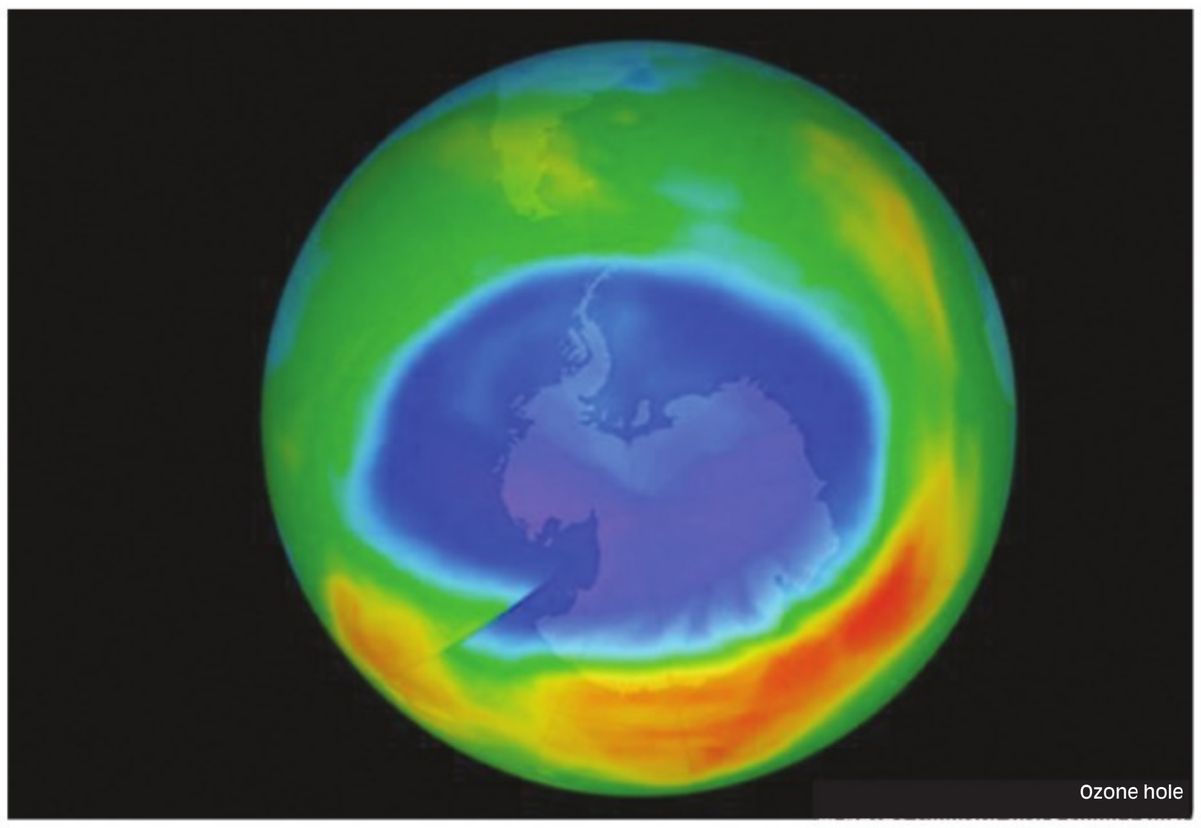
Ozone faces second strike

Another round of global effort has become necessary to save the cover that protects the earth from the harmful ultraviolet rays of the sun

