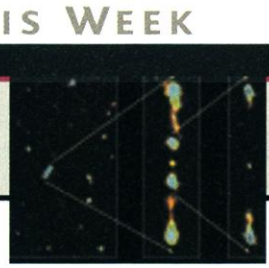

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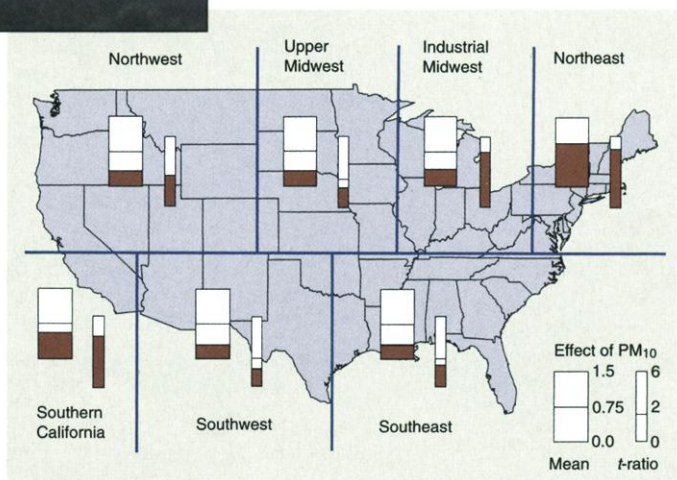
AIR POLLUTION

Evidence Mounts That Tiny Particles Can Kill

Four years ago, the U.S. Environmental Protection Agency (EPA) ignited a fire storm when it declared that tens of thousands of people were dying each year from breathing tiny particles of dust and soot—and issued tough new regulations to crack down on these pollutants. Industry groups and many scientists assailed the decision, arguing that the data underlying the new particulate matter (PM) standard were inconclusive at best, and industry took their case to court. Now, a long-awaited study, by a group widely perceived to be politically neutral, comes in solidly behind the earlier EPA decision and strongly implicates particles in excess deaths.

The study is the largest yet to examine the relation between daily levels of particles—which come mainly from soils, motor vehicles, and power plants—and deaths in the United States. Released last week by the Health Effects Institute (HEI) in Cambridge, Massachusetts, a nonprofit organization funded by industry and the government, the study* found that death rates in the 90 largest U.S. cities rise on average 0.5% with each tiny 10 micrograms per cubic meter increase in particles less than 10 micrometers in diameter, known as PM_{10}. That number is not much different from those found in earlier studies. But this time, the case is stronger because the breadth of the new study dispels any notion that the effect might have been caused by a pollutant other than PM_{10}, or even hot weather. Indeed, although many questions remain about how fine particles kill people, the HEI study shows there's no mistaking that PM is the culprit, lead author Jonathan Samet of Johns Hopkins University says emphatically.

It was similar studies of the relation between day-to-day fluctuations in fine particles and death rates that raised the alarm about PM some 10 years ago. In cities such as Philadelphia, researchers found that on days when air pollution jumped yet remained within federal standards, there were more deaths and hospitalizations of elderly people for cardiac and lung disease. Although the increase was slight in each city, studies of the long-term effects of particles found it added up to a significant number of deaths, roughly 60,000 a year by some estimates. Lab studies showed that the tinier the particle, the more likely it was to lodge in the lungs, suggesting to EPA that it needed to target even finer particles than before—those less than 2.5 micrometers across.



Profile of a killer. Particle pollution leads to increased deaths across much of the country, according to this map showing the rise in death rates with each 10 $\mu g/m^3$ rise in PM_{10}. In areas where the *t*-ratio was below 2, the correlation was not statistically significant. Left, Houston, barely visible.

But in 1996, when EPA proposed a first-ever maximum level for $PM_{2.5}$ together with tighter ozone standards, industry groups went on the warpath. In congressional hearings, scientists also raised a host of questions, among them whether the apparent link between deaths and PM levels was real or due to other pollutants (*Science*, 25 July 1997, p. 466). EPA went ahead with the standard but built in a 5-year delay to allow for more research. Meanwhile, a U.S. appeals court last year ruled that the science supported EPA's $PM_{2.5}$ standard. This fall, the U.S. Supreme Court will look at a related legal question—whether the EPA's interpretation of the Clean Air Act exceeds Congress's constitutional authority.

To help resolve the uncertainties in PM epidemiology, HEI in 1996 began funding the National Morbidity, Mortality, and Air Pollution Study, or NMMAPS. Samet's team and collaborators at Harvard scoured federal databases on daily deaths, weather, and air pollution. By including every major city with significant PM pollution and using the same methods to analyze each, the team achieved statistically stronger results than had previous single-city studies. The results varied by region—the rise in death rates was highest in the Northeast and lowest in the Southwest—but overall, the team found "a robust effect" from PM_{10} across the 90 cities, says Samet. Adds biostatistician Gerald Van Belle of the University of Washington, Seattle, "Whatever concern there was about a single-city idiosyncratic effect is no longer a tenable hypothesis."

Other recent research has also firmed up the case against fine particles. For example, studies of men equipped with heart monitors have found potentially harmful changes in their heart rates with rising PM levels (*Science*, 21 April, p. 424). A related NMMAPS study released in May showed that outdoor fine particle measurements are likely a reasonable surrogate for the particles that get inside homes, where people spend most of their time. And this month, HEI expects to release another study whose preliminary results appear confirmatory—a reanalysis of two controversial papers, one

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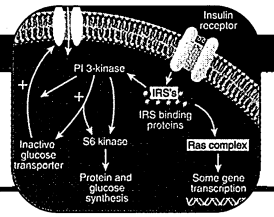
* www.healtheffects.org/news.htm



known as the Six Cities Study, on long-term deaths and PM levels in cities.

