

# Scientists striving to micro manage

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size particles may behave differently in the environment than bigger particles do, raising the specter of widespread and persistent contamination.

Some researchers now argue that the health and environmental effects of nanomaterials should become a research priority.

"It will be among the biggest issues that nanotechnology will face in the next few years," said Dr. Vicki Colvin, a chemist who directs the Center for Biological and Environmental Nanotechnology at Rice University in Houston.

Dr. Colvin took her concern to Congress in April, testifying in front of the House science committee on the need to study nanotechnology's societal and ethical implications. The House passed a bill incorporating these issues; the Senate is considering a similar one.

## Federal dollars

Already, the federal government has made a big investment in all things nano. The president's budget request for next year allocates nearly \$850 million for the National Nanotechnology Initiative, which already had three years of flush funding. Some experts predict that nanotechnology will become a trillion-dollar industry by 2015, providing new sensors, batteries, displays and other futuristic gadgets.

"The smell of money has brought people to think about these things," said Dr. Alexandra Navrotsky, director of the Nanomaterials in the Environment, Agriculture and Technology program at the University of California, Davis.

Long before people existed, na-

*"Every time you get a new technology, you produce things that are chemically new. You'll put them in the environment no matter how good your controls are."*

Dr. Alexandra Navrotsky, University of California, Davis

ture was making nanomaterials. Some of the first cosmic particles to condense into the sun and planets were probably nanometer size, Dr. Navrotsky said. But with the advent of 21st-century nanotechnology, engineers are deliberately creating materials with chemical and physical properties unlike anything before.

Nano-size particles of gold, for instance, appear red instead of gold because they interact differently with light when they shrink. Nanomaterials are exciting because they behave very differently than macroscopic particles of the same stuff, said Dr. Navrotsky.

But pushing into the unknown means that scientists don't know the downsides of the new materials — a scenario that Michael Crichton exploited in his latest novel, *Prey*.

"Every time you get a new technology, you produce things that are chemically new," Dr. Navrotsky said. "You'll put them in the environment no matter how good your controls are."

As a result, scientists are scrambling to understand how nanomaterials travel and how they might interact with air, water and soil.

Few studies have been done in this area, said Mason Tomson of Rice, and the early work is not encouraging. For instance, he has found that carbon nanoparticles called buckyballs trap the chemical contaminant naphthalene much differently than soil does.

If nanoparticles become wide-

spread in the environment, he said, they might make it more difficult to clean up polluted sites. But if scientists could better understand the chemistry of nanomaterials, they might use the stuff to their benefit — perhaps discovering a nanoparticle that could permanently absorb and clean up anything before.

While some researchers worry about nanotechnology's effect on the environment, others are concerned about what it could do to human health. By definition, nanoparticles are tiny enough to enter individual cells; scientists don't know how often that happens or what the effects might be.

## SPF nano

In some cases, the public serves as guinea pigs. Anyone who has put on clear sunscreen in the last year is probably applying nano-size particles of titanium or zinc oxide. Shrinking the particles allowed sunscreen manufacturers to make the lotion transparent while still scattering dangerous ultraviolet light, said Rice's Kevin Ausman.

The Food and Drug Administration approved the sunscreen nanoparticles based on research on larger particles of titanium and zinc oxide, and there's little reason to worry about them. But Dr. Ausman uses it as an example of how science has yet to address many of these health concerns.

The few studies that have been performed seem to have conflicting results — including the new

studies dealing with carbon nanotubes.

Nanotubes, which are sheets of carbon atoms wrapped into a nano-size cylinder, have attracted scientific excitement for several reasons. They are super-strong, giving rise to dreams of thin and tough nanotube cables. They can carry a lot of electrical charge, promising applications in miniaturized electronics.

But nobody knows how nanotubes affect human health. Asbestos fibers once provided terrific insulation, Dr. Ausman pointed out, but at a health cost that became apparent only much later.

Two toxicologists presented their latest nanotube findings this spring at a national meeting of the American Chemical Society. One study seemed to indicate that nanotubes could be a serious health hazard, while the other suggested it's too early to tell.

The first study, led by Dr. Chiu-wing Lam of NASA's Johnson Space Flight Center in Houston, introduced nanotubes, as well as particles of carbon black and quartz, into the lungs of mice. Researchers examined some of the lung tissue seven days later and the rest of it 90 days later.

The second study, led by Dr. David Warheit of the DuPont Haskell Laboratory for Health and Environmental Sciences in Newark, Del., investigated nanotubes, as well as quartz and iron particles, in the lungs of rats. Analysis was done at 24 hours, one week, one month and three months after exposure.

Both teams noted that rodents exposed to nanotubes got small inflammatory nodules in their lungs. But Dr. Warheit's group reported no accompanying signs that the nanotubes were toxic; exposure to

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quartz particles, a well-known health hazard, appeared to be much more dangerous. In contrast, Dr. Lam's team warned that nanotubes could be more toxic than quartz.

Neither study looked at the more realistic scenario in which the rodents breathed in nanotubes, rather than having tubes injected into their lungs. And neither reproduced the fact that carbon nanotubes tend to clump together rather than lodge in the lungs one by one — a property that Dr. Warheit thinks could make them less dangerous.

