Experts Warn:

Stricter Fossil Fuel Rules Needed

Woods Hole, Mass.

"Something very frightening is on the horizon!"

This is the current, somber assessment of ecologist Jerry M. Melillo, Ph.D., and his co-workers at the Marine Biological Laboratory (MBL) here on the threat posed by a predicted worldwide increase in atmospheric carbon dioxide (CO$_2$). This rise is due principally — but not exclusively — to the burning of coal, gasoline, kerosene, and other carbon-based fossil fuels.

Melillo, who is co-director of the MBL's Ecosystems Center, told science writers here last month: "You can release a lot less non-environmental CO$_2$ than you might have thought," based on the current "business as usual scenarios."

New Data Coming

Melillo told reporters that he did not want to be quoted on the new data underlying this "preliminary" analysis, until he has presented them formally to colleagues later this year. But, he asserted:

"A big warning light is flashing very brightly."

This fear, he added, is grounded in the mathematical models — linked sets of suppositions and equations — being developed here and at other research centers. They account for, and then predict global fluxes in CO$_2$ and other forms of carbon, as well as the closely related elements oxygen, nitrogen, phosphorus, and sulfur, and heat-trapping greenhouse gases like methane (CH$_4$) and nitrous oxide. Melillo said his projections are based on a global model of climatic factors and nutrient fluxes that MBL and the University of New Hampshire have developed; it is called the TEM, or terrestrial ecosystems model.

The TEM and related models have two purposes, Melillo said: to describe how the contemporary world functions, and to project how climate changes or land use changes will affect the growing cycles of the earth's vegetation.

Satellites Provide Information

The TEM is grounded in NASA satellite data from 63,000 $1/2^\circ 	imes 1/2^\circ$ grid squares that cover earth. Other global models yield similar forecasts, he said.

The modelers' fears also reflect an early trickle of field data that are being used to confirm and correct the models, and by widely accepted data from ice cores which show that global temperatures are rising, while atmospheric CO$_2$ has increased in the last 160 years by 25%. The count now is 353 parts CO$_2$ per million by volume (ppmv) — the highest level in many thousands of years.

These trends are believed to be largely man-made: They reflect fossil fuel emissions, the cutting of forests — which releases carbon when wood is burned or decays — and other ecological disturbances.

Carbon Releases Tallyed

About 7 petagrams (pg) — which is 7 billion metric tons — of carbon are emitted from plants and soils as CO$_2$ each year. Of this, 5.4 pg are released from fossil fuels, 1.6 pg from deforestation, a current published estimate says.

This is about 14 or 15 pg annually. Current scenarios for the next century foresee 24 pg a year of newly released carbon, Melillo said.

"The thinking now is that you have to cut this to a lot less," he added.

Balancing the carbon sources are carbon sinks: 2 pg are calculated to be absorbed into the oceans each year, and 3.4 pg accumulates in the atmosphere, where it accounts for the annual, measurable rise of 1.8 ppmv, or 0.5%, of CO$_2$.

But: This leaves about 1.6 pg of carbon unaccounted for; this is the so-called "missing carbon sink" — which ecologists continued on page 6
DNA May Not Be Needed In Simpson Case

In a lead “Week in Review” piece in the *New York Times* (June 26), science writer Gina Kolata sees the O.J. Simpson murder case as a major forensic test of DNA fingerprinting. The method can be used to identify bloodstains — but it is not fully accepted by the courts.

“A huge amount of blood was spilled at the site where Ms. Simpson and Mr. Goldman were found dead,” writes Kolata. “Since millions of people share the same blood type, it would not be very illuminating to determine simply whether some of the blood was the same type as Mr. Simpson’s. More sophisticated testing” — meaning DNA identification — “is required.”

Kolata is dead wrong. *Newsweek* made the same mistake (July 11). Millions of people share the ABO blood types. But few except identical twins have identical blood.

The Los Angeles DA may be able to make her case — without need for direct DNA evidence. ABO types are widely shared. But what Kolata fails to say is that red cells carry a host of other identifiers, including the Rh factor, and many less-well-known proteins such as M, N, P, Duffy and Kell, to name just a few. Taken together, they can be used to identify individuals with roughly the same 100,000 to 1, or million to 1 certainty attainable with DNA.

