

Cures for a sick planet

CLIMATE

Roger Highfield

SCIENTISTS are considering "atmospheric engineering" to halt the effects of what Mrs Thatcher last week called "a massive experiment with the system of this planet itself".

She told scientists at the Royal Society of her concern over the damage being done to the Earth's atmosphere, notably the global warming caused by the greenhouse effect and the damage done to the planet's protective ozone layer.

Now, bold and fantastic ideas in atmospheric engineering — further man-made climate changes — are being suggested to heal our ailing atmosphere.

Dr Richard Warrick of the Climatic Research Unit, who is studying the greenhouse effect, regards them as impractical. Dr Joe Farman of the British Antarctic Survey, who led the team that discovered the ozone hole in 1985, calls them "fun".

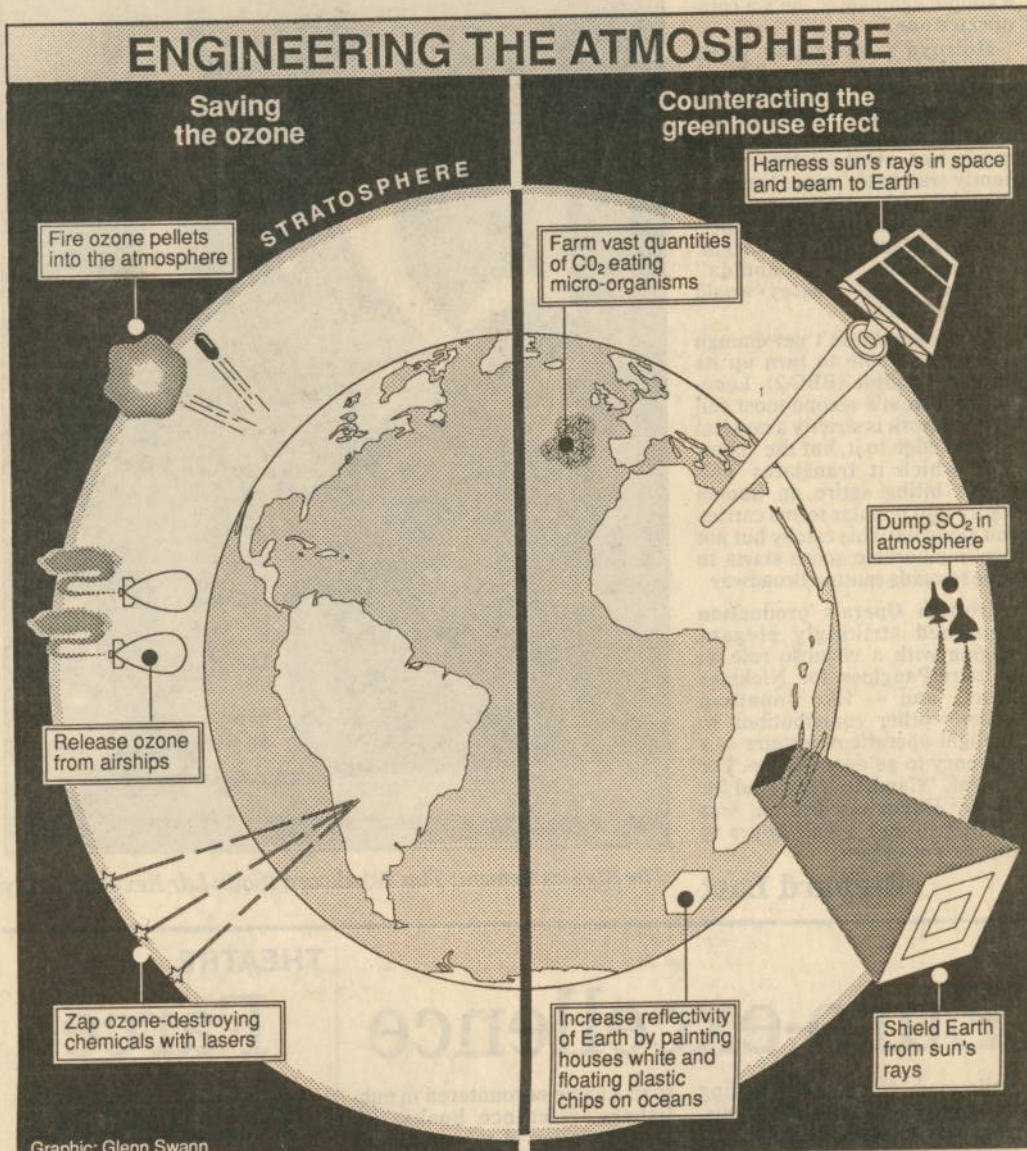
Both emphasise that prevention through limiting discharges is better than cure. Atmospheric engineering is technically feasible. But, said Dr Farman: "We are not clever enough to try it yet. Our understanding of the atmosphere is so bad we would be foolish to try."

