Soap-film shots tell more about swirls

In the iridescent eddies of a soap film, scientists see a parallel to the whirling flows of Earth's thin coating of atmosphere and oceans. The analogy also extends to sister planets, whose turbulent phenomena befuddle fluid-flow experts.

Past laboratory studies of soap-film turbulence have generated wishy-washy results because experimenters have been limited to recording the velocity of flowing films at a single point. Now, a research team at Los Alamos National Laboratory has leaped that hurdle with an apparatus that simultaneously measures velocities at thousands of points in a patch of cascading film.

"They're pushing the instrumentation about as hard as you could," says John Sommerer at Johns Hopkins University.

In the latest version of the experiment, a continuously replenished film of soapy water races more than a meter down two nylon wires strung 6 centimeters apart. A comb inserted through the film induces swirling eddies downstream, which a digital camera records through a 5-centimeter-square window. Mixed into the water, microscopic spheres of titanium dioxide, the reflective substance in white paint, render the eddies visible.

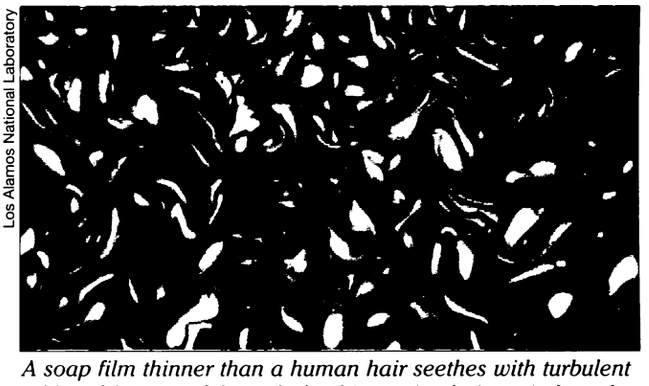
By flashing strobe lights twice per camera exposure, the researchers create images that show the change in position of each of the thousands of marker particles. Computer analysis transforms the stop-action frames into velocities yielding, for the first time, a quantitative portrait of a soap film's swirls, report Michael Rivera of the University of Pittsburgh and Peter Vorobieff and Robert E. Ecke of Los Alamos in the August 17 PHYSICAL REVIEW LETTERS.

The velocity data is sufficiently detailed for unprecedented mathematical examination of the turbulence, says Vorobieff. "This analysis allows us to explicitly compare our data to existing theories and provide benchmarks for people who do numerical calculations."

From their investigation, the researchers conclude that the observed turbulence is "roughly consistent" with two-dimensional turbulence theory. That model, however, assumes a uniform thickness of the film, which the researchers did not find. The camera detected plumping-up at the fringes of eddies, where more light was scattered by the increased number of marker particles.

Fluid dynamics researchers have had some doubts about soap films as a model for two-dimensional turbulence, Sommerer says, because they suspected that such films might have significant flow in the third dimension, evident as thickness variations. The finding that the film has ripples but still can be described by existing theory suggests that the flow in the third dimension is suitably small. That should inspire "increased confidence" in the results derived from soap-film turbulence studies, he says.

Given the striking images possible from their easy-to-build, inexpensive apparatus, Vorobieff and Ecke, are promoting it as a classroom tool for physics teachers. —*P. Weiss*



Los Alamos National Laboratory

A soap film thinner than a human hair seethes with turbulent eddies (shown in false color), akin to circulating winds and ocean currents.

Truffle genes are much alike in the dark

Are French black truffles better than Italian black truffles?

That's hardly a question to treat lightly, and a team of French scientists has brought the techniques of population genetics to bear on the underpinnings of the controversy.

Their conclusion may only inflame the debate, however. The black truffle, *Tuber melanosporum,* displays remarkably little genetic variation across its European range, report Guillaume Bertault from the University of Montpellier and his colleagues. The variation that does occur follows no geographic pattern. In the August 20 NATURE, the researchers say that any regional difference in fragrance and flavor "probably results from environmental, rather than genetic, influences."

Small, earlier surveys had hinted at the low variability but had not explored regional patterns. Bertault's team checked 207 wild truffles from Italy and France for variation in 15 DNA sections. "We found a bit of everything everywhere," Bertault says.

Black truffles can command up to $900 a pound retail. "Yes, we did eat some," Bertault admits. "That's the advantage of molecular biology: You need only a very small amount of biological material."

The genetic picture suggests that about 10,000 years ago, the truffle endured a population bottleneck, a massive die-off that left only a few survivors to repopulate the range, the researchers say. The disaster that nearly wiped out the black truffle could have been the last glacial period, which ended a little more than 10,000 years ago.

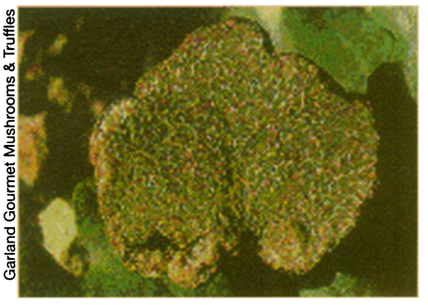
The black truffle ripens in winter and suffers more from the cold than Europe's summer truffle does, Bertault points out. The warm-weather cousin that's dormant through the winter has retained more genetic variety, he says, which supports the notion that it suffered less from the glaciers.

The genetic analysis intrigues Jim Trappe, who studies truffles at Oregon State University in Corvallis. Lots of mysteries remain about basic biology, he notes. Truffles belong to a maddening group of fungi that live only as partners to other plants, and scientists have yet to coax the spores to germinate in laboratory cultures. Even placing bits of the fungus on tree roots outdoors to start a truffle orchard is an uncertain business.

French agricultural advisers emphasize location, location, location as the key to success in commercial orchards, Trappe notes, advice that supports the geneticists' argument for the primacy of environmental influences.

So far only two orchards in the United States have managed to produce commercial black truffles. The owner of one, Franklin Garland of Hillsborough, N.C., thinks the environmental emphasis sounds "very reasonable."

His own trees were inoculated with French cultures, and he has tried to mimic French soil. "My truffles taste just like the ones grown in France," Garland says. Moreover, his Laborador retriever, trained with a French truffle, now sniffs out the home-grown delicacy. —*S. Milius*



Garland Gourmet Mushrooms & Truffles

A black truffle (in cross section) can attract dogs and pigs by its odor.