



# THE GREENHOUSE EFFECT



Andean cockof-the-rock (Rupicola peruviana). Peru.



Nuclear power station. new planetary emergency: the fight against global warming, due to the well-known greenhouse effect. In particular, avoid a temperature rise

of over 2°C. That requirement involves a halving or even quartering of world emissions of greenhouse gases by 2050. Between now and then the population on Earth will have risen by a half, and the energy consumption of developing countries will be rising strongly. In that context, the object that has been set will be difficult to attain. The greenhouse effect is at the origin of life on Earth. Because of humans, it has become a Sword of Damocles. We do not know exactly how biodiver-

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Tropical forest in Queensland, Australia.

sity will react to the phenomenon. Heat wave in Europe in 2003 (37 000 dead), Hurricane Katrina over New Orleans, etc. – the last ten years have been marked by unprecedented catastrophes that a large number of meteorologists associate directly with climate disturbance.

### HOW DOES IT WORK?

Solar energy crosses the atmosphere and heats up the earth's soil. In turn, the latter sends that radiation into space in the form of infrared radiation. Greenhouse gases then partially block that transfer by reflecting that heat back to Earth. Hence, life on our planet exists because of that protective layer. Without that natural phenomenon, average temperatures would fall from 15°C to -18°C!

> Slash-and-burn and forest fire.

Moon has nighttime temperatures close to -170°C, which prevent it from supporting any life. Carbon in the atmosphere comes above all from the breakdown and respiration of living beings

With no atmosphere or greenhouse gases, the





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animals and plants alike, which consume oxygen and release carbon dioxide ( $CO_2$ ). In gaseous form, atmospheric  $CO_2$  is absorbed in part by plants and by oceanic phytoplankton for photosynthesis.

#### A DESTABILISED PROCESS

For the last two centuries, that process has been destabilised by industrialisation and by the development of the car, based on the combustion of carbon-based fossil matter (oil, coal, and natural gas). That has released into the atmosphere tens of billions of tonnes of carbon buried beneath the soil and the oceans. The soils and oceans are "carbon sinks", but they nonetheless manage to absorb and re-incorporate half of those discharges linked to human activity. In that way, the biosphere can naturally recycle 3 to 4 billion tonnes of carbon per year. However, that capacity is lessened by global warming, which reduces sedimentation capacity. Deforestation causes 1.6 billion tonnes of discharges each year.



Solar energy. Photosensitive panels.

The amount of CO2 emitted increases inexorably by about 8 billion tonnes each year, of which 6.8 billion tonnes are emitted by human activities. Transport accounts for 65% of global warming. Water vapour accounts for two thirds of greenhouses gases; the remaining one third is made up of CO2, methane, nitrogen oxide, and chlorofluorocarbons (CFCs). Paddy field, ruminants,



Every day, a bovine weighing 500 kg releases 300 litres of methane. A herd of cows in Touraine. France.



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discharges, biomass combustion, and the use of fossil energies are the cause of methane emissions. CFCs are used in aerosols, refrigerators, and air-conditioners, as well as in insulating foam and in fire-fighting equipment. CFCs are propellant gases that diminish the ozone layer and encourage the greenhouse effect. Under the action of the sun, those refrigerant gases release chlorine, which destroys ozone molecules and absorbs solar radiation, which warms up the atmosphere.

The Montreal Protocol was signed in 1987, and it banned the use of those products; however, their effect will persist for a few decades. In 2006, the World Meteorological Organisation confirmed the correlation between the increase in CFC emissions and the partial reconstitution of the ozone layer.

CFCs: gases used in aerosols, refrigerators, and air-conditioners.

