Smog's ozone: EPA wants more controls

While there is growing concern about the depletion of the beneficial stratospheric ozone layer, environmental scientists are becoming increasingly wary of an overabundance of harmful, ground-level ozone. More than one-third of the U.S. population lives in areas that fail to meet the federal air-quality standard for ozone, a major constituent in urban smog, according to Lee M. Thomas, administrator of the Environmental Protection Agency (EPA). That's particularly troubling, he told a meeting of the Air Pollution Control Association in Minneapolis on Monday, because of new health effects data EPA has collected.

These data, from a variety of studies, indicate that even healthy individuals – and especially those who exercise strenuously outdoors – may be suffering adverse respiratory effects from concentrations of ozone at the current standard. Previously, policymakers had thought the current ozone standard provided a margin of safety even to those considered at increased risk, including people with emphysema, asthma and other chronic respiratory problems.

In urban air, ozone (O_3) forms when nitrogen oxides (from power plants and other sources) and hydrocarbons (from sources such as gasoline and paint thinner) react with oxygen in the presence of sunlight. The chemical can lead to shortness of breath and aggravate existing respiratory disease. In animals, it has damaged lung tissue and increased susceptibility to infection. Ozone is not the only photochemically produced oxidant, but EPA has decided to focus on it as the primary irritant in smog – the assumption being that reducing ozone production will simultaneously reduce the production of related photochemical oxidants.

The host of new human studies suggesting that some people may be suffering subtle adverse respiratory effects from exposure to ozone concentrations at 0.12 parts per million – the level now allowed by EPA – is leading his agency to question whether its current standard is too high, Thomas says. The Clean Air Act requires not only that EPA base its primary ozone air-quality standard on health effects data, but also that this standard provide an adequate margin of safety to "protect the health of any (sensitive) group of the population."

Thomas sees the more critical problem for EPA right now, however, as what to do for the one-in-three people who live in what he refers to as "nonattainment" areas – 32 major U.S. metropolitan regions that, after failing to meet the ozone air-quality standard in 1982, were given a five-year extension. Some areas should make the December 1987 deadline. Others won't be able to, Thomas says, "no matter how hard they try."

While open to suggestions on how to reduce urban ozone pollution, especially in chronic nonattainment areas, Thomas says he is now considering four basic approaches: forcing states to toughen enforcement of existing ozone-limiting procedures; instituting new control measures – such as limits on gasoline volatility or a requirement that new cars contain on-board gasoline-vapor-control systems; requiring that states outline how they plan to comply relatively soon – perhaps in three years; and developing a "sustained progress program" for those states with nonattainment areas well above the current standard that would require a succession of new steps be taken to continually reduce ozone levels over time.

David Doniger of Washington, D.C., a senior attorney with the Natural Resources Defense Council, calls Thomas's four-point strategy "disappointing." "We'd hoped for real action," he says, "not just talk about possible action." Requiring on-board controls for curbing gasoline vapors during car refueling has already been under discussion for two years, he says. And, he adds, the agency could have long ago designated the "stage two" vapor-control nozzles already standard on gas pumps in California and Washington, D.C., as a "reasonably available control technology." Such a designation would have made them all but mandatory in states having nonattainment areas, he points out. Finally, he says that if every state were made to assume the type of hydrocarbon-emissions control program used in California – the state with the biggest problem – far fewer states would be out of compliance with the existing ozone standard today.

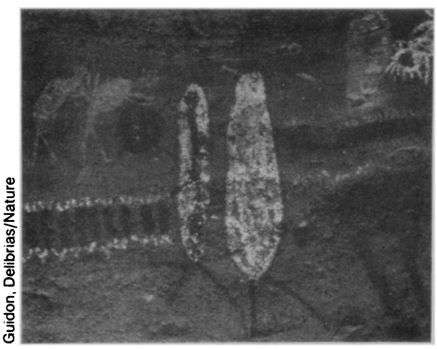
William Becker, executive director of the Washington, D.C.-based State and Territorial Air Pollution Program Administrators, agrees with Doniger on the gasoline vapor controls. Becker estimates that "about half a dozen states will make or not make their 1987 deadline based upon their ability to implement stage-two [gas pump] controls." Maryland is one state, he says, that was politically forced to back down on a planned requirement for these gas-pump controls when industrial leaders pointed out that the controls had not yet been designated as "reasonably available" by EPA.

