starlight suggest that a network of clouds lies just beyond the Local Fluff, within 35 light-years of the solar system.

Using the wide-angle lens, the movie's third scene reveals the landscape of the Local Bubble, the giant cavity that encloses the solar system and its surroundings. A new study may help elucidate the origin of a high-temperature region nested within it. To examine this region, Q. Daniel Wang of Northwestern University in Evanston, Ill., analyzed X-ray emissions recorded by the ROSAT satellite.

Fierce stellar winds from a rash of massive newborn stars, combined with the blast from supernova explosions, may have created a smaller cavity that abuts the Local Bubble. Gas from this cavity, known as a superbubble, could have heated the solar neighborhood. Frisch has proposed that violent outbursts from a group of stars called the Scorpius-Centaurus Association, which lies about 600 light-years from the sun, generated the superbubble.

Just as an inflating balloon expands more easily into a region of lower density, the superbubble pushed deep into the region around the sun, already swept clear of material by the much older and larger Local Bubble. Inside the Local Bubble were tiny remnants of the giant cloud that gave birth to the Scorpius-Centaurus Association. Subsequent generations of supernova explosions eroded the surface of these remnants, causing their gas to evaporate and blow toward the solar region. Some of this gas, speculates Frisch, may have formed the Local Fluff.

Wang notes that his findings, presented at the American Astronomical Society meeting in January, argue against the proposal that a single, relatively close supernova called Geminga created the Local Bubble (SN: 1/2/93, p. 4). Some researchers now believe that Geminga resides in the wrong place to have carved out a hole in space near the solar system.

In his ROSAT study, Wang measured the absorption of X rays by two gas clouds that appear in adjacent patches of sky in the constellation Reticum. One of the clouds lies about 200 light-years from Earth, the other about twice as far. ROSAT detected X-ray emissions in front of both clouds, although the signal in front of the nearer cloud was only 40 percent as strong as that in front of the more distant cloud.

The signals indicate that, rather than concentrating behind a particular cloud, hot, X-ray-emitting gas pervades the region, he says. Wang interprets the data as suggesting that a bubble of hot gas bathes the area surrounding both clouds and, by inference, much of the rest of the region surrounding the sun.

Wang also found that the cloud nearer the sun has a higher temperature than the more distant one. That finding, he says, suggests that the superbubble recently blew out a stream of hot gas that flooded the solar neighborhood.

"The X-ray evidence appears to support the view that the hot gas represents a breakout from the [Scorpius-Centaurus] superbubble," says Frisch.

The coming attractions in the movie theater might be based on another type of direct observation that looms on the horizon. Scientists calculate that by 2010, the venerable Voyager 1 and Voyager 2 craft, now more distant than Pluto and speeding rapidly toward the edge of the solar system, will cross the heliopause. Equipped with ultraviolet spectrometers and radio-wave detectors, these craft may help pinpoint the exact location of the hydrogen wall and detect interstellar gas as it enters the solar system.

Such observations may have more than academic interest. Fifty thousand to 100,000 years from now, says Frisch, when the sun is expected to emerge from the passing Local Fluff, it may encounter a far denser cloud. Atoms and ions from such a cloud would penetrate deep into the solar system, overwhelming the solar wind near Earth and bombarding its atmosphere.

Frisch and her colleagues haven't yet calculated the effect of this bombardment, but it could make a world of difference to Earth's climate. □

Materials Science

Richard Lipkin reports from San Francisco at a meeting of the Materials Research Society

Sound signals surf on waves of light

As a means of carrying signals from one place to another, nothing beats light. Fast and frictionless, photons trounce electrons as the ideal carriers of information.

As computers get ever speedier, scientists are finding that microprocessors are pushing the physical limits of electric conduction. So researchers have been looking for ways to use pulses of light to ferry digital information within a computer.

Now, Jurgen Michel and Lionel C. Kimerling, materials scientists at the Massachusetts Institute of Technology, have used light to transmit messages—specifically, the sound of a voice. They've fabricated an integrated circuit, a single chip made entirely of silicon, that combines conventional semiconducting logic with optical data transfer.

Their circuit consists of three components—an erbium-silicon light-emitting diode, a device to guide the light waves, and a detector to pick up the processed signal at the other end. Although others have used light to carry signals, he adds, this is the first success with a single silicon chip, which would fit inside a computer.

Although the long-term goal isn't to transmit chatter, says Michel, the circuit proves that one can use light to move information "from one place to another on a chip or between chips." The technique could obviate the need for metallic interconnections, which limit signal-processing speed on chips. Computers would still use conventional semiconductors and microelectronics to perform calculations.

"With the metal interconnects in use today, it's hard to push microprocessors faster than 1 gigahertz," Michel says. This speed represents 1 billion operations per second. Using silicon-based optical electronics, it's possible to double or even quadruple that rate, he believes.

Bite-sized vacuum tubes

Paying homage to the early days of broadcasting, when oak-paneled radios blared out swing tunes, physicists Griff L. Bilbro and Christopher W. Hatfield of North Carolina State University in Raleigh and their colleagues are fashioning tiny vacuum tubes out of diamonds.

"We're revisiting vacuum tubes from the 1940s," says Bilbro. "But now we're taking advantage of new materials and computer design tools to predict their performance at very high frequencies, for use in radar and cellular phones."

Vacuum tubes offer some advantages over semiconductors and computer chips, Bilbro says. They're more durable than other microelectronics materials, outperforming semiconductors at high temperatures, voltages, and radiation levels.

The researchers made arrays of vacuum tubes by encasing electrodes in diamond, then evacuating the air from the interiors. These arrays resemble "furrowed fields, with rows of ridges and troughs," Bilbro says. "Each array looks like a glass bead, about the size of a match head."

A big difference between the new diamond vacuum tubes and the large glass bulbs of 50 years ago is heat. The old tubes had to glow red-hot to emit streams of electrons. The new tubes produce current at room temperature.

"There's an interesting irony here," says Hatfield. "Vacuum tubes paved the way for solid-state transistors. Now we're seeing that, for certain applications, the new vacuum tubes offer advantages over solid-state components."