Letters

Global Warning

Ever since 1957, when Revelle and Suess called attention to man's inadvertent conduct of "a large-scale geophysical experiment" (*1*), warnings of the perils of increasingly profligate consumption of fossil fuels and the consequent carbon dioxide induced warming of the planet have been sounded by a growing fraternity. Slowly the level of public and political consciousness has risen, bringing to the fore arguments for taking at least modest steps to slow down the rate of growth of carbon dioxide and other greenhouse gas emissions (*2*). It is even becoming respectable to use the threat of deleterious climate change as grounds for advocating a reduction in primary energy growth rate through such steps as increased energy conservation and higher efficiency energy use and production (*3*).

In almost all circles—scientific professional conferences included—description of the nature of the possible warming and its effects centers on the "best guess" estimate of climatic change that would result from effective doubling of atmospheric CO_2 concentrations, to occur 40 to 50 years from now under a climate equilibration assumption (*4*). Although the very large uncertainties in the size, timing, and impacts of the warming are always acknowledged, typical responsive measures that might be suggested are tied to this norm, resulting in argument over the degree of seriousness of the portended climate change and even whether it might be good or bad (*5*). Meanwhile, the possibility that a considerably larger, though less likely, temperature rise presents the greater risk remains ignored. The latter eventuality is more to be feared, principally because of the high cost of its effects, the draconian and expensive steps needed to avert it, and the time required, first, to obtain global agreement on the need to act, and then to transmute world energy production into a nonfossil-fuel–using system (*6*).

Although it is probably not possible—and indeed is not the responsibility of the decision-maker–politician—to rectify the misdirection of focus in the greenhouse gas environmental debate that has taken place, it is up to the scientific professional community to bring out the most critical policy-relevant aspects of the problem.

J. A. LAURMANN
3372 Martin Road,
Carmel, CA 93923

REFERENCES AND NOTES

1. R. Revelle and H. Suess, *Tellus* **9**, 18 (1957).
2. Such a strategy appeared to receive wide acceptance at a recent well-attended, politically influential meeting—the First North American Conference on Preparing for Climatic Change, Washington, DC, 27 to 29 October 1987; G. E. Brown, "Climate change: A view from Congress," speech delivered at the above mentioned conference.
3. The World Commission on Environment and Development's report *Our Common Future* (Oxford Univ. Press, London, 1987) specifically makes this point, as does a recent World Resources Institute publication. [I. M. Minzer, "A matter of degrees, The potential for controlling the greenhouse effect" (World Resources Institute, Washington, DC, 1987)].
4. Carbon Dioxide Assessment Committee, *Changing Climate* (National Academy Press, Washington, DC, 1983).
5. The existence of "winners" and "losers" in such a climatic change scenario is well acknowledged and most recently exemplified at the latest World Meteorological Organization–International Council of Scientific Unions meeting concerning the greenhouse problem: "Developing Policies for Responding to Climatic Change," Villach, Austria, 28 September to 2 October 1987.
6. My earlier editorial [*Climat. Change* 7, 261 (1985)] made the same point in more detail. Its rationale requires quantitative argument, which I attempted in a report ("An International Council on Remediation of Greenhouse Gas Environmental Impacts") delivered to the 1986 meeting of the World Commission on Environment and Development, Ottawa, Canada, 26 and 27 May.

In discussing rapidly growing concern about global warming (*1*), both Richard A. Kerr (Research News, 1 July, p. 23) and the popular media suggest two leading strategies for reducing CO_2 emissions from fossil-fuel combustion: revitalizing nuclear power and improving energy productivity. In fact, only one of these options can yield major, timely CO_2 reductions at reasonable cost (*2*).

Under present conditions, the total cost (in 1987 dollars) of generating electricity from new U.S. nuclear plants is around 13.5 cents per kilowatt-hour (*3*). Lawrence Berkeley Laboratory and the American Council for an Energy-Efficient Economy have documented large potential electrical savings at average costs of 2 cents per kilowatt-hour (*4*). The reciprocals of these costs give the amounts of fossil-fueled electricity generation displaced per dollar invested: 7.4 kilowatt-hours per dollar for nuclear and 50 kilowatt-hours per dollar for efficiency. Thus, per marginal dollar invested, electric end-use efficiency displaces 6.8 times as much carbon as nuclear power.

Proponents of nuclear power argue that building standardized plants in a stable regulatory environment could reduce the cost of new nuclear electricity to as low as 5 cents per kilowatt-hour (*5*). Others contend that new efficiency technologies offer large potential electrical savings for 0.5 cent per kilowatt hour or less (*6*). Even under the most optimistic cost projections for nuclear power, electric efficiency still displaces 2.5 to 10 times more CO_2 per dollar invested.

