

In Kyoto, The Subject Is Climate; The Forecast Is for Storms

By WILLIAM K. STEVENS

IN its 4.5 billion years of existence, the earth has withstood both deep cold that nearly turned the entire planet into a ball of ice and blazing heat that opened the Arctic to alligators and other warm-weather creatures.

Compared with that, and even with far less extreme climatic swings in the 10,000 years since the end of the last ice age, today's climate — for all its sometimes sharp variations — is remarkably stable.

Now, for the first time, humans are altering the atmosphere in ways that mainstream scientists believe are threatening to shatter that relative calm and set off a new round of climatic disruptions and extremes.

Starting today, representatives of some 150 countries will meet in Kyoto, Japan, to take what they hope will be the first step in a decades-long effort to cope with the prospect of global climate change. Rarely, if ever, has humanity made an attempt like this one: to exercise deliberate, collective foresight on a risk whose full impact is unclear and will not be felt for decades.

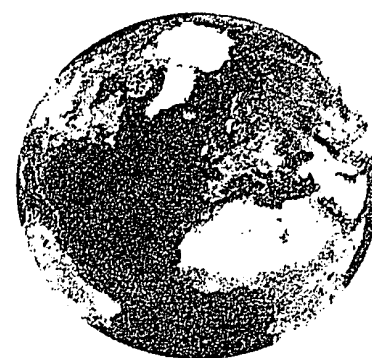
And rarely has any question on the global bargaining table been so difficult.

The negotiators' task is to agree on measures that would begin to reduce emissions of waste industrial gases that trap heat in the atmosphere. Chief among these "greenhouse" gases is carbon dioxide, which is spewed into the air every day around the globe by the burning of coal, oil and natural gas in power plants, factories and motor vehicles.

The world runs on these fuels, and any action to control their use would reverberate in every corner of

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This section contains new material and adaptations of previously published articles.



United Nations Conference on Climate Change

WHO IS GOING

More than 5,000 delegates representing more than 150 countries.

