

## A Hotter Planet?

“Imagine a world of relentlessly rising temperatures, where farmlands are scorched into desert and inland waters like the Great Lakes shrink in the heat. As global warming intensifies, the polar ice caps dissolve and ocean levels rise by more than 100 feet, swamping low-lying islands and coastal areas. Vancouver, Halifax, New York City, Amsterdam, Shanghai and other port cities are inundated. As the global floodwaters rise, more than a quarter of the world’s population is displaced.” *Maclean’s* magazine continues: “Plenty of scientists believe that the growing accumulation of man-made gases in the Earth’s atmosphere could someday push temperatures to dangerously high levels and bring cataclysmic changes to the planet.”<sup>1</sup> Welcome to global warming.

A *Toronto Star* article reprinted in a science text, discusses the issue of global warming, and then warns that “there’s an ice mass half the size of a continent, resting on a rock shelf that’s a little below sea level on one side of Antarctica. If the Antarctic Ocean warms up a bit in 50 years, and laps enough at the bottom of the ice mass, the whole thing might slip off its rock and float into open water. “That would be like throwing the world’s biggest ice cube into the world’s

biggest drink. That one event, if it happens, could push the sea level up several metres and cause coastal flooding such as we've never even dreamed."<sup>2</sup>

### Is the Earth Getting Warmer?

Despite these frightening depictions, global warming should not keep your children awake at night. It is true that over the past one hundred years, the Earth has become slightly warmer, but only by about half a degree Celsius or 1 degree Fahrenheit. (The Intergovernmental Panel on Climate Change estimates that the increase was between three-tenths and six-tenths of a degree Celsius or one-half to one degree Fahrenheit.) But most of the warming occurred before most of the greenhouse gases were put in the atmosphere by human actions.

As for the future, scientists do not know if the Earth will continue to get warmer. If it does, the increase may be so slight as to be hardly noticeable. Clearly, apocalyptic claims of a rise in the sea level of twenty-five feet are no longer taken seriously, except perhaps by overly imaginative writers. Recent studies have predicted a possible rise in sea level of six to forty *inches*, not feet.<sup>3</sup> And one reputable study suggests that warming would *lower* sea levels. (Warming would lead to more snow in the Arctic, which would increase the size of the ice caps.)<sup>4</sup>

Temperature predictions, too, have moderated. In 1989, some scientists were predicting an increase in global temperatures of between 3.5 and 5 degrees Celsius (6.3 to 9 degrees Fahrenheit) as early as the middle of the twenty-first century.<sup>5</sup> In 1990, an intergovernmental panel of scientists projected an increase of 3 degrees Celsius (5.4 degrees Fahrenheit) by the year 2100.<sup>6</sup> The latest estimate, however, is that temperatures may increase by between 1 and 3 degrees Celsius (between 1.8 and 5.4 degrees Fahrenheit) by the year 2100.<sup>7</sup>

Global warming captured public attention because of some very hot summers in the 1980s, especially one in 1988. On a hot day James Hansen, who heads NASA's Goddard Institute, told a congressional committee that he thought that human actions were beginning to raise the world's temperatures—that global warming had arrived. It is true that some studies show that several years in the 1980s were the hottest on record.

But measurements of temperature taken by satellite (rather than measurements close to the ground), showed no warming between 1979 and mid-1996 (see figure, page 173).<sup>8</sup> In fact, there was a slight cooling trend, which can be explained by the 1991 eruption of the Mt. Pinatubo volcano in the Philippines. Volcanic dust kept out sunlight, cooling the Earth.

