

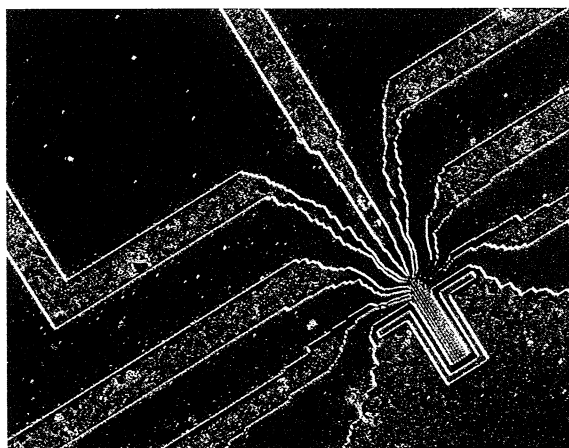
In her collaborations with scientists, Frankel has learned a great deal about science and about the special needs and constraints of scientific photography, especially the necessity for technical accuracy. She has developed a strong interest in formulating standards for visualization.

Her collaborators have also benefited. "Pictures help you do science," Frankel says. "They encourage thinking."

To photograph a physical system, it's often necessary to consider such factors as color, texture, and lighting. "Each time we find ourselves thinking about the system in a way that requires a greater degree of control, we learn something about it," Whitesides says.

Such requirements can also lead to useful observations that might not otherwise have been made. For example, when Whitesides and his coworkers were studying drops of water separated by very thin barriers, they introduced dyes into the liquid to make the photographs more interesting.

"Putting in dyes enabled us to think about the question of whether there were



Spider Pipes. The solid metal wires of these microelectrodes, outlined in gold, serve as conduits for electrons, which can leak into the liquid that covers the wires.

small channels that allowed the fluids to leak from one drop to another without necessarily making a visible bridge," Whitesides says. "As far as we could see, there was no such thing, but we had a new piece of information."

Frankel's NSF project gives her a chance to see how much of the art she brings to scientific photography and to imaging in general can be readily con-

veyed to students. "It's technically very demanding and not at all obvious how to take these pictures," Whitesides notes.

When Frankel's project is completed, students who go through her course or read the resulting handbook should be much better able to select appropriate methods and equipment to document their research.

In addition, "I think it's useful to teach students how to look at something for its visual qualities," Whitesides says.

Another issue is fidelity. "One of my principal concerns is that visual materials in their present digital form can be readily manipulated," Beck says. "In the future, students are going to have to be trained to be as critical of visual materials as

they are now trained to be critical of verbal materials."

Frankel herself appreciates the dangers. "As an architectural or landscape photographer, I knew how to make a wonderful picture out of something not so wonderful," she says.

In scientific work, accuracy is paramount. It's the combination of truth and beauty that merits attention. □

Earth Science

From a meeting in San Francisco of the American Geophysical Union

Pollution surge from new Chinese cars

As residents of China trade in their bicycles for cars, the resulting tailpipe pollution will harm the entire western Pacific and have indirect global ramifications, according to calculations by an atmospheric chemist and his colleagues.

Only a few million people in China now own private cars, but that number could rise to 400 million in 50 years, as the country's population tops 1.5 billion, says Scott Elliott of Los Alamos (N.M.) National Laboratory. Starting with these estimates, Elliott analyzed how the exhaust would spread across the country and out over the Pacific. His initial report appeared in the Nov. 1 *GEOPHYSICAL RESEARCH LETTERS*.

A computer simulation of air currents shows China producing a broad plume of ozone pollution, generated by the nitrogen oxides in car exhaust. "We compute that cars would bathe the entire western Pacific in ozone, which means that Korea and Japan would have ozone levels comparable to [those in] Los Angeles on a bad summer day," says Elliott. Ozone from China could even reach North America.

The additional cars would also contribute significantly to greenhouse warming. Elliott estimates that global emissions of carbon dioxide could rise as much as 30 percent.

Thomas E. Graedel, an industrial ecologist at Yale University, notes that Chinese motorization would not occur in isolation. Elliott's calculations do not take into account the massive development that China must undergo before it could produce and support such a large increase in the number of cars, he says.

Elliott adds that China is only one of many countries that will expand their automobile fleet in the next half century. —R.M.

California volcano starts to stir

Soon after the debut of *Dante's Peak*, a fictional film chronicling a volcanic eruption in the Pacific Northwest, nature pro-

vided some unanticipated publicity for the movie. This summer, a real volcanic site in eastern California began generating many earthquakes even as instruments picked up signs that the ground there was expanding. Since then, the region has spawned a handful of house-rattling jolts and 8,000 small tremors above magnitude 1.2, reports David P. Hill of the U.S. Geological Survey (USGS) in Menlo Park, Calif.

The seismic activity, called a quake swarm, remained relatively minor through the spring and summer but took off in October, culminating with three jolts approaching magnitude 5 in late November. The earthquakes have centered on the southwest side of the Long Valley caldera, a 30-kilometer-long oval depression on the eastern flank of the Sierra Nevada. Overlapping the ski town of Mammoth Lakes, Calif., the caldera formed 760,000 years ago when an eruption of magma caused the crust to drop by 2 km.

Over this year, instruments have detected the ground inside the caldera warping upward by 5 centimeters, a dramatic jump over the gradual deformation seen in the last few years. The dome-shaped region has risen 70 cm since 1980.

Geoscientists have been monitoring the seismic unrest and ground movement closely, looking for signs that magma is squeezing up through the crust toward the surface, perhaps portending an eruption. So far, no clear evidence of magma movement has emerged, and the USGS assessment of eruption risk remains on the lowest level of a four-tier alert system.

Scientists at USGS have seen even stronger quake activity at Long Valley twice before, in 1980 and 1983, without any eruptions. In 1982, the agency prepared a notice of potential volcanic hazard that alienated many residents of Mammoth Lakes and turned into a public relations fiasco. Since then, there have been occasional smaller quake swarms and quiet intervals. "These can go on for decades or centuries without an eruption. What we have to do is keep watch," says Hill. —R.M.