Issue 55

Absorption of Radiation: Greenhouse Effect

Just by breathing, you add to the greenhouse effect!

As people burn wood, coal, oil, and gasoline ($C + O_2 \rightarrow CO_2 + \text{heat}$), carbon dioxide is released into the atmosphere. Like glass panes of a greenhouse, carbon dioxide molecules are transparent to sunlight, allowing it through to warm the earth's atmosphere. But when the earth's surface is warmed, it gives off its heat as infrared radiation to which the carbon dioxide molecules are not transparent. Blocked from radiating its accumulating warmth into space, the earth's surface heats up. As a result of this "greenhouse effect," the surface averages a comfortable 59°F. In the absence of all carbon dioxide, it would be below 40°F, perhaps even below freezing (32°F).

The planet Venus is an excellent example of the greenhouse effect. Venus's 455°C average surface temperature is largely due to its carbon dioxide-laden atmosphere.

Methane (CH_4) emitted by decaying organic material, garbage, and bacteria is 20 times as effective as carbon dioxide, molecule for molecule, and chlorofluorocarbons (CFCs) are 10,000 times as effective in blocking the passage of infrared radiation. Ozone and nitrogen oxides from automobiles are also important contributors to the effect. Another is the accelerating destruction of trees (cutting down forests) and other green ground cover (overgrazing), since their photosynthesis would have *absorbed* carbon dioxide from the atmosphere and thus reduced the greenhouse effect.

$$(6CO_2 + 6H_2O + \text{light} \rightarrow C_6H_{12}O_6 + 6O_2).$$

Even the best scientists disagree on whether the effect has already begun. (They *do* agree that the warming is inevitable in the near future.) Their disagreement arises largely because of the complexity of the feedbacks involved (see "Feedback: Positive and Negative," p. 114), which are not yet well understood. It has become clear that we are altering our environment faster that

we can predict the consequences. This situation is bound to lead to surprises, mostly catastrophic. Unfortunately, planners may use this lack of unanimity as an excuse to postpone the very unpleasant political and economic actions that soon must be required of them. (See "Long-Term Effects of Technology," p. 116.)

If the warming trend is imminent, Canada and the Soviet Union may one day own most of the world's fertile land. Can you imagine the effect *that* will have on the world's economy and on international politics?

Another consequence of the greenhouse effect would be the melting of the Antarctic ice cap. That would raise ocean levels worldwide as much as 1½ meters (5 feet). The Environmental Protection Agency predicts a 30-cm (1-foot) rise in just the next 30 to 40 years. In parts of Florida, a 30-cm (1-foot) rise may mean 300 meters (1000 feet) of land lost to the sea. Louisiana already is losing 130 square kilometers (50 square miles) of wetlands per year. Wetlands and saltmarshes are the nurseries of the sea; with their loss worldwide, the entire ocean food chain may be broken.

At its extreme, this water rise also will flood seaport cities (e.g., Hong Kong, New York, and Amsterdam) and make them uninhabitable.

As marginal lands are rendered totally uninhabitable because of diminishing water supplies, political conflicts will intensify (e.g., Egypt vs. Sudan over the shrinking Nile River, and between our Western states along the Colorado River). As poverty spurs further depletion of forests and topsoil, hastening the effect, hordes of refugees will be forced to flee Dust Bowl conditions—to where?

And yet, China plans to double its coal production in the next 15 years to spur development!

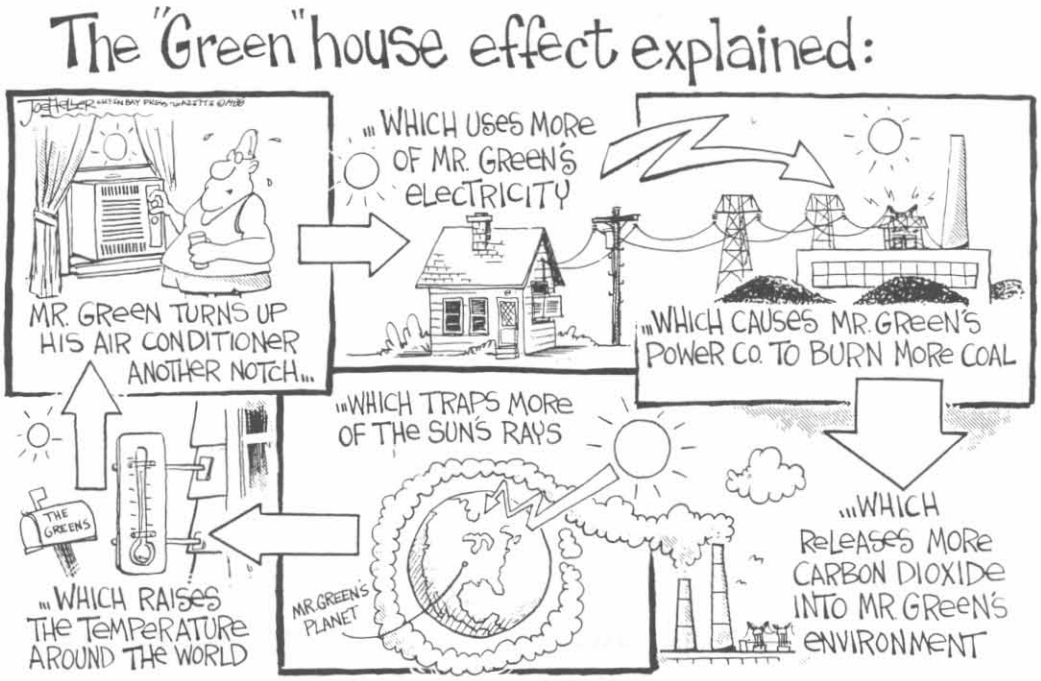
Another concern is that as temperature and humidity climb, such parasitic and infectious tropical diseases as yellow fever, dengue fever, and Chagas' disease may migrate northward.

What can be done? Consider the pros and cons of each of the following possibilities:

1. Impose special taxes on carbon dioxide emission to encourage energy conservation.
2. Increase funding for research on alternative energy sources, including solar power and safer nuclear reactors.

3. Provide developing countries with financial aid to build high-efficiency power plants.
4. Launch a worldwide tree-planting program.
5. Develop techniques for recovering part of the methane given off by landfills.
6. Require all new cars worldwide to achieve an average of at least 65 kilometers per 3.8 liters (40 miles per gallon) of gasoline and to have catalytic converters for reducing tail pipe emissions.
7. End all industrial production of chlorofluorocarbons (CFCs).

(See "Ozone Catalysis: Destruction of Our Atmosphere," p. 52.)



Reprinted with permission of Joe Heller, Green Bay Press-Gazette.