Coal and the Coming (?) Superinterglacial

As the energy-hungry world finds petroleum running out, the nuclear potential frightening, and significant solar conversion still a far-off goal, it has been turning increasingly toward coal as the frontrunner short-term energy hope of the future. No wonder. Coal resources are massive.

Yet some scientists have been peering ahead at a possible dangerous cloud on the horizon of the coal economy. It is not the black cloud of soot associated with coal burning of past times but an invisible and possibly more ominous threat: the inevitable addition to the atmosphere of unprecedented quantities of carbon dioxide from coal combustion.

This week one of the strongest warnings yet on the climate consequences of a coal economy was presented at the spring meeting of the American Geophysical Union in Washington by geochemist Wallace S. Broecker of the Lamont-Doherty Geological Observatory.

The coal economy destines us, he says, to a CO_2-induced "superinterglacial" climate about which we know very little. "Before we take the actions which will lock us into bestowing a millennium of warmer climate on the generations to follow, we had best learn more than we now know about life in this 'superinterglacial' world." Broecker says the problem "could become the single most important environmental issue of the next 30 years."

In addition to developing better computer models to predict how temperature, rainfall and vegetation will be affected, "we must develop contingency plans for the removal of the excess CO_2 from the atmosphere if its effects prove highly objectionable. Indeed," says Broecker, "we must rethink the wisdom of developing technologies for the larger-scale recovery, transport and liquification of coal."

A member of the President's Council of Economic Advisers who has been analyzing the problem, William D. Nordhaus, reinforced Broecker's concern. He said it has severe long-term policy implications.

At the heart of the concern is the well-known warming "greenhouse" effect of CO_2 in the atmosphere and the huge quantities of underground coal being eyed by policymakers trying to find ways to fuel the world's energy needs.

For each ton of fossil fuel burned, roughly three tons of CO_2 is released into the atmosphere. The best evidence shows that to date, combustion of gas, oil and coal has raised the CO_2 content of the atmosphere by 12 percent. Broecker forecasts that to see our way through to what he calls the golden era of solar power a century from now, we will almost certainly have to burn enough of the coal reserves to double the atmosphere's CO_2 content. Best estimates suggest a doubling leads to a 2° to 3°C (5°F) rise in temperature. The warming that brought us from the last period of full glaciation was only about twice that, according to computer analysis of all recent available data. So, points out Broecker: "We are talking about a major climate change. Environmental consequences are likely to be large."

His term "superinterglacial" for these conditions refers to the fact that for the past 10,000 years the earth has been in a relatively warm or interglacial interval between glaciations. "The addition of large quantities of CO_2 will likely push the earth's climate into a realm considerably warmer than that experienced during the last several interglacials. In this sense the post-coal burning era will be 'superinterglacial.' "

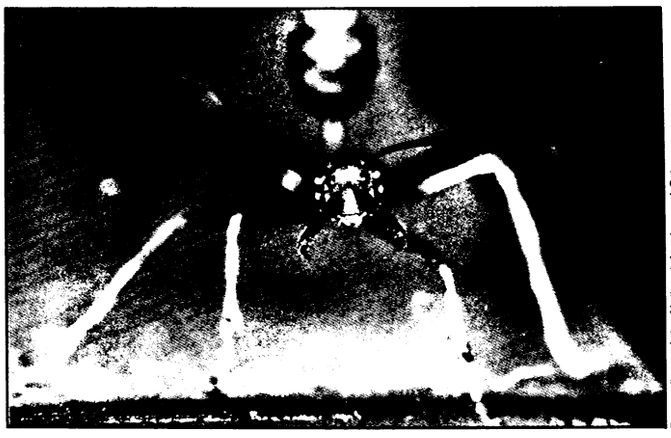
The onset of a coal-burning-caused superinterglacial will not likely be so profound as that which accompanied the change from glacial to interglacial, but it will certainly be more abrupt. "The demise of the conditions responsible for the glacial epoch took at least several hundred, and perhaps as much as several thousand years," Broecker notes. "We will load the majority of our CO_2 into the air in a single century."

Broecker feels the world has, in a sense, been lulled into complacency by the often-noted natural Northern Hemisphere cooling since 1945 that has compensated for the CO_2-induced warming up till now and disguised its effects. But computer simulation based on evidence for cyclical air temperature variations over the last several thousand years that has been found in Greenland ice cores indicates a bottoming-out of the natural cooling, says Broecker. Adding CO_2-induced heating to the simulation, "a dramatic warming is predicted for the latter two decades of this century."

What about the eventual expected end of the interglacial itself? Won't the cooling effect of that counteract the CO_2 warming? Too far off (several thousand years) and too gradual, counters Broecker. "The superinterglacial will have come and largely gone before any significant natural cooling occurs. I see no basis for any argument calling on a natural cooling as a balancing force. . . . The rise toward the superinterglacial will be so rapid that no natural change of comparable magnitude can be foreseen."

What can be done? Soon, Broecker admits, we will be as hooked on coal as we are now on oil. There are no quick answers. But, he says, in policy planning, the climate consequences of the coal economy can no longer be ignored. □

Odor gives home team ants early lead



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African weaver ant opens mouth parts and raises abdomen in aggressive stance.

In mortal battle, weaver ants defending their own turf triumph in the early skirmishes. This advantage seems to stem not from visual familiarity with an area but rather from its odor. An ant acts confidently and recruits fighters more rapidly when it senses a chemical deposited by fellow nestmates, Bert Hölldobler and Edward O. Wilson report in the May PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. This territorial pheromone is the latest discovery in the complex communication repertory of the aggressive *Oecophylla longinoda* for exploring, seizing and exploiting new terrain.

Although anecdotal evidence suggests that many kinds of mammals mark their home ranges with scents, only the deposits of house mice and European rabbits clearly alert intruders of the same species. The results of Hölldobler and Wilson are