The Threat to the Planet

By Jim Hansen

The Weather Makers: How Man Is Changing the Climate and What It Means for Life on Earth
by Tim Flannery

Atlantic Monthly Press, 357 pp., $24.00
Field Notes from a Catastrophe: Man, Nature, and Climate Change
by Elizabeth Kolbert

Bloomsbury, 210 pp., $22.95
An Inconvenient Truth:
The Planetary Emergency of Global Warming and What We Can Do About It
by Al Gore

Melcher Media/Rodale, 325 pp., $21.95 (paper)
An Inconvenient Truth
a film directed by Davis Guggenheim

Jim Hansen is Director of the NASA Goddard Institute for Space Studies and Adjunct Professor of Earth and Environmental Sciences at Columbia University's Earth Institute. His opinions are expressed here, he writes, "as personal views under the protection of the First Amendment of the United States Constitution."

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Animals are on the run. Plants are migrating too. The Earth's creatures, save for one species, do not have thermostats in their living rooms that they can adjust for an optimum environment. Animals and plants are adapted to specific climate zones, and they can survive only when they are in those zones. Indeed, scientists often define climate zones by the vegetation and animal life that they support. Gardeners and bird watchers are well aware of this, and their handbooks contain maps of the zones in which a tree or flower can survive and the range of each bird species.

Those maps will have to be redrawn. Most people, mainly aware of larger day-to-day fluctuations in the weather, barely notice that climate, the average weather, is changing. In the 1980s I started to use colored dice that I hoped would help people understand global warming at an early stage. Of the six sides of the dice only two sides were red, or hot, representing the probability of having an unusually warm season during the years between 1951 and 1980. By the first decade of the twenty-first century, four sides were red. Just such an increase in the frequency of unusually warm seasons, in fact, has occurred. But most people who have other things on their minds and can use thermostatshave taken little notice.

Animals have no choice, since their survival is at stake. Recently after appearing on television to discuss climate change, I received an e-mail from a man in northeast Arkansas: "I enjoyed your report on Sixty Minutes and commend your strength. I would like to tell you of an observation I have made. It is the armadillo. I had not seen one of these animals my entire life, until the last ten years. I drive the same forty-mile trip on the same road every day and have slowly watched these critters advance further north every year and they are not stopping. Every year they move several miles."

Armadillos appear to be pretty tough. Their mobility suggests that they have a good chance to keep up with the movement of their climate zone, and to be one of the surviving species. Of course, as they reach the city limits of St. Louis and Chicago, they may not be welcome. And their ingenuity may be taxed as they seek ways to ford rivers and multiple-lane highways.

Problems are greater for other species, as Tim Flannery, a well-known Australian mammal-

ogist and conservationist, makes clear in The Weather Makers. Ecosystems are based on interdependenciesbetween, for example, flower and pollinator, hunter and hunted, grazers and plant lifeso the less mobile species have an impact on the survival of others. Of course climate fluctuated in the past, yet species adapted and flourished. But now the rate of climate change driven by human activity is reaching a level that dwarfs natural rates of change. And barriers created by human beings, such as urban sprawl and homogeneous agricultural fields, block many migration routes. If climate change is too great, natural barriers, such as coastlines, spell doom for some species.

Studies of more than one thousand species of plants, animals, and insects, including butterfly ranges charted by members of the public, found an average migration rate toward the North and South Poles of about four miles per decade in the second half of the twentieth century. That is not fast enough. During the past thirty years the lines marking the regions in which a given average temperature prevails ("isotherms") have been moving poleward at a rate of about thirty-five miles per decade. That is the size of a county in Iowa. Each decade the range of a given species is moving one row of counties northward.

As long as the total movement of isotherms toward the poles is much smaller than the size of the habitat, or the ranges in which the animals live, the effect on species is limited. But now the movement is inexorably toward the poles and totals more than a hundred miles over the past several decades. If emissions of greenhouse gases continue to increase at the current rate"business as usual"then the rate of isotherm movement will double in this century to at least seventy miles per decade. If we continue on this path, a large fraction of the species on Earth, as many as 50 percent or more, may become extinct.