#### **CONSEQUENCES FOR FAUNA**

No ecosystem is spared by global warming. That new threat may strike most species. Some forecasts covering over one thousand species in the





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six regions with the richest biodiversity show that 15 to 37% of those species will have disappeared by 2050. The Earth has warmed up by about 0.6°C over the last few years, and it is experiencing its greatest thaw. Glaciers are retreating, and by 2030, some of them will have disappeared completely. The polar ice cap at the North Pole has shrunk by 17% over twenty-three years. The melt calendar is running one or two weeks ahead of where it was about twenty years ago, and pack ice is late in forming. That layer of ice, on which polar bears depend for their food and to reproduce, is currently melting by 8% every year. As a result, the sub-populations to the west of Hudson Bay in Canada and to the south of the Beaufort Sea have



Pollution: used batteries stored on the ground.

declined by 22% and 17% respectively over the last two decades. Some researchers suggest that those mammals may become extinct in Canada



Biodiversity suffers the harmful effects of greenhouse gases. 1/3 of species will have disappeared by 2050. Hoffman's two-toed sloth (Cholœpus hoffmanni). Costa Rica.



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Polar bears are condemned by the gradual reduction in pack ice, due partly to the greenhouse effect.

over the next twenty-five years if global warming carries on at its current rate. That has led to the polar bear being placed on the species red list. The main signs of disequilibrium include their average weight, which has fallen by 15% in twenty years. Their hunting season has been shortened, and they are no longer able to store fat until the next winter, which means a far longer fasting period. That terrestrial carnivore needs pack ice to go hunting, especially for seals, which form 90% of its diet (polar bears kill their prey when it comes up to the surface to breathe). That food shortage also disturbs its long sleep (during which its life systems slow down) and its reproduction. Previously, females would regularly bear litters of triplets. Nowadays, they give birth to a single cub. The weaning period has fallen from 18 months

> Ocean warming leads to a reduction in the amount of krill.

to 12 months. In Antarctica, penguins and some marine animals are the victims of water warming. Krill (freshwater shrimp) form the main source of food for gentoo penguins and chinstrap penguins; the amount of krill has fallen sharply. In



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some penguin colonies, the population has fallen by between 30% and 66%. The same is true for the emperor penguin, with the weakened pack ice carrying away large numbers of eggs and young. Most at risk is the Adélie penguin, which lives on the north-west coast of the Antarctic Peninsula. Not only is its food getting scarcer, but it is suffering competition from gentoo penguins, which are better adapted to heat. According to the WWF, the Adélie penguin is as risk of becoming extinct to the benefit of its cousin. In lagoons that have become too hot, coral reefs are beginning to disappear, and with them the animals that they shelter. Islands in the Pacific Ocean, the Caribbean Sea, and Indian Ocean may disappear under the waves. The cold water generated by melting ice may divert the Gulf Stream, an ocean current that warms Northern Europe. Without the heat provided by that current, average temperatures may fall by 5 to 10°C in Europe and in North America. That paradox of



Global warming endangers populations of gentoo penguins.

warming would lead to a sharp decrease in rainfall for Central America, leading to the extinction of fauna and of the tropical forest. The general rise



**L'Arcire** 

The poles in danger: the alarming ice melt in Antarctica.



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Several islands may disappear due to the observed rise in sea levels. Aldabra Atoll, Indian Ocean.

in temperatures and in precipitation also encourages the development of diseases, parasites, and insects carrying diseases like malaria and dengue fever.

WHAT SOLUTIONS ARE THERE?

Global warming is impossible to stop. However, by adopting a more sober way of life, developed countries may be able to contain the phenomenon in the long term, and contribute to the survival of large numbers of endangered species. The

Carbon fossil energies contribute to the greenhouse effect.

first imperative is to reduce greenhouse-gas emissions by three quarters over forty years. Renewable energies offer an undeniable alternative for attaining that objective. Renewable





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Insects in tropical forests are also victims of the greenhouse effect. Giant African fruit beetle (Chelorrhina polyphemus).

Greenhouse gases are a serious threat to the whole biosphere. Green-and-black poison-arrow frog (Dendrobates auratus). Costa Rica.

energies are inexhaustible and discharge-free, and they are spread naturally around the world, allowing for low-cost supplies. In spite of high installation costs, wind farms, tidal power stations, and hydroelectric dams should develop in the future, as well as liquid hydrogen, which may prove to be an attractive substitute for oil.

**ЦАРСИРЕ** РНОТО G КАРНІ QUE. O К G Text by Laurent Tenard - Photographs by Gilles Martin