his colleagues came in 0.07% below the standard value with their torsion balance experiment. Back in Germany, Hinrich Meyer's group at the University of Wuppertal ended up 0.06% low using a different system—a pair of pendulums deflected by the gravitational tug of two large masses.

At least one explanation is out. The researchers firmly reject the notion that G could be changing with time or position on the planet. Still, the challenge of pinning down its value remains. The best place to do so, the researchers agreed, would be in orbit, away from Earth's gravity and other confounding signals. But "no one is going to pay for that," says Luther, so he is now remeasuring the constant "for fun" on an arid mesa a thousand feet above the Rio Grande River. Far from traffic and the troublesome water table, the experiment will make two simultaneous measurements of G using different techniques. That, says Luther, should make it the most precise yet.

–A.R.

Edging Toward Supersymmetry

Much of particle physics is in the doldrums. The canceled Superconducting Super Collider will never be more than a hole in the Texas prairie; the Large Hadron Collider at CERN, in Switzerland, won't reach its full energy until well into the next century. But inside tabletop atomic physics devices like the one in Norval Fortson's laboratory at the University of Washington, physics at the frontier is alive and well.

That was Fortson's message at the APS meeting, where he reported that his laboratory had made the most sensitive search yet for an electric dipole in the atom—a tiny separation between its centers of positive and negative charge. The experiment doesn't sound like the stuff of high-energy physics: lining up the magnetic spin axes of mercury atoms, then nudging them with an electric field and probing for the wobble that betrays a dipole. But this wobble, if it appeared, might support a theory called supersymmetry, which many physicists have embraced as their best hope for extending their picture of the forces of nature. "It would be an epoch-making discovery," says theoretical physicist Stephen Barr of the Bartol Research Institute in Newark, Delaware.

So far, though, Fortson and his colleagues Steve Lamoreaux, Blayne Heckel, James Jacobs, and William Klipstein have seen no trace of a wobble. The lack of any dipole larger than 8×10^{-28} centimeters—the current sensitivity of the Washington experiments—"is a soft bound on supersymmetry," says Fortson, who notes that the simplest versions of the theory predict an effect at least 100 times that size. But the dipole could be smaller in other versions of the theory, says Barr, which means that something interesting might be just around the corner.

Supersymmetry creates a single framework for the two basic kinds of particles in nature—force-carrying particles such as photons and "matter" particles such as quarks and electrons—and posits massive, shadowy partners for known particles. These particles would materialize only at energies higher than the largest accelerators today can muster. But quantum mechanics grants even particles that aren't at home at everyday energies a fleeting presence as "virtual particles" that wink in and out of existence. Like ghosts that subtly rearrange a room while no one is looking, the virtual supersymmetric particles would interact with the quarks in an atom's protons and neutrons, leaving a mark in the form of a tiny electric dipole.

Tiny is just what the Washington experiment is designed to see. The latest results, submitted to *Physical Review A*, could reveal a separation of charge so small that "if you took a mercury atom and blew it up to the size of the Earth, that little bit [the dipole] would correspond to a hundredth of an angstrom," says Fortson. Its absence, along with the failure of other experiments to find any dipole in the neutron and the electron, shows that "the simplest [version of the] theory can't be right," says Barr. "I don't want to give the impression that there is some sort of crisis in supersymmetry. But it is extremely interesting for a theorist."

Actually finding a dipole would be still more interesting, of course. Fortson's group and others are promising an even closer search over the next couple of years. Just by probing for the wobble with a laser beam rather than the high-intensity lamp of their current apparatus, for instance, Fortson thinks his group can boost the sensitivity of their experiment by a factor of 10. "We have a lot of room for growth," he says—a claim not many experimental physicists can make these days.

–Tim Appenzeller

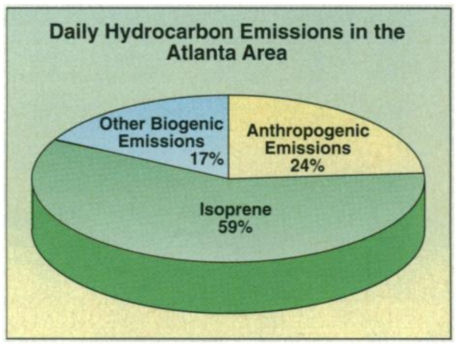
PLANT BIOLOGY

A Clearer View of Why Plants Make Haze

Australia's Blue Mountains. Virginia's Blue Ridge. Jamaica's Blue Mountain Peak. Places all over the world have acquired names evoking the bluish haze that hangs over wooded hills in summer. But what makes them hazy? In 1960, botanist F. W. Went suggested that simple hydrocarbon gases given off by trees were responsible, a phenomenon that 20 years later prompted the Reagan Administration to blame "killer trees" for air pollution. But the scientific story behind the emissions—and the implications for air quality—have remained, well, hazy.