Further, nuclear power can displace only fossil-generated electricity, which accounts for just one-third of fossil-fuel CO_2 emissions. In contrast, powerful end-use efficiency options are available for the *entire* range of fossil-fuel uses, including the two-thirds of uses (transport and heat) for which electricity is an uneconomic or impractical substitute. Since 1973, efficiency has effectively reduced U.S. carbon emissions by 30% and cut the nation's energy bill by $160 billion per year (*7*). Yet enormous "efficiency reserves" still remain. For example, replacing a single 75-watt incandescent light bulb with an equally bright 18-watt compact-fluorescent bulb eliminates the burning of 400 pounds of coal (and saves the consumer $15). Full use of efficiency improvements in the U.S. would cut today's energy consumption in half (reducing CO_2 emissions accordingly) *and* save an additional $220 billion a year (*8*).

Improving energy productivity can simultaneously ameliorate greenhouse warming, reduce acid rain and air pollution, save money, increase U.S. competitiveness abroad, and avoid the problems of nuclear power. Given the urgency of abating global warming, can we afford to invest in nuclear power when those same dollars put into efficiency would displace far more CO_2?

BILL KEEPIN
GREGORY KATS
Rocky Mountain Institute,
Old Snowmass, CO 81654–9199

REFERENCES AND NOTES

1. For a review of greenhouse theory, see V. Ramanathan, *Science* **240**, 293 (1988).
2. B. Keepin and G. Kats, *Energy Pol.*, in press.
3. Using approximate empirical values of $3000 per kilowatt installed (in 1987 dollars), 20% per year nominal fixed-charge rate (including capitalized interest during construction), 0.65 capacity factor, and 1 cent per kilowatt-hour each for fuel (including waste disposal), operation and maintenance, and net capital additions. No correction is made for grid losses, although efficiency improvements are already delivered.
4. H. Geller *et al.*, *Ann. Rev. Energy* **12**, 357 (1987), weighted average in table 4.
5. *A Comparison of Future Costs of Nuclear and Coal-Fired Electricity: An Update* (U.S. Council for Energy Awareness, Washington, DC, 1987).
6. COMPETITEK update service, Rocky Mountain Institute, Old Snowmass, CO 81654–9199.
7. W. U. Chandler, H. S. Geller, M. R. Ledbetter, *Energy Efficiency: A New Agenda* (American Council for an Energy-Efficient Economy, Washington, DC, 1988).
8. A. H. Rosenfeld and D. Hafemeister, *Sci. Am.* **258**, 78 (April 1988).

An error appears in Richard A. Kerr's article concerning the Bellagio report on greenhouse warming. The article states that at a "moderate" warming rate of 0.3°C per decade, "after 20 years Chicago's summers would be as warm as New Orleans' are now." Published climatic normals (*1*) for the present standard 30-year period 1951–1980 do not support this statement.

Mean temperatures (averages of the daily maximum and minimum values) in the Chi-

cago area are about 5°C lower than those in the New Orleans area during the climatically defined summer (June through August). For this 3-month period, the listed means at three Chicago stations (converted from their original Fahrenheit units) range from 21.8°C at O'Hare Airport to 22.8°C at Midway Airport. In comparison, the means at the two listed New Orleans stations, Moisant Airport and Audubon Park, are 27.4°C and 28.0°C, respectively. For the normally warmest month, July, the Chicago means range from 22.8°C to 23.9°C; New Orleans, 27.8°C to 28.3°C.

With the above conditions, it would take about 170 years, rather than 20 years, for Chicago's average summer temperatures to equal those now experienced in New Orleans. This comment is not at all meant to deny the urgency of averting the greenhouse warming; a warming of even 1°C would be too much.

ARNOLD I. FINKLIN
Post Office Box 7795,
Missoula, MT 59807

REFERENCES

1. Environmental Data Service, National Oceanic and Atmospheric Administration, *Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1951–80* (Climatography of the United States No. 81, National Climatic Center, Asheville, NC, 1982), Illinois and Louisiana sections.

Benveniste on *Nature* Investigation

In Robert Pool's article of 5 August (Research News, p. 658), the conditions of the publication and dismissal of our recent paper in *Nature*, "Human basophil degranulation triggered by very dilute antiserum against IgE" (*1*), are discussed instead of what is crucial to this debate, the validity of the subsequent *Nature* investigation (*2*) of our results. Three facts suffice to show that the *Nature* report is neither sound nor fair.

1) Figures 2 and 6 of the *Nature* report actually confirm our work. These figures show two remarkable results that were obtained—one after blind counting of cells in front of the "investigation squad" and the other in Milan. Both show 70% degranulation (achromasia) after 18 and 22 dilutions and after 34 and 35 dilutions, respectively. Yet these clear-cut data are not seriously challenged in the *Nature* report. For figure 2, I am supposed to have "not seen one like this before," but identical data are in table 1 and figure 1b of our original paper (*1*). Such data must be either real or "synthetic." Yet we are declared honest by the antifraud squad. The two curves shown in figure 6 of the *Nature* report are criticized for being "discordant" by two dilutions, which is exactly what we stated in our original paper (*1*).