So the DA can ignore the still-controversial DNA method, and use the traditional red cell identifiers. Or, she can use the red cell information to reinforce DNA findings that the victims’ blood is on O.J.’s clothing — if it is — or, that O.J.’s blood mingled with theirs at the murder site, if in fact it did.

All red cell identifiers of course are determined by DNA.

###

We wrote the above late in June. The judge has since ruled that Simpson must stand trial. The DA’s strongest evidence turned out to be a blood stain at the crime scene that a pathologist has linked to a specimen of Simpson’s blood. No direct DNA evidence was introduced.

The DA’s evidence was based on ABO, Rh, and a few other red cell proteins. At the trial, she certainly will add tests on other of these markers to increase the odds against Simpson.

Our question is: Why didn’t Kolata and other of our colleagues make a phone call or two before rushing into print with a dubious prediction?

---

**Times Discovers The Irrational**

The *New York Times*, only a decade behind the times, has discovered the epidemic irrationality that has seized much of the nation. “As Life Gets More Complex, Magic Casts a Wider Spell,” the paper of record reported June 13. Next day, appropriately enough, the *Times* reported, with a straight face, that followers of the deceased Lubavitch Grand Rabbi, Menel Schneerson, were eagerly awaiting his resurrection as the new messiah!

*Times* writer Molly O’Neal, author of the “magic is back” piece, which appeared on page one, wrote:

Americans are increasingly enchanted with products and notions that promise a simple route to transformation, salvation or cure. More and more marketers are imbuing foods and forms of exercise, cosmetics and folk cures with magical powers to fight aging and disease.

Exactly!

O’Neal quotes anthropologist Lionel Tiger, Ph.D., of Rutgers University, as saying that resurgent interest in magic is “a clear reach into the anthropological past.” But she adds, confusingly, many see this trend as “a logical response to contemporary life [emphasis added].”

In the contrary, it is an illogical response to what Tiger correctly calls feelings of being powerless and overwhelmed.

Clearly, what is needed is not more mystical mumbo-jumbo. How about, instead, a good dose of the Protestant Ethic!
Scientists and Reporters Snookered In Animal Rights Role-Playing Game

Woods Hole, Mass.

We joined — a bit reticently — a role-playing game.

It pitted real scientists and science administrators against real journalists, in the wake of a fictional arson attack on a fictitious university research lab. The attack was carried out by make-believe animal rights advocates allied with a group called People for the Ethical Treatment of Non-human Animals (PETNA). Twenty-four rabbits were stolen.

This exercise was scripted and directed by Washington Post science writer Boyce Rensberger. He is co-director of the Marine Biological Laboratory (MBL) Science Writing Fellowship Program here. We were surprised how quickly and clearly Rensberger brought to light key reasons why both professions — science and journalism — respond badly to the animal rights challenge.

Following the “break-in,” the science crowd was truculent and defensive. This made the press skeptical and aggressive.

Torture Is Alleged

To bait the two sides, Rensberger gave the writers an anonymous “letter” from an animal rights activist. It alleged that mice were being hideously tortured at the fictive Generic State University (GSU). The scientists, meanwhile, were given an anonymous memo to GSU’s chief, Dean Rasputin, alleging that a bewildered old researcher was needlessly blinding kittens, and another was mercilessly pinching rats’ tails in a study of refractory pain.

The scientists and reporters then confronted each other in an MBL lounge. Among themselves, the journalists had been dismissive of the anonymous allegations; most would not have pursued them. But a top GSU science administrator stone-walled them:

He would not hold a press conference. He wanted to investigate PETNA’s allegations, and more important, confer with GSU’s trustees before responding to the press — a posture some of his scientific colleagues felt was too guarded. His reluctance triggered the reporters’ paranoia — and adrenaline.

“Cover up!” they declared. Their jobs and reputations suddenly were on the line — for reporters, like scientists, are paid not to be snookered.

Suspicions Grow

The more the science leader backed and filled — displaying a good bit of professional arrogance in the process — the angrier the reporters grew. And the more willing they became to lend credence to PETNA’s cat- and rat-torturing charges.

The scientists became more and more defensive under the reporters’ onslaught of questions. The reporters became more and more credulous — and fearful — and now seemed ready to countenance the anonymous charges.