An experiment reported in last week's issue of *Nature* dispels some of the haze by offering an answer to one question: Why do plants go to the trouble of producing it? The research implies that plants produce one major haze ingredient, isoprene, as a strategy for coping with heat. And that, together with recent evidence that these hydrocarbons are far more abundant than was thought, could change researchers' picture of the less benign haze that forms over urban and even rural areas on hot, sunny days. By understanding when and why plants give off hydrocarbons, explains Chris Geron, who does atmospheric modeling for the Environmental Protection Agency (EPA) in Research Triangle Park, North Carolina, "we can better understand the impact [of plant compounds] on our models of air quality."

Plant hydrocarbons, innocuous or even appealing on their own (the scent of a Christmas tree comes from one), are ingredients in photochemical smog. Along with hydrocarbons from cars and backyard grills, they combine with nitrogen oxides from combustion in engines and industry to generate low-level ozone—an irritant to lungs and to the plants themselves. "When plants did this 100 years ago, ozone formation was [probably] not being catalyzed," says Ray Fall, a biochemist at the University of Colorado, Boulder. "Now it triggers ozone."



SOURCE: W. L. CHAMEIDES AND CARLOS CARDELINO

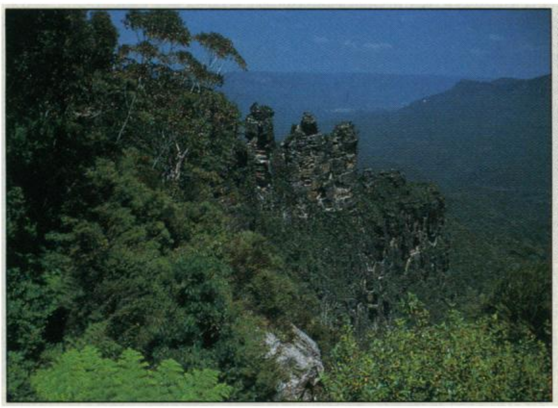
Recently, Geron and other researchers have come to realize just how large a role plants can play in ozone formation. Geron notes that the latest EPA inventories put emissions of isoprene at levels three to five times higher than previous estimates. One study of all hydrocarbon emissions in the Atlanta area showed that plants were by far the largest contributor (see graph), with isoprene topping the charts.

But researchers have been at a loss to say why plants should produce isoprene in such quantities. Doing so, after all, is an expensive proposition for plants, with no apparent function. Isoprene production alone typically siphons off 2% of the carbon fixed through photosynthesis, carbon that could otherwise be converted into sugars. "It's a puzzle," says Fall. "Why would plants waste all this energy?"

For University of Wisconsin plant physiologist Tom Sharkey, a compelling clue was the observation in field and greenhouse studies that isoprene emissions from plants are extremely sensitive to temperature: "Every time you get an increase in temperature, you get an increase in isoprene." So he and graduate student Eric Singsaas set up a system to find out whether isoprene helps plants take the heat.

To control a plant's exposure to isoprene, Sharkey and Singsaas had to prevent it from synthesizing any on its own. They did so by placing leaves of a potted kudzu plant—ordinarily a prolific isoprene emitter—inside a miniature climate-controlled chamber with an atmosphere free of carbon dioxide. Without carbon dioxide, the leaf couldn't photosynthesize, so its isoprene production was shut down. Next, the researchers raised its temperature while either adding isoprene or leaving it isoprene-free. The result: The chlorophyll of isoprene-exposed leaves stayed intact well beyond the point at which leaf chlorophyll without isoprene gave out—about 37°C, or the temperature of a scorching summer day.

The physiologists haven't worked out a mechanism, but they suspect that isoprene, which is fat soluble, might dissolve in the lipid membranes surrounding the chlorophyll molecule—the light-absorbing site in photosynthesis—and somehow serve as a glue to keep the whole thing from melting down when temperatures get above biological optimum. But because isoprene, a five-carbon chain, is so light, it quickly evaporates, prompting the plant to keep churning it out as the temperature climbs.