WHERE, WHEN

Kyoto, Japan
 Dec. 1-10

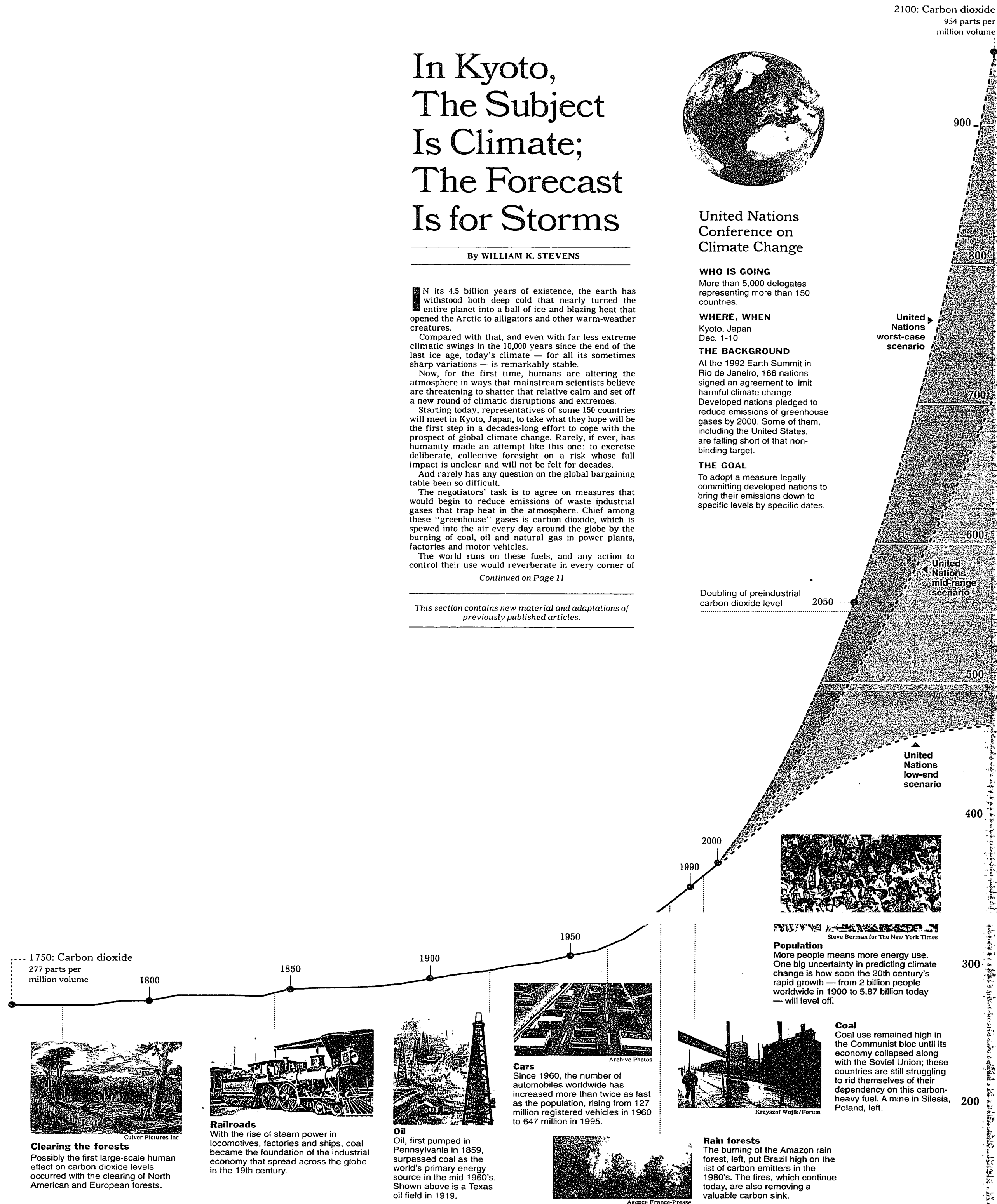
THE BACKGROUND

At the 1992 Earth Summit in Rio de Janeiro, 166 nations signed an agreement to limit harmful climate change. Developed nations pledged to reduce emissions of greenhouse gases by 2000. Some of them, including the United States, are falling short of that non-binding target.

THE GOAL

To adopt a measure legally committing developed nations to bring their emissions down to specific levels by specific dates.

2100: Carbon dioxide
 954 parts per
 million volume



1750: Carbon dioxide
 277 parts per
 million volume

1800

1850

1900

1950

2000

2050

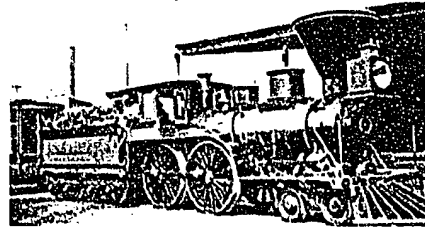
2100



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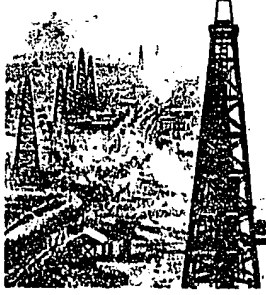
Clearing the forests

Possibly the first large-scale human effect on carbon dioxide levels occurred with the clearing of North American and European forests.



Railroads

With the rise of steam power in locomotives, factories and ships, coal became the foundation of the industrial economy that spread across the globe in the 19th century.



Oil

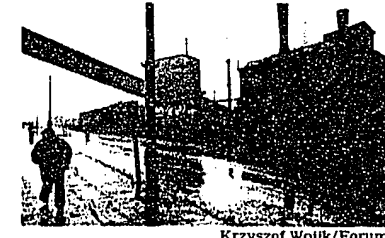
Oil, first pumped in Pennsylvania in 1859, surpassed coal as the world's primary energy source in the mid 1960's. Shown above is a Texas oil field in 1919.