In general, however, Becker says his group found the structure of Thomas's new ozone strategy sound. He adds that "there are a plethora of unresolved issues that will make or break this policy. But we got a commitment from the EPA staff [on June 23] that they will work with state and local air-pollution control officials to resolve them." One of the biggest of those issues is what to do about polluters whose hydrocarbon emissions cross state lines. – *J. Raloff*

People in Americas before last ice age?

A rock shelter on a sandstone cliff in northeastern Brazil has yielded evidence of the earliest known human occupation in the Americas, approximately 32,000 years ago, according to a report by two French scientists.

Although the discovery, reported in the June 19 NATURE, does not resolve long-standing archaeological disputes over when and how people first arrived in the New World, the site is much older than others where human occupation has been firmly established. Several such finds in the southwestern United States date to 11,500 years ago, and a rock shelter near Pittsburgh is thought to contain evidence of use by humans 19,000 years ago; previously, the earliest known site occupied by humans in South America was 14,200 years old.



Guidon, Delibrias/Nature

Prehistoric cave art at Pedra Furada.

The case for a much earlier occupation at the Brazilian site, known as Pedra Furada, is based on radiocarbon dating of charcoal from hearths found in different layers of sediment beneath the floor of the shelter. Stone tools have also been found in the same layers of earth, say anthropologist Niède Guidon of the Institute of Advanced Social Science Studies in Paris and Georgette Delibrias of the French National Center for Scientific Research in Gif-sur-Yvette.

Carbon dates from the sedimentary layers indicate, according to the researchers, that the shelter was occupied repeatedly by different groups of tool-making people from at least 32,000 years ago until as recently as 6,000 years ago.

In addition, the investigators note that a hearth in the shelter dated at 17,000 years old contains a rock with two red painted lines, suggesting that cave art began in the Americas about the same time it appeared in Europe and Africa. The walls and ceiling of Pedra Furada are still covered with prehistoric paintings.

"Pedra Furada is a very important site," says anthropologist Alan L. Bryan of the University of Alberta in Edmonton. Bryan, who has visited the shelter, adds that the French carbon dating tech-

niques are reliable and accurate.

"Some of the artifacts found by the French scientists appear to be manufactured by humans," says anthropologist Tom D. Dillehay of the University of Kentucky in Lexington, who recently observed the work at Pedra Furada. At a Chilean site, Dillehay has uncovered preliminary evidence of human occupation in sediments containing charcoal dated at about 33,000 years old.

Most archaeologists have held that people first reached the Americas from Asia sometime between 11,500 and 20,000 years ago by crossing a land bridge that connected Siberia and Alaska across the Bering Straits. At that time, the last ice age created massive continental glaciers and considerably lowered worldwide sea levels.

Recent South American discoveries that predate North American sites have caused some researchers to speculate that people first arrived in South America after voyaging across the Pacific Ocean and then spread northward.

Guidon and Delibrias do not, however, subscribe to this notion. "The present findings testify to the presence of man in the north of South America 32,000 years ago," they write, "and strongly suggest that the migration from Asia to North America occurred earlier."

Bryan agrees. "If you assume a Bering Straits entry, and I believe this to be a reasonable speculation, then there should be even earlier sites of human occupation in North America," he contends. He and his colleague Ruth Gruhn are now in Nevada looking for such sites.

A Bering Straits crossing 32,000 years ago is plausible, says Dillehay. "But we have to be cautious," he says. "You can't establish a theory of human origins in the Americas based on just one site."

— B. Bower

Milestone for man-made geothermal well

Scientists from Los Alamos National Laboratory (LANL) have plumbed more than 2½ miles into a New Mexico mountain and brought up enough heat to run a small commercial power plant. In the first month-long test of this "hot dry rock" geothermal energy system, which ended June 18, the engineers pumped 290 gallons of water a minute into the system, heating it to 375° F.

