

cules that “could prove invaluable in discovering new drugs or diagnosing disease.”

Inside a chamber of Mirkin’s microscope, Rotman explains, “the tips of tiny probes dip into a well of organic molecules. The microscopic tips, sharpened to a point only a few atoms wide, then ‘write’ the words typed by Mirkin in letters tens to hundreds of nanometers wide.” (A nanometer is one-billionth of a meter.) “By automating the procedure and rigging up a number of tips in parallel,” Rotman continues, “Mirkin has learned how . . . to rapidly and directly create structures at the nanometer

scale.” This could be a way to mass-produce nanostructures, Mirkin believes.

His structures are a far cry from Drexler’s nanobots, but they have the advantage of being real. Other advances in nanotechnology, notes Service, “have already led to improvements in computer data storage, solar cells, and rechargeable batteries.” More are on the way. Adding to private-sector efforts, Congress last year approved the National Nanotechnology Initiative. The federal government is spending on nanoscience this year some \$423 million—hardly a nanosum.

Tuskegee Redux?

“The Shame of Medical Research” by David J. Rothman, in *The New York Review of Books* (Nov. 30, 2000), 1755 Broadway, Fifth Floor, New York, N.Y. 10019-3780.

As American medical researchers have pressed the fight against AIDS, some have been conducting more of their clinical trials in Africa and Asia. So have investigators from American drug firms who want to test new treatments for various ailments without the regulatory and financial burdens of research at home. But the researchers seldom give their overseas test subjects the same high level of medical care that Americans receive. Rothman, a professor of social medicine at the Columbia College of Physicians and Surgeons, says this is wrong.

The question of whether Western standards should be applied in Africa and Asia first arose, Rothman says, after clinical trials in the United States determined in 1994 that the drug azidothymidine (AZT), though highly toxic, significantly reduced the transmission of HIV from infected pregnant mothers to their children. This treatment immediately became standard in American hospitals, but it was too expensive (\$800 for a six-month course of AZT) for developing countries, where the average citizen spends less than \$25 a year on health care. Researchers then sought to determine whether administering a small amount of AZT late in the pregnancy, at a cost of only \$50, would be almost as effective. They conducted clinical trials involving some 17,000 pregnant women, mostly in southern Africa and Thailand. The women generally were given either the small amount

of AZT or a placebo. Had the trials been conducted in the United States, Rothman notes, the women in the control group would have been given not a placebo but the already-proven six-month AZT treatment.

Critics such as Marcia Angell of the *New England Journal of Medicine* charged that in giving the women placebos, the researchers showed “a callous disregard of their welfare,” in violation of the World Medical Association’s code of ethics for human experimentation. But Harold Varmus and David Satcher, the then-heads, respectively, of the National Institutes of Health and the Centers for Disease Control and Prevention, which funded some of the research, defended the use of placebos. The six-month AZT treatment, they said, not only was very expensive but required frequent medical monitoring beyond the capacity of developing countries. Use of the placebos also allowed researchers to find out more quickly that the small-dose treatment was effective, thus sparing more infants. Africans and Asians on local review boards had approved the clinical trials, and the United States, proponents said, should not be dictating research ethics for developing countries.

That was far from the end of the controversy, however. “AIDS investigations in developing countries often withhold effective treatments from research subjects,” says Rothman. This is not only because the treat-

ments are costly and hard to administer, but because they can fatally undermine the research. For example, researchers from the University of Washington and the University of Nairobi who were studying not the efficacy of AZT but how HIV is transmitted from pregnant women to their children, could not have carried out their study if they had given the women AZT.

Some advocates, Rothman notes, contend

“that the tidal wave of AIDS sweeping the world, particularly in southern Africa, is so dreadful that researchers must be given a relatively free hand.” But he disagrees. “When we take account of the misery and stunted hopes of people in Uganda, it is not enough for investigators to say that their research left them no worse off. . . . Do unto others as we do unto ourselves—a principle for researchers everywhere.”

Why Do Horses Sleep?

“Do Horses Gallop in Their Sleep?” by Matt Cartmill, in *The Key Reporter* (Autumn 2000), Phi Beta Kappa Society, 1785 Massachusetts Ave., N.W., Fourth Floor, Washington, D.C. 20036.

Is consciousness unique to humans, or do other animals also possess it? Scientists—who are generally reluctant to deal with so subjective a thing as consciousness—are divided on the question. But Cartmill, a professor of biological anthropology and anatomy at Duke University Medical Center, thinks that the form of unconsciousness known as sleep offers some clues to the mystery.

Like humans—and unlike most animals—horses and other mammals (as well as birds and possibly some reptiles) engage in “true sleep, involving a shift from fast to slow waves in the forebrain,” Cartmill notes. Because such sleep is “dangerous, complicated, and time-consuming,” there must be “a payoff.” It’s not to conserve energy, he says, since “mammalian sleep uses almost as much energy as wakeful resting.” And it’s not to avoid predators, since “birds and mammals that are too big to hide still have to flop down and fall asleep every day, right out there on the prairie, exposed to every predator in the world. They do it as little as possible—a horse sleeps only about three hours a

day, of which only 20 minutes is spent lying down—but they’d be better off if they didn’t do it at all,” like most invertebrates and cold-blooded vertebrates.

It appears to be “the needs of the brain” that make sleep necessary for humans, Cartmill says. “Consciousness damages or depletes something in the waking brain, and we can’t keep it up indefinitely. If we’re forced to stay conscious around the clock, day after day, with rest but no sleep, we soon start manifesting pathological symptoms.” Sleep seems to restore that damaged or depleted “something” in the brain.

If that is so, Cartmill concludes, then “it seems reasonable to think that animals that have to sleep as we do are conscious when they are awake.”

The evidence for animal consciousness “is necessarily indirect,” Cartmill says. But that evidence, in his view, “seems at least as persuasive as the indirect evidence that we have for other unobservable phenomena—for example, the Big Bang, or neutrinos, or human evolution.”

ARTS & LETTERS

Remaking the Landscape

“A Word for Landscape Architecture” by John Beardsley, in *Harvard Design Magazine* (Fall 2000), Harvard Univ., Graduate School of Design, 48 Quincy St., Cambridge, Mass. 02138.

Unlike architecture and the fine arts, landscape architecture seldom appears in the limelight. But that may be about to change. The low-profile discipline is fast

becoming perhaps “the most consequential art of our time,” claims Beardsley, a senior lecturer in landscape architecture at the Harvard Graduate School of Design. No