The scientists’ reaction was to stonewall further, while they “investigated the charges.” They asserted that, as scientists, they could not make any substantive statement until they were sure their accused colleagues were wholly innocent. Meanwhile, they said everything they could think of to convince critics of their rectitude and purity — which further enraged the now openly-hostile reporters. We are good boys and girls doing...
Global Warming Studies: A (Brief)

Few things are as complex as the play of forces that drive and continuously change the earth we live on. Few questions are as urgent as whether these natural forces and human actions will raise — or lower — temperatures, oceans, or concentrations of the gases and nutrients that underlie the web of life.

To provide answers, a new scientific discipline, ecosystems studies, is being developed. Urgently. It uses many standard analytic tools, such as gas chromatography. But it also relies on a unique combination of space-age and down-to-earth methods.

On the big side, billions of bytes of data on temperature, moisture, cloud cover, and other environmental factors are gathered by satellites. These data are crunched, and are being synthesized into intricate global mathematical models that may take hours to run on computers.

The models can incorporate some historical data: the verified warming of parts of the globe over the last 160 years, for example, and the con-comitant increase in carbon dioxide (CO₂) and methane (CH₄). This latter greenhouse gas is 10-20 times more efficient than CO₂, in trapping the sun's radiant energy inside the atmosphere.

**Soil Plots Provide Data**

At the other extreme, providing data to check and refine these models, are a small but growing number of soil plots in a variety of biomes, or vegetations. In the plots, the seepage of nutrients and pollutants into and out of plants, soils and waters are sampled, punctiliously, for months, years, or even decades to detect changes that occur over time.

**Tools Vary**

The young researchers who perform these repetitive, micro-environmental samplings rarely venture into the woods or fields, or onto the tundra without computers and high tech sampling equipment. But they also use a variety of simpler tools: gardeners' bulb-planters to dig soil cores, and divers' belt weights to anchor mice on a glue trap, the more they struggle and protest, the more entangled they become.

What neither scientists nor press seemed aware of, and able to cope with, was PETNA's extraordinary skill in maneuvering both groups into a trap, in which their every move served the animal rights agenda, at the expense of science's and journalism's search for truth. The animal activist's truth, which is political and ideological, is that science and reason are wrong, and should be subverted.

**New Tactic Suggested**

One reporter — this one — suggested that the scientists choose a new tack: Attack their antagonists. Find their vulnerable spots — and target them.

The scientists demurred. To fight back in this way was undignified for a great university like GSU, and unacceptably aggressive for scientists.

This reporter suggested that they use the standard academic tool: research. Allocate money to behavioral researchers. Let them study the animal rights movement close up, and in detail. Publish and broadcast the results. Tell the truth about it as an antidote to the lies it tells about you.

The scientists were not persuaded to take this course. They are, pitifully, sitting ducks. No wonder the animal rights movement attacks them!

##

We were impressed — and depressed — by how quickly the press and the scientists replicated the real impasse that they face over animal rights and similar irrationalist movements. Of course, the press has been as timorous as the scientific community in challenging and investigating these movements.

**Snookered ...**

continued from previous page

society's work — please trust and love us! the scientists protested (too much).

**Openness Advocated**

A rift opened in their rank. One science leader recommended immediate openness and candor with the press:

Let's tell our story. Answer all of their questions. Give them a tour of the labs to show them how well the animals are treated. Several reporters seconded this strategy — which is the conventional wisdom among knowledgeable public relations advisors.

But the hard-line science leader objected, saying — correctly — that the press was not interested in positive stories or "good news" — and would probably ignore it. Even so, some of our journalist colleagues said that these steps ought to be taken — even though the mouse torturers might be assumed to operate in the dead of night, when no one else was around.

**Defense Called Futile**

All of the scientists seemed eager to ignore this fact: They could never prove themselves pure enough to charm or disarm their assailants. Animal rights activists, like reporters, feed their aggression on scientists' protestations of virtue. Nothing a scientist does right, like putting his or her animals in larger cages, with mates and with toys, will ever appease them. Their goal is to triumph over and destroy a system — science — that they don't understand, and therefore hate.

They cannot be appeased.