The species most at risk are those in polar climates and the biologically diverse slopes of alpine regions. Polar animals, in effect, will be pushed off the planet. Alpine species will be pushed toward higher altitudes, and toward smaller, rockier areas with thinner air; thus, in effect, they will also be pushed off the planet. A few such species, such as polar bears, no doubt will be "rescued" by human beings, but survival in zoos or managed animal reserves will be small consolation to bears or nature lovers.

In the Earth's history, during periods when average global temperatures increased by as much as ten degrees Fahrenheit, there have been several "mass extinctions," when between 50 and 90 percent of the species on Earth disappeared forever. In each case, life survived and new species developed over hundreds of thousands of years. The most recent of these mass

extinctions defines the boundary, 55 million years ago, between the Paleocene and Eocene epochs. The evolutionary turmoil associated with that climate change gave rise to a host of modern mammals, from rodents to primates, which appear in fossil records for the first time in the early Eocene.

If human beings follow a business-as-usual course, continuing to exploit fossil fuel resources without reducing carbon emissions or capturing and sequestering them before they warm the atmosphere, the eventual effects on climate and life may be comparable to those at the time of mass extinctions. Life will survive, but it will do so on a transformed planet. For all foreseeable human generations, it will be a far more desolate world than the one in which civilization developed and flourished during the past several thousand years.

2

The greatest threat of climate change for human beings, I believe, lies in the potential destabilization of the massive ice sheets in Greenland and Antarctica. As with the extinction of species, the disintegration of ice sheets is irreversible for practical purposes. Our children, grandchildren, and many more generations will bear the consequences of choices that we make in the next few years.

The level of the sea throughout the globe is a reflection primarily of changes in the volume of ice sheets and thus of changes of global temperature. When the planet cools, ice sheets grow on continents and the sea level falls. Conversely, when the Earth warms, ice melts and the sea level rises. In Field Notes from a Catastrophe, Elizabeth Kolbert reports on the work of researchers trying to understand the acceleration of melting, and in his new book and film An Inconvenient Truth, Al Gore graphically illustrates possible effects of a rising sea level on Florida and other locations.

Ice sheets waxed and waned as the Earth cooled and warmed over the past 500,000 years. During the coldest ice ages, the Earth's average temperature was about ten degrees Fahrenheit colder than today. So much water was locked in the largest ice sheet, more than a mile thick and covering most of Canada and northern parts of the United States, that the sea level was 400 feet lower than today. The warmest interglacial periods were about two degrees Fahrenheit warmer than today and the sea level was as much as sixteen feet higher.

Future rise in the sea level will depend, dramatically, on the increase in greenhouse gases, which will largely determine the amount of global warming. As described in the books under review, sunlight enters the atmosphere and warms the Earth, and then is sent back into space as heat radiation. Greenhouse gases trap this heat in the atmosphere and thereby warm the Earth's surface as we are warmed when blankets are piled on our bed. Carbon dioxide (CO_2), produced mainly by burning fossil fuels (coal, oil, and gas), is the most important greenhouse gas made by human beings. Methane (CH4), which is "natural gas" that escapes to the atmosphere from coal mines, oil wells, rice paddies, landfills, and animal feedlots, is also an important greenhouse gas. Other significant warming agents are ground-level ozone and black soot, which arise mainly from incomplete combustion of fossil fuels and biofuels.

In order to arrive at an effective policy we can project two different scenarios concerning

climate change. In the business-as-usual scenario, annual emissions of CO_2 continue to increase at the current rate for at least fifty years, as do non-CO_2 warming agents including methane, ozone, and black soot. In the alternative scenario, CO_2 emissions level off this decade, slowly decline for a few decades, and by mid-century decrease rapidly, aided by new technologies.

The business-as-usual scenario yields an increase of about five degrees Fahrenheit of global warming during this century, while the alternative scenario yields an increase of less than two degrees Fahrenheit during the same period. Warming can be predicted accurately based on knowledge of how Earth responded to similar levels of greenhouse gases in the past. (By drilling into glaciers to analyze air bubbles trapped under layers of snow, scientists can measure the levels of each gas in the atmosphere hundreds of thousands of years ago. By comparing the concentrations of different isotopes of oxygen in these air bubbles, they can measure the average temperature of past centuries.) Climate models by themselves yield similar answers. However, the evidence from the Earth's history provides a more precise and sensitive measure, and we know that the real world accurately included the effects of all feedback processes, such as changes of clouds and water vapor, that have an effect on temperature.

