sometime in 1997. So far, the virus, which is injected directly into the patients' tumors, appears safe. In Texas, four sets of patients, a total of 12 in all, have received the injections, and no side effects have appeared, even with the higher doses. That's "rare" for new cancer treatments, Von Hoff says. "Usually by now we'd see some fever or chills."

Still, it's too early to tell whether the injections are producing any therapeutic effects. And other researchers point out that the mice the McCormick team used to test the virus's anti-tumor effects may not be a good model of human patients. For one thing, the animals lacked immune systems, and therefore the studies could not address whether the body's immune system will get in the way of any therapeutic effects. Most adults have already been infected by adenoviruses, Klausner points out, and as a result they have immune systems that are primed to destroy the virus, possibly before it has a chance to spread throughout a tumor. Inactivation of the virus by the immune system has hindered efforts to use adenovirus in gene therapy, for example. "That's been a real problem," McCormick admits.

Also, says Berk, "[the virus's] therapeutic value depends on the ability to discriminate between cancer cells and normal cells." Because adenovirus does not infect mouse cells, the mouse studies do not indicate whether the infection will be restricted to the tumor. And there are reasons to suspect that it might not be. Studies conducted 20 years ago with different mutant adenoviruses indicated that sometimes viruses lacking E1B do grow in certain cells containing p53, such as human embryonic kidney cells, so it may be that the cell-killing virus would not restrict itself to cancer cells. Conversely, in other tests, mutants like dl1520 failed to thrive in cervical cancer cells lacking the p53 protein. These somewhat contradictory findings suggest "the story is much more complicated" than the ONYX researchers think, says Berk, and that the virus might not be as effective or as discriminating as they hope.

And even if the virus works, delivering it to a deep or inaccessible tumor, let alone to any distant metastases, could be a challenge. "The real issue is how to get the virus to a particular site," McCormick says. Consequently, for the time being, the viral treatment can be tried only against tumors in the head, neck, brain, ovaries, and cervix, tissues into which virus can be directly injected.

But if the virus really can selectively kill cancer cells, even if only for a few kinds of tumors, "it will be a godsend," says pediatric oncologist Michael Kasten of The Johns Hopkins Hospital in Baltimore. "I can't wait to see how it works in people."

–Elizabeth Pennisi

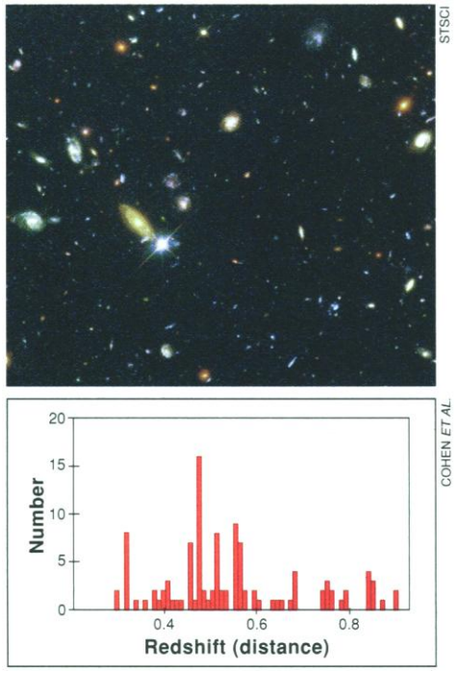
ASTRONOMY

Goodness Gracious, Great Walls Afar

A portrait of the early universe has gained a third dimension and a new element of mystery. Last December, scientists pointed the Hubble Space Telescope at the same spot near the Big Dipper for 10 days straight—an exposure so long that it revealed some of the faintest objects ever seen, many of them early galaxies (*Science*, 26 January, p. 450). But two-dimensional pictures rarely do justice to a landscape. Now California Institute of Technology astrophysicist Judith Cohen and her colleagues have determined distances to some of the galaxies in the image, called the Hubble Deep Field, and found that they aren't evenly distributed in space. Instead, as the observers report in the 1 November *Astrophysical Journal*, the galaxies are grouped in discrete structures—perhaps filaments, sheets, or walls.

Astronomers are used to such giant structures in the nearby universe, but at such great distances—about 6 billion light-years away, when the universe was roughly half its present age—a lumpy universe makes theorists uncomfortable. Their scenarios of how the universe evolved generally imply that large structures could not have formed until more recently. Cohen and her team ran into skepticism this spring when they reported evidence for distant structures in another patch of sky (*Science*, 14 June, p. 1590). But the latest measurement, she says, suggests that the previous observations were not a fluke and "structures at this distance are widespread."

To determine the distances of Deep Field galaxies, Cohen and her colleagues had to gather enough light from each one to make a spectrum and determine the light's redshift—an astronomical measure of distance. Using the powerful 10-meter Keck Telescope in Hawaii, they did so for 140 objects in and around the Deep Field. The group found that the redshifts seemed to cluster in six peaks, with relatively empty stretches between. The authors speculate that their line of sight may have punched through distant walls of galaxies similar to ones observed much closer to our sun.



Wall marks? Clustered redshifts in galaxies seen in the Hubble Deep Field *(top)*.

If the team really has found large-scale structures, says Joseph Silk, an astrophysicist at the University of California, Berkeley, "that would be an interesting constraint" on cosmological theories—especially if the structures are walls, which are more highly organized than clusters or strings. Many current theories assume that matter in the universe is dense enough for structures like the ones seen today to coalesce in short order, implying that structure formation somehow got delayed until recently. If the process started earlier, it must have proceeded more slowly, explains Ray Carlberg, an astrophysicist at the University of Toronto, implying that the universe is less dense than is widely assumed.

But not everyone is convinced that Cohen is really seeing early walls. Carlberg says it's too soon to say exactly what the clustered redshifts represent, because the scientists' data stab through a limited patch of sky. (It would take nearly 250 such patches to cover the full moon.) Such surveys are like "skewers through the universe," adds David Koo, an astrophysicist at the University of California, Santa Cruz, and it's not easy to extrapolate a large-scale structure from one stab. "It's difficult to tell whether they've hit a meatball-like cluster or a sheetlike wall," he says. The authors acknowledge such limitations, and they are surveying adjacent patches to see if the putative walls continue across the sky.

Even if these stabs are not conclusive, astronomers agree that the wider picture should be visible soon. Several other projects are under way at Keck, including an ambitious effort called the Deep Extragalactic Evolutionary Probe, which will use a yet-to-be-built spectrograph to map the redshifts of thousands of galaxies at about the same distances as the ones Cohen observed. Carlberg predicts success. "They have the Keck, and that's the biggest hammer around," he says. "They are going to clobber this problem."

–Gretchen Vogel