This leaves researchers at a significant disadvantage: Like
Look at How Eco-Scientists Work

collecting vessels tightly to the ground. Falling leaves are captured for study in plastic laundry baskets. A shotgun may be used for blasting leaf specimens out of the tallest treetops.

To get these leaves, quips ecologist Richard D. Bowden, Ph.D., who studies forest gases at the Harvard Forest, in Central Massachusetts, and at Allegheny College, in Meadville, Pa., you have to hire a monkey. Or find a graduate student who likes to climb trees. Or, bring along a shotgun — which is cheaper, easier and faster.

So, that's what he does.

More Sites Envisioned

Data-generating soil plots like the ones here have been started at tundra sites in Alaska and Sweden, tropical rain forest and adjacent slash-and-burn fields in Brazil, and a few other locations. Many others, obviously, are needed to check and refine the computer models. This means money — which thus far is not available.

Ecosystem researchers here, and at the Marine Biological Laboratory (MBL) in Woods Hole, Mass., have developed one of the several new global models. It is called TEM, for terrestrial ecosystem model. Current global models do not take human activities, including fires and deforestation, into account — a major shortcoming, some researchers say.

The modelers "have always been purists," Harvard Forest director David Foster, Ph.D., an ecologist, declared in a recent interview. They like to study "relatively undeveloped ecosystems, where people are not in dominant force."

Modeler Melillo and his MBL colleagues were not concerned about the human role, Foster recalled. But, he added: "It does make a big difference!"

Plow Marks Endure

Carbon levels in the Harvard Forest soils may relate to whether people plowed it a century ago, he said. Recognizing the importance of this and other human disturbances, Foster added, the National Science Foundation, which funds much of this work, is changing its policy to "explicitly incorporate people" in its ecological purview.

"We're not looking at changes in land use," MBL modeler Edward B. Rastetter, Ph.D., countered in an interview.

"We don't predict climate. We take [other models'] predictions of climate change to predict what terrestrial ecosystems will do in response."

Dirt Plots Are Plumbed for Data
On Hazards of Greenhouse Gases

Soil scientist Kathleen Newkirk, M.S., is carrying a tool box filled with pliers, cutters, splicers, and other electrician’s tools. She steps gingerly into a gridwork of weathered strings and colored tapes. The 20 x 20 foot plot — one of a dozen — looks like an experimental garden.

But it is deep in shade, in hilly, second-growth woods here that belong to a research facility called the Harvard [University] Forest. What is more, no domestic plants are in evidence.

The gridded plot is ordinary forest floor, carrying striped maple, blueberry, Canadian mayflower, sarsaparilla, princess pine, and other plants. It is rich in leaf litter from the trees overhead, as are the surrounding woods.

Researcher Newkirk is dressed in sweatshirt, jeans and a pink baseball cap to keep the voracious mid-June mosquitoes out of her hair. She and her Marine Biological Laboratory (MBL) associate, Christina Catricala, M.S., a hydrologist, now kneel, and carefully rummage in the soil under the stringlines. Beneath each string is resistance wire — and hence, heat; 620 feet of this wire has been buried, in rows, in the plot. This is enough wiring to warm the underlying soil 5°C. — about 9°F. — above the ambient temp, as measured in control plots. The grid delivers 67 watts per meter² at a depth of 5 centimeters. Just

Arctic Grayling Will Swim in ‘Treadmill’ for Energy Study

Except for termites and earthworms, animals are only minor contributors to global nutrient fluxes. But all animals are deeply dependent on the nutrients available to them.

One question MBL ecologist Linda Deegan, Ph.D., and her associates are trying to answer is, How much energy do Alaska graylings, trout-like tundra stream fish, require?

To find an answer, Deegan’s associate, Brown University undergraduate John Harrison, has designed and built a “fish treadmill” that he hopes to test this summer in Alaska.

Energy need can be calculated from a fish’s oxygen consumption, Harrison explained in an interview at the MBL last month. To measure oxygen use, he built a closed, system, in which a fish swims in a clear plastic chamber about the size of a tennis ball can. A stream of water is recirculated through the chamber. Flow rate and water temperature can be set.