S ANANTHANARAYANAN

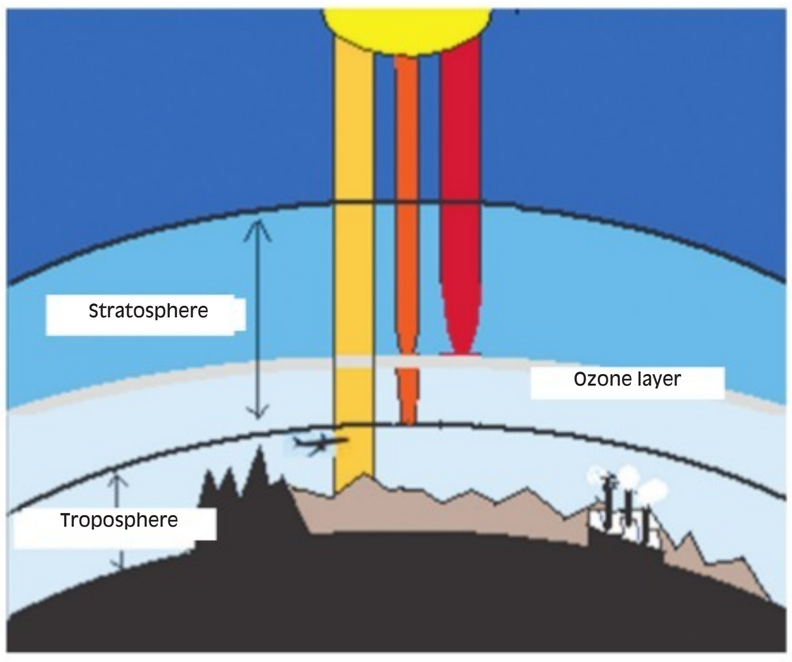


A layer of ozone, high in the atmosphere, protects the earth from ultra violet radiation from the sun. This protective cover had been under attack, but was saved by international action through the Montreal Protocol. The Protocol recognised that manmade chemicals, mainly the chlorofluorocarbons, were depleting the ozone layer, and it set in motion a world-wide drive to cut down the use and release of these substances.

Chlorofluorocarbons, which are contained in refrigerant fluid, in aerosol sprays and industrial solvents, were considered the chief culprit and the focus of campaign was to phase them out. Some other substances, chloroform being one of them, also affect the ozone layer, but as they rapidly decompose, these were not covered under the Protocol. The Protocol has been exceedingly successful and it was expected that the "ozone hole" over the Antarctic would disappear by 2050.

A group of scientists from MIT, the universities of California and Bristol, Kyungpook National University, South Korea, the Climate Science Center at Aspendale, Australia and the Met Office, Exeter, UK, however, writes in the journal, Nature Geoscience, that levels of substances like chloroform are rising anyway, and the improvement in the ozone hole may be slowing down.

■ **Ozone depletion:** Ozone gas is a form of oxygen which builds up at higher altitudes and protects the earth by absorbing much of the ultra violet radiation that comes from the sun. The oxygen atom has an incomplete outer electron shell and tends to combine with other atoms. Oxygen gas consists of molecules made up of two oxygen atoms that share their outer shell electrons and form a stable unit. At higher altitudes, energetic photons of ultra violet light split oxygen molecules into the component atoms. Lone atoms represent a higher energy state and they need to form bonds for stability. This, they manage with other oxygen molecules, to form a three-atom molecule of ozone. The ozone



molecules again, readily absorb ultra violet light and release 'lone' oxygen atoms, which then again combine with oxygen molecules to form ozone, and so on. The cycle keeps going till lone atoms become less frequent, because of lone atoms having come together to form normal oxygen molecules, the state of the lowest energy.

There is thus a process of ozone generation, which starts with ultra violet light splitting oxygen molecules and then reduction of ozone when lone atoms combine, leading to a balance of net ozone content at higher altitudes. This ozone content keeps up the process of absorbing ultra violet radiation and keeping it away from reaching the surface of the earth. Less ultra violet radiation at the surface is a good thing for humans, and other animals too.

But this comfortable condition of a steady level of ozone is disturbed when substances which speed up the break-down of ozone into oxygen migrate into the upper atmosphere. The most important of these is the negatively charged, OH part of the water molecule, or the NO part of nitric oxide, or free chlorine or bromine atoms. These substances are able to pull the extra oxygen atoms away from ozone and then release oxygen atoms to form other compounds. These substances then get back to pull oxygen atoms from other ozone molecules - and keep doing this for a long time. Chlorine is the most important of these at high altitudes and a single chlorine atom stays active for as long as two years, reacting with 100,000 ozone molecules before it leaves the cycle.

The natural processes that send ozone depleting substances into the atmosphere are negligible. But still, serious depletion of the high altitude ozone layer has been observed since the 1970s. The cause has then been pinned on the release of chlorofluorocarbons, the CFCs, whose use in industry had begun to rise. These materials, which are volatile, diffuse to the high reaches of the atmosphere and release single atoms of chlorine, which wreck havoc on the ozone layer.

The ozone layer has been there, to contain ultra violet radiation at the surface of the earth, since thousands of years while life forms evolved. Low levels of ultra violet radiation, in fact, may be a precondition for the origin of life. Reduction of ozone and increase in UV radiation hence has serious health implications, one being the increase in incidence of skin cancer. The detection of a region of severe depletion, in the Antarctic, the so called 'ozone hole', led to the Montreal Protocol and it has been estimated that checking CFC use would save two million cases of skin cancer by 2030.

