of PHYSICS TODAY, which is devoted to grade-school education of children in science, Robert Karplus has pointed out that when a student has reached the age of 15 it is too late to try to interest him or her in science. 2) The information of the public, too long neglected, can be brought about through many channels: adult education, the news media, science museums, and so on. (It is worth noting that New York has not had a true museum for the physical sciences for more than thirty years. On the other hand, there are two excellent new science museums at the West Coast: The Lawrence Hall of Science in Berkeley, and the Exploratorium, under the imaginative directorship of Frank Oppenheimer in San Francisco.) In particular the daily press could contribute a great deal in this respect by dispensing not only science news, but by presenting results that are well established, in attractive, easily digested articles, for instance, in daily columns, possibly in serial form. Such a column could report on the discovery and the properties of x rays (possibly starting out from a novel use of x rays), or on some phase of astronomy, on conversion of energy, and so on. The use of a moderate amount of mathematics in such articles could be made possible by exposing the readers occasionally to mathematical and scientific puzzles, in addition to verbal puzzles such as the ubiquitous crossword puzzle. This might prevent the receivers of high-school certificates to allow their generally quite appreciable knowledge of mathematics to atrophy within a short time, instead of making constructive use of it. Thus, slowly, the general public could learn to understand the beauty and power of science.

Some excellent recent examples of how to present past scientific developments in a dramatic and entertaining form are: *Worlds Within Worlds: The Story of Nuclear Energy* by Isaac Asimov, Volumes 1–3, published by the AEC (1972) and *Einstein—Creator and Rebel* by Banesh Hoffman, Viking, New York (1972).

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Superconductors again

I disagree with William Little's argument about not developing high-T_c superconductors (November, 1972, page 13). The real economical limit of refrigeration is not from the consumption of hydrogen or helium but from the second law of thermodynamics. The limit of T_c to high-temperature superconductors is not that well established. Empirically we have the limit set by B. T. Matthias and coworkers, who have searched thousands of superconducting alloys. Theoretically we have the rule of W. L. McMillan, who set the phonon limit of T_c for all superconductors. It appears that breaking the limits set by McMillan and Matthias is still easier than building a perpetual-motion machine.

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THE AUTHOR COMMENTS: The most efficient cryogenic refrigerators available today for superconductor cooling have an efficiency between 10% and 20% of Carnot efficiency. Machines under development may raise this figure 30% for large-capacity systems. An improvement by a factor of at least three in this efficiency is possible, in principle, before one runs into the limit set by the second law. On the other hand, to obtain a similar improvement in system efficiency by the development of high-temperature superconductors would require values of T_c about a factor of three higher than those available today. I contend that the probability that a conventional phonon superconductor will be found with anything like this value of T_c is identically zero and, hence, refrigerator research is much more likely to yield an improvement in overall system efficiency than such superconductor research. Shen's letter appears to miss the point that existing refrigerators are so inefficient relative to the Carnot limit.

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Remedy for fear of physics

I am very disheartened when I hear of decreasing enrollments of liberal-arts students in the physics and astronomy courses. Four years ago, I began to investigate the problem and have come to interesting conclusions. I have implemented these thoughts, and, I believe, not in vain, since my modern-physics/astronomy course has increased in enrollment from 45 to 200.

What I essentially discovered was that liberal-arts students are intrinsically interested in physics and astronomy, but they are terribly afraid of not understanding it, especially when it comes to dealing with mathematics. Thus the main task is to make students comfortable and feel that some of the physics and astronomy phenomena are indeed very much in line with their own way of thinking and philosophy. Introducing mathematics as a mere tool and letting the students