MARCEL ISY-SCHWART / IMAGE BANK

Hazy summer day. Plants emissions soften the view of the Blue Mountains in Australia.

The thermal protection theory might explain not only why isoprene emissions are highest on hot days but also why some plants emit more than others, Sharkey says. Isoprene production, he thinks, generally comes into play in plant species that are subject to short bursts of high temperatures. That may be why desert plants like the creosote bush don't seem to emit isoprene—presumably they have come up with other, more economical means for coping with constant high temperatures.

Colorado's Fall sees "some shortcomings" in that picture. "One of the main things that it doesn't explain is why plants in the same genera would include emitters and nonemitters" even when they experience the same temperature regimen, he says. Most oaks, for example, are on the high end of isoprene emission, but a few, such as cork oak, emit little or no isoprene, even at high temperatures. But he adds, "I think it's an interesting idea."

EPA's Geron agrees. "To me the thermal protection idea makes the most sense," he says. He thinks air-quality models may have to be modified to account for the greater flux of isoprene from heat-stressed plants; at the moment, the models assume all plants emit at a steady rate. A more biologically based model would actually show episodic increases in ozone, says Geron.

Already, the realization that natural sources of hydrocarbons can swamp any human contributions has spurred the National Oceanic and Atmospheric Administration (NOAA) and other agencies to rethink ozone-control strategies for rural areas and heavily wooded urban areas like Atlanta. Because plant hydrocarbons can't be controlled, researchers have been urging a shift in the focus of control efforts from hydrocarbons to nitrogen oxides, the other key ingredient of low-level ozone. EPA, NOAA, and industry and academic researchers have also drummed up a new 10-year research plan, the North American Research Strategy on Tropospheric Ozone, that puts high priority on determining how much natural sources contribute to ozone formation.

There should be plenty to learn, says Sharkey. For one thing, atmospheric chemists aren't sure of all the ingredients in the plant hazes; many others are not as easy to measure as isoprene but may contribute to ozone formation as well. Fall and his co-workers, for example, have recently devised a way to measure one such compound, methanol. Their preliminary analysis, in press in *Plant Physiology*, indicates that methanol, although less reactive than isoprene, may be emitted in quantities as large. "We're only beginning to learn about all the organic compounds plants are putting into the atmosphere," says Fall. And that means that the haze surrounding these questions is likely to persist, at least for a while.

–Christine Mlot

Christine Mlot lives near Blue Mounds, Wisconsin.

DARK MATTER

EROS, MACHO, And OGLE Net A Haul of Data

Explorers like Columbus and Vespucci went looking for gold and spices; instead, they found a couple of continents. Astronomers who search the heavens for the mysterious stuff called dark matter are having a similar experience: They haven't yet found much of what they set out to look for, but they are turning up all sorts of surprises that "are turning out to be as important as the dark matter" itself, says Alain Milsztajn of the Saclay Institute in France, a member of one of the search teams, called Expérience de Recherches d'Objets Sombres (EROS).

Those surprises include new insights into the structure of the Milky Way's central bulge, vastly improved catalogs of variable stars, and a completely fresh approach to searching for planetary systems. And they could open up the cosmic equivalent of whole new continents to researchers who may care nothing about dark matter.

These extra benefits flow from "an absolutely new approach" to looking at the sky, according to Andrzej Udalski at Warsaw University Observatory and a member of another of the teams, the Optical Gravitational Lensing Experiment (OGLE). The new approach owes its existence to Princeton University's Bohdan Paczyński, who in 1986 came up with an idea initially considered "science fiction," Paczyński says.

Paczyński's science fiction was a novel way to observe dark matter. Observations of spiral galaxies such as the Milky Way had demonstrated that their outer stars revolve so rapidly that they would fly off into space if the gravity of some unseen—"dark"—matter were not holding them in place. Predicted by some theories to make up perhaps 90% of all matter in the universe, dark matter could take the form of roughly Jupiter-size chunks of ordinary matter that swarm in halos around galaxies like our own. Paczyński's bold proposal was that a phenomenon called gravitational lensing might be used to detect these mysterious objects.

Astronomers already knew that gravity bends starlight, causing objects between us and distant stars to act as lenses. Paczyński, who leads the OGLE group, pointed out that this effect should occasionally magnify the brightness of stars when dark objects in the Milky Way's halo pass in front of them. But he also knew it was wishful thinking to expect that these rare lensing events could be detected among the confusion of variable stars