How much will sea level rise with five degrees of global warming? Here too, our best information comes from the Earth's history. The last time that the Earth was five degrees warmer was three million years ago, when sea level was about eighty feet higher.

Eighty feet! In that case, the United States would lose most East Coast cities: Boston, New York, Philadelphia, Washington, and Miami; indeed, practically the entire state of Florida would be under water. Fifty million people in the US live below that sea level. Other places would fare worse. China would have 250 million displaced persons. Bangladesh would produce 120 million refugees, practically the entire nation. India would lose the land of 150 million people.

A rise in sea level, necessarily, begins slowly. Massive ice sheets must be softened and weakened before rapid disintegration and melting occurs and the sea level rises. It may require as much as a few centuries to produce most of the long-term response. But the inertia of ice sheets is not our ally against the effects of global warming. The Earth's history reveals cases in which sea level, once ice sheets began to collapse, rose one meter (1.1 yards) every twenty years for centuries. That would be a calamity for hundreds of cities around the

world, most of them far larger than New Orleans. Devastation from a rising sea occurs as the result of local storms which can be expected to cause repeated retreats from transitory shorelines and rebuilding away from them.

Satellite images and other data have revealed the initial response of ice sheets to global warming. The area on Greenland in which summer melting of ice took place increased more than 50 percent during the last twenty-five years. Meltwater descends through crevasses to the ice sheet base, where it provides lubrication that increases the movement of the ice sheet and the discharge of giant icebergs into the ocean. The volume of icebergs from Greenland has doubled in the last ten years. Seismic stations reveal a shocking increase in "icequakes" on Greenland, caused by a portion of an ice sheet lurching forward and grinding to a halt. The annual number of these icequakes registering 4.6 or greater on the Richter scale doubled from 7 in 1993 to 14 in the late 1990s; it doubled again by 2005. A satellite that measures minute changes in Earth's gravitational field found the mass of Greenland to have decreased by 50 cubic miles of ice in 2005. West Antarctica's mass decreased by a similar amount.

The effect of this loss of ice on the global sea level is small, so far, but it is accelerating. The likelihood of the sudden collapse of ice sheets increases as global warming continues. For example, wet ice is darker, absorbing more sunlight, which increases the melting rate of the ice. Also, the warming ocean melts the offshore accumulations of ice"ice shelves" that form a barrier between the ice sheets and the ocean. As the ice shelves melt, more icebergs are discharged from the ice sheets into the ocean. And as the ice sheet discharges more icebergs into the ocean and loses mass, its surface sinks to a lower level where the temperature is warmer, causing it to melt faster.

The business-as-usual scenario, with five degrees Fahrenheit global warming and ten degrees Fahrenheit at the ice sheets, certainly would cause the disintegration of ice sheets. The only question is when the collapse of these sheets would begin. The business-as-usual scenario, which could lead to an eventual sea level rise of eighty feet, with twenty feet or more per century, could produce global chaos, leaving fewer resources with which to mitigate the change in climate. The alternative scenario, with global warming under two degrees Fahrenheit, still produces a significant rise in the sea level, but its slower rate, probably less than a few feet per century, would allow time to develop strategies that would adapt to, and mitigate, the rise in the sea level.

3

Both the Department of Energy and some fossil fuel companies insist that continued growth of fossil fuel use and of CO_2 emissions are facts that cannot be altered to any great extent. Their prophecies become self-fulfilling, with the help of government subsidies and intensive efforts by special interest groups to prevent the public from becoming well-informed.

In reality, an alternative scenario is possible and makes sense for other reasons, especially in the US, which has become an importer of energy, hemorrhaging wealth to foreign nations in order to pay for it. In response to oil shortages and price rises in the 1970s, the US slowed its growth in energy use mainly by requiring an increase from thirteen to twenty-four miles per gallon in the standard of auto efficiency. Economic growth was decoupled from growth in the use of fossil fuels and the gains in efficiency were felt worldwide. Global growth of CO_2 emissions slowed from more than 4 percent each year to between 1 and 2 percent growth each year.

