'Great Green Wall' dampens Gobi dust storms

The ancient Chinese emperors built the Great Wall, ostensibly to defend against Mongol forces from the north. When Mao Tse-tung took over China, he continued that tradition, with a green twist. Since the 1950s, the world's most populous nation has planted 300 million trees along the path of the Great Wall to keep out invading dust storms from the Gobi Desert and other arid regions.

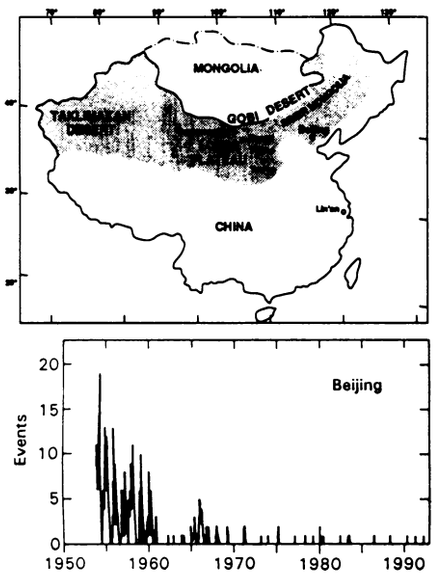
The ancient stone and earthen barrier worked only marginally well as a defensive measure. But the green version has succeeded, according to a team of U.S. and Chinese researchers. In the June 1 GEOPHYSICAL RESEARCH LETTERS, the group reports that the frequency and duration of dust storms have dropped over the last four decades at several monitoring stations in China.

At a time when several nations are contemplating planting millions of hectares of trees to offset global warming, the Chinese effort demonstrates that afforestation can alter regional climate.

"Vast belts of forest planted across the northern arid lands of China, called 'The Great Green Wall,' are probably one of the most aggressive weather modification programs in the 20th century," according to atmospheric chemist Farn Parungo of the National Oceanic and Atmospheric Administration in Boulder, Colo., and her colleagues.

The team of researchers analyzed weather data reaching back to 1955 for Beijing and two cities to the west. Chinese meteorologists define a dust storm as any time that wind-blown dust reduces visibility to less than 1 kilometer.

During the 1950s, 10 to 20 dust storms blew through Beijing each spring, blotting out the sky for 30 to 90 hours per month. By the 1970s, fewer than five storms hit each spring, and their duration dropped to less than 10 hours per month. Fine-grained silt continues to sweep through Beijing each spring, at times quite noticeably. But it rarely reaches the meteorological definition of a dust storm, Parungo says.



Parungo/GEOPHYSICAL RESEARCH LETTERS

China has planted trees in parts of the shaded region to prevent dust storms. Graph shows monthly frequency of storms in Beijing.

Belts of trees reduce dust principally by slowing winds and preserving soil moisture. Cities and villages typically plant swathes of fast-growing trees, with land in between left for cultivation.

Kenneth Andrasko, a forestry researcher with the U.S. Environmental Protection Agency in Washington, D.C., says China may have the largest tree-planting program in the world. Yet he wonders whether other factors helped reduce the frequency of dust storms: Advances in farming techniques, changes in livestock distribution, or subtle climate shifts might also have played a role.

Parungo and her colleagues suggest that the Green Wall could have effects that reach far beyond China's borders. The dust storms transport silt across the Pacific, even as far away as Hawaii and Alaska, dumping minerals and nutrients into the ocean. Dust also stimulates the growth of clouds and enhances precipitation. — *R. Monastersky*

Last word not yet in on Fermat's conjecture

Last June, mathematician Andrew Wiles of Princeton University stunned the mathematical community and drew worldwide attention when he dramatically announced a proof of Fermat's last theorem. A year later, the arguments presented by Wiles stand as a considerable mathematical achievement, but a troublesome gap in his lengthy chain of reasoning leaves Fermat's last theorem unproved.

"It took people a while to realize how serious the problem was," says Kenneth A. Ribet of the University of California, Berkeley. "And it has not yet been taken care of."

Fermat's last theorem asserts that for any whole number n greater than 2, the equation $x^n + y^n = z^n$ has no solution for which x, y, and z are all whole numbers greater than zero. A proof of this assertion's validity has eluded mathematicians for more than 350 years.

