tion. It should be possible to devise guidelines to identify low-risk or trivial-risk situations."

The participants also discussed a Catch-22 of environmental release. Many people argue that field tests should be prohibited until solid predictions can be made. Yet a variety of biologists presented evidence from introductions of foreign and traditionally altered species that laboratory and greenhouse experiments simply don't predict well the behavior of an organism in the field.

"There is a way out. The multistage test approach can be used, beginning with small-scale, isolated test plots with means to monitor [the surroundings]," Edward A. Adelberg of Yale University says. "We must get permission to move to well-contained but outdoor field plots."

While the meeting certainly produced no consensus on how to prepare for and perform environmental release experiments, Harlyn O. Halvorson of Brandeis University in Waltham, Mass., says, "People who have been talking past one another have now started talking to each other." —*J. A. Miller*

A parallel path for speedy solutions

Meteorologists sometimes joke that it takes three days of computer time to figure out tomorrow's weather. The equations are so complicated that a long sequence of computations is needed to come up with an accurate forecast. But the time required to solve such equations may be shortened with the recent invention of a simple method that, with the right kind of computer, substantially speeds up the process.

The new algorithm, developed by mathematicians Victor Pan of the State University of New York at Albany and John Reif of Harvard University, involves solving systems of linear equations. The simplest such system consists of two equations, each expressed in terms of two variables, x and y. Solving this system requires finding values for x and y that satisfy both equations at the same time. Linear systems that arise in weather forecasting, aerodynamic design or economic modeling often involve thousands of equations and thousands of variables.

Efficient computer methods already exist for finding solutions to these equations, but the size of many linear systems overwhelms computers that must perform each step in order, one at a time. The answer is to divide and conquer — by using a multiprocessor computer that simultaneously performs many computations in parallel. Pan and Reif found a method that, by taking advantage of parallel processing, reaches the answer in less time.

Their method involves systems of linear equations expressed as blocks of numbers called matrices. Each matrix has as many rows as there are equations and an equal number of columns. Solving the equations is equivalent practically to finding the inverse of the original matrix.

But finding a matrix inverse is a thorny problem. The key discovery was an efficient way of computing an "approximate matrix inverse," which is used as a starting point for an iterative method that, step by step, brings the approximate matrix closer to the "true" answer.

What surprises Pan and Reif is how simple the scheme turns out to be. The basic method had been discovered about 50 years earlier, but until they came along, no one knew of a simple way to find an approximate matrix inverse.

"It was the missing step that we didn't know how to do before," says computer scientist Ronald L. Rivest of the Massachusetts Institute of Technology. "It was an exciting, nice result."

With only one computer processor, the method the mathematicians developed is about as speedy as any algorithm now available. But as the number of processors used increases, their method proves to be significantly faster. For a system of n linear equations, the algorithm is at its best when n^3 processors are used. Although very few computers now available have a sufficiently large number of parallel processors, within the next few years several companies are planning to introduce machines with as many as 64,000 processors.

In addition, Pan and Reif developed a faster way of handling "sparse" matrices, in which most of the numbers are zeros. Almost all systems of linear equations encountered in fluid dynamics or other physical situations generate matrices of this type. Their new algorithm helps because several steps involve computing matrix inversions.

Recently, Pan and Reif also found that their algorithm for matrix inversion may be useful in speeding up some of the steps in a new linear programming method developed by Narendra Karmarkar of AT&T Bell Labs in Murray Hill, N.J. (SN: 12/22 & 29/84, p. 408). This improvement could give Karmarkar's algorithm a decided edge among the competing methods used to solve these problems.

With the theoretical work done, it's now up to computer programmers to implement and test the Pan-Reif algorithm. "I don't see any practical problems for implementation because the code is very simple," says Pan. "Most of the complications in the work were to find it and to justify it, to prove things." —*I. Peterson*

Fungus degrades toxic chemicals

A fungus that rots fallen trees will reduce to carbon dioxide such persistent environmental poisons as DDT, lindane, PCBs, benzo[a]pyrene and dioxins, say biochemists at Michigan State University (MSU) in East Lansing.

Their report, published in the June 21 SCIENCE, describes the experimental growth of a white rot fungus in glucose solutions containing different organohalides — carbon-containing compounds with attached chlorine or bromine atoms. These chemicals, which include many environmental pollutants, resist degradation by most organisms. Some, like DDT, tend to accumulate in the bodies of animals high on the food chain.

The Environmental Protection Agency (EPA), which funded the study, says it is "guardedly optimistic" about the results. The MSU researchers and the EPA hope the fungus can one day be used to help clean up soils contaminated with toxic chemicals.

The fungus, *Phanerochaete chrysosporium*, normally lives off the cellulose in wood. The cell walls of wood are protected by lignin, a highly complex ring polysaccharide. Most organisms are incapable of breaking down the lignin to get through to the more digestible cell wall and cell contents, but the white rot fungus possesses an enzyme system that can.

The fungus is thought to break down the lignin by a free-radical mechanism, says John A. Bumpus, one of the paper's authors and a visiting assistant professor at MSU. Free radicals are atoms each with an unpaired electron. They are typically very reactive and nonspecific, attacking a variety of structures. It was the enzyme system's lack of specificity that suggested to Steven D. Aust, professor of biochemistry at MSU, that the fungus might well degrade organohalides as well as lignin.

Aust, Bumpus and two students, Ming Tien and David Wright, labeled the carbon rings of the organohalides with carbon-14, which is mildly radioactive. They then estimated these compounds' rates of degradation in fungus-infected glucose solutions by measuring the rate of carbon-14-labeled carbon dioxide produced. After 30 days, 1 to 15 percent of the organohalides had degraded to carbon dioxide. Greater amounts were partially degraded. In the case of DDT, after 18 more days and the addition of more glucose, only 10 percent of the original amount remained, although not all of the other 90 percent had yet been reduced to carbon dioxide.

The fungus's actual usefulness remains to be determined. "It's a long jump from the laboratory to applications in the field," Bumpus says. "We're optimistic, but we recognize that there may be a lot of roadblocks." —*J. Dusheck*