Archive Photos

Cars

Since 1960, the number of automobiles worldwide has increased more than twice as fast as the population, rising from 127 million registered vehicles in 1960 to 647 million in 1995.



Krzyszof Wojcik/Forum

Coal

Coal use remained high in the Communist bloc until its economy collapsed along with the Soviet Union; these countries are still struggling to rid themselves of their dependency on this carbon-heavy fuel. A mine in Silesia, Poland, left.



Agence France-Presse

Rain forests

The burning of the Amazon rain forest, left, put Brazil high on the list of carbon emitters in the 1980's. The fires, which continue today, are also removing a valuable carbon sink.



Steve Berman for The New York Times

Population

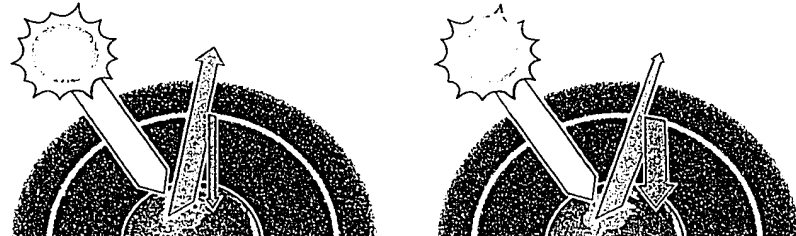
More people means more energy use. One big uncertainty in predicting climate change is how soon the 20th century's rapid growth — from 2 billion people worldwide in 1900 to 5.87 billion today — will level off.

Carbon on the Rise

Changes in the atmospheric levels of carbon dioxide, the main greenhouse gas, have been directly linked to changes in global temperatures. After a long period of stability, carbon dioxide levels began to rise with the onset of the Industrial Revolution. The increase has become progressively more rapid in this century, reflecting ever-increasing consumption of fossil fuels. Trying to gauge the changes ahead, a United Nations panel made a range of estimates of how carbon levels would increase in the 21st century under a "business as usual" scenario — in the absence of an effort to limit carbon emissions. Three of the estimates are shown; for details, see p. 4. Many scientists believe the likelihood of catastrophic climate changes will increase the closer the atmosphere comes to a doubling of the preindustrial carbon level.

The Earth's 'Glass Ceiling'

Sunlight heats the Earth. But the Earth would be far cooler if not for the presence of water vapor and greenhouse gases in the atmosphere. They let sunlight through to warm the Earth, but trap some of the heat escaping back to space in the form of infrared radiation — just as a greenhouse's glass ceiling slows the escape of heat. Increasing the atmosphere's levels of greenhouse gases is like adding thicker glass to a greenhouse's roof. As more heat is trapped, the greenhouse grows warmer. Many scientists believe that the carbon dioxide released by human activities has already begun to raise the Earth's overall temperature.



Sources: Tom Boden/Oak Ridge National Laboratory, Scripps Institute of Oceanography/University of California, Intergovernmental Panel on Climate Change

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the global economy. This attempt to manipulate the world's energy system has set off a complex clash of economic and political interests.

Among other things, it pits rich countries against poor ones, rich countries against one another and the nations and industries that produce fossil fuels (as well as some industries that use them heavily) against much of the rest of the world. Even as the great majority of players say they accept the need for common action, each is making its own calculation of cost and benefit, advantage and disadvantage.

The panel of scientists from around the world who advise the negotiators under United Nations auspices has said that if no action is taken, the average surface temperature of the globe will rise by two to six degrees Fahrenheit by the end of the next century, and more after that. That might not sound like much, and it is a far cry from the deepest cold and hottest heat of the remote past. But it is not trivial; the difference between the average temperature now and that at the depths of the last ice age, some 20,000 years ago, is only five to nine degrees.

It would be more warming, coming more rapidly, than the planet has experienced in the last 10,000 years, the period in which human civilization arose. It could profoundly affect the earth's climate.

