

## Global warming plays hide & seek

IT APPEARS THAT MERELY WATCHING WORLD TEMPERATURE MAY MASK THE REAL MALADY, SAYS S ANANTHANARAYANAN

For a decade now the world has kept in mind a target of containing the rise in global temperature to two degrees Celsius. There is a general understanding, at least in principle, that our way of living, consuming electricity generated by burning coal, burning petrol, using plastics and the rise in population are filling the atmosphere with greenhouse gases and the planet is warming. The figure of two degrees Celsius has been put as a responsible, which is to say practical and adequate, limit to the warming that we must enforce, but there is a less clear understanding of how this can come about.

David G Victor and Charles F Kennel, professor at the School for International Relations and Pacific Studies, and distinguished professor and director emeritus at the Scripps Institution for Oceanography, both of the University of California, San Diego, respectively, in a comment published in the journal *Nature*, raise serious questions and warn of the dangers of putting this two-degree Celsius number into the minds of the public and leaders of nations.

An important point they make is that while the rise in global tempera-

ture refers to the average surface temperature, the real harm to Planet Earth is the rise in total heat content, which happens because of more absorption of heat than reflection and radiation.

The authors note that while heat content has been steadily rising, the surface temperature has remained almost unchanged for the last 16 years. But how could heat content be going up but temperature not? The answer lies in the role of the sea, which is taking up the heat and circulating it out of sight for some time, they say.

The total mass of water in the oceans, which cover 71 per cent of earth's surface, is around 1.3 billion cubic km. A cubic metre of just water, without the saline content, weighs a tonne. A cubic kilometre weighs a billion tonnes. The water in the oceans then weigh 1.3 billion times as much. The mass of the atmosphere, in comparison, is about five billion times a billion kg (not tonnes), which is to say that the water in the oceans weighs



David G Victor explains how design of regulatory law effects issues like environmental pollution and the operation of energy markets.



Charles F Kennel was space plasma and astrophysicist with Nasa but switched to earth and environment science.

about 250 times more than the atmosphere. The next thing about water is that it has great *heat capacity*. Heat capacity is how much heat it takes to raise the temperature of one kilogram of water by one degree Celsius. It turns out that the heat it takes for a kilogram of water is four times what it takes for a kilogram of air. As the oceans weigh about 250 times the atmosphere, they can absorb heat about 1,000 times more effectively than the atmosphere.

Water, in fact, has almost the highest heat capacity of ordinary substances, over 10 times that of most metals, for instance, and it is not far wrong to say that the total heat capacity of the oceans is 1,000 times that of the atmosphere and the outer land mass of the earth, too.

Now, how about the temperature of the oceans? Well, the surface gets warmed by the sun and would stay at the top, but the wind and waves mix up the top layer, at least. And this warming depends on the latitude. The surface water keeps getting colder as one approaches the poles, and can be as cold as minus two degrees Celsius, with the formation of sea ice. Till the temperature drops to four degrees Celsius, in fact, the cold water sinks to the bottom and creates an under-water current that flows towards the equator. The result is that apart from the surface layer at lower altitudes, the sea is a pretty cold place. The average temperature at the surface is 17° Celsius, but 90 per cent of the vol-

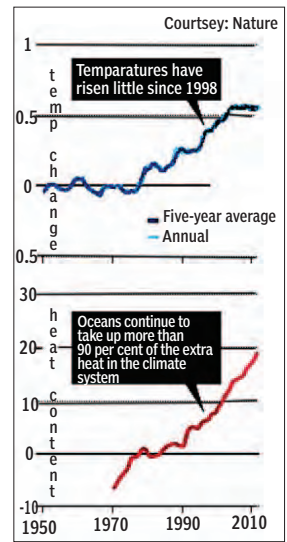
ume of the sea is in deeper water, where the temperature is as low as zero to three degrees Celsius.

Warming at the surface, as a result of global warming, must hence percolate down to the ocean, and we have seen that the ocean has 1,000 times the capacity of the atmosphere to absorb heat. This appears to be the mechanism that has set in to stall the rise in global temperature in recent years. And this, Victor and Kennel say, is why the surface temperature is not a good indicator of the health of the planet.

While it is one indicator, there are many others, the main one being the levels of CO<sub>2</sub> in the air. The temperature in the sea, warming at the poles and melting of polar ice, changing weather conditions, changes in vegetation and animal population are among the others.