This slower growth rate in fossil fuel use was maintained despite lower energy prices. The US is still only half as efficient in its use of energy as Western Europe, i.e., the US emits twice as much CO_2 to produce a unit of GNP, partly because Europe encourages efficiency by fossil fuel taxes. China and India, using older technologies, are less energy-efficient than the US and have a higher rate of CO_2 emissions.

Available technologies would allow great improvement of energy efficiency, even in Europe. Economists agree that the potential could be achieved most effectively by a tax on carbon emissions, although strong political leadership would be needed to persuasively explain the case for such a tax to the public. The tax could be revenue-neutral, i.e., it could also provide for tax credits or tax decreases for the public generally, leaving government revenue unchanged; and it should be introduced gradually. The consumer who makes a special effort to save energy could gain, benefiting from the tax credit or decrease while buying less fuel; the well-to-do consumer who insisted on having three Hummers would pay for his own excesses.

Achieving a decline in CO_2 emissions faces two major obstacles: the huge number of vehicles that are inefficient in their use of fuel and the continuing CO_2 emissions from power plants. Auto makers oppose efficiency standards and prominently advertise their heaviest and most powerful vehicles, which yield the greatest short-term profits. Coal companies want new

coal-fired power plants to be built soon, thus assuring long-term profits.

The California legislature has passed a regulation requiring a 30 percent reduction in automobile greenhouse gas emissions by 2016. If adopted nationwide, this regulation would save more than $150 billion annually in oil imports. In thirty-five years it would save seven times the amount of oil estimated by the US Geological Services to exist in the Arctic National Wildlife Refuge. By fighting it in court, automakers and the Bush administra-tion have stymied the California law, which many other states stand ready to adopt. Further reductions of emissions would be possible by means of technologies now being developed. For example, new hybrid cars with larger batteries and the ability to plug into wall outlets will soon be available; and cars whose bodies are made of a lightweight carbon composite would get better mileage.

If power plants are to achieve the goals of the alternative scenario, construction of new coal-fired power plants should be delayed until the technology needed to capture and sequester their CO_2 emissions is available. In the interim, new electricity requirements should be met by the use of renewable energies such as wind power as well as by nuclear power and other sources that do not produce CO_2. Much could be done to limit emissions by improving the standards of fuel efficiency in buildings, lighting, and appliances. Such improvements are entirely possible, but strong leadership would be required to bring them about. The most effective action, as I have indicated, would be a slowly increasing carbon tax, which could be revenue-neutral or would cover a portion of the costs of mitigating climate change.

The alternative scenario I have been referring to has been designed to be consistent with the Kyoto Protocol, i.e., with a world in which emissions from developed countries would decrease slowly early in this century and the developing countries would get help to adopt "clean" energy technologies that would limit the growth of their emissions. Delays in that approachespecially US refusal both to participate in Kyoto and to improve vehicle and power plant efficienciesand the rapid growth in the use of dirty technologies have resulted in an increase of 2 percent per year in global CO_2 emissions during the past ten years. If such growth continues for another decade, emissions in 2015 will be 35 percent greater than they were in 2000, making it impractical to achieve results close to the alternative scenario.

The situation is critical, because of the clear difference between the two scenarios I have projected. Further global warming can be kept within limits (under two degrees Fahrenheit) only by means of simultaneous slowdown of CO_2 emissions and absolute reduction of the

principal non-CO_2 agents of global warming, particularly emissions of methane gas. Such methane emissions are not only the second-largest human contribution to climate change but also the main cause of an increase in ozonethe third-largest human-produced greenhouse gasin the troposphere, the lowest part of the Earth's atmosphere. Practical methods can be used to reduce human sources of methane emission, for example, at coal mines, landfills, and waste management facilities. However, the question is whether these reductions will be overwhelmed by the release of frozen methane hydrates the ice-like crystals in which large deposits of methane are trappedif permafrost melts.

If both the slowdown in CO_2 emissions and reductions in non-CO_2 emissions called for by the alternative scenario are achieved, release of "frozen methane" should be moderate, judging from prior interglacial periods that were warmer than today by one or two degrees Fahrenheit. But if CO_2 emissions are not limited and further warming reaches three or four degrees Fahrenheit, all bets are off. Indeed, there is evidence that greater warming could release substantial amounts of methane in the Arctic. Much of the ten-degree Fahrenheit global warming that caused mass extinctions, such as the one at the Paleocene-Eocene boundary, appears to have been caused by release of "frozen methane." Those releases of methane may have taken place over centuries or millennia, but release of even a significant fraction of the methane during this century could accelerate global warming, preventing achievement of the alternative scenario and possibly causing ice sheet disintegration and further long-term methane release that are out of our control.