The seas would rise, according to the panel of scientists, inundating many coastal areas and swamping small island nations. The world as a whole would become rainier, with most of the increase coming in the big downpours that cause floods. At the same time, drought-prone areas would get more droughts.

Climatic zones would shift away from the poles, the scientists predict. Since the warming would be unusually rapid, many natural ecosystems might be unable to adjust, and whole forest types could disappear. Growing seasons are already lengthening in northern latitudes, and temperate-zone agriculture might benefit in the long run. But in dry areas, like much of Africa, warming could bring agricultural and economic ruin. Tropical diseases like malaria and dengue fever could spread. And while temperate-zone winters would be milder, summer heat waves would be more

intense and deadly. The list goes on.

Such forecasts, of course, are rife with uncertainty. But many scientists believe that much of the impact is unavoidable. The implication is that preventive action to head off the risk, however uncertain, should have been taken years ago.

But who knew? It has been only two decades since 20th-century scientists, with their computer models, first began to make numerical forecasts of climate change, only one decade since the issue first burst into the public consciousness and only five years since the nations of the world gathered at Rio de Janeiro and signed a treaty aimed at preventing dangerous climatic change.

For much of the last two decades, scientists have cited a doubling of atmospheric carbon dioxide concentrations — to 560 parts per million from 280 parts per million before the Industrial Revolution began in the late 18th century — as a threshold of

concern. If that threshold should be reached, they say, the air at the earth's surface would warm by anywhere from a relatively moderate three degrees to eight degrees, a level at which the impact of some of the predicted climatic changes could assume catastrophic proportions.

Now many are saying that it may not be possible to prevent a doubling late in the next century. The world's economic and political systems cannot turn on a dime, they say, and they argue that the real task now is to prevent concentrations from growing beyond a doubling, to possibly even tripling or quadrupling. Those concentrations, they say, would bring certain climatic catastrophe. In the meantime, the world may have to learn to adapt.

Not everyone is so pessimistic. Environmentalists' goal is to stabilize carbon dioxide concentrations at about one and a half times the preindustrial level, then to begin to gradu-

ally reduce them. Although that might still cause some disruption, they believe, it would head off the most damaging effects.

There remain contrarians who say the problem has been overblown and may not exist. Given the uncertainty that permeates climate science, even many experts who are not skeptics argue for modest action until the extent of the problem is clearer.

As has been the case all along under the 1992 Rio treaty that governs the Kyoto talks, the industrialized countries are expected to take the lead in setting specific targets for reducing emissions. The rationale, based largely on considerations of equity, is that they got rich by burning fossil fuels and are responsible for most of the problem. But developing countries are also to undertake specific commitments at some point because their emissions will probably surpass those of the rich nations in two decades or so.

When that will happen, and how, will be a big issue in Kyoto, possibly a deal-breaker. If the talks collapsed, the process would not be over because discussions would certainly resume at some point. But proponents of action argue that valuable time would be lost.

AT Rio five years ago, the rich nations adopted the voluntary goal of stabilizing emissions at 1990 levels by 2000. But many nations, including the United States, will miss that target. Proposals now on the table for the meeting in Japan call for legally binding reductions. They range from reducing the rich countries' emissions to 1990 levels by around 2010 (proposed by the United States) to cutting them to 35 percent below 1990 levels by 2020 (proposed by the developing countries). None of the proposals would reduce emissions enough to keep overall atmospheric concentrations from rising.

But, given the political reality, those proposals probably define the range of what can be achieved just now. Some environmentalists believe that it is possible to emerge from the talks with cuts sufficient to preserve the option of eventually stabilizing concentrations at one and a half times preindustrial levels. They also say it is possible in Kyoto to send a signal to industry that business as usual must change. Some experts who argue caution, on economic grounds, believe likewise. But other interested parties, including oil-producing countries and many American manufacturers, argue that any action now risks unacceptable short-term economic damage. Environmentalists counter that by insisting that in the long run, cutting fossil fuels would make the economy more efficient.

At most, Kyoto will be a beginning, not an ending.