Scientists studying atmospheric engineering argue that limitation of man-made discharges by agreements such as the Montreal protocol need what Dr Wallace Broecker of Columbia University calls a "global insurance policy".

"We ought at least to consider how we would bail ourselves out if things go badly. Think about the year 2010 — the temptation to engineer climate is going to be extraordinarily high," he said.

Current concern about changes in atmospheric chemistry focuses on the production of carbon dioxide by the burning of fossil fuels, which has been linked to global warming, and the use of chlorofluorocarbons (CFCs) in aerosols and foam packaging, which are responsible for damaging the ozone layer protecting us from harmful ultraviolet radiation.

● Saving the ozone layer — Dr



Thomas Stix of Princeton University suggests spending \$10 billion on a Star Wars-style infra-red laser installation to blast harmful chemicals such as CFCs out of the Earth's atmosphere before they have the opportunity to damage the ozone layer.

The trick would be to tune the energy of the lasers so that the energy of the beam is absorbed only by CFCs and no other molecules. However, laser beams would, by their nature, only sweep out limited areas and there is the possibility that the quantities of energy needed to run them would indirectly feed the greenhouse effect.

Russian scientists have suggested ringing the Earth with a vast track on which would run linear motors carrying liquid oxygen to the upper atmo-

sphere. Others have talked of firing pellets of frozen ozone into the atmosphere.

Ozone replacement sounds simple but is much trickier than CFC control because, as Dr Farman pointed out, every CFC molecule destroys some 100,000 ozone molecules. "I think the Russians missed this factor. They were 100,000 times out in the amount of material required."

● **Preventing global warming** — Greenhouse gases such as carbon dioxide, methane and CFCs cause global warming by trapping the sun's infra-red energy.

Traditional thinkers propose better energy efficiency coupled with the use of renewable, nuclear and even fusion energy (which is unproven) to

replace the burning of fossil fuels and curb the warming.

The more fanciful suggestions include harvesting energy in space by vast solar collectors and then beaming it back to Earth by lasers. But the visionaries want to counteract the damage wreaked by greenhouse gases by cutting down on the sun's energy incident on the Earth.

One suggestion is to increase the amount of solar energy reflected back into space by a range of methods from painting the roofs of houses white to covering the world's oceans with white polystyrene chips.

Even some of the visionaries balk at this prospect. Dr Broecker said: "I don't think there are enough houses. As for polystyrene chips, that is a possibility but, Holy smoke, that boggles the mind!"

Higher in the atmosphere, sulphur dioxide in the form of acid droplets has been seen to shield the sun's rays and cause slight global cooling when it is spewed into the atmosphere from volcanoes.

Following nature's example, Dr Broecker said about 35 million tonnes of sulphur dioxide could be distributed by a fleet of 700 jumbo jets operating round the clock in the stratosphere each year to counter the global warming caused by a doubling of the carbon dioxide in the Earth's atmosphere.

Unfortunately, this example of atmospheric engineering would produce a white haze, consume ozone and increase acid rain. But the cost, at \$10 billion a year, "is nothing compared with the total energy use in the world," he said.

To counter the effects of doubled carbon dioxide levels, which is the equivalent of turning up the power of the sun by two per cent, Dr Broecker said that huge spaceborne reflectors could be used to reflect back the equivalent amount of sunlight.

"But covering two per cent of the sky is one grand and glorious and incredibly expensive engineering project," he said.

In the battle against the greenhouse effect, our fellow creatures may come to the rescue. Dr James Aiken of the Natural Environment Research Council's Plymouth Marine Laboratory said phytoplankton were being considered for the conversion of sunlight into useful chemicals and drugs, drastically cutting the amount of energy required for such processes.

He is one of a team studying vast slicks of algae, called coccolithophores, which absorb large quantities of carbon dioxide and may mitigate the greenhouse effect. It has been suggested by other scientists that by cultivating such marine creatures global warming could be controlled.

However, even the more traditional approach — conserving and replanting forests which take up carbon dioxide in photo-synthesis — may be a long shot.

Dr Warwick said: "You would have to plant an unbelievably large area every year to take up a relatively small fraction emitted in fossil fuel combustion. There is no way you could do it."