"It certainly makes no sense to save all species at any cost, any more than to attempt to save all human lives at any cost," assert University of Maryland economist Julian L. Simon and Berkeley political scientist Aaron Wildavsky in *Society* (Nov.–Dec. 1992). They suggest looking backward. "What were the species extinguished when the settlers cleared the [U.S.] Middle West? Are we the poorer now for their loss? Obviously, we cannot know in any scientific way. But can we even imagine that we would be enormously better off with the persistence of any hypothetical species?"

Maybe not. But defenders of biodiversity see the future in dire terms. "We don't know how many species can be lost before the system ceases to function," biologist Richard L. Wyman of the State University of New York at Albany told the *New York Times Magazine*'s Emily Yoffe. "But eliminate enough species and

sooner or later it will cease to function."

Yet change, dramatic change, is a constant in the story of life on this planet, observes Thomas Palmer in the *Atlantic,* and the imminent end of the world has frequently been proclaimed in times past. "To say that the changes [humans] have brought, and will continue to bring, are somehow alien to the world, and are within a half inch of making its 'natural' continuance impossible, displays some contempt, I think, for the forces at work, along with a large dose of inverted pride ...."

"Few would deny that the effort to preserve and protect as many as possible of the millions of species now existing represents a fresh and heartening expansion of human ambitions," Palmer writes. "But to suppose that earthly diversity is past its prime, and that a strenuous program of self-effacement is the best contribution our species has left to offer, is neither good biology nor good history."

Fatal Glitches

Occasional computer failure is a familiar fact of modern life. The usual result is inconvenience, a day's work lost or a file destroyed. When computers are used in critical applications, however, flaws in the software can spell disaster. During the Persian Gulf War, for example, the Patriot missile system failed to track an Iraqi Scud missile that killed 28 U.S. soldiers. The apparent problem: The Patriot computer was kept on so long that minor inaccuracies in its internal clock accumulated and threw off its timing.

As complex computer programs are used in more and more critical applications, from nuclear reactors to antilock brakes in automobiles, the danger of computer-generated catastrophe spreads. The solution might seem to be simply to search out and eliminate all the "bugs" lurking in a computer program. In theory, that can be done, but in practice, it is not always easy, warn Littlewood, a computer scientist who directs the Center for Software Reliability, in London, and Strigini, a researcher at the Institute for Information Processing of Italy's

National Research Council.

"Despite rigorous and systematic testing, most large programs contain some residual bugs when delivered," they write. "The reason for this is the complexity of the source code." A computer program with only a few hundred lines of code may permit thousands of alternative "paths" of decisions—and programs written for critical applications can have *millions* of lines of code. A "wrong" decision can result from a particular "input" not foreseen by the program's designer or not used during testing of the program. There are many other routes to error. Specifications often change during a system's development, and the changes can introduce bugs into previously designed parts. Or the system may be used in unintended ways, as in the Patriot missile case. Its designers expected that it would be turned off and restarted often enough to prevent the accumulated error in timekeeping from ever becoming dangerous.

Digital systems intrinsically make creation of reliable software difficult, the authors say. Changing only one "bit" from 0 to 1, for instance, may make a radical difference. A single incorrect character in the control program for the Atlas rocket carrying the first U.S. interplanetary spacecraft, *Mariner 1,* in 1962, caused it to veer off course soon after launch. The craft had to be destroyed.

The lesson to be drawn from the imperfections of computer software, Littlewood and Strigini conclude, is that, especially in situations where concern for safety is paramount, software should not be given "too critical" a role. Either the assigned role should be so modest that the reliability of the software can be demonstrated beforehand, or else independent backup systems using different technology or taking a different approach should be used. An industrial plant whose operations are controlled primarily by computers, for example, could be equipped "with safety systems that do not depend on any software or other complex design." In short, despite the dazzling technical achievements of the past two decades, "being skeptical is the safest course of action."

ARTS & LETTERS

Barbershop Dustup

"'Play That Barber Shop Chord': A Case for the African-American Origin of Barbershop Harmony" by Lynn Abbott, in *American Music* (Fall 1992), Univ. of Ill. Press, 54 E. Gregory Dr., Champaign, Ill. 61820.

Mention *barbershop quartet*, and a Gay Nineties image of dapper white barbers and their patrons harmonizing together comes to mind. The impression that barbershopping is a white tradition was fostered for decades by the Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America, founded in 1938 in Tulsa, Oklahoma. Abbott, an independent scholar, strikes a dissonant note. Like jazz and rock music, he says, the "barbershop" style probably originated with African-Americans.

During the late 19th and early 20th centuries, American black men frequently lifted their voices in harmonious song. In Kansas City during the late 1880s, recalled vaudevillian Billy McClain, "about every four dark faces you met was a quartet." Dr. Laddie Melton, who began harmonizing in schoolyard quartets in New Orleans around 1910, said that whenever "three or four Negroes [got] together," they'd say, "Let's crack up a chord! Let's hit a note!"

"The art of 'cracking up a chord,'" Abbott says, "was born in unabashed celebrations of the 'weird,' organically blended harmonies that first distinguished the group-singing traditions of plantation slavery." Although heard in many places, from lodge halls to barrooms, the unique sound came to be especially associated with black barbershops, which served as places for socializing and for rehearsing and performing music, and so it came to be known as "barbershop harmony." The father of the famous Mills Brothers—who began singing in the 1920s, made successful recordings in the '30s, and had a spectacular national hit in 1943 with *Paper Doll*—had taught his boys harmony in his barbershop in Piqua, Ohio.

"In the days when such a thing as a white barber was unknown in the South," black lyricist James Weldon Johnson wrote in 1925, drawing on his memories of Jacksonville, Florida, in the 1880s, "every barber shop had its quartet, and the men spent their leisure time playing on the guitar . . . and 'harmonizing.'" Their style, Johnson added, "gave a tremendous vogue to male quartet singing, first on the minstrel stage, then in vaudeville; and soon white young men, where four or more gathered together, tried themselves at 'harmonizing.'"

Pablo Picasso, Classicist

"Picasso: In the Beaux Quartiers" by Michael C. Fitzgerald, in *Art in America* (Dec. 1992), 575 Broadway, New York, N.Y. 10012.

During the years after World War I, Pablo Picasso (1881–1973) suddenly shed the image of bohemian Cubist and assumed the role of fashionable Classicist. He even did some paintings that very much resemble society portraits. At the center of this re-creation of himself, according to Fitzgerald, an art historian at Trinity College, Hartford, is *Studies* (1920–22), a painting that looks like an intriguing puzzle picture and that until recently was little known.

"At first glance," Fitzgerald notes, "one might dismiss *Studies* as merely a chance assemblage of unrelated sketches." But the images have a distinct order. "Highly finished miniature Cubist still lifes at the outer edges frame the canvas, while figures