Any responsible assessment of environmental impact must conclude that further global warming exceeding two degrees Fahrenheit will be dangerous. Yet because of the global warming already bound to take place as a result of the continuing long-term effects of greenhouse gases and the energy systems now in use, the two-degree Fahrenheit limit will be exceeded unless a change in direction can begin during the current decade. Unless this fact is widely communicated, and decision-makers are responsive, it will soon be impossible to avoid climate change with far-ranging undesirable consequences. We have reached a critical tipping point.

4

The public can act as our planet's keeper, as has been shown in the past. The first human-made atmospheric crisis emerged in 1974, when the chemists Sherry Rowland and Mario Molina reported that chlorofluorocarbons (CFCs) might destroy the stratospheric ozone layer that protects animal and plant life from the sun's harmful ultraviolet rays. How narrowly we escaped disaster was not realized until years later.

CFC appeared to be a marvelous inert chemical, one so useful as an aerosol propellant, fire suppressor, and refrigerant fluid that CFC production increased 10 percent per year for decades. If this business-as-usual growth of CFCs had continued just one more decade, the stratospheric ozone layer would have been severely depleted over the entire planet and CFCs themselves would have caused a larger greenhouse effect than CO_2.

Instead, the press and television reported Rowland and Molina's warning widely. The public, responding to the warnings of environmental groups, boycotted frivolous use of CFCs as propellants for hair spray and deodorant, and chose non-CFC products instead. The annual growth of CFC usage plummeted immediately from 10 percent to zero. Thus no new facilities to produce CFCs were built. The principal CFC manufacturer, after first questioning the scientific evidence, developed alternative chemicals. When the use of CFCs for refrigeration began to increase and a voluntary phaseout of CFCs for that purpose proved ineffective, the US and European governments took the lead in negotiating the Montreal Protocol to control the production of CFCs. Developing countries were allowed to increase the use of CFCs for a decade and they were given financial assistance to construct alternative chemical plants. The result is that the use of CFCs is now decreasing, the ozone layer was damaged but not destroyed, and it will soon be recovering.

Why are the same scientists and political forces that succeeded in controlling the threat to the ozone layer now failing miserably to deal with the global warming crisis? Though we depend on fossil fuels far more than we ever did on CFCs, there is plenty of blame to go around. Scientists present the facts about climate change clinically, failing to stress that business-as-usual will transform the planet. The press and television, despite an overwhelming scientific consensus concerning global warming, give equal time to fringe "contrarians" supported by the fossil fuel industry. Special interest groups mount effective disinformation campaigns to sow doubt about the reality of global warming. The government appears to be strongly

influenced by special interests, or otherwise confused and distracted, and it has failed to provide leadership. The public is understandably confused or uninterested.

I used to spread the blame uniformly until, when I was about to appear on public television, the producer informed me that the program "must" also include a "contrarian" who would take issue with claims of global warming. Presenting such a view, he told me, was a common practice in commercial television as well as radio and newspapers. Supporters of public TV or advertisers, with their own special interests, require "balance" as a price for their continued financial support. Gore's book reveals that while more than half of the recent newspaper articles on climate change have given equal weight to such contrarian views, virtually none of the scientific articles in peer-reviewed journals have questioned the consensus that emissions from human activities cause global warming. As a result, even when the scientific evidence is clear, technical nit-picking by contrarians leaves the public with the false impression that there is still great scientific uncertainty about the reality and causes of climate change.

The executive and legislative branches of the US government seek excuses to justify their inaction. The President, despite conclusive reports from the Intergovernmental Panel on Climate Change and the National Academy of Sciences, welcomes contrary advice from Michael Crichton, a science fiction writer. Senator James Inhofe, chairman of the Committee on Environment and Public Works, describes global warming as "the greatest hoax ever perpetrated on the American people" and has used aggressive tactics, including a lawsuit to suppress a federally funded report on climate change, to threaten and intimidate scientists.

