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the devastating drought in the Midwest (pictured right) the sign of a climatic pollution that will bring rising temperatures and the risk of floods as the polar ice-caps melt? Scientists and politicians gather today at a conference in Toronto to discuss measures to curb man's harmful influence on the climate, says GUY HIGFIELD reports from Toronto on the growing debate on the much-vaunted Greenhouse Effect



# The hottest topic on earth

time to stop waffling and the Greenhouse Effect is With that warning to the States Congress last an American climatologist used the minds of economic and political leaders on a danger which, until many of them have chosen with scepticism: namely, a great gathering of pollutants in the earth's atmosphere will ultimately cause a serious over-heating of the climate. prediction that the Greenhouse Effect, which keeps the earth warm, would one day get control is at least 50 years away, says most scientists, while supporters of the theory, have been predicting when it would happen and its implications might be felt at large has no doubt felt it safe to regard the matter as another "science fiction" story like the San Anselmo or the puncturing of the ozone layer.

the disastrous drought in the Midwest, conjuring up the 1930s Dust Bowl, focused attention on the threat. At a major conference to discuss man's impact on the earth's climate beginning today in Toronto, scientists will try to persuade government representatives, legal experts, economists and industrialists that the time has come to treat the threat seriously.

James Hansen, the NASA climatologist who told a congressional committee last week that "waffling" had to stop, says the drought is 99 per cent likely to be an early manifestation of the Greenhouse Effect.

Other scientists are less sure we are on the verge of a climatic revolution. Shall we see, over the next 50 years, ice-caps melting and the level of the oceans rising? Will harsh winters get warmer while desert temperatures actually

mean more cloud — and thus actually help to shield us from the direct rays of the sun?

Certainly the debate is heating up. One of the scientists attending the Toronto conference says he has proof that the Greenhouse Effect will occur. Dr Wayne Evans, of the Atmospheric Environment Service in Ontario, whose study is published in the latest edition of *Nature* says: "This is an experimental demonstration that man has changed the planet's atmosphere — like a smoking gun for the Greenhouse Effect."

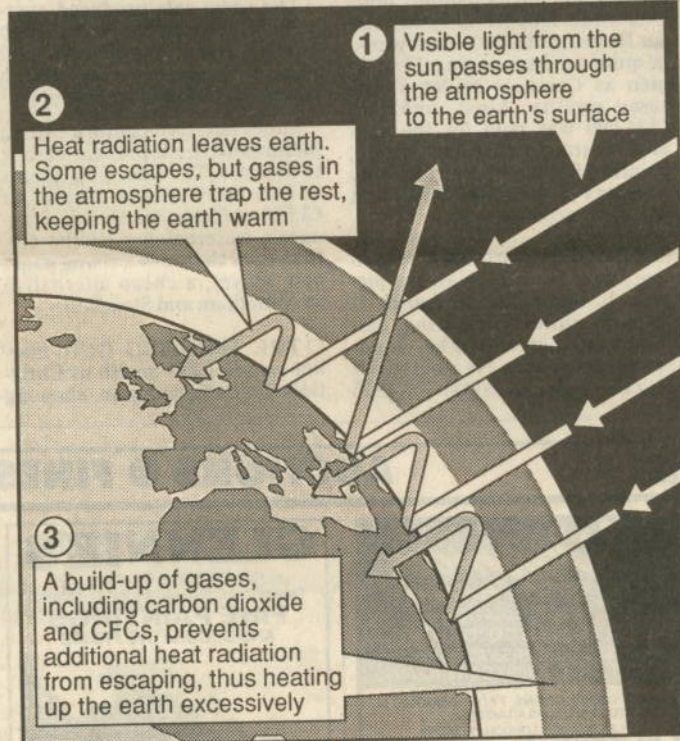
He says he can show that chlorofluorocarbons (see explanation, right), which are already known to have a damaging effect on the earth's ozone layer, are also contributing to the Greenhouse Effect.

From readings taken with a balloon between altitudes of five and 25 kilometres, Dr Evans has for the first time measured the greenhouse radiation of two varieties of chlorofluorocarbon, CFC-12 and CFC-11.

In the past 12 years, says Evans, the heat radiation returned to earth by greenhouse gases has doubled in line with increases in CFC concentration. "CFCs are damaging to the environment on two counts: the damage to the ozone layer; and their radiation properties, which are much worse than those of carbon dioxide. It is another good reason to get rid of CFCs."

Man's use of CFC's has altered the energy balance of the planet's climate by one tenth of a percent which will produce warming of around half a degree in 50 or so years. "That warming does not take into account future levels of CFCs which are increasing faster in the atmosphere than the other greenhouse gases," said Evans.

A similar change in the radiation balance has not been



## THE GREENHOUSE EFFECT: HOW IT WORKS

● LIGHT from the sun is absorbed by the earth and much of the heat is then radiated back into space. Gases in the atmosphere, such as ozone and carbon dioxide, create a shield which traps some of the heat and keeps the earth warm. Without the shield, the earth would be a lifeless, frozen planet with an estimated surface temperature of minus 20 degrees centigrade.

