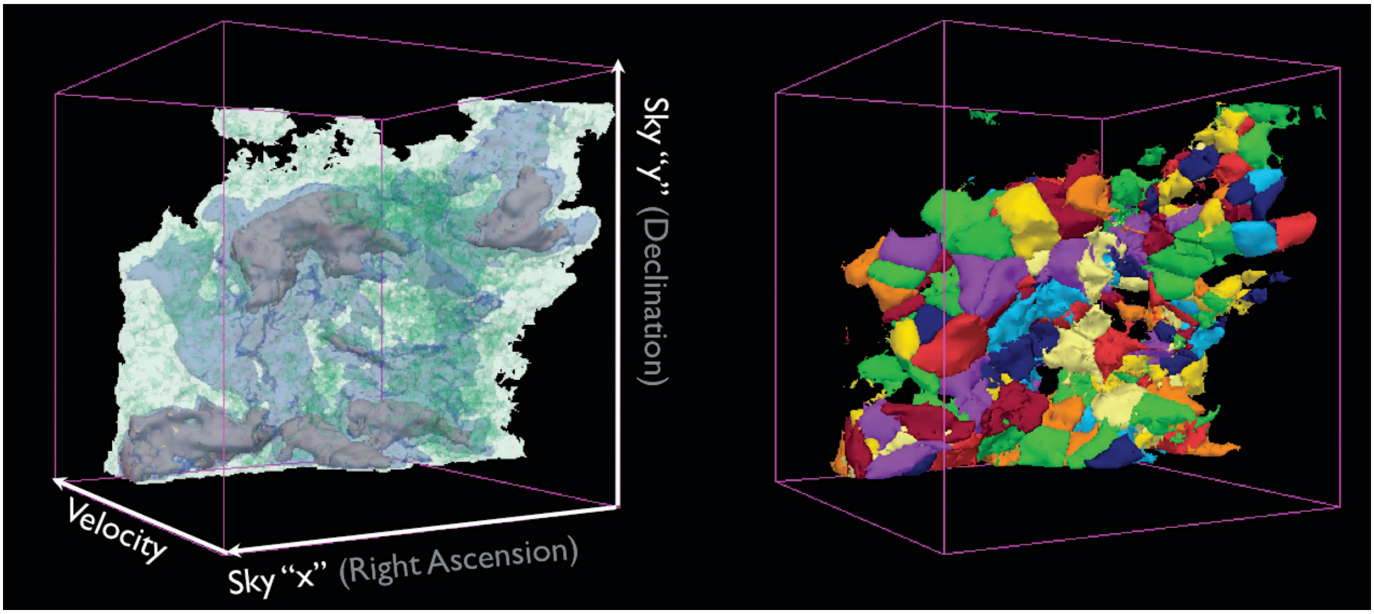

A. GOODMAN ET AL, "A ROLE FOR SELF-GRAVITY AT MULTIPLE LENGTH SCALES IN THE PROCESS OF STAR FORMATION." *NATURE* 457:63-66 (2009).

The image on the left shows data gathered from the L1448 region of Perseus, analyzed using the dendrogram algorithm devised by Erik Rosolowsky, Alyssa Goodman, and colleagues. By taking into account the hierarchical nature of structures in the cloud, the algorithm enables scientists to see, within already dense parts of the cloud, even denser areas. An image generated using an earlier, widely used algorithm (right) depicts the same region as disparate, non-overlapping blobs.

important discovery. Earlier astronomical simulations of star formation had routinely omitted gravity, presuming its influence to be small relative to other forces, except at very high density. The new results, which Goodman and Rosolowsky published in *Nature*, suggested that gravity is in fact very important in star formation, exerting influence across distances much greater than previously thought.

The fact that they checked their work by looking at a photograph reminds us that the human brain is still our best tool for pattern recognition, more powerful than the fastest computer or the most precise algorithm. "Face-recognition software has *just now* gotten to the point where it can distinguish a face, and maybe tell who it is," says Goodman. "You can see a fuzzy cell-phone picture of somebody you haven't seen in 10 years and say, 'Hey, that's Mike!' A computer cannot come anywhere close to doing that, and probably won't for 10 years."

To create a visual representation of the dendrogram analysis, the scientists used a program adapted from medical-imaging software by Michael Halle, an instructor in radiology at the Harvard-affiliated Brigham and Women's Hospital, and colleagues. But for submission to *Nature*, they converted their image of the Perseus region, representing four million data points, to a common file format: PDF, viewable with Adobe Reader, a common, free software program. Theirs was the first-ever three-dimensional PDF published in a major scientific journal. The printed copy of the journal had two-dimensional figures, and people who saw that version found it less convincing: "It has a take-my-word-for-it feel," reports Goodman, the former director of the Initiative in Innovative Computing (see "Science's 'Third Branch,'" May-June 2007, page 56). She points to the 3-D PDF on her screen: "*This* is what convinces people."