Policies favoring the short-term profits of energy companies and other special interests are cast by many politicians as being in the best economic interests of the country. They take no account of the mounting costs of environmental damage and of the future costs of maintaining the supply of fossil fuels. Leaders with a long-term vision would place greater value on developing more efficient energy technology and sources of clean energy. Rather than subsidizing fossil fuels, the government should provide incentives for fossil-fuel companies to develop other kinds of energy.

Who will pay for the tragic effects of a warming climate? Not the political leaders and business executives I have mentioned. If we pass the crucial point and tragedies caused by climate change begin to unfold, history will judge harshly the scientists, reporters, special interests, and politicians who failed to protect the planet. But our children will pay the consequences.

The US has heavy legal and moral responsibilities for what is now happening. Of all the CO_2 emissions produced from fossil fuels so far, we are responsible for almost 30 percent, an amount much larger than that of the next-closest countries, China and Russia, each less than 8 percent. Yet our responsibility and liability may run higher than those numbers suggest. The US cannot validly claim to be ignorant of the consequences. When nations must abandon large parts of their land because of rising seas, what will our liability be? And will our children, as adults in the world, carry a burden of guilt, as Germans carried after World War II, however unfair inherited blame may be?

The responsibility of the US goes beyond its disproportionate share of the world's emissions. By refusing to participate in the Kyoto Protocol, we delayed its implementation and weakened its effectiveness, thus undermining the attempt of the international community to slow down the emissions of developed countries in a way consistent with the alternative scenario. If the US had accepted the Kyoto Protocol, it would have been possible to reduce the growing emissions of China and India through the Protocol's Clean Development Mechanism, by which the developed countries could offset their own continuing emissions by investing in projects to reduce emissions in the developing countries. This would have eased the way to later full participation by China and India, as occurred with the Montreal Protocol. The US was right to object to quotas in the Kyoto Protocol that were unfair to the US; but an appropriate response would have been to negotiate revised quotas, since US political and technology leadership are essential for dealing with climate change.

It is not too late. The US hesitated to enter other conflicts in which the future was at stake. But enter we did, earning gratitude in the end, not condemnation. Such an outcome is still feasible in the case of global warming, but just barely.

As explained above, we have at most ten yearsnot ten years to decide upon action, but ten years to alter fundamentally the trajectory of global greenhouse emissions. Our previous decade of inaction has made the task more difficult, since emissions in the developing world are accelerating. To achieve the alternative scenario will require prompt gains in energy efficiencies so that the supply of conventional fossil fuels can be sustained until advanced technologies can be developed. If instead we follow an energy-intensive path of squeezing liquid fuels from tar sands, shale oil, and heavy oil, and do so without capturing and sequestering CO_2 emissions, climate disasters will become unavoidable.

5

When I recently met Larry King, he said, "Nobody cares about fifty years from now." Maybe so. But climate change is already evident. And if we stay on the business-as-usual course, disastrous effects are no further from us than we are from the Elvis era. Is it possible for a single book on global warming to convince the public, as Rachel Carson's Silent Spring did for the dangers of DDT? Bill McKibben's excellent book The End of Nature is usually acknowledged as having been the most effective so far, but perhaps what is needed is a range of books dealing with different aspects of the global warming story.

Elizabeth Kolbert's Field Notes, based on a series of articles she wrote for The New Yorker, is illuminating and sobering, a good book to start with. The reader is introduced to some of the world's leading climate researchers who explain the dangers in reasonably nontechnical language but without sacrificing scientific accuracy. The book includes fascinating accounts of how climate changes affected the planet in the past, and how such changes are occurring in different parts of the world right now. If Field Notes leaves the reader yearning for more experience in the field, I suggest Thin Ice by Mark Bowen, which captures the heroic work of Lonnie Thompson in extracting unique information on climate change from some of the most forbidding and spectacular places on the planet.[1]

Tim Flannery's The Weather Makers puts needed emphasis on the effects of human-made climate change on other life on the planet. Flannery is a remarkable scientist, having discovered and described dozens of mammals in New Guinea, yet he writes for a general audience with passion and clarity. He considers changes in climate that correspond to what I have defined as the business-as-usual and alternative scenarios. Flannery estimates that when we take account of other stresses on species imposed by human beings, the alternative scenario will lead to the eventual extinction of 20 percent of today's species, while continuing with business-as-usual will cause 60 percent to become extinct. Some colleagues will object that he extrapolates from meager data, but estimates are needed and Flannery is as qualified as anyone to make them. Fossil records of mass extinctions support Flannery's shocking estimate of the potential for climate change to extinguish life.