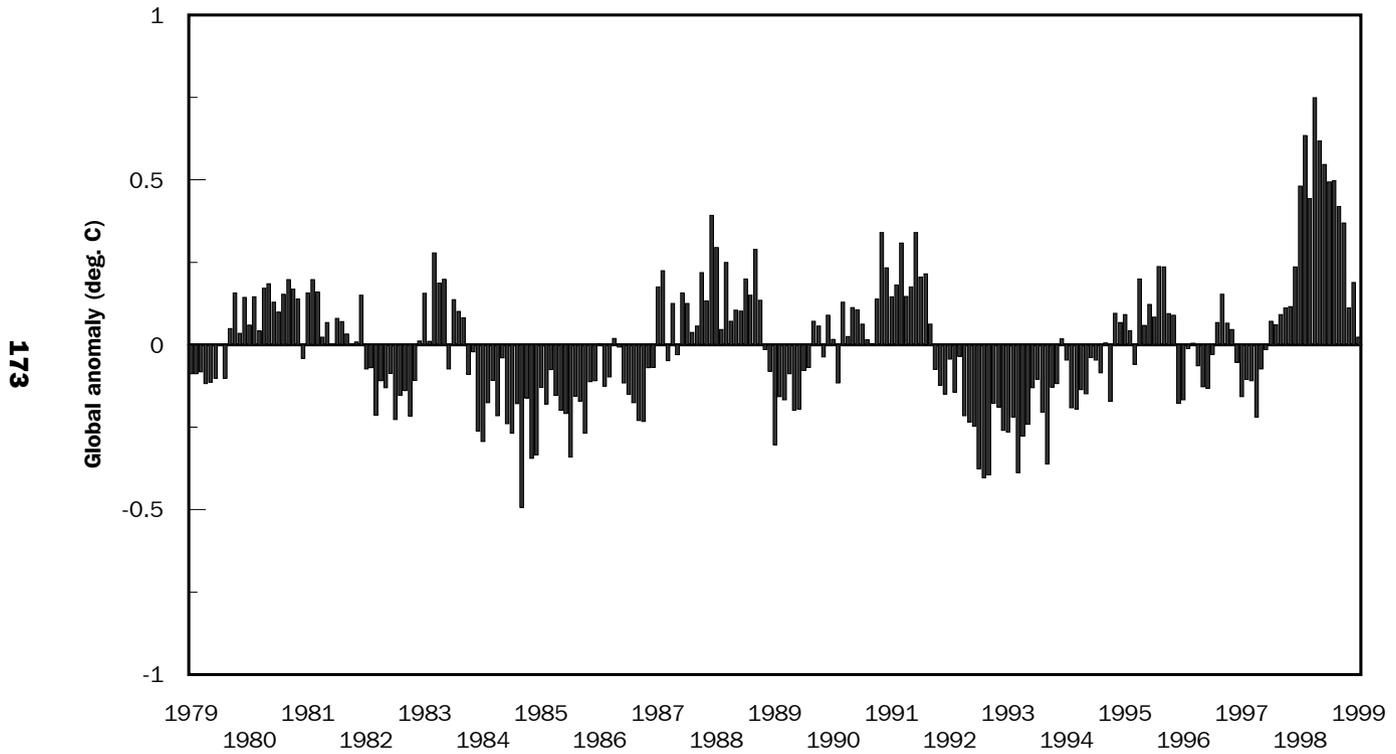
### **What Scientists Know**

Let's look at what scientists do know. They agree that average world temperatures have gone up slightly since good record keeping began about one hundred years ago, probably about half a degree Celsius or about 1 degree Fahrenheit.<sup>9</sup> That increase, which is pretty small, may reflect natural variation in temperature.

And temperatures haven't been going up steadily. There was a significant decline in temperatures between 1938 and 1970. That decline led scientists in the 1970s to worry about a coming Ice Age. In fact, Stephen Schneider, a scientist now predicting severe global warming, urged in 1976 that people consider "massive world-wide actions" to hedge against the possibility of a new Ice Age.<sup>10</sup>

When people talk about global warming, they usually mean that temperatures will rise due to the "greenhouse effect." There is nothing sinister about the greenhouse effect. A number of gases, including water vapor, CO<sub>2</sub>, methane, and others, keep the earth warm by trapping infrared rays that would otherwise be lost to

## Changes in Earth's Temperature as Measured by Satellite



Source: John R. Christy, Earth System Science Lab, University of Alabama in Huntsville.

space. (Infrared rays are invisible rays of heat that are emitted by all objects that have temperature.)

This warming process is something like the buildup of heat that occurs in greenhouses, but it is not the same. Most warming in a greenhouse occurs because air is warmed and then trapped by the glass or plastic walls. In contrast, global greenhouse gases trap invisible rays of heat emitted from the Earth's surface.<sup>11</sup> Thanks to the greenhouse effect, the Earth is warmer than it otherwise would be.