Reversal of the trend

As we have said, CFCs were considered the main cause of ozone depletion and the Protocol did not target other causes, like chloroform, both because they are 'very short-lived substances' (or VSLS) and because they were considered to arise mainly from natural sources. Nevertheless, the Nature Geoscience paper observes, the level of VSLS in the lower stratosphere has been found to be rising. The level of chloroform the study says, rose from a 3.7 trillionth part in the southern polar atmosphere in 1920 to a 6.5 trillionth part in 1990, and then began to fall. In the northern polar atmosphere, the level rose from a 5.7 trillionth part to a 17 trillionth part over the same period, followed by reduction. The falling trend then continued, at different observation stations, till 2010, but then began to rise. The rise, till the data available for 2015, is mainly in the northern hemisphere. This indicates, the paper says, that the main sources of chloroform entering the atmosphere are in the northern hemisphere.

And further, the magnitude of pollution events, or increases in the chloroform level due to emission from nearby sources, was not significant, during 2007 to 2015, at the observation stations in Australia, the west coast of North America and Europe. In contrast, there was substantial increase at the stations in Japan and South Korea, during 2010-2015.

To assess why this was happening, the researchers used models to simulate the transport of chloroform from potential sources to the measurement locations. The exercise reveals a rapid increase in emission from eastern China, after 2010, with Japan and South Korea ranking second, and the increase from other East Asian countries being not significant. And the increase in China is in a region that is highly populated and industrialised, consistent with factories that emit chloroform gas. It is clear that a substantial part of chloroform in the air comes from industry and the increase being seen in chloroform levels in man-made, the paper says.

The current level of increase in VSLS, the paper says, could delay the recovery of the ozone hole by several years. "The findings mark an important step towards opening the discussion of regulating anthropogenic VSLS emissions," says Susann Tegtmeier from the GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, in a commentary carried in Nature Geoscience.

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Not a reliable source

Our memories are ever only as trustworthy as the most recent story we told ourselves

ROBERT NASH

Your memory probably isn't as good as you think it is. We rely on our memories not only for sharing stories with friends or learning from our past experiences, but also for crucial things like creating a sense of personal identity.

Yet evidence shows that our memory isn't as consistent as we'd like to believe. What's worse, we're often guilty of changing the facts and adding false details to our memories without even realising.

To understand a bit about how remembering works, consider the "telephone game" (also known as Chinese whispers). In the game, one person quietly whispers a message to the person beside them, who then passes it on to the next person in line, and so on.

Each time the message is relayed, some parts might be misheard or misunderstood, others might get innocently altered, improved, or forgotten. Over time the message can become very different from the original.

The same can happen to our memories. There are countless reasons why tiny mistakes or embellishments might happen each time we recall past events, ranging from what we believe is true or wish were true, to what someone else told us about the event, or what we want that person to think. And whenever these flaws happen, they can have long-term effects on how we'll recall that memory in the future.

Take storytelling for example. When we describe our memories to other people, we use artistic licence to tell the story differently depending on who's listening. We might ask ourselves whether it's vital to get the facts straight, or whether we only want to make the listener laugh. And we might change the story's details depending on the listener's attitudes or political leaning.

Research shows that when we describe our memories differently to different audiences it isn't only the message that changes, but sometimes it's also the memory itself. This is known as the "audience-tuning effect".

In one study on the audience-tuning effect, participants watched a video of a bar fight. In the video, two intoxicated men get into a physical confrontation after one man argues with his friend, and the other sees his favourite football team lose a match. Afterwards, participants were asked to tell a stranger what they had seen. The participants were split into two groups. One group was told that the stranger disliked one of the two fighters in the video. The other group was told that the stranger liked this same fighter. Unsurprisingly, this extra information shaped how people described the video to the stranger. Participants gave more negative accounts of the behaviour of the fighter if they believed the stranger disliked him.

More importantly though, the way people told their story later affected the way they remembered the fighter's behaviour. When participants later tried to remember the fight in a neutral, unbiased way, the two groups still gave somewhat differing accounts of what had happened, mirroring the attitude of their original audience. To an extent, these participants' stories had become their memories.

Results like these show us how our memories can change spontaneously over time, as a product of how, when, and why we access them. In fact, sometimes simply the act of rehearsing a memory can be exactly what makes it susceptible to change. This is known as "retrieval-enhanced suggestibility".

In a typical study of this effect, participants watched a short film, then took a memory test a few days later. During the days between watching the film and taking the final test, two other things happened. First, half of the participants took a practice memory test. Second, all of the participants were given a description of the film to read, which contained some false details.

These studies found that participants who took a practice memory test shortly before reading the false information were more likely to reproduce this false information in the final memory test. In this case, practice makes imperfect.