The water contains normal oxygen levels at the start of a “treadmill” session. After two or three hours of swimming, the fish has depleted the oxygen. Data are collected continuously, and from them Harrison and Deegan hope to calculate its energy needs.

continued on page 8
Eager Novices
Are Having Fun
Doing Science

Petersham, Mass.

"We have a great time talking about science, and laughing about it. It's wonderful!"

The speaker is Oberlin College sophomore, Kaelyn Stiles. She is spending the summer at the Harvard Forest research facility here collecting and processing soil samples from normal and heated (+5° C) forest plots. This long-term experiment is designed to show how global warming may change the influx and output of nitrogenous compounds from various soils.

Stiles' friend and co-worker, Gwen Stevens, a senior in environmental sciences at Allegheny College in Meadville, Penn., says:

"I'm just one small part of this study . . . . But they are teaching me what is really done at a place like this . . . . I want to immerse myself in all of the stuff they're doing here!"

Careers Foreseen

Stiles has her eyes set on a research career: Stevens favors scientific management or government work.

Their youthful enthusiasm, and that of a dozen other undergraduates who are sharing a research summer here, may be a major human resource for environmental science. They are subsidized by grants from the National Science Foundation (NSF), the Department of Energy and other federal and state agencies.

Harvard Forest is 3,000 acres of abandoned 19th century farmland that has grown back as trees. It was started early in this century, and thrived, briefly, until Harvard abandoned its forestry school, which was the forest's raison d'etre. A half dozen years ago, current administrators say, the research facility was moribund.

New Questions Asked

Then forests became important in a new context: as major, but largely unprobed, sources and sinks in the global flux of nutrients — carbon, nitrogen, oxygen and sulfur — that are being altered by human disturbance. Forests hold answers to key questions on how hazardous these changes may be.

This new scientific mission reanimated Harvard Forest as a research station. Dozens of senior scientists, post-docs, and students now work there full or part time; labs are being refurbished.

This renaissance created the opportunity to bring in novice researchers like Stevens and Stiles — whose tasks we were privileged to share for a few days last month. They and others like them are an important resource for the environment and for the American people, as well as for science in the same way.

Many more such labs that will train and attract young people to the practice of science are badly needed.

###

Fossil . . .

continued from page 1

say they have yet to find. They worry, Melillo indicated, that the missing carbon may be being sequestered in a hidden, highly hazardous sink, where it may cause unforeseen harm.

Missing Carbon Sought

"What I'm looking for is the missing carbon," explains his associate, eco-mathematician Edward B. Rastetter, Ph.D.

One place scientists have not found the carbon is in the arctic tundra. Grasses and underlying plant litter there may already contain 26 pg of carbon.

MBL studies at Toolik Lake, on Alaska's North Slope, and in Sweden, indicate, ecologists here say, that this high-latitude carbon currently is trapped, not by the cold, but, rather by the wet ground, which delays plant decomposition. Also, there is a paucity of nitrogen — fertilizer — that could re-invest and bind the dormant carbon into new plant growth.

A warming, drying climate thus could untie these arctic carbon stores. They might enter the atmosphere, compounding the greenhouse effect.

Ecologist Melillo and ecosystem experts like him say they are bent on finding the missing carbon sink, and on improving their global models. The models can help them identify other oncoming environmental hazards, so that they can suggest cost-effective countermeasures — if possible.

For carbon, the only foreseeable option, Melillo suggested, is a major cut-back in the use of fossil fuels:

It's "a tough economic and social question," he said. "We have to release a lot less carbon dioxide in 2050 than the business-as-usual scenarios allow."

# # #

Distasteful as many will find it, the overt hazards of CO₂ and other greenhouse gases may harbingers the need for greater reliance on nuclear energy technologies.
Surveyors’ Marker Trees Help Write History of New England’s Woodlands

Petersham, Mass.

New England now is heavily forested, as it was when the Pilgrims came. But new, cleverly derived data indicate that today’s abundant, second-growth woodlands are a far cry from the primeval forest that the Pilgrims found here.

“In no way is the ecosystem and structure of the forest anything like it was in the past,” says ecologist David R. Foster, Ph.D., who is director of the Harvard Forest in the central Massachusetts uplands here.