Still, NMMAPS raises as many questions as it answers. "The issue now is, why is there this heterogeneity across the country?" says Sverre Vedal, a toxicologist at the University of British Columbia. One possibility is that PM in the Northeast contains more sulfate than in the West, due to coal-burning power plants. Figuring out which components of PM—sulfates, metals, acids, or ultrafine particles—inflict harm, and how they do so, is critical for determining what sources EPA should regulate. Lab researchers are now attacking those issues with "a huge wave of mechanistic work," notes Samet, who expects some answers soon. **–JOCELYN KAISER**

ASTROBIOLOGY

Ames's Proposal for Lab Triggers Battle at NASA

Just east of California's sprawling Silicon Valley sits Moffett Field, home to NASA's Ames Research Center. The 800-hectare former Navy base also includes an airfield, abandoned wind tunnels, and plenty of open space, the last a rare and valuable commodity in this booming region. Ames officials would like to trade the use of part of that land for a new building largely dedicated to NASA's nascent astrobiology program, the core of which is a 2-year-old virtual institute based at Ames (*Science*, 20 March 1998, p. 1840). Although some scientists applaud the idea, stiff opposition from other researchers and from officials at NASA headquarters could well sink it.

The fracas began last year, when Ames managers decided to cash in on their prime real estate and their proximity to a rich supply of intellectual capital. "We want to create a research park with university, government, and industry partners," says Bill Berry, Ames deputy director. "And we can make land available to our partners to further NASA's research agenda." Ames officials envision a 32-hectare site with a 10,000-square-meter lab, primarily dedicated to astrobiology. Built by the potential partners, it would cost NASA about $15 million to outfit and another $15 million a year to operate. NASA Administrator Dan Goldin is intrigued by the idea, which Ames officials say has attracted the attention of local companies.

It has also drawn criticism. Some researchers and officials at NASA headquarters argue that a brick-and-mortar project defeats the purpose of a virtual institute, and that a building would divert money from science. "There's no compelling reason to do this," says David Black, director of Houston's Lunar and Planetary Institute. Adds one NASA manager: "This is not an obvious slam dunk, so why do it?"

Faced with such conflicting views, NASA appointed an 11-person panel last fall to conduct an independent review of the proposed facility. Although its report is not due until September, NASA last month asked the chair, Stanford geologist Donald Lowe, for a preliminary summary to inform its planning for the 2002 budget cycle. The 10-page document, obtained by *Science*, says that the facility "represents an opportunity to establish a unique national laboratory." In particular, the panel suggested that the facility could be used to design and test astrobiological experiments; to simulate the environments of other planets, comets, or asteroids; and to provide computational capability for everything from understanding planetary formation to the self-assembly of living systems. "I think it's a pretty good idea," says panelist David Deamer, a biophysicist at the University of California, Santa Cruz. At the same time, the document warns that start-up and operating funds should not come out of the hide of other NASA science programs.

Out there. NASA's "Highway to the Stars" program depicts one focus of the astrobiology institute at Ames.

The Lowe panel's findings rattled opponents of the new lab. According to NASA sources, Anne Kinney, the NASA headquarters official who leads the parent Origins program, wanted the Astrobiology Task Force—a group of a dozen outside researchers—to consider the findings. On 9 June, just 3 days after Lowe submitted his preliminary report, the researchers discussed the document in a teleconference; the next day they submitted a letter to Kinney. In it, task force chair Charles Beichman, an astronomer at the Jet Propulsion Laboratory in Pasadena, California, opines that the three research areas outlined by the Lowe panel are not compelling enough to warrant a new facility. "We do not agree that it is necessary to establish a national laboratory," the letter states.

Task force members say it wasn't a close call. "To spend $15 million a year on this when researchers are struggling along with $50,000 grants is not a good balance," one member explains. Black also casts doubt on some of the plans themselves. The idea of creating an environmental simulation facility, for example, "is nuts. ... You can't simulate the gravity on a comet," he says.

Next week the battleground shifts to Washington, D.C., when Beichman briefs NASA's space science advisory committee. Lowe is out of the country and will not attend the meeting, although another panel member might speak on his behalf. That arrangement infuriates the lab's supporters, who feel that NASA headquarters has ears only for the critics. Last week Ames's director, Henry MacDonald, wrote to Ed Weiler, NASA space science chief, to complain about how the Lowe report has been handled.

But lab supporters may be fighting a losing battle. The head of the astrobiology institute, Nobel Prize–winning biologist Baruch Blumberg, has refused to take sides in the disagreement and did not return calls seeking comment. His silence, along with a lack of support from Weiler and the advisory committee, could doom any land-for-space deal.

–ANDREW LAWLER

HYPERTENSION

Mutation Points to Salt Recycling Pathway

One in five Americans and Europeans has high blood pressure, a dangerous disorder whose numerous genetic causes are only beginning to be revealed. Now a team of researchers at Yale Medical School has uncovered a piece of the puzzle: a gene mutation that leads to early-onset hypertension that may point the way to causes for more common forms of high blood pressure.

CREDIT: NASA