~ELIZABETH GUDRAIS

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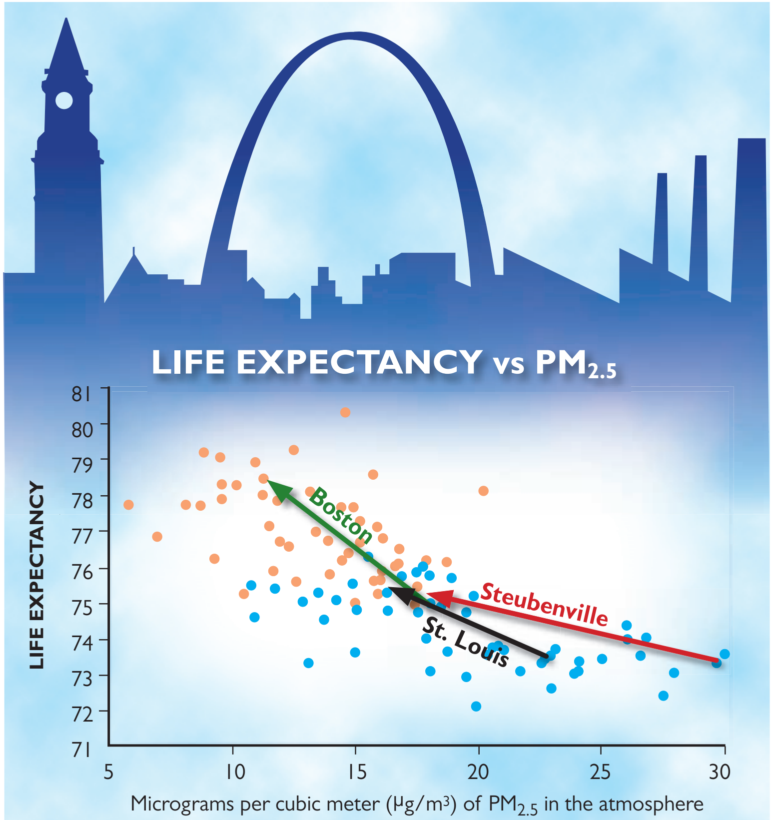
FINE CONSEQUENCES

Clean Air, Longer Life

When it comes to personal health, breathing is not like handwashing. Clean or dirty, like it or not, every day you breathe in 20,000 liters of air; you can't decide when to do it. But research has shown that the cleaner the air you breathe, the longer you will live. Investigators at the Harvard School of Public Health demonstrated that association in 1993 when they compared the average lifespan of residents in U.S. cities known for the worst air pollution with that of residents in cities with much cleaner air. Now some of the same researchers have published a paper demonstrating that federal regulations reducing concentrations of fine particles—those most hazardous to human health ($PM_{2.5}$, or 2.5 microns in diameter)—have had a salutary effect on public health: adding five months to the average lifespan during the period from roughly 1980 to 2000 in the 51 metropolitan areas studied.

The recent investigations, which compiled data from a variety of earlier projects, used a different approach than the 1993 study. Rather than comparing one city to another, the researchers compared the evolving air quality of the respective met-



Particulate matter that is 2.5 microns or less in diameter ($PM_{2.5}$), the kind emitted from smokestacks and tailpipes, is known to be especially harmful. Reductions in such pollution lead to increased life expectancy. In Boston between 1980 and 2000, for example, as $PM_{2.5}$ concentrations dropped from 18 to 11 micrograms per cubic meter, local average life expectancy climbed four years. Of that increase, four-tenths of a year—or 10 percent of the total gain—was attributable to improved air quality.

ropolitan areas over time. Their findings validate the previous work.

During the roughly 20-year span studied, the overall average increase in lifespan was just under three years. Although much of this gain was due to other factors—including greater use of statin drugs, reductions in smoking, the increased prevalence of defibrillators, better diets, and better healthcare during the period—the cities with the biggest improvements in air quality invariably saw the biggest improvements in life expectancy. Even in a city like Boston, which registered relatively cleaner air, generally good healthcare, and an increase of four years in life expectancy, cleaner air accounted for 10 percent of the gain.

In those cities with the *largest* improvements in air quality, the increase in lifespan attributable to cleaner air was 10 months. "It is a dramatic gain," says professor of environmental epidemiology Douglas Dockery, the paper's senior author, who chairs the department of environmental health. Given the small changes in the overall levels of these all-but-invisible particles (whose average concentration dropped fewer than 7 micrograms per cubic meter), he notes, "It is startling that we can detect this effect at all." Yet an analysis by the federal Office of Management and Budget has shown that the public-health benefits of controlling fine-particle pollution vastly outweigh the costs. As an editorial stated in the *New England Journal of Medicine*, in which the new findings appeared, the results are significant because they provide "direct confirmation of the population health benefits of mitigating air pollution...."

The public-health benefits of controlling fine-particle pollution vastly outweigh the costs.

~JONATHAN SHAW

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DISK DRIVE

Fighting Disease *in Situ*

THE DISKS at the center of Dr. David Mooney's current cancer research don't appear very powerful. Grayish-brown circles with the texture of a dry, hardened sponge, they are dwarfed by a fingertip and snap in half easily. But if recent work on melanoma therapies by the McKay professor of bioengineering and his team are any kind of harbinger, these tiny disks could become cancer's biggest challenger.

Cancer is a tough enemy. Against most diseases, the human immune system is a stalwart defender, equipped with a huge arsenal of molecular weapons to fight off bacteria, viruses, and all sorts of other harmful foreign invaders. But cancer flies under the radar: created by the body, it is camouflaged by familiar proteins the system has learned to view as harmless.

The relatively new field of cancer immunotherapy seeks to resolve this quandary by retraining the body's defenses to seek out and destroy cancer cells it would normally pass by. So far, the vaccines and therapies developed using this approach typically involve removing cells from a patient's body, programming them externally, and then reinjecting them. At that point, the hope is that the cells will travel to the lymph nodes and activate tumor-fighting killer T-cells.

"But there are limitations with that protocol," says Omar Ali, a postdoctoral fellow and a principal collaborator with Mooney. "Specifically, when you inject the cells back into the patient, many of them—which you have spent so much time programming—will die." Once trained outside their natural environment, Ali says, the cells have trouble readjusting to the body, leaving only 1 to 2 percent to mobilize cancer-fighting T-cells.

Mooney's team has solved this problem by finding a way to deliver cancer therapy from within. Mooney had been working with biomaterials and implantable systems in his research for years, stimulating