"The bottom line," he said, "is there could be some potential hazards, but the nature of the carbon nanotubes also raises a lot of question about relevance."

Dr. Warheit is trying to find money to conduct a full-fledged inhalation study. But part of the problem is the sheer cost of nanotubes, which can run \$500 or more per gram.

## Exposure limited

So far, the only people who might be at risk from breathing nanotubes would be those who work in production facilities in universities or in a few specialized companies. The National Institute for Occupational Safety and Health recently sampled the air in nanotube laboratories at Rice, NASA and elsewhere and found that very few tubes make it into the air where they could be inhaled.

In the meantime, chemists are taking the usual precautions with nanotubes. At the University of

## THE MEASURE OF A NANOMETER

Scientists are making progress in nanotechnology. Nanoscale devices are ultratiny, measured in nanometers — one nanometer is a billionth of a meter. For comparison:

### Nanometer

Ten hydrogen atoms (the balls at right) placed side by side measure 1 nanometer across. A DNA molecule (the twists) measures about 2 nanometers across. \*



### Billions of nanometers

A 6-foot-6-inch person is 2 meters, or 2 billion nanometers, tall.

\*The atoms and DNA are not to scale.

As nanotechnology research advances, concerns are arising about the possibility of nanomaterials becoming pervasive in the human body (through inhalation or ingestion) and in the environment (water, soil and air).

SOURCES: National Science and Technology Council; Principles of Biochemistry

Staff graphic

Texas at Dallas, laboratory workers handle nanotubes as they would any hazardous material, said Ray Dr. Baughman, head of UTD's NanoTech Institute. Students wash their hands frequently, use chemical hoods whenever prudent and generally practice good lab techniques.

"My concerns about nanotechnology," Dr. Baughman said, "are the concerns you would have about any chemicals."

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# Mexico awakens to rising star of López Obrador

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the most popular politician in Mexico. He's the great hope of the leftist Party of the Democratic Revolution, or PRD, to win the presidency in 2006.

To many, he's the opposite of President Vicente Fox. Where Mr. Fox is a tall, garrulous cowboy from Mexico's farm belt, the mayor is a soft-spoken man of average height from the Gulf Coast state of Tabasco who must be prodded by reporters to take shots at the president.

While 60-year-old Mr. Fox is losing ground as he pushes the agenda of his conservative National Action Party, the liberal Mr. López Obrador, 50, is surging as standard-bearer of the PRD — even though the party lags behind the nation's two other major parties.

An official in the Fox administration conceded that the mayor is the "800-pound political gorilla down the street that you always think about as you make daily decisions."

## Speculation on future

Despite rampant speculation about his future, Mr. López Obrador has dodged the question of whether he will run for president, saying he wants to focus on being mayor. "Being able to help others gives me tremendous satisfaction," he said recently. "That is the essence of power."

But behind the scenes, political backers have quietly commissioned pollsters to evaluate the mayor's chances.

A recent poll by the newspaper *Reforma* put Mr. López Obrador's approval rating at 83 percent.

His numbers have climbed as engineers finish a double-decked thoroughway that he predicts will unclog rush-hour traffic. Even delays and a recent, deadly construction accident on the highway have not diminished its support.

But Mr. López Obrador's game plan is not limited to the freeway. The public has smiled as he has roped some of the country's richest men into paying for a physical makeover of the city's historic center and the \$4 million fee for crime-fighting advice from former New York Mayor Rudolph Giuliani.

And while he has spent \$20 million on restoring downtown and the city's most important thoroughfare, Reforma Boule-

vard, the mayor has noted that that expenditure in turn attracted \$250 million in private capital to erect the street's new landmark, the 55-story Torre Mayor.

All this investment happened as Mr. López Obrador funneled new money to social programs.

The city is subsidizing the grocery bills of single mothers and senior citizens at a time of dwindling assistance from the federal government.

Analysts have praised Mr. López Obrador's work away from the limelight, in some of the city's rougher neighborhoods, where he has paved roads and redeployed police.

"He saw that people wanted certainty in their government, and he's provided that," said pollster María de las Heras, whose research shows Mr. López Obrador as the very early 2006 presidential favorite.

Last week, Mr. López Obrador stunned aides during the inauguration of senior citizen housing in a run-down Mexico City neighborhood. At the urging of elderly women who led him by the hand, he left the event for an impromptu visit to a grade school threatened with demolition because of a land dispute.

In a message broadcast on live radio, Mr. López Obrador promised to save the school.

"Up with the kids!" he said amid a torrent of children's screams normally more likely to be directed at pop stars.

Mr. López Obrador's aides said the event lifted his spirits. He had struggled in recent days with a massive traffic slowdown while hundreds of city employees — members of unions aligned with the PRI — demonstrated for higher pay on the streets.

## Union tactics

The mayor is no stranger to union tactics.

Mr. López Obrador cut his political teeth in Tabasco, where he began as an organizer of indigenous Mexican tribes then loyal to the PRI. In Tabasco he was a combative politician who could get people out in force to protest.

