

Coal and Climate: A Yellow Light on CO₂

A National Academy of Sciences committee has concluded that of the three by-products of energy production and consumption—particulate matter, heat and gases—the warming due to the greenhouse effect from carbon dioxide produced by burning fossil fuels poses by far the greatest threat to global climate. In fact, the effect is so potentially serious that it concludes, “The climatic effects of carbon-dioxide release may be the primary limiting factor on energy production from fossil fuels over the next few centuries.”

Or as Roger Revelle, chairman of the Panel on Energy and Climate, puts it, for the next 20 or 30 years it will be all right to use coal—as long as we don’t get committed to it. “But we will have to be prepared to go to other sources of energy than coal within a finite time, about 50 years . . . We will have to kick the fossil fuel habit by 2050.”

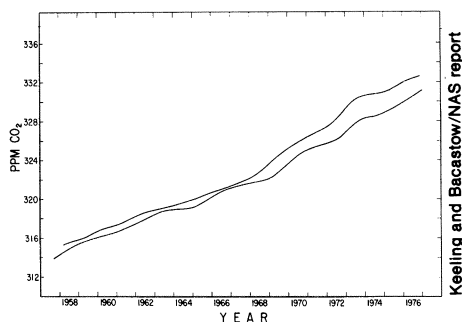
In the meantime, an extensive world-wide program of research is recommended to try to resolve the “profound uncertainties” regarding carbon dioxide and the atmosphere-ocean-biosphere system, plus climate, future population changes, and energy demands, and expected effects on food production.

The two-and-a-half-year Academy study involved not only climatologists and energy specialists on the panel but also a group of prominent geophysicists on the parent Geophysics Study Committee, co-chaired by Philip H. Abelson and Thomas F. Malone. Until now, statements of concern about carbon dioxide and climate have mainly come from individual scientists, such as Columbia University geochemist Wallace S. Broecker (SN: 6/4/77, p. 356). Now for the first time a major scientific body has expressed strong concern. According to the study leaders, the federal agencies involved with climate and with energy policy have shown serious interest in the report’s implications.

Panel scientists at first thought that the direct production of heat and of particles from the generation of energy might represent the greatest impact of energy production on climate on a global scale. They soon found that these effects were dwarfed by the potential heating effect due to carbon dioxide.

Somewhat less than half of the carbon dioxide released by man since the industrial revolution has remained in the atmosphere. Since that time about a 13 percent rise in atmospheric concentration of CO₂ has taken place, including a 5 percent rise in the last 15 years, as measured at Mauna Loa in Hawaii and at the South Pole.

If present energy trends continue upward and fossil fuels continue to supply the bulk of the energy, the panel finds



CO₂ at Mauna Loa, South Pole: Steady rise.

that by the middle of the next century CO₂ in the atmosphere will have doubled over preindustrial levels and by A.D. 2150 to A.D. 2200 it might be four to eight times the preindustrial level. Climatic modeling by Syukuro Manabe and Richard Wetherald—though admittedly imperfect—indicates a 3°C (5°F) rise in the average temperature of the lower atmosphere at middle latitudes for each doubling of the CO₂ level. Thus the panel concludes: “The mean increase in carbon dioxide anticipated for A.D. 2150 to A.D. 2200 might lead to an increase in global mean air temperature of more than 6°C (11°F)—comparable with the difference in temperature between the present and the warm Mesozoic climate of 70 million to 100 million years ago.”

Such a warming would obviously have vast effects on ocean waters, polar caps, agriculture, plant photosynthesis, agriculture zones and life in arid and semi-arid regions, where most people live. Some of the repercussions would clearly be deleterious, some possibly beneficial. But the world would have to change.

Examples: Warmer ocean water would form a “lid” on the ocean, reducing vertical mixing and lessening the upwelling of nutrients to the surface, thus cutting the productivity of marine plants.

Marine ecosystems including fish populations would shift poleward. Sea levels would rise 1 meter due merely to thermal expansion of the water volume. The area of sea ice would be reduced, probably so much that both the Northwest and Northeast passages would be open to ships through most of the year. The Greenland and Antarctic ice caps would still remain below the freezing point, but the climate changes could nevertheless possibly lead to destruction of the West Antarctic ice cap (causing a rise in sea level of about 5 meters over 300 years).

Consequences for agriculture would be far reaching. The cornbelt might have to be shifted considerably northward, from Iowa and Indiana well into central Canada, where the soil is poor. Average annual precipitation would rise globally, but all this benefit might be lost through increased evapotranspiration from crops. The main effects would be shifts in the locations of crop-growing zones plus greater variability in weather, with all the problems that causes for agriculture.

