us cannot be faked. The test tube never lies; the experiment is never wrong. Errors arise occasionally in observations but commonly in interpretations and deductions. Except for a degree of wariness or special familiarity with his subject, the scientist is no better than anyone else in moral outlook. In effect, he may well be worse, because of the well-fostered notion that he is faultless, or that objective attitudes lead always to truths.

Whether scientists are the ones to decide about scientists might be debated. On the whole, perhaps this form of gossip should be discouraged, if only because discovery of the truth might injure their status as recipients of hero worship.

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Programmed Instruction and the Arts

With reference to the editorial "But you have premises to keep" [*Science* **136**, 837 (1962)], while the objections to the technique of programming evident in *Poetry 230* are well taken, it does not necessarily follow that the type of subject matter treated in this text is inherently unsuited for programming.

The editorial did not make clear to me whether its author considered poetry in general, or Frost's short poem in particular, unsuitable. However, the main question appears to me to be: What does one want from an analysis of a work of art (literary, musical, or other)? It seems to me that no analysis —whether by text, college professor, or teaching "machine"—can make a student like, or even appreciate, art. What can be done—and perhaps the only thing that can be done—is to instill in him an understanding of the ideas of the artist and of the materials and techniques which the artist uses in his attempt to communicate these ideas. Clearly, if a sensitive student can understand and appreciate Frost on first reading, then for him it makes no difference how a supplementary analysis is presented, for he will be able to see these techniques in the light of feelings which the poem has already evoked in him.

For the student who cannot appreciate a particular work of art, it is necessary to prepare a background and an analysis. While all that may be necessary to comprehend a Frost poem is careful rereading, there is a wealth of fairly subtle constructive techniques employed in each one. To direct the student's attention to these, and to get him into the habit of looking for such techniques, may be just the stimulus needed to evoke genuine interest and appreciation.

We are, therefore, led to ask: Can a well-programmed text help the student to acquire the sensitivity and background necessary for the development of appreciation? To this I think the answer is yes. In fact, I should think the programming techniques come as close as possible to a serious classroom discussion headed by an inspired professor. Unlike a textbook, a good program demands that the student be continuously thinking and applying what he has learned to new situations. I have noticed that many students whom I have tested on various programs show a marked increase in reading sensitivity. The good programs capture a certain acuteness and sense of discovery which are extremely important factors in learning to appreciate poetry, music, and literature.

Programmed learning is a relatively new technique, one that, unfortunately, has been used by many who have failed to master it. In particular, its application to the arts has been, so far, rather clumsy. Eventually some sensitive artist, musician, or poet with a gift for writing will come along and show us how it *should* be done. Just as programming in the hands of some mathematicians has taken much of the boredom from math and replaced it with insight and excitement, so may programming yet serve the other branches of the arts and sciences.

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The most inexperienced programmers realize the danger of analyzing a single frame (item) out of sequence and context. Yet the writer of the editorial "But you have premises to keep" attempts to do exactly this, selecting the following frame for his excursion into literary criticism: "Even Frost would probably not have forced so much rhyme on himself if he had planned a long poem. Since he doubtless had a hunch that this was to be a _____ rather than a long poem, he decided to increase the difficulties of his rhyme game still more."

The primary objection given is that "the basis for a hint is supposed to be something more than the redundancy of a sentence made redundant for no other purpose."

The only redundant portion of this frame is the phrase "rather than a long." The purpose of this phrase, as any programmer will recognize, is to provide a thematic prompt (by introducing contrast) for the correct response, "short." A rereading of the article