In 1988, Mr. López Obrador joined a political rebellion within the PRI and broke away to form the PRD with Cuauhtémoc Cárdenas, whom he later followed as Mexico City's second elected mayor.



EVA ALVAREZ PRIETO/Special Contributor

Andrés Manuel López Obrador strolls on the campus of the National Polytechnic Institute. One pollster tabbed Mr. López Obrador, a member of the Party of the Democratic Revolution, as the early favorite in the race for the presidency in 2006.

## ANDRÉS MANUEL LÓPEZ OBRADOR

**Occupation:** mayor of Mexico City  
**Age:** 50; born in Macuspana, state of Tabasco  
**Education:** political science undergraduate degree from the National Autonomous University of Mexico  
**Family:** Widower; three sons, José Ramón, Andrés and Gonzalo  
**Career:** Began public life in 1977 as director of the Indigenous Institute of Tabasco state; in 1984 he became chief of social promotions for the

Mexico City Consumers' Institute; in 1988 he joined a splinter group rebelling from the then-ruling Institutional Revolutionary Party, or PRI, and launched an unsuccessful run for the governorship of Tabasco state; in 1994 he again ran unsuccessfully for governor; in 1996 he was elected president of the Party of the Democratic Revolution, or PRD; in 2000 he was elected mayor of Mexico City.

In Tabasco, Mr. López Obrador clashed with Roberto Madrazo, who is president of the PRI. Mr. López Obrador lost a gubernatorial bid to Mr. Madrazo in 1994.

Mr. Madrazo is said to be preparing his own 2006 presidential bid, setting up a potential rematch between the two old political foes.

Today Mr. López Obrador is seen as more relaxed. "He has evolved," said Ms. de las Heras, who for years has tracked Mr. López Obrador's political growth. "He appears mature now. He seems very practical and down to earth."

Mr. López Obrador is also austere, aides and analysts said. He drives a humble Nissan Sentra. And while he moves amid a few discreet bodyguards, he shuns the fleet of security vehicles that most Mexican politicians use.

As Mr. López Obrador's standing has risen, so has demand for his time. Recently, before a group of American business leaders, he sounded very much like a candidate for national office.

"The principal objective of any government is bettering the conditions in which its people live. No government can justify itself if it does not procure the well-being," he said in an address to the American Chamber of Commerce in Mexico City — not usually a crowd that embraces leftist, populist politicians.

He sought to reassure them that he supports capitalism — much as Brazilian President Luiz Inácio Lula da Silva, a former labor leader, has wooed the business community there.

## 'Find a balance'

"It is said that the political right ... is concerned with generating wealth but does not know how nor wants to redistribute it," Mr. López Obrador said. "Of the left it is said that it knows how to redistribute income but is not concerned with how it's produced. We need to find a balance."

That message is reaching the United States. A high-ranking U.S. government official said Mr.

López Obrador is "someone to take very seriously."

But Mr. López Obrador was not always so popular.

At first he battled the feisty Mexico City media, which played up the city's lingering debt problem, and the antics of a wayward son who liked to take city vehicles out for unsanctioned spins. In the beginning, the morning news briefings were awkward.

Mr. López Obrador often arrived still groggy, his salt-and-pepper hair untamed and his answers stilted.

But the meetings evolved, along with his leadership. Today the briefings are efficient proceedings in which reporters ask Mr. López Obrador for his opinion on everything from local taxes to the war in Iraq. His words and his face are almost daily features on radio and television news shows.

His morning routine has been infectious. Unlike other Mexican bureaucrats, his Cabinet members gather for 7 a.m. staff meetings. And opposition leaders now rebut Mr. López Obrador in their own morning news briefings.

Not everyone is convinced that Mr. López Obrador can fix what ails Mexico City, let alone become president. Critics of the crosstown freeway focused last week on a construction worker's death, calling it an accident caused by Mr. López Obrador's political aspirations — and his push to see the project finished by the promised June 1 deadline.

"If the wave of crime that terrorizes people of Mexico City has not yet drowned [López Obrador] ... the tragedy that cast the troubled project into mourning threat-

ens to finish his so-called popularity and his oft-denied presidential aspirations in 2006," an angry Francisco Cárdenas Cruz wrote in the Political Pulse column of the Mexico City newspaper *El Universal*.

Political opponents have also questioned missing funds at various city agencies — gaps identified by federal auditors. Mexico City, like Washington, D.C., is a national capital whose budget is controlled by the federal government.

## PRD has limited clout

Then there is doubt that his party can help Mr. López Obrador. The PRD has only limited presence in northern Mexico and suffers from rampant infighting. In the last federal election, the party captured 16 percent of the vote, leaving it unable to advance legislation on its own.

That may change in the July 6 midterm election. But PRD weakness takes the luster off thoughts of a López Obrador presidency, said Armand Peschard-Sverdrup, a Mexico analyst with the Center for Strategic and International Studies in Washington.

"He'd have even less power [than Mr. Fox] in Congress," Mr. Peschard-Sverdrup said. "As a result you'll have even greater gridlock, and in the end, he'd end up having done less as a president than Fox."

Staff writer Alfredo Corchado in Washington contributed to this report.

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