called for a Manhattan Project-style assault on weapons of bioterror. Mukherjee, a doctor at Massachusetts General Hospital who teaches at Harvard Medical School, believes such targeted research will likely waste money and yield few results. "Scientific discoveries often happen when they are least expected," he points out.

Collier's case is instructive. He began studying anthrax in 1987, intrigued by the manner in which the bacterium attacks human cells. He did not set out to find an antidote but rather to delve "deeper and deeper into the basic biology of anthrax toxin." (U.S. Army researchers at Fort Detrick, Md., began working on anthrax in the 1960s but made no comparable contribution.) Collier's approach unlocked a critical method in the microbe's attack, leading to the discovery of the drugs that could interrupt the process.

Almost the opposite approach was tried with HIV research. In the early 1990s, AIDS activists put tremendous pressure on scientists at the National Institutes of Health (NIH) to produce results. And they got them. Adopting a "mission-oriented" approach, the researchers were able to develop effective antiviral therapies, "even before much of the basic biology of the virus was fully understood." The cost, however, was enormous. A 1999 study by NIH found that the federal government had spent proportionately more money (in dollars per year of life saved) on AIDS than on any other disease. Collier explained to Mukherjee that declaring war on a disease invites "bad science—a lot of junk aimed at getting some of that pork-barrel money."

Ironically, NIH and the National Science Foundation were established to provide federal backing for exactly the kind of "curiosity-driven" basic science that Collier represents. Important discoveries more often come about by synthesizing results from seemingly disparate fields than emerge as the end product of goal-oriented research. The protease inhibitors that have been the most effective weapon against AIDS were only found because of earlier work by scientists studying kidney disease.

"Examples of such serendipitous breakthroughs abound in the folklore of science," says Mukherjee. But "the more narrowly you define a scientific goal—hoping to focus and streamline discovery—the more you potentially logjam the discovery process itself."

Baby, It's Busy Up There!

"The Gas between the Stars" by Ronald J. Reynolds, in *Scientific American* (Jan. 2002), 415 Madison Ave., New York, N.Y. 10017–1111.

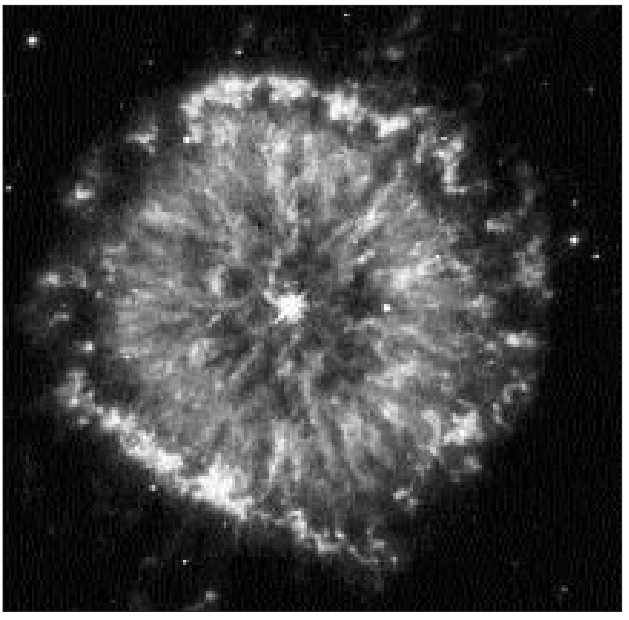
A new and startling picture of the vast interstellar regions of the Milky Way has emerged over the past several decades. Astronomers long conceived of the "interstellar medium" as a static reservoir of very thin gases, little more than a nuisance that got in the way of their efforts to observe the stars. The medium was thought to be much like the atmosphere of the moon, which is to say no atmosphere at all—a medium that conducted neither sound nor heat.

"Now we recognize the medium as a tempestuous mixture with an extreme diversity of density, temperature, and ionization," reports Reynolds, an astronomer at the University of Wisconsin, Madison. (The medium is about 90 percent hydrogen in various forms and 10 percent helium, with trace amounts of other elements.) "Supernova explosions blow giant bubbles"; there are "fountains," "chimneys," and "clouds." Conceptually, the interstellar medium increasingly looks like Earth's atmosphere, binding together the galaxy and ensuring that an event in one place will have an impact in another. This new view is revolutionizing the way scientists comprehend the galaxy.

For example, it now appears that supernovas (exploding stars) create vast "hot bubbles," along with cosmic rays that "raise the pressure of the interstellar medium; higher pressures, in turn, compress the dense molecular clouds and increase the chance they will collapse [and form] stars." Oversized bubbles may extend all the way to the halo of the galaxy, each forming a kind of cosmic chimney that transports hot gases

from its supernova to the outer reaches of the Milky Way, where the gases cool and rain back on the galaxy.

Stars thus seem to be the "main source of power for the interstellar medium." But it's not a certainty. Reynolds says that the loop above one huge bubble "looks uncomfortably similar" to certain features of our own sun that are created by the sun's magnetic field. It may be that magnetic activity dominates the galaxy's atmosphere, just as it does that of the planets and stars. That would make the analogy between the interstellar atmosphere and our own earthly one "even more apt than we think."



This collapsing star in the constellation Aquila began emitting a huge cloud of gas several thousand years ago, but the image is only now being captured by the Hubble Space Telescope.

ARTS & LETTERS

The Decline of Commercial Architecture

"Design and Development" by Witold Rybczynski, in *Wharton Real Estate Review* (Fall 2001), Lauder-Fischer Hall, 3rd fl., 256 S. 37th St., Philadelphia, Pa. 19104–6330.

Commercial real estate developers, who are responsible for the vast majority of new buildings in the United States, seldom win plaudits for great architecture. Not one of the nine projects that won the Progressive Architecture Awards last year was a developer-driven building. Yet Rybczynski, an author and University of Pennsylvania professor, isn't ready to lay the blame at the feet of money-grubbing developers.

"In the past," he notes, "some of the most imaginative and experimental architecture was commissioned and built precisely by and for real estate developers." As long ago as 1728, the speculative builder and designer John Wood erected a spectacular and innovative residential complex in the English resort town of Bath that included, among other things, "33 three-story houses behind a façade that was loosely based on the Roman Coliseum." The renowned architect John Nash designed the Royal Opera Arcade, a glass-roofed shopping street (and precursor of the mall) that opened in London in 1818. Other examples include New York City's Dakota apartment building (1884) and Rockefeller Center (1933). The many commercial commissions of modernist master Mies van der Rohe included the aluminum-and-glass Lake Shore Apartments (1951) in Chicago—a now familiar style that was revolutionary in its day, according to Rybczynski, "influencing the design of both office buildings and high-rise apartments for more than two decades."

So why did developers move away from cutting-edge architecture? Rybczynski is skeptical of the pocketbook explanation. History shows that good architecture doesn't have to cost more. He thinks the change has more to do with a shift in the patronage of high-profile architecture.

Beginning in the late 1960s, governments, tax-exempt institutions, and private individuals had the biggest building budgets,