Scientists who think the earth will get significantly warmer base their view on the fact that some greenhouse gases, especially carbon dioxide, are increasing in the atmosphere. Carbon dioxide is released when fossil fuels such as coal and oil are burned; and CO<sub>2</sub> in the atmosphere has been going up since the start of the Industrial Revolution. It is believed to be about 27 percent higher than two hundred years ago.<sup>12</sup> Some other gases have been increasing as well.

But keep in mind that carbon dioxide, while extremely important, represents a very small part of the total atmosphere—about 0.035 percent or 350 parts per million. (In contrast, oxygen represents about one-fifth of the atmosphere or 200,000 parts per million!)

### **The Computer Did It**

One reason why global warming has received so much attention is that computer models predict it. Climate models are simplified descriptions of the world's climate, written in mathematical formulas on computer programs. By changing the formulas, scientists can change climate predictions.

Some years ago, scientists decided to see what would happen if they assumed that CO<sub>2</sub> had doubled, as they thought it would by the middle of the twenty-first century. The result: Significantly higher temperatures, higher by between 2 and 6 degrees Celsius. The projections looked scientific. But scientists know that these computer

models of the world's climate have strengths and weaknesses. Robert Jastrow, founder of NASA's Goddard Institute, and two colleagues point out that the models give such a rough picture of the Earth's climate that they miss entirely the effect of mountains such as the Rockies, the Sierra Nevadas and the Cascades. According to these models, the climate of heavily forested Oregon and the climate of the Nevada desert would be about the same, rather like equating the climate of the British Columbia rainforests with the climate of the southern Albertan Badlands.<sup>13</sup>

Another problem is that scientists are really guessing about how different aspects of the climate affect one another. For example:

- ◆ Water vapor is far more important than carbon dioxide in trapping heat. Carbon dioxide will increase temperatures significantly only if water vapor increases significantly. But will it?
- ◆ Clouds (composed of water vapor that has condensed into droplets) may increase if carbon dioxide goes up. Some clouds increase the warming effect and others decrease it by reflecting sunlight back into space.<sup>14</sup>
- ◆ Oceans and vegetation absorb CO<sub>2</sub>, but how much, how fast, and for how long? No one knows.

If some of the early computer projections are correct, we should already have seen significant warming—an increase over the past one hundred years of 1.7 degrees Celsius (3 degrees F), says climatologist Patrick Michaels.<sup>15</sup> The actual increase, however, is only about half a degree Celsius. Recently, scientists have proposed that air pollutants such as sulfur dioxide may have slowed down the warming that would otherwise occur.<sup>16</sup> “It is still an open question,” says Richard Peltier, a climatologist at the University of Toronto, “as to whether anything that is happening now can be attributed to the greenhouse effect.”<sup>17</sup>

Another problem is that the pattern of warming does not follow the rise in CO<sub>2</sub>. As the graph on page 177 shows, CO<sub>2</sub> concentrations in the atmosphere increased dramatically *after* World War II, but most of the temperature rise during the last century occurred *before* World War II. If the greenhouse theory is true, temperatures should have risen in tandem with the rise of greenhouse gases. They should not have fallen, as they did, between 1940 and 1970.<sup>18</sup>