In his approach, Wiles followed up several key discoveries made by other mathematicians during the 1980s. These insights linked Fermat's last theorem to important ideas in number theory, particularly to mathematical entities known as elliptic curves (SN: 6/20/87, p.397).

Wiles took advantage of these connections in his announced proof of certain cases of the so-called Taniyama-Shimura conjecture, which in turn establishes the truth of Fermat's last theorem. He outlined his reasoning in three lectures last June at the University of Cambridge in England (SN: 7/3/93, p.5).

"His overall strategy looked wonderful," Ribet notes.

Wiles then submitted a preliminary, 200-page manuscript of the proof to the journal INVENTIONES MATHEMATICAE. In turn, copies of the manuscript were sent out to about half a dozen mathematicians for checking, but no copies were circulated publicly. Wiles himself continued to work quietly on his proof, clarifying arguments and correcting problems pointed out by the referees.

Late last year, Wiles broke his silence and sent out an electronic-mail message acknowledging a gap in what he had thought was an airtight proof (SN: 12/18&25/93, p.406). The problem involved calculating a precise upper limit on the size of a mathematical object called the Selmer group. Without confirming that this group is small, the proof remained incomplete.

Disappointed but intent on continuing, Wiles said at the time, "I believe that I will be able to finish this in the near future using the ideas explained in my Cambridge lectures."

Starting in February, Wiles gave a detailed account of his work in a course he was teaching at Princeton, covering parts of the proof that had already been checked and verified. Meanwhile, he refined the first few chapters of his lengthy manuscript into a form suitable for circulation.

Wiles also expended a great deal of effort thinking about the obstacle lying in his path toward Fermat's last theorem. In a rare public lecture, which took place last month at the Institute for Advanced Study in Princeton, N.J., a relaxed Wiles explained that he now believes the difficulty is probably surmountable — that he understands the problem well enough to see its connection with something more standard in mathematics.

"I think his intuition is that he's very close and that no new ideas are needed," says Peter C. Sarnak, one of Wiles' Princeton colleagues. "But you never know with something that looks standard. There may be some subtle issue here which makes it nonstandard."

Wiles will continue his lecture course at Princeton this fall, when he will at last reach the point in the proof where his difficulty lies. He may have an answer by then or he may not.

As mathematicians begin to understand the details of what Wiles has accomplished, it's possible that someone else may find a way to bridge the gap

while preserving Wiles' original line of reasoning. Alternatively, someone may completely rework the argument, using some of Wiles' ideas in a different way.

"Or [Fermat's last theorem] could be proved from some completely different perspective," Ribet says.

At the same time, despite the gap and the complexity of the approach, Wiles' work has already inspired several mathematical efforts on related questions. "Any time there's a major achievement like this, it changes what people work on and how they think about things," Ribet says.

"Mathematically, he's made a major breakthrough in the subject," Sarnak adds.

But the final step toward Fermat's last theorem remains untrodden. Quoted in the June SCIENTIFIC AMERICAN, veteran mathematician André Weil of the Institute for Advanced Study said, "[T]o some extent, proving Fermat's theorem is like climbing Everest. If a man wants to climb Everest and falls short of it by 100 yards, he has not climbed Everest."

"People are now even more convinced than they were that Fermat's last theorem is true and ought to be proved," Ribet says. "Probably, someone is going to prove it. The question is how long that is going to take." — *I. Peterson*

A quicker, cooler bleach for whiter whites?

Those darn stains. One tries bleaching them out. And rubbing them out. But, as some soap companies warn, one still ends up with a ring around the collar.

In the United Kingdom, this subject has become a matter of frothy debate. Two large detergent companies, Unilever Corp. and Procter & Gamble, have come to blows over a new product that claims to bleach clothes more quickly and thoroughly — and at lower temperatures — than comparable agents, while causing less harm to the environment.

The detergent in question, marketed by Unilever as Persil Power in the United Kingdom and as Omo Power in Europe, contains new manganese-based catalysts.

But the rub lies in Procter & Gamble's contention that under certain conditions the new product can damage fabric. In fact, after Unilever took Procter & Gamble to court for making "untruthful and misleading statements," Procter & Gamble came back with research reports from six European institutes showing damaged fabric allegedly caused by laundering with Persil Power.

Accompanying "evidence" included photos of men's boxer shorts in tatters and a statement that certain dyes, combined with the catalysts, can accelerate fabric damage and cause "holes well within the expected lifetime of the garment."