Why might this be? One theory is that rehearsing our memories of past events can temporarily make them malleable. In other words, retrieving a memory might be a bit like taking ice-cream out of the freezer and leaving it in direct sunlight for a while. By the time our memory goes back into the freezer, it might have naturally become a little misshapen, especially if someone has meddled with it in the meantime.

These findings teach us a lot about how our memories are formed and stored. And they might lead us to wonder how much our most treasured memories have changed since the very first time we remembered them.

Or perhaps not. After all, my research with other colleagues shows that people are generally pretty unwilling to invest time and effort in checking the accuracy of their memories. But whether or not you ever actually discover any small or large changes that have occurred, it's unlikely that your treasured memory is 100 per cent accurate.

Remembering is an act of storytelling, after all. And our memories are only ever as reliable as the most recent story we told ourselves.

The conversation / the independent

PLUS POINTS

Ages of solitude

Loneliness peaks at three periods in life, according to a study published this week in the journal International Psychogeriatrics.

Research suggests that loneliness severity and age have a complex relationship, with increased loneliness in the late 20s, mid 50s and late 80s. Study participants reported feeling moderate to severe loneliness during those years, as compared to other life periods.

These three peaks correspond to certain life milestones, the study published recently said.

Dilip Jeste, senior author of the study and a professor of psychiatry and neurosciences at the University of California, San Diego, said that the late 20s is a period of stress, which increases loneliness. The stress arises from the major life decisions that have to be made, as well as from the comparison to peers and guilt from certain choices, he said.

"The mid-50s is the midlife crisis period," Jeste was quoted as saying by CNN, adding that this was the time when health begins to decline.

Along with health issues, at late 80s you may experience financial issues and the death of a spouse and friends.

About 75 per cent of participants reported moderate to high levels of loneliness, said Jeste, contrasting against the initial hypothesis of the researchers who had expected it to be around one-third.

"One thing to remember is that loneliness is subjective. Loneliness does not mean being alone; loneliness does not mean not having friends," said Dr Jeste, who is also director of UC San Diego's Centre for Healthy Ageing.

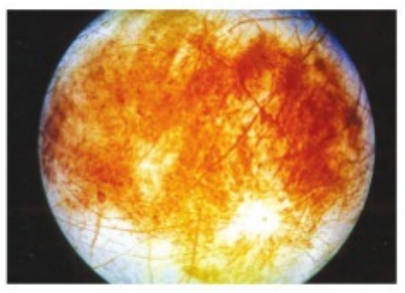
"Loneliness is defined as 'subjective distress'. It is the discrepancy between the social relationships you want and the social relationships you have," he said.

While the study results may seem gloomy, there is a hint of a rainbow behind the clouds. The study also found an inverse relationship between loneliness and wisdom. "In other words, people who have high levels of wisdom didn't feel lonely, and vice versa," said Jeste to CNN.

The 340 participants in the study were San Diego county residents between the ages of 27 and 101.

The straits times/ann

Hunt for aliens



Scientists including researchers at Nasa have proposed a plan for a nuclear-powered robot drill that would dig into a moon in an attempt to find aliens.The plan, nicknamed "tunnelbot", would offer an opportunity to delve deep beneath the distant world of Jupiter's moon Europa and check whether there are aliens hiding beneath its surface, as some researchers suspect.

The water hidden beneath Europa is considered one of the most promising places to find alien life in our own solar system. But it is stuck beneath a crust of ice, making it difficult to explore directly. Now scientists have suggested that they could send the drill to dig into that crust and explore to try and find extraterrestrial life.

"We have performed a concept study for a nuclear powered tunneling probe (a tunnelbot) that can traverse through the ice shell and reach the ocean, carrying a payload that can search for nested, corroborative evidence for extant/extinct life," the researchers wrote in a proposal given at the 2018 meeting of the American Geophysical Union. "The tunnelbot would also assess the habitability of the ice shell and underlying ocean."There are still a series of problems with the plan, including the question of how the tunnelbot would actually get all the way to the distant world. The researchers actually considered two possibilities: one that is powered by a nuclear reactor and another by heat source bricks. Both use the heat generated from those power sources to melt through the ice sources.But burying deep into the world would come with other challenges, too. It would be hard for messages to be able to be sent through the ice, for instance, meaning that the robot would carry a cable that could send messages back up onto earth. The researchers also note that the tunnelbot would have to leave a cable or float when it reaches the ocean to make sure that it doesn't fall into the water when it digs through the ice.

The independent