Flannery concludes, as I have, that we have only a short time to address global warming

[1] Henry Holt, 2005. See the review by Bill McKibben, "The Coming Meltdown," The New York Review, January 12, 2006.

before it runs out of control. However, his call for people to reduce their CO_2 emissions, while appropriate, oversimplifies and diverts attention from the essential requirement: government leadership. Without such leadership and comprehensive economic policies, conservation of energy by individuals merely reduces demands for fuel, thus lowering prices and ultimately promoting the wasteful use of energy. I was glad to see that in a recent article in these pages, he wrote that an effective fossil energy policy should include a tax on carbon emissions.[2]

A good energy policy, economists agree, is not difficult to define. Fuel taxes should encourage conservation, but with rebates to taxpayers so that the government revenue from the tax does not increase. The taxpayer can use his rebate to fill his gas-guzzler if he likes, but most people will eventually reduce their use of fuel in order to save money, and will spend the rebate on something else. With slow and continual increases of fuel cost, energy consumption will decline. The economy will not be harmed. Indeed, it will be improved since the trade deficit will be reduced; so will the need to protect US access to energy abroad by means of diplomatic and military action. US manufacturers would be forced to emphasize energy efficiency in order to make their products competitive internationally. Our automakers need not go bankrupt.

Would this approach result in fewer ultraheavy SUVs on the road? Probably. Would it slow the trend toward bigger houses with higher ceilings? Possibly. But experts say that because technology has sufficient potential to become more efficient, our quality of life need not decline. In order for this to happen, the price of energy should reflect its true cost to society.

Do we have politicians with the courage to explain to the public what is needed? Or may it be that such people are not electable, in view of the obstacles presented by television, campaign financing, and the opposition of energy companies and other special interests? That brings me to Al Gore's book and movie of the same name: An Inconvenient Truth. Both are unconventional, based on a "slide show" that Gore has given more than one thousand times. They are filled with picturesstunning illustrations, maps, graphs, brief explanations, and stories about people who have important parts in the global warming story or in Al Gore's life. The movie seems to me powerful and the book complements it, adding useful explanations. It is hard to predict how this unusual presentation will be received by the public; but Gore has put together a coherent account of a complex topic that Americans desperately need

[2]See "The Ominous New Pact," The New York Review, February 23, 2006.

to understand. The story is scientifically accurate and yet should be understandable to the public, a public that is less and less drawn to science.

The reader might assume that I have long been close to Gore, since I testified before his Senate committee in 1989 and participated in scientific "roundtable" discussions in his Senate office. In fact, Gore was displeased when I declined to provide him with images of increasing drought generated by a computer model of climate change. (I didn't trust the model's estimates of precipitation.) After Clinton and Gore were elected, I declined a suggestion from the White House to write a rebuttal to a New York Times Op-Ed article that played down global warming and criticized the Vice President. I did not hear from Gore for more than a decade, until January of this year, when he asked me to critically assess his slide show. When we met, he said that he "wanted to apologize," but, without letting him explain what he was apologizing for, I said, "Your insight was better than mine."

Indeed, Gore was prescient. For decades he has maintained that the Earth was teetering in the balance, even when doing so subjected him to ridicule from other politicians and cost him votes. By telling the story of climate change with striking clarity in both his book and movie, Al Gore may have done for global warming what Silent Spring did for pesticides. He will be attacked, but the public will have the information needed to distinguish our long-term well-being from short-term special interests.

An Inconvenient Truth is about Gore himself as well as global warming. It shows the man that I met in the 1980s at scientific roundtable discussions, passionate and knowledgeable, true to the message he has delivered for years. It makes one wonder whether the American public has not been deceived by the distorted images of him that have been presented by the press and television. Perhaps the country came close to having the leadership it needed to deal with a grave threat to the planet, but did not realize it.