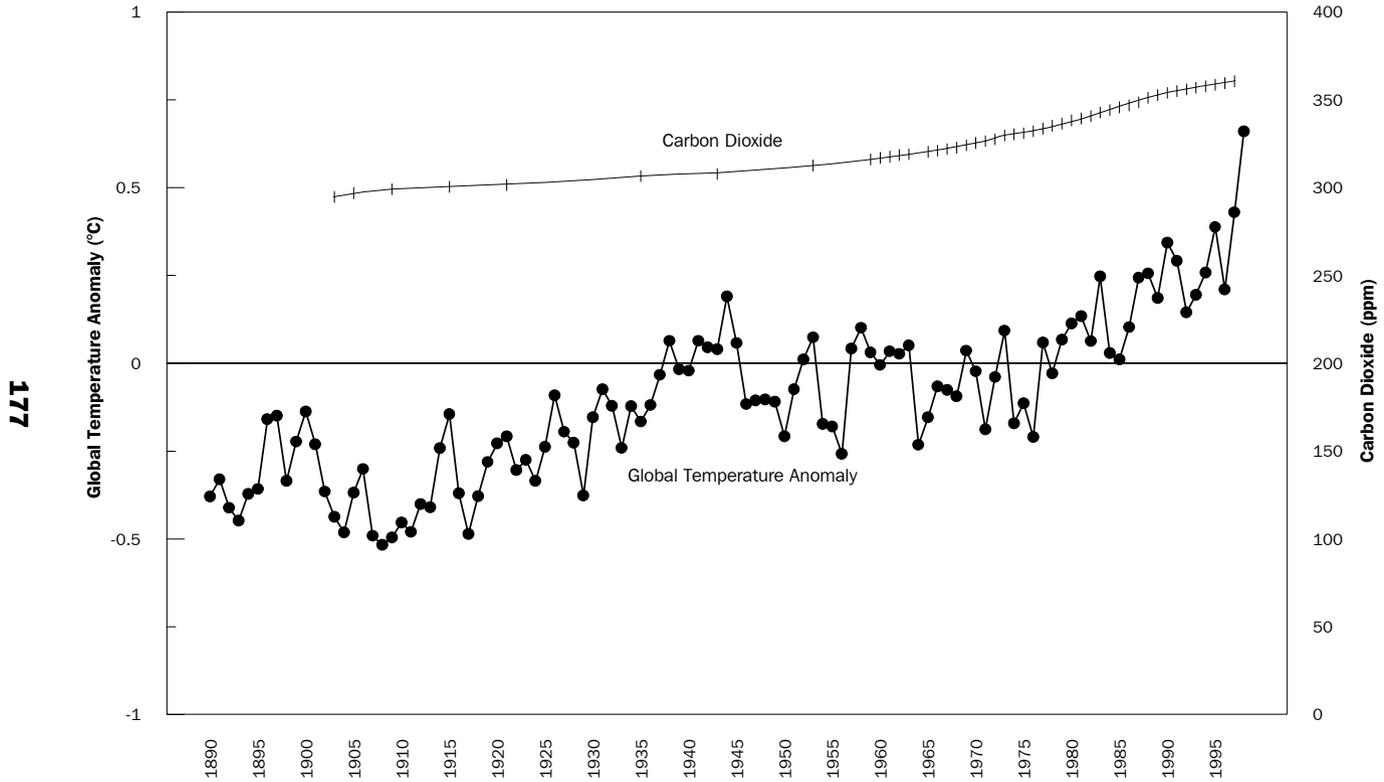
And, temperatures in the Arctic, which should be getting significantly warmer if the computer projections are right, have been going down. Over the past forty years, they declined by 1.5 degrees Celsius (2.7 degrees F).<sup>19</sup>

### **A Warmer World: Some Benefits?**

Children's textbooks, reflecting the popular view, discuss only the negative impacts of warming. But some scientists note that if the world gets warmer, that would not be all bad.

- ◆ "In fact," says Andrew Solow, a scientist at Woods Hole Oceanographic Institute, "there is some irony in the description of global warming as problematic, since it is not unreasonable to view human history as a struggle to stay warm."<sup>20</sup>
- ◆ Thomas Gale Moore, a prominent economist at the Hoover Institution, has even concluded that warmer weather would reduce deaths from heart disease and respiratory illness.<sup>21</sup> Cold temperatures lead to death more often than hot ones.
- ◆ More carbon dioxide in the air will benefit many plants. It causes more luxuriant growth, larger flowers, and greater crop yield.<sup>22</sup> Some scientists think that rising levels of CO<sub>2</sub> in the air have already contributed to the Green Revolution, that is, to the remarkable increases in food production of the past few decades.<sup>23</sup>

## Changes in Temperature and Levels of CO<sub>2</sub>, 1890–1998



Source: Robert C. Balling, Jr., Office of Climatology, Arizona State University.  
Data for series "Carbon Dioxide" is available only for points shown.