“The relative abundance” of various tree species “has changed very dramatically,” Foster said, in an interview. American chestnut is disappearing, due to blight; beech is following; and there have been many other changes. Pitch pines and other species that thrive on disturbed soils are increasing.

Land Uses Change

Throughout New England, Foster explained, there has been a “homogenization” of the woodlands. The original large stands have been replaced by a “patchy” mix of opportunistic species. The changes reflect the disturbances of 300 years of land use, and the widespread abandonment of farming in this region.

Even if allowed to regrow freely, Foster said, the present forests — which have re-covered much of the landscape, cannot reduplicate the forest that once was.

These conclusions are based on recent groundbreaking studies of New England forest history. He and his associates used two methods to find out what trees grew where in the past, for comparison with current forests. One was to count pollen grains in sediment cores from lake bottoms to identify the predominant species. Another more ingenious method was to check surveyors notes.

Boundary Trees Identified

Fields and farms changed hands frequently. Surveyors used dominant trees, which they identified by species name, as their boundary-marking corner posts; they also described nearby trees in these records, Foster said. By comparing the species cited through time as corner posts, he added, he can document the forests’ histories in a way “that’s never before been done.”

New England, he noted, was heavily farmed; when Thoreau wrote “On Walden Pond,” in 1800, most of Massachusetts, Vermont and adjacent states had been cleared. Fields and pasture predominated. The soils were repeatedly — often deeply — disturbed by plowing.

Plow marks can be detected in soil even after a hundred years, Foster’s associate, soil morphologist Arthur Allen, B.S., explained. Plowed topsoils are smoother in texture, and deeper than unplowed patches, he said. Potassium and nitrogen may be depleted, but other nutrients are roughly the same.

The plowed soil is more compacted than unplowed. As a result, it holds more water. Soil scientist Allen, based at the University of Massachusetts, in Amherst, said he is now working on a comparison of water retention rates on formerly plowed and unplowed sites.

The opening of the West, in the 1800s, eventually killed off most New England family farms. The trees have been growing back, and have been harvested ever since.

These new forests are very important ecologically, Foster said. They remove carbon dioxide (CO₂) from the atmosphere, store the carbon in wood and soil, and release the oxygen into the air.

“These forests in this region are an incredible sink for carbon!”

They also embellish a landscape that now is more valuable for recreational uses than it would be as farmland — and these forests also harbor many wild animals.

But the wild forestland that the settlers found here is gone — forever.

Hidden Changes

“The forest landscape of central New England effectively conceals the extent of the historical changes. . . . The modern forest, although seemingly mature and stable, is unlike any preceding vegetation, and is a poor analogue for the pre-settlement forest. Many . . . species that were common before . . . are . . . today . . . uncommon in the landscape.” — D. Foster, et al. Journal of Ecology, vol. 80, P. 773, 1992.
Greenhouse ...

continued from page 5

now, the juice is off, so Newkirk and Catricala can find and splice a break in the wire — which they hasten to do to stay ahead of impending rain. They then retreat to a nearby control shack, to turn the power back on.

The electrical heating array, linked to sophisticated control and recording equipment, reveals the complexity of this experiment: It is a million-dollar plus experiment that is just entering its fourth year of operation. It is the first inground heating experiment of its type in the contiguous states, Newkirk explains (the MBL operates one older such site, in summer, on tundra near the Brooks range, in Alaska). The purpose:

To measure changes in the fluxes of greenhouse gases — specifically, carbon dioxide, nitrous oxide, and methane (CH4) — when ground temperatures rise. What can be anticipated for these gases, which shuttle between plants, soil, water, and the atmosphere, if temps rise around the globe?

Some soil gas movements can be read directly from probes set into the ground. Others are detected from soil cores cut from the ground with bulb-planting garden tools.

The heating experiment, which Newkirk hopes will run for a decade, is just starting to yield informative data. The first year, warming the soil 5° C. raised the plot’s CO2 output, compared with unheated control plots. But this difference in CO2 output diminished toward parity with the controls in the second year.

For this greenhouse gas the increased output thus may be relatively modest, Newkirk said. The nitrogen picture is different:

Adding heat — as in global warming — accelerated the conversion of nitrogen in organic debris into mineralized forms, which are the ones farmers and gardeners use as fertilizers. Soil warming thus may promote plant growth.