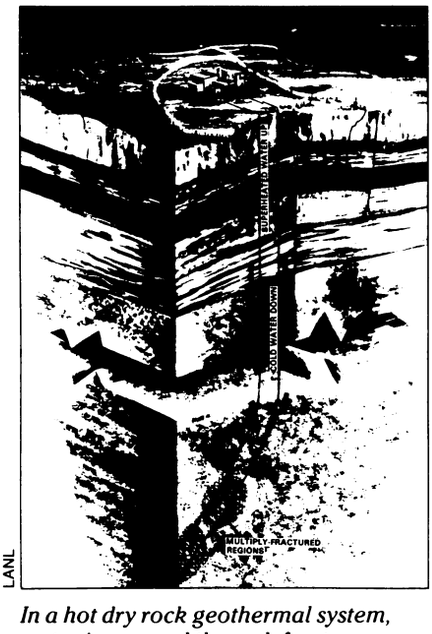
"This is a major milestone," says Michael Berger, head of LANL's Energy and Technology Office. "It is a successful test of the world's largest man-made geothermal energy system."

The promise of such systems is that they can be built almost anywhere, not only in places where there are underground steam fields. "Anywhere in the country, if you drill deep enough, you can find hot rock," Berger says.

The idea behind hot dry rock systems, first proposed in 1970, is to tap into the hot rock, use hydraulic pressure to crack open a reservoir of fractured rock and then pump water through to extract the heat.

The LANL scientists first tested the idea in the mid-1970s by digging a small system about 8,500 feet deep. They were able to heat water to about 316° F and to use this heat to run a power plant and produce a small amount (60 kilovolt-amperes) of electricity.

They built the second system — the one just tested — to see whether the idea would work on a scale large enough to be commercially useful, and they have found it does. In the May-June test, water heated in the system's 4-billion-cubic-foot reservoir carried about 10 megawatts of thermal power, and LANL scientists think they could double that by plugging leaks in the wells and letting the system operate longer, which would allow the reservoir to fill completely. Twenty megawatts of thermal power could produce about 4 megawatts of electricity, enough to supply a town of 4,000, Brown says. So far, however, the scientists have not run the larger system through a power plant.



LANL

In a hot dry rock geothermal system, water is pumped through fractures more than 2 miles deep.

They also are looking into the possibility of using the water as process heat for industry. In a study for the Ore-Ida company, for example, LANL scientists showed they could use the heat to boil water for making Tater Tots.

A year-long test of the system may begin next summer, Brown says.

— M. Murray

Surprise quake spurs new ideas

Last week's earthquake in the Aleutian Islands intrigues seismologists more for where it didn't happen than for where it did. The earthquake, an aftershock of a quake on May 7, failed to break through a seismic gap — an area where no earthquakes have occurred for many years and where scientists have been expecting accumulated seismic strain to trigger a major rupture. Scientists are using such unexpected events to refine their models for understanding and predicting the movement of the earth's crust.

The June 18, magnitude 6.3 aftershock stopped at the western edge of the earlier, magnitude 7.7 rupture, ending at the eastern wall of submerged Adak Canyon. Carl Kisslinger of the University of Colorado in Boulder says both the main earthquake and the recent aftershock seem to have run up against an asperity — a hard spot along a fault that holds strong when the rest of the fault breaks, like a knot in a pine board being sawed in two.

The recent earthquakes in unexpected places, the increased volcanic activity in the Pacific basin (SN: 5/17/86, p. 309) and the existence of at least two large seismic gaps in the Gulf of Alaska (SN: 2/15/86, p. 104) tantalize seismologists but elude attempts to establish a clear pattern that would explain the upsurge in activity. According to Klaus Jacob of Lamont-Doherty Geological Observatory in Palisades, N.Y., an active background of ordinary seismic movement in the area makes pinpointing significant events difficult. "We're not sure whether we can call it a pattern," he says of the recent events.

They do, however, give scientists an opportunity to refine crude models of plate tectonics to better explain why earthquakes continue to occur in unexpected places. Jacob speculates that, although seismologists used to view plate boundaries as uniform, the boundaries may actually be thinner under oceans than under continents. The oceanic part of the North American-Pacific plate boundary, where the Adak quakes occurred, may accumulate strain more quickly than regions under the continent. If this is the case, "the time between major earthquakes would be shorter on the average than previously thought," Jacob says. Events at the edges of these boundaries could forebode a future rupture, he concludes.

Kisslinger, too, expects more movement in the Adak region. "Based on what we know about this region," he says, "I would expect eventually that the region out to the west [of Adak Island] will break in one or two substantial earthquakes, but we have no way of knowing when."

— T. Kleist