Plant photosynthesis would increase. Revelle is optimistic that this could be a major benefit (“plants love carbon dioxide”). In fact he tends to be optimistic about turning these changes to advantages generally (“it’s nice to be warm”). Other panelists, however, place emphasis on the uncertainties and the disruption to society of such widespread change. Clearly, much more needs to be known. The study recommends creation of a government Climate Council. Revelle guesses that a U.S. research program of \$20 million to \$100 million a year for the next 50 years will be necessary. As for the current administration emphasis on coal as the energy hope of the near future, Malone says: “The report should be treated as a flashing yellow light to the administration policy.” □

At sea: ‘Plesiosaur’ merely a rotten whale?

What has four flippers, weighs two tons, is 44 feet long and was netted by Japanese fishermen near New Zealand? Japanese scientists say it’s a descendent of an ancient reptile; American biologists guess it’s only a small whale. Neither group will be able to substantiate their opinions; the only specimen was dropped back into the brine.

The dead animal, caught in fishing nets, was hoisted to the sea surface from a depth of about 1,000 feet. The stench was overpowering, the fishermen report, and they feared the oozing fatty liquids would spoil their cargo of fish. However, crewmen measured the animal and took several photographs before it was dumped. They also kept a sample of tissue.

Professor Yoshinori Imaizumi, director of animal research at the Japanese National Science Museum, examined the photographs and a drawing. “It’s a reptile and the sketch looks like a plesiosaurus,” he was quoted in the *Washington Post*. “It has to be a plesiosaurus,” Tokio Shikama, a Yokohama National University “scholar of ancient animals” said in a *United Press International* report. Plesiosaurs are marine reptiles that flourished more than 100 million years ago.

American marine biologists scoff at the identification of a modern sea monster, calling it flotsam and jetsam, nonsense and mass hysteria. Carl Hubbs of the Scripps Institution of Oceanography in La Jolla told *SCIENCE NEWS*, “I

am virtually certain that it is not an extinct reptile" on the basis of a newspaper report and photographs sent to him by a Japanese biologist. "It is probably a small whale. It was so rotten that most of the flesh was sloughed off." Richard Rosenblatt, head of the Scripps fish collection agrees, "Rotting whales have been identified as all sorts of things." Hubbs is very skeptical that any unknown ancient reptiles lurk in the sea, because they would need to surface frequently for air. "But if I'm wrong, I'd like to know," he insists. It would add an intriguing section to his lecture on "Monsters of the deep: What are and what ain't." □

Nuclear laser power up 100-fold

Physicists at NASA's Langley Research Center have successfully tested a 10-watt argon laser pumped by nuclear energy—a power increase of 100-fold compared with previous experiments. The achievement marks an important step in development of a "self-critical" laser, a nuclear reactor that emits much of its energy directly as coherent light.

Today's nuclear power reactors are still trapped in the "steam age," for their energy is first used inefficiently to heat water before being converted again into electricity. Theoretically, nuclear energy could be converted directly into light, but early experiments had to rely on the cumbersome process of irradiating a uranium foil around the laser with neutrons (SN: 10/12/74, p. 229).

Then came "volume pumping," a process in which neutrons from a reactor induced fission in helium-3 nuclei mixed with the lasing gas (SN: 5/15/76, p. 309). The latest achievement has resulted by optimizing the volume-pumping process—selecting the right gas concentrations, increasing the pressure and so forth.

This accomplishment now opens the way for what may be the climactic experiment—volume pumping with uranium hexafluoride (UF₆) present. For self-critical lasers to be developed, a lasing medium must be found that is compatible with UF₆, which will eventually be used as the fuel, thereby creating an internally powered reactor-laser. So far, however, the presence of UF₆ has stubbornly quenched the lasing process.

Karlheinz Thom, director of the program, says successful completion of the next stage of experimentation could lay the groundwork for providing "proof of principle" of the self-critical laser concept within two or three years. Once a simulated reactor, still externally powered, can be caused to lase, NASA scientists should feel confident enough of their design to request funding for a prototype reactor-laser. Parallel work on the "plasma core" design is proceeding at Los Alamos. □

Exotic forest saved by foreign sting

Parasitic wasps have rescued a Colombian pine forest from destruction by leaf-eating moth larvae. The researchers who bred, released and observed the parasites hope that this example will spur efforts to control pests without use of dangerous chemicals.