Unilever subsequently produced its own studies showing "no physical damage" to items laundered 15 to 25 times with the new agent.

Coincidentally, a research report by Ronald Hage, a chemist at the Unilever Research Laboratorium in Vlaardingen, the Netherlands, and his colleagues appears in the June 23 NATURE. Hage reveals some details about the new manganese complexes. The compounds, his group contends, "act as highly effective catalysts for the bleaching of stains by hydrogen peroxide at low temperatures."

Launderers have long used hydrogen peroxide to bleach fabrics — though it works well only in hot water, above 140°F. The new catalysts — derived from either 1,4,7-trimethyl-1,4,7-triazacyclononane or triazacyclononane ligands — improve bleaching mainly by enhancing hydrogen peroxide's effectiveness in cooler water.

To demonstrate this, the Unilever chemists soaked tea-stained cloth for half an hour in various solutions, with and without the additives, at 104°F. With the additives, they report, stains came out faster and more completely than without them.

"The fundamental problem in bleaching textiles," says Alan E. Comyns, a chemist and consultant in Chester, England, "is how to oxidize the color without oxidizing, and thereby weakening, the cloth. Both the color and the cloth are organic materials, and a powerful oxidant will attack both."

Many of today's fabrics require cooler water for laundering, and many of today's consumers want to save energy in washing, says Comyns.

Since the 19th century, chemists have investigated the interactions between hydrogen peroxide, transition-metal ions, and organic materials. More recently, detergent companies have searched far and wide for "selective organic oxidants" that satisfy "a plethora of practical requirements — performance, toxicology, environmental acceptability, and cost," Comyns says. "Unilever now claims to have found such a system."

The truth, ultimately, will come out in the wash. — *R. Lipkin*

Genetic test for colon cancer under way

Just 6 months after two separate research teams announced the chromosomal home of MSH2, the first gene discovered for one common form of colon cancer (SN: 12/11/93, p.388), Richard Fishel has even better news: a bioassay that will tell high-risk individuals if they are likely to develop the inherited disease.

Fishel, a member of one of the MSH2 teams, is a molecular biochemist at the University of Vermont Medical School in Burlington. He announced the new test last week at the General Motors Cancer Research Foundation Scientific Conference held at the National Institutes of Health in Bethesda, Md. The new test, or bioassay, is intended for people at risk of hereditary nonpolyposis colorectal cancer (HNPCC), one of the most commonly inherited cancers in humans.

The same genetic defect can also contribute to cancers other than that of the colon: ovarian, uterine, endometrial, lung, stomach, and others.

"We now have the unparalleled opportunity to help 23,000 Americans yearly who develop cancer as a result of inheriting a defective MSH2 or MLH1 gene," Fishel says. Both these genes can contribute to HNPCC, he points out. His group now links a third, as-yet-unreported gene to colon cancer. All three were originally discovered in yeast cells and affect DNA production.

In healthy yeast cells, a repair protein called MSH2 fixes glitches in the genetic alphabet, Fishel says, a process akin to a computer's spell-checker. When the gene that controls MSH2 is defective, there's nothing to check DNA "spelling," thus creating faulty DNA full of "spelling errors." Fishel points out that his team is ahead of the cancer game because of 20 years of basic research done with yeast. "We already knew how these genes functioned."

Currently, there exists a blood test that determines only the presence of a genetic alteration. However, Fishel says, his bioassay can determine the presence of a *functional* alteration, which has shown — in "the handful of families" he's worked with so far — to predict cancer.

"We might encourage predisposed individuals to alter their lifestyle," Fishel says. "High-fiber, low-fat diet."

High-risk individuals who don't carry the functional mutations can breathe easier. "Those individuals don't have to be screened by colonoscopies every year, don't have to be encouraged to alter their lifestyle. They basically can lead normal lives, and that reduces health care costs," Fishel adds.

Though the bioassay results are preliminary, they are also promising. Says Richard Kolodner, a researcher at the Dana-Farber Cancer Institute in Boston who worked with Fishel on the MSH2 gene: "The data that have come along... are convincing enough that companies that do commercial testing are starting to work on developing tests.... And that's happened in a year."

"Combining genetic diagnostics with bioassays," says Fishel, "is the wave of the future." — *G. Marino*