## Talking to Your Children

It is little wonder that our children are frightened. We would be, too, if we read the textbooks our children do. But now you can give your children a more balanced picture.

- ◆ Is the world going to get hotter?

No one really knows. Carbon dioxide keeps heat from being emitted into space and, because carbon dioxide is increasing in the atmosphere, temperatures may get warmer. However, the warming may be so small as not to be noticeable by the average person.

- ◆ Are human activities causing global warming?

Perhaps. By burning fossil fuels, humans add carbon dioxide to the atmosphere, and more carbon dioxide should keep more heat in the Earth's atmosphere. But the increase in warmth may be very small since many, many factors affect climate. Until recently, some scientists were more worried about a coming Ice Age than too much warming.

- ◆ Has the world been getting hotter?

Yes, a little. Scientists think that the Earth's average temperatures have increased by between three- and six-tenths of a degree Celsius or between one-half and one degree Fahrenheit over the past one hundred years. But the increase has been irregular, not steady, and it may simply reflect natural variation in temperatures over time.

- ◆ Is carbon dioxide harmful?

No. In fact, it is a beneficial part of the atmosphere. It provides food for plants. More carbon dioxide in the atmosphere should increase plant growth. This will increase the output of oxygen from plants through photosynthesis.

### **Activities for Parents and Children**

The following activities should help reassure your children that the world is not “out of control” even if a modest amount of warming should occur.

#### ***Carbon Dioxide and Dinosaurs***

Go to the library and check out books about dinosaurs. You might start with:

- ◆ K. Brasch, *Prehistoric Monsters* (Salem House, 1980), or
- ◆ J. W. Watson, *Dinosaurs and Other Prehistoric Reptiles* (Golden Press, 1970).

Show these books to your children and ask them to describe the trees and other vegetation that surrounds the dinosaurs. Then ask them if this world was warmer or cooler than the one we currently live in.

Now tell them that the Earth had an atmosphere that contained carbon dioxide levels that were five to ten times greater than now. The high CO<sub>2</sub> levels contributed to the rich vegetation. The earth was warmer and wetter, not burning up or drying out. (At other times, however, high carbon dioxide levels coexisted with cold temperatures.) The point is that the image of global warming that many people hold may be unnecessarily grim.

**Take a Trip to a Greenhouse**

What better way to learn about the “greenhouse effect” than to take your children on a trip to a commercial greenhouse? (Look under “Greenhouses” in the Yellow Pages.) Keep in mind that the “greenhouse effect” is a misnomer. The warming in a greenhouse occurs differently, as we discussed earlier in this chapter. But greenhouses create a warm, moist environment that encourages rapid plant growth. In addition, many greenhouses increase the CO<sub>2</sub> level in the greenhouse. As our children learn in basic science, plants use CO<sub>2</sub> to make food through photosynthesis. By increasing the CO<sub>2</sub> levels, the plants have more of what they need to grow vigorously.

Ask the greenhouse manager to explain how conditions in the greenhouse are controlled to help plants grow. Does this greenhouse add carbon dioxide? Why or why not?

**A New Ice Age?**

Doomsday predictions of climate change are nothing new. Your children may not be aware that in the mid-1970s many people worried about the coming Ice Age.

Take your children to the library and have them look up the following articles and book:

- ◆ Nigel Calder, “In the Grip of the New Ice Age,” *International Wildlife*, July 1975.
- ◆ D. Colligan, “Brace Yourself for Another Ice Age,” *Science Digest*, Feb. 1975.
- ◆ “Are We Headed for a New Ice Age?” *Current*, May/June 1976.
- ◆ *The Cooling*, by Lowell Ponte (Prentice Hall, 1976).

Indeed, in the early 1990s, after parts of North America experienced heavy snows and severe cold, a new interest in an Ice Age reemerged. Have your children look this one up, too: Michael D. Lemonick, "The Ice Age Cometh?" *Time*, January 31, 1994.