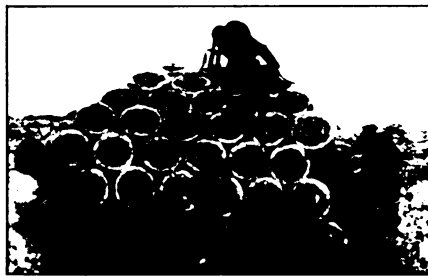
The pine forest in Colombia is one of many extensive plantations of exotic tree species being established in that country to produce pulp and paper. With the new trees comes an opportunity for insects that were previously unimportant to cause serious problems. For example the defoliating moth larvae (*Oxydia trychiata*) has already eliminated plantations of cypress.

Formerly foresters believed that only parasites, predators or diseases that naturally keep an insect in check are likely to control it in a new environment. But Arnie T. Drooz, Gerry F. Fedde and Vicki H. Fedde of the U.S. Forest Service Southeastern-Forest Experiment Station and Alex E. Bustillo of the Instituto Colombiano Agropecuario decided to try an unorthodox procedure. They collected small wasps (*Telenomus alsophilae*) from North American fall cankerworms, which defoliate broadleaved trees such as oaks, maples, hickories and elms. The most aggressive parasites were collected from a field in Virginia. In the laboratory the wasps were successfully raised on eggs of a surrogate host.

About 18,000 wasps were released in a plantation seriously infected with moth larvae in the winter of 1975. The wasps parasitize by inserting their own eggs into moth eggs. The adults walk across a clump of moth eggs laying wasp eggs in one moth egg after the other. By December over half the moth egg clumps were thoroughly parasitized. At the normal emergence time in April, few moths could be located. "The absence of larvae anywhere in the area in May confirmed the outbreak had been controlled," the researchers say in the July 22 SCIENCE.

The advantage of these parasites, Drooz points out, is that they are long-lived. They can attack moth eggs for six to eight months, while producing succeeding generations of offspring. He hopes that once they have diminished their supply of moth eggs they will spread out and maintain themselves on related insects.

Drooz has no worry that the parasitic wasps will get out of control. "We'd love for them to get out of hand," he jokes. "They attack essentially within two orders, both of which are harmful groups of insects to agriculture and to forestry. There's only one beneficial Geometridae I know of and that was just discovered in Hawaii and it catches fruit flies." The researchers conclude, "Our experience with *T. alsophilae* shows that use of egg parasites offers many control possibilities and requires only imagination, cooperation and support. □



Arnie T. Drooz

Laying an egg in an egg: Wasp parasitizes eggs of the fall cankerworm.

Five new 'far-out' quasars found

Discoveries of five more have increased to ten the number of known quasars that inhabit the farthest reaches of our universe. Among these, a newly discovered quasar Q0420-388 is the brightest and most luminous. According to conventional wisdom, their large redshifts—all greater than 3—are an index of their tremendous distances from us.

Cosmologists are particularly interested in high-redshift (remote) objects because they offer a coveted look into the past, when the universe was still an infant. Light just now reaching earth from Q1442+101 (the most distant) first escaped from the quasar's surface about 10 billion years ago.

In addition to discovering four of the new quasars, Patrick S. Osmer of the Cerro Tololo Inter-American Observatory in Chile and Malcolm G. Smith of the Anglo-Australian Observatory also reported on two somewhat closer ($z=2.28$ and $z=2.16$) but peculiar ones. The farther one is unusual because it apparently has dimmed substantially (from magnitude 18.5 down to 20.4) since it was discovered in 1974. The other of the pair seems not to be producing the dominant quantity of Lyman-alpha radiation typical of quasars. Lyman-alpha is a spectral line (particular wavelength of radiation) characteristic of hydrogen,

Most-Distant Quasars

NAME	REDSHIFT	DISTANCE (billion light years)
Q1442+101	3.530	10.63
Q0642+449	3.402	10.58
Q0347-383*	3.23	10.5
Q1402+044*	3.20	10.5
Q0938+119	3.190	10.48
Q2204-408*	3.18	10.47
Q0420-388*	3.12	10.44
Q0324-407	3.056	10.41
Q0130-403	3.015	10.39
Q0351-390*	3.01	10.38

(*) indicates newly discovered quasar
(These calculations were made for SCIENCE NEWS assuming the current value of Hubble's constant, $H_0=55$ km/sec/Mpc, and a popular hypothetical model of the universe named after Einstein and DeSitter. Distances are those traversed by a quasar's light.)