### Political fallout

Apart from not being the right



indicator from the point of view of science, Victor and Kennel say setting a target in terms of limit to temperature rise is also not specific in terms of actions that world governments need to urgently take. Not setting down goals in terms of specific action, which can be planned and monitored, has been the problem with dealing with global warming since the beginning, they say. Even in 1992, the UN Framework Convention on Climate Change expressed the objective as preventing "dangerous anthropogenic interference in the climate system." Setting down an objective as broad as this leads to no coordinated, concerted and effective action by all or any of the signatories — as even science cannot specify what interference is dangerous, many answers being possible, according to what part of the climate system is being looked at and, again, from what perspective. This is unlike other areas of international cooperation, where "goals have had a big effect when they have been translated into concrete, achievable actions", the authors say.

Global action, if any has been taken, has thus been without direction and the persistence of the target of "within two degrees Celsius" has taken the spotlight away from more meaningful goals like capping CO<sub>2</sub> emissions, which have been articulated in later international conventions. "Because it sounds firm and concerns future warming, the two-degree Celsius target has allowed politicians to pretend that they are organising for action when, in fact, most have done little," the authors say. The two-degree Celsius target, despite theoretical models, is unattainable in practice and, with growing emissions the world over, is sure to be passed before long, they say. But the comfort of the target is drawing attention away from urgent action that nations need to take to cope with the inevitable, they add.

This is the time and an opportunity, the paper says, for refining the content of the new global agreement to be entered into at the UNFCCC meet in late 2015. "Getting serious about climate change requires wrangling about the cost of emission goals, sharing the burdens and drawing up international funding mechanisms. But diplomats must move beyond the two-degree Celsius goal. Scientists must help them to understand why, and what should replace it," the paper says.

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### PLUS POINTS



#### Coffee clues

Genetics may be what separates people who can't function without coffee and those who never touch the stuff, according to a

new largescale study. Scientists have long known that your DNA influences how much java you consume, but the new study has pinpointed six new genetic variants associated with habitual coffee drinking.

Four of the new variants implicate genes that are involved with caffeine, either in how the body breaks it down or in its stimulating effects, the researchers said in the paper. The two other newly implicated genes were the most surprising, as they are rarely linked to coffee of caffeine, but rather involved with cholesterol levels and blood sugar.

Researchers believe these findings could help to explain why a given amount of coffee or caffeine has different effects on different people, and provides a genetic basis for future research exploring the links between coffee and health. To make their findings published in the journal *Molecular Psychiatry*, researchers from Harvard School of Public Health and Brigham and Women's Hospital analysed 20,000 regular coffee drinkers of European and African-American ancestry.

They also analysed the results of around two dozen previous studies with a combined total of more than 120,000 people. Each participant described how much coffee they consumed a day and also allowed scientists to scan their DNA. The new work looked for minute differences in the DNA that were associated with drinking more or less coffee.

The resultant study suggests that people naturally curb their coffee intake to achieve the best effect caffeine can give them, and that the strongest genetic factors linked to increased coffee intake likely work by directly increasing caffeine metabolism.

KASHMIRA GANDER/THE INDEPENDENT

#### ET forebears?

The truth about alien life isn't just out there, it's continuously raining down on us, and could possibly explain the



The dragon particle which scientific analysis shows is made of carbon and oxygen and is therefore not a piece of cosmic or volcanic dust.

origins of all human life. That's according to researchers at the University of Sheffield and the University of Buckingham Centre for Astrobiology, who claim this picture of particulate matter in the earth's

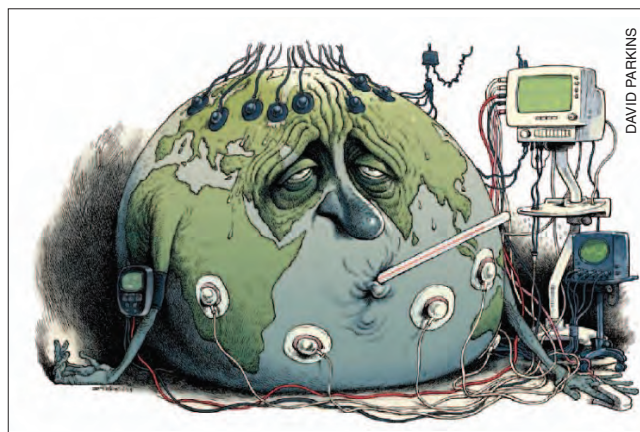
stratosphere is the long awaited proof of extraterrestrial life.