## Notes

- 1 Mark Nichols, "Feeling the Heat" in *Maclean's* April 24, 1995, 52–53, 53.
- 2 Margaret Fagan, *Challenge for Change* (Toronto: McGraw-Hill Ryerson 1991), 246.
- 3 J. J. Houghton, *et al.*, eds., *Climate Change 1995: The Science of Climate Change*. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. (New York: Cambridge University Press, 1996).
- 4 Gifford H. Miller and Anne de Vernal, "Will Greenhouse Warming Lead to Northern Hemisphere Ice-sheet Growth?" *Nature*, Vol. 355 (January 16, 1992), 244–246.
- 5 Stephen H. Schneider, "The Greenhouse Effect: Science and Policy," *Science*, Vol. 243 (February 10, 1989), 771–781 at 774.
- 6 R. Monastersky, "Global Warming; Politics Muddle Policy," *Science News*, June 23, 1990, 391.
- 7 J. J. Houghton *et al.*, *op. cit.*
- 8 R. W. Spencer and J. R. Christy, "Precise Monitoring of Global Temperature Trends from Satellites," in *Scientific Perspectives on the Greenhouse Problem* (Ottawa, IL: Jameson, 1990), 95–104, for figures through 1988; figures updated by R. W. Spencer.
- 9 See for example P. D. Jones, "Hemispheric Surface Air Temperature Variations: Recent Trends and an Update to 1987," *Journal of Climate*, Vol. 1 (1988), 654–660, and Philip D. Jones and Tom M. L. Wigley, "Global Warming Trends," *Scientific American*, August 1990, 84–91.

- 10 Quoted on the dust jacket of Lowell Ponte, *The Cooling* (Englewood Cliffs, NJ: Prentice Hall, 1976).
- 11 Sylvan H. Wittwer, "The Greenhouse Effect" (Burlington, NC: Carolina Biological Supply Company, 1988), 3.
- 12 Robert R. Balling, Jr., *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute for Public Policy, 1992), 23.
- 13 Robert Jastrow, William A. Nierenberg, and Frederick Seitz, "An Overview," *Scientific Perspectives on the Greenhouse Problem* (Ottawa, IL: Jameson, 1990), 11.
- 14 Aaron Wildavsky, "Introduction" to *The Heated Debate: Greenhouse Predictions versus Climate Reality*, by Robert C. Balling, Jr. (San Francisco: Pacific Research Institute for Public Policy, 1992), xxiv.
- 15 Patrick J. Michaels, "Crisis in Politics of Climate Change Looms on Horizon," *Forum for Applied Research and Public Policy* (Winter 1989), 15.
- 16 Summary for Policymakers of the Contribution of Working Group I to the IPCC Second Assessment Report 1995.
- 17 Nichols, *op. cit.*
- 18 Frederick Seitz, Robert Jastrow, William A. Nierenberg, *Scientific Perspectives on the Greenhouse Problem* (Washington, D.C.: George Marshall Institute, 1989), 19.
- 19 J. D. Kahl, D. J. Charlevoix, N. A. Zartseva, R.C. Schnell and M. C. Serreze, *Nature*, Vol. 361 (1993), 335–337, cited in *Are Human Activities Causing Global Warming?* (Washington, DC: George C. Marshall Institute, 1996), 33.
- 20 Andrew R. Solow, "Is There a Global Warming Problem?" in Rüdiger Dornbusch and James M. Poterba, *Global Warming: Economic Policy Responses* (Cambridge MA: MIT Press, 1991), 7–28, at 26.
- 21 Thomas Gale Moore, "Health and Amenity Effects of Global Warming," *Working Papers in Economics E-96-1*, Hoover Institution, Stanford University (January 1996).

- 22 Sherwood B. Idso and Bruce A. Kimball, "Tree Growth in Carbon Dioxide Enriched Air and Its Implications for Global Carbon Cycling and Maximum Levels of Atmospheric CO<sub>2</sub>," *Global Biogeochemical Cycles*, Vol. 7, No. 3, September 1993, 537–555.
- 23 J. Goudriaan and M. H. Unsworth, "Implications of Increasing Carbon Dioxide and Climate Change for Agricultural Productivity and Water Resources," in *Impact of Carbon Dioxide, Trace Gases, and Climate Change on Global Agriculture* (Madison, WI: American Society of Agronomy Special Publication Number 53, 1990), 111.