nitrogen in proteins and other biological compounds. More than 90% finds its way back into the atmosphere as gaseous nitrogen, but some—perhaps as much as 8%—is converted to nitrous oxide. Because nitrous oxide is about 150 times as effective as carbon dioxide in trapping heat, that small proportion could make a big difference to global greenhouse warming.

"My gut feeling is that terrestrial [denitrification] is more significant [than denitrification in the oceans]," says Philip O'Kane, a mathematical modeler who is director of the Centre for Water Resources Research at University College in Dublin. "But there will be a large increase in denitrification related to the increased organic load associated with eutrophication. The global effect of that is unknown."

Another unknown is the role of dimethylsulfide (DMS), a planktonic compound that is at the heart of the atmospheric sulfur cycle. A square kilometer of *Phyaeocystis* bloom contains about 2 tons of sulfur, which is released as DMS when those cells die. DMS contributes roughly half the sulfuric acid in the atmosphere, and hence phytoplankton blooms could mean considerably more acid rain. But that remains unproven.

And if the issue of coastal effects on global processes is uncertain, the converse—how global warming could affect coastal processes—is doubly so. Even the high current levels of eutrophication could prove trivial by future standards if global change begins to affect fundamental processes within the oceans. John Walsh, a biological oceanographer in the Department of Marine Science at the University of South Florida, points out that only 10% of the new life in coastal zones depends on nutrients coming down rivers. The remainder uses nutrients from the open ocean. In Walsh's view, any changes man may make to the rivers will not necessarily be catastrophic. "But if global climate change alters the deep-sea circulation," Walsh says, "all bets are off."

■ JEREMY CHERFAS

Irrationality—Skeptics Strike Back

The way John Paulos tells the story, he was sitting around with a group of his friends one weekend. The group was a well-educated, bunch. They were carrying on a fairly arcane discussion about the difference between the meanings of "continually" and "continuously," and everybody was pitching in. After a while the TV was turned on. The local weatherman came on with predictions for the weekend. The chance of rain, he said, was 50% on Saturday and 50% on Sunday. Therefore the probability of rain for the whole weekend was 100%. Paulos—a mathematician at Temple University—says he was the only one who noticed the glaring error in the weatherman's logic.

But that's not unusual, according to speakers at a recent conference on scientific literacy and critical thinking. Even well-educated people can be led into fallacies by a lack of understanding of simple mathematical concepts such as probability. The theme of the conference, organized by the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP), which publishes the *Skeptical Inquirer*, was that unscientific thinking is pervasive in our society and that it undermines the population's ability to think rationally about many subjects.

Indeed the U.S. population may be heading toward new heights of belief in the paranormal. One poll cited at the conference, conducted by researchers at the University of Chicago, showed that 42% of American adults believe they have been in contact with someone who has died. And a Gallup youth survey showed that between 1978 and 1988, the proportion of young people who believe in astrology climbed from 40% to 58%.

The attraction of irrational and pseudoscientific beliefs is particularly strong for the poorly educated and is closely related to the current crisis in scientific literacy, said speakers at the CSICOP meeting. But participants warned that the problem is not limited to the poorly educated. Which may be why, as Andrew Fraknoi of the Astronomical Society of the Pacific pointed out, some normally skeptical members of the press "lose their minds when they hear of a ghost or a UFO."

Biologist Michael Zimmerman of Oberlin College reported that politicians are scarcely more rationally inclined than the general public. Zimmerman surveyed members of the U.S. Congress. When asked to agree or disagree with the assertion that "aliens made ancient monuments," not even two of three responding congressmen "strongly" disagreed. Elected officials in Ohio were even less confident that extraterrestials had not built the pyramids—only 45% strongly disagreed.

In another survey, Zimmerman found that 22% of Ohio high school biology teachers who responded to a poll said they teach creationism. A separate poll of newspaper editors revealed that only half disagreed with the statement that humans and dinosaurs lived at the same time.

Paulos argued that the absence of a "visceral understanding of probabilities" opens the way to being awed by coincidence. For example, it's easy to be impressed by the fact that someone in the U.S. dreamed of an earthquake the night before one actually occurred. But it would be even more surprising if no one dreamed of an earthquake that night, given that Americans log half a billion dreaming hours a night.

Paulos went on to assert that an inadequate understanding of mathematics can skew the debate on significant social issues. Stanford, he noted, has been accused of discriminating against women because proportionally fewer female than male applicants are admitted. But that result is unavoidable, Paulos claimed, because the ratio of applicants to openings is much higher in the fields that are attractive to women (such as literature and psychology) than in male-dominated fields such as mathematics and engineering.

As for making public debate of the issues more rational, some of the nation's leaders aren't offering much in the way of role models. Ronald Reagan couldn't decide whether he espoused modern science or ancient Babylonian superstition. Asked last year at a press conference whether he believed in astrology, Reagan declined to answer, saying, "I don't know enough about it to say if there is something there or not."

So the problems continue to grow. But if you're of a skeptical turn of mind, then there is another increase that might seem like a good sign: the growth in the number of debunkers. Since its founding in 1976, CSICOP has attracted almost 36,000 members. The organization now has 60 affiliates around the world, including one in the Soviet Union, where the era of perestroika and glasnost is accompanied by what CSICOP's chairman, philosophy professor Paul Kurtz of the State University of New York in Buffalo, calls "paranormal pandemonium." And the extraterrestials sighted in the land of Gorby are reported to be even bigger than the ones that land in Florida.

■ CONSTANCE HOLDEN