▷ It is time limited.
▷ It is the only place in the Constitution where the word "right" occurs. Remarkably enough, this right was overlooked by Alexander Hamilton in his enumeration of Constitutional rights and has therefore perhaps been neglected ever since as a right of profound, general significance.

Article I, section 8(8), is also unique in that it is the only clause in the Constitution or in its amendments that directly encourages any branch of learning. And it represents a precocious appreciation of the importance of science to the useful arts, which today we take for granted.

The role of this trebly unique "right" in encouraging self-expression and as an incentive to economic development can be particularly gauged today in comparisons with contemporary systems that lack this right or have it in varied and often diminished forms. By providing the basis for various forms of intellectual property (patents, copyrights and trademarks), article I, section 8(8), laid the Constitutional basis for the creativity and viability of the American experiment, for its material and scientific progress, and for its military security. The results of its incentives now extend to the entire globe through trade and technology transfer, and in the last 200 years they have produced benefits to health and well-being without parallel in the history of man on this planet.

Nothing appeared in PHYSICS TODAY in the year of the bicentennial of the Constitution about the relationship between science and the Constitution except for one news story (November 1987, page 43) in which it was asserted that "the Constitution doesn't mention" science and technology! During the bicentennial year the distinguished patent attorney Tom Arnold, of Arnold, White and Durkee in Houston, Texas, and I urged the Bicentennial Commission to publicize the impact the Constitution has had on science and invention. The only effect we had was the incorporation in the registry of the commission of an abstract of a 2000-word paper by me titled "Science, Invention and the Constitution." I will be happy to send copies of the paper to interested parties.

LAWRENCE CRANBERG
1205 Constant Springs Drive
10/90 *Austin TX 78746*

In Science Education, What's Fair is Fairs

I was very interested in your September special issue on pre-college education. Though a wide variety of aids, tools and programs for teachers and students were described therein, one activity was not mentioned: the ever growing arena of student science, engineering and invention fairs held each year from grade school levels through to international competitions among high school students. As a product of the science fair system, I can say that it was highly motivating, challenging and rewarding. I chose science as a career based on those extracurricular science activities. The science fair process uses many of the instructional concepts described in the September issue: It offers hands-on experience, is self-paced, is available each year for refinement and advancement of projects, and affords a competitive opportunity for recognition and reward. It allows me, as a scientist today, to contribute to pre-college education without teaching by being a judge, encouraging students with good presentations and serving on science fair committees. Judging by the growth of fairs over the years, I believe they will continue to prosper and expand as scientists, technical corporations, teachers and the media discover the tool and educational outlet they offer.

G. L. DYBWAD
Sandia National Laboratories
10/91 *Albuquerque, New Mexico*

Greenhouse Effect Evidence Debated

I have just read in the July 1991 issue (page 82) Raphael Kazmann's response to readers' letters concerning his earlier letter on global warming (July 1990, page 13). The lack of detailed agreement among global circulation models, the dispute over the effects of different types of cloud, the disagreement among various local temperature indicators and so on are often used as fuel in arguments not to proceed with expensive programs to control the release of greenhouse gases. Kazmann states that "the world's people have already had enough trouble . . . without embarking on worldwide economic changes based on a hypothetical cause [increasing greenhouse gas concentrations] and effect [rising global temperature]."

While the presence of a correlation cannot be taken as proof of cause and effect, the practically one-to-one relationship between CO_2 concentration and atmospheric temperature during approximately the past 150 000 years[1] cannot be ignored. Whatever

continued on page 123

continued from page 15

the reason for the correlation, it is clear that high atmospheric CO_2 is accompanied by high global temperature. In fact, theory provides a ready explanation for this relationship—the greenhouse effect: Were it not for atmospheric CO_2, the mean temperature at the Earth's surface would be substantially below zero.

The conclusion is inescapable: If we increase the atmospheric CO_2 concentration, the temperature will rise. The exact form this warming will take at different locations is of course extremely hard to predict. For this very reason it is essential that we take swift and sweeping measures to drastically reduce our greenhouse gas emissions. As Edith Borie points out (July 1991, page 82), the side benefits of such a policy—a cleaner, richer and healthier environment—will more than pay for the development of the requisite new technology.

Reference

1. R. Houghton, G. Woodwell, Sci. Am., April 1989, p. 36.

ALISON CAMPBELL
The Johns Hopkins University
9/91 *Baltimore, Maryland*

Raphael Kazmann, in his reply to the letters of Richard Alley, Charles Bentley and Edith Borie, cites as evidence that the Earth is not warming up but cooling down the revised "Plant Hardiness Zone Map" of the Department of Agriculture. He states that "the 1990 map shows that the zones in the 1965 map are now 5–10 °F colder." The revised Hardiness Zone Map was based on much more information than the old one.[1] Thus to conclude that any zone is colder would necessitate a comparison of the two data sets, not just the zone maps. Also, the new map is based on data from 1974 to 1986 only. Therefore we cannot conclude from this map what the relative temperatures of the zones are now.

Reference

1. J. Ruttle, National Gardening, July 1990, p. 26.

MARILYN BOYSEN
8/91 University of California, Santa Cruz

Advice to Foreign and Following Speakers

I truly enjoyed reading James C. Garland's "Advice to Beginning Physics Speakers" (July 1991, page 42), but I want to add a point for those of us not fortunate enough to have English as our first language. Garland dis-