The problem comes with an excessive build-up of gases which means that less and less heat can escape through the atmosphere. Thus the shield has the same effect as the glass in a greenhouse. The gases causing the build-up are mainly carbon dioxide, which arises from the burning of fossil fuels, methane and, increasingly, chlorofluorocarbons (CFCs) which are used in aerosol sprays, refrigeration and plastic foams.

observed for carbon dioxide, he said. "That will require more sophisticated instruments operating maybe for 10 or 20 years."

Another scientist convinced by the greenhouse build-up is Dr David Rind, one of Hansen's colleagues at Nasa. He says the phenomenon can be proved by recent increases in the global temperature.

He says that the 1980s had the four hottest global temperatures on record in the past 100 years. "1988 seems to have a step up on all the others," he said.

In 1985 a major meeting of climatologists in Austria issued a statement which said that scientists agreed that a global climate warming unprecedented in human history was inevitable.

"The magnitude is still quite disputed but the fact that it is large is not," said Dr Henry Hengeveld, a member of Environment Canada and one of the organisers of the Toronto conference.

The effect would be that countries like England and Canada would see greater warming than those to the south, while the mid latitudes of the Northern Hemisphere would be likely to become drier.

He said that despite further research since then "there has not been much of a change in understanding" but that "there is a large consensus that the Greenhouse Effect is very real."

Analysis of ice cores in Greenland has shown a correlation between historic carbon dioxide

levels in the ice and the indicators of contemporary temperatures. "That is a very positive natural indicator of a link between how warm the world is and carbon dioxide levels."

However, what is still disputed is how this temperature rise will manifest itself in terms of climate changes. "Outside of the general warming, the additional impacts are much more debatable," said Dr Rind.

"It will be another decade before scientists start predicting the detailed effects of the temperature change on climate," said Dr Hengeveld.

But can the world afford to wait for scientific proof? Dr Phil Jones of the University of East Anglia's Climatic Research Unit

says: "By the time we get categorical proof of the Greenhouse Effect it will be too late to do much about it. We should be doing things about it now at an international level. We are confident the Greenhouse Effect is going to happen and the longer we put off doing anything, the more drastic the remedy will have to be."

A study carried out by the Climatic Research Unit with the University of Massachusetts of 150 years of records from 1,500 weather stations in the Northern Hemisphere has shown a shift in rainfall from low latitudes to middle and high latitudes, agreeing with some of the predictions of mathematical experiments simulating the Greenhouse Effect.

In Britain, there has been evidence that plants have altered their anatomy to keep pace with changes in our climate. A study by Dr Ian Woodward of Cambridge University, in which leaves of eight British plants and trees were compared with 200-year-old preserved specimens, showed that plants have changed as a result of increasing carbon dioxide levels.

One consequence of the global warming caused by the Greenhouse Effect would be to melt glaciers and ice sheets while warming the ocean, causing it to expand. Dr William Carter of the University of Ulster warned recently that to ignore the rise in sea levels is to court disaster.

Based on information from America's Environmental Protection Agency (EPA) he said there could be devastation of Britain's coastlines including flooding of low-lying land, destruction of wetlands and even loss of life.

The EPA's figures predicted the sea increasing in depth by up to 3 millimetres a year. By the year 2100, sea levels could rise by between 0.5 and 3.5 metres. Other estimates by the World Resources Institute in Washington put the rise in sea levels between 50 and 200 centimetres by the year 2100.

Even if Dr Hansen is judged to have been too quick to point to the drought as proof of the greenhouse build-up, the evidence does appear to suggest that those who treat the theory as so much waffle are playing with fire.

## If the Greenhouse Effect is not to blame, what is?

The Greenhouse Effect is not only theory being put forward to explain the drought in the Midwest states.

**Volcanic ash effect:** Handler, physics professor at University of Illinois, claims the US is experiencing its wettest and driest weather in more than 50 years because there have been no major volcanic eruptions in the past year. Volcanic eruptions spew

small liquid particles into the atmosphere," says Handler. "This stratospheric aerosol forms a band around the earth and cools it."

He says that when there is a volcanic eruption in areas close to the equator a few months prior to crop planting in North America, the US corn crop is generally a bumper harvest.

The most recent example of the "volcanic ash effect" came

after a huge volcanic eruption in Colombia, killing 25,000 people in April 1986. It was followed by two bountiful US corn crops in 1986 and 1987.

"But by 1988, the aerosol had finally disappeared and we have a relatively clear stratosphere and dry weather," Handler said.

Handler is sceptical of the greenhouse theory. He says it takes about 20 years to prove and that weather throughout the globe should be getting generally

hotter instead of this year's pattern of isolated droughts.

**The sunspot effect:** It is not carbon dioxide and not volcanic ash but sunspots that are heating up the world, some weather experts claim.

Since 1840, the sun has been observed to go through 11-year cycles. At the peaks of these cycles, sunspot activity increases and decreases.

Sunspots are areas of the sun

that appear darker than others. Climatologists say that this is because the other areas are actually brighter than normal, thus affecting the amount of sun on certain regions of the earth.

The next dry period, according to sunspot watchers, should peak in the next decade. From the autumn of 1987 through to 1992, it should be getting drier. It will be driest in 1992 then for the next five or six years, it will get a little less dry.