Not content with solving one of the universe's greatest mysteries, however, the researchers also claim that their findings explain the origins of humanity and reveal that all life on earth originally came from space. Professor Milton Wainwright and his team made the discovery after launching a balloon high into the stratosphere during the Perseid meteor shower last year. The balloon was launched 27 km into the earth's atmosphere and was equipped with sterile slides designed to capture tiny biological organisms. During the trip one of the slides caught an organism, around 10 microns in size, which Wainwright says is a structure "colloquially called 'the dragon particle' which scientific analysis shows is made of carbon and oxygen and is therefore not a piece of cosmic or volcanic dust".

In an interview with the *Daily Express*, Wainwright explained that it was unclear whether the organism was a single life-form or was made up of a number of smaller microbes. He was also unequivocal that the biological entity was "like nothing found on earth... What is amazing is that these organisms appear on the sampling stubs in an absolutely pristine condition," he told the paper. "There is no pollen, grass or pollution particles found with them, or for that matter soil or volcanic dust. Unless a means of lifting them from earth exists which selectively sieves them out from other earth-derived debris then they must be incoming from space. This, plus the fact that some of the biological material samples by the team produce impact craters when they hit the sampler, confirms their space origin."

However, Wainwright's claims have attracted criticism from the scientific community. One astrobiologist told *Space.com*, "The jump to the conclusion that it is alien life is a big jump and would require quite extraordinary proof. (The usual Sagan saying: extraordinary claims require extraordinary evidence.)" He went on to say that Wainwright would need to show that the organism was composed of all D amino acids instead of L amino acids, that is, some kind of proof that the debris did not contain the same biochemistry as earth objects.

ROB WILLIAMS/THE INDEPENDENT



DAVID PARKINS

## GENE EXPRESSION

TAPAN KUMAR MAITRA EXPLAINS PROTEIN SYNTHESIS AND SORTING

Translation is the process by which polypeptides are synthesised on ribosomes in the cell. The cellular machinery of translation is dominated by RNA molecules of various kinds. Messenger RNA determines the order of amino acids in the polypeptide, tRNA brings the amino acids to the ribosome, and rRNA helps position the mRNA on the ribosome and catalyses peptide bond formation. In addition, a number of protein factors trigger specific events during the initiation, elongation and termination stages of the process.

GTP binding and hydrolysis drive the necessary conformational changes in the protein factors and the specificity required to link the right amino acids to the right tRNA molecules is a property of the aminoacyl-tRNA synthetases that catalyse these reactions. After the mRNA, ribosomal sub-units and initiator aminoacyl tRNA come together to form the initiation complex, other aminoacyl tRNAs recognise successive codons in the mRNA and add their amino acids to the growing polypeptide chain. Chain termination occurs when one of the stop codons is encountered and the completed polypeptide is then released from the ribosome. The proper folding of released polypeptides is normally assisted by molecular chaperones. Abnormalities in protein folding can lead to a variety of ailments, such as Alzheimer's and "mad cow" disease.

Knowledge of the genetic code and details of the translation process enable us to understand how nonsense mutations cause their deleterious effects and also how these can be suppressed by compensating mutations in tRNA. The phenotypic effect of a mutation that changes an amino

acid codon to a stop codon can be largely overcome if a tRNA mutated in its anti-codon reads the stop codon as an amino acid.

Proteins reach their final destinations in the cell by two main pathways, both of which involve polypeptide targeting and sorting. The general strategy is that newly made polypeptides have special sequences of amino acids that serve as targeting signals; proteins selectively recognise and bind to these signals, thus sorting the polypeptides. In one pathway, proteins destined for components of the endomembrane system or secretion from the cell are co-translationally imported into the ER. The signal sequence that targets these polypeptides to the ER is located at the N-terminus of the newly forming polypeptide. An SRP in the cytosol binds to the signal sequence and then to an SRP receptor on the ER membrane, docking the ribosome-mRNA-polypeptide complex to the membrane.

As polypeptide synthesis then proceeds, the growing polypeptide is translocated across the ER membrane through a protