AAPT PHYSICS EDUCATION | AMERICAN JOURNAL of PHYSICS

Computers mean more physics, less math, in classroom

W. P. Lonc

Citation: American Journal of Physics **58**, 1128 (1990); doi: 10.1119/1.16241
View online: http://dx.doi.org/10.1119/1.16241
View Table of Contents: http://scitation.aip.org/content/aapt/journal/ajp/58/12?ver=pdfcov
Published by the American Association of Physics Teachers

tegrating these data without contradiction into the sum of one's knowledge.[2] The method of religion is revelation: "knowledge" gained directly from God or intuition, i.e., by some nonsensory, nonspecifiable, unprovable means. To quote philosopher Ayn Rand, "Rationality is the recognition of the fact that existence exists, that nothing can alter the truth and nothing can take precedence over the act of perceiving it, which is thinking—that the mind is one's only judge of values and one's only guide to action—that reason is an absolute that permits no compromise—that a concession to the irrational invalidates one's consciousness and turns it from the task of perceiving to the task of faking reality—that the alleged short-cut to knowledge, which is faith is only a short circuit destroying the mind—that the acceptance of a mystical invention is a wish for the annihilation of existence and, properly, annihilates one's consciousness."[3]

In answer to why it is beneficial to have religious figures preach the conclusions of some scientists, Dr. Sagan states, "The historical record makes clear...religious teaching, example, and leadership are powerfully able to influence personal conduct and commitment." That's certainly true; religion is able to influence people. But the important question is: influence them in what way? If a religious figure cites the evidence and uses rational arguments he is not arguing as a religious figure. The only use such a figure could have is to lend some nonrational, mystical weight to the argument, thereby inducing his followers to accept the conclusions on faith. Dr. Sagan may argue, however, that he merely wants religious leaders to stress that proenvironmentalism is the "good." But he neglects to note that the standard of good and evil for any religion qua religion is nonrational and mystical in nature. Thus *any* appeal to religion is an appeal to mysticism and faith.

On this basis the author is, in effect, trying to deal with people by faith and assertion rather than by reason and proof. He is speaking in the name of reason and science to encourage people to follow faith and revelation. The author intentionally or inadvertently is using the prestige of science to destroy science by undermining its basis: reason. I don't known which is worse: that the author believes that faith and revelation are acceptable means of knowledge ("Efforts to safeguard the environment need to be infused with a vision of the sacred"), or the pragmatic view that they are acceptable ways of dealing with others ("We understand that what is regarded [by others] as sacred is more likely to be treated with care and respect"). If the author succeeds in having mankind throw out reason, science will revert to what it was when, in Dr. Sagan's words, "...our technology was feeble [and] we were powerless to influence the environment of our world"—namely magic.

Frank Loreti
Department of Physics
University of Wisconsin—Madison
Madison, WI 53706
4 August 1990

[1]Carl Sagan, "Guest Comment: Preserving and cherishing the Earth—An appeal for joint commitment in science and religion," Am. J. Phys. **58**, 615–617 (1990).
[2]For a full discussion of what constitutes using reason, see Ayn Rand, *Introduction to Objectivist Epistemology* (Penguin, New York, 1979); see also Leonard Peikoff, *Objectivism: The Philosophy of Ayn Rand* (Penguin, New York, to be published, Fall 1991), Chaps. 3–5.
[3]Ayn Rand, *For the New Intellectual* (Penguin, New York, 1961), p. 128.

COMPUTERS MEAN MORE PHYSICS, LESS MATH, IN CLASSROOM

The prospect of a rather drastic change in physics education appears to be developing as a consequence of computers in the classroom, in the lab, etc. The drastic change involves more than simply increased "number-crunching" power—it has to do with the prospect of symbolic manipulative power accessible from a keyboard. It could mean that there would be much less time spent by the physics instructor guiding the student through a solution to an algebraic expression, or even through a solution to a differential or integral equation. The freed-up time could then be spent actually doing physics, such as modeling the problem and obtaining the solutions, either in numerical or symbolic form, from appropriate software.

This prospect was brought home to more than a few of the people at the recent Summer Meeting of the AAPT in Minneapolis. Several workshops and a number of papers dealt with using computers to perform symbolic operations as well as to run simulations of various physical situations. For example, there was a graphical display of the **B** field along the rotational axis of the classical Helmholtz pair of coils. The software calculated the field at various points along the axis and produced a three-dimensional "wire-frame" plot. It was then very easy to see which spacing between coils produced the classical optimum region of homogeneity at the center of the coil pair. Needless to say, producing a similar graphical display by hand calculations, even on a calculator, would have been very time consuming.

And if this demonstration was not already strongly impacting the viewers, a nearby demonstration of a symbolic-manipulator package (MATHEMATICA, in this case), surely suggested the unthinkable—teaching physics without at the same time teaching mathematics!

In fact, watching these demonstrations suddenly made the viewer conscious of the large amount of time spent in a typical physics course on doing mathematics rather than physics. One needs only to reflect on the class time spent doing derivations or finding solutions to differential equations. Hence, the situation at the present time seems to be quite analogous to the situation when calculators first became easily available; time formerly spent on doing additions and subtractions by hand and multiplications, etc. on a slide rule was then available to do more physics. And now, in our own days, the symbolic manipulators can be seen as freeing up even more time. This additional time can then be used to concentrate even more on the physics. For example, more time would be available setting up a symbolic expression to model the physical problem, and deciding on boundary conditions on the basis of physics, leaving it to the symbolic manipulator to obtain a solution.

One could imagine that even a factor of 2 reduction in the time spent doing mathematics could have a significant effect on the amount and kind of physics that could then be done. These are surely great days!

W. P. Lonc
Physics Department
Saint Mary's University
Halifax, Nova Scotia B3H 3C3,
Canada
13 July 1990