2) The sentence "plainly this [the statistical noise] does not apply to all the data, for example, the fourth experiment" (shown in figure 2 of the report), appeared in the "final version" of the *Nature* report shown to me and was referred to in my reply (*3*), but it did not appear in the printed version of the report (*2*). Why? Most likely because it plainly means that a lot of our data are statistically sound.

3) The report complains (*2*, p. 290) that a legal official "is said not to have had time to decode" the data, and twice that data obtained in Israel "are not available"; the official report we have in hand (*4*) testifies that these data were decoded on 11 June 1987, and they are printed in our *Nature* paper (*1*). *Nature* thus calls "not available" data they published 1 month ago.

Our results are honest and true; the only problem is that they are unexplainable. If challenging results are condemned by means of specially designed laws (*5*), this constitutes a death penalty to science.

JACQUES BENVENISTE
INSERM U 200,
Université Paris-Sud (Paris XI),
32, rue des Carnets,
92140 Clamart, France

REFERENCES

1. E. Davenas *et al.*, *Nature* **333**, 832 (1988).
2. J. Maddox, J. Randi, W. W. Stewart, *ibid.* **334**, 287 (1988).
3. J. Benveniste, *ibid.*, p. 291.
4. M. Simart, "Procès-verbal de constat" (bailiff's report), Clamart, France, 11 June 1987.
5. H. Metzger and S. C. Dreskin, *Nature* **334**, 375 (1988).

HHS Policy on in Vitro Fertilization

Colin Norman's article (News & Comment, 22 July, p. 405) about the Department of Health and Human Services' announcement that an Ethics Advisory Board (EAB) would be restored was welcome news about a possible remedy to one of the most serious injustices in U.S. science. There was one error in his history. The recommendations of the original EAB that federal funds support research on clinical in vitro fertilization and untransferred human embryos were not "adopted as department policy" in 1979. Secretary Joseph Califano received but did not approve the recommendations, preferring first to publish them in the *Federal Register* for comment. The next HHS secretary, Patricia Harris, decided that the federal government should not be involved at all in such research and also decided not to recharter the EAB. The recommendations of the EAB have never been approved by a secretary of HHS and are not "department policy." Infertile persons and families at high genetic risk have been the great losers from the lack of research support and involvement of the National Institutes of Health in peer review of science in this area.

JOHN C. FLETCHER
Department of Medicine,
School of Medicine, University of Virginia,
Charlottesville, VA 22908

Hazardous Waste Clean-Up

The Superfund project chosen for discussion by Mark Crawford (News & Comment, 24 June, p. 1725) is a clear example not just of management deficiencies in the national toxic waste program but of the persistant failure of the Environmental Protection Agency (EPA) to consider secondary consequences of its actions. Whether or not in situ vitrification, electrical heating of soil to a glassy state for encapsulating waste, is a suitable technology at the Ohio River Valley site, it is obvious that attaining a vitrifying soil temperature requires a very large electrical input. Most electricity in the Ohio Valley is generated by coal-fired power stations linked in a regional network that has an output governed by aggregate demand. Emissions from these stations are widely implicated as major contributors to the acid rain and ozone that are straining relations between the United States and Canada and are believed to be damaging forests in the northeastern United States and crops in the Ohio Valley. Coal burning also adds to the atmospheric carbon dioxide that most climatologists believe is leading to a worldwide greenhouse warming. EPA is active in all these areas, yet the agency's compartmentalization virtually precludes its Superfund program from considering such issues in choosing decontamination technologies.

CHARLES F. COOPER
Department of Biology,
San Diego State University,
San Diego, CA 92182

Erratum: In the report "Iron photoreduction and oxidation in an acidic mountain stream" by D. M. McKnight *et al.* (29 Apr., p. 637), reference 17 [E. L. Madsen, M. D. Morgan, R. E. Good, *Limnol. Oceanogr.* **31**, 382 (1986)] was cited (p. 638) as indicating "that biological processes are not responsible for light-induced Fe(II) production." This possibility was not addressed by Madsen *et al.*, nor did Madsen *et al.* use both poisoned and natural streamwater-sediment mixtures to distinguish between biotic and abiotic contributions to iron reduction. In table 1 of the same report, the values in columns two and three were incorrect. They should have been, for sodium, calcium and magnesium, respectively, 2.7 ± 0.34 mg liter^{-1}, 13.0 ± 0.73 mg liter^{-1}, and 4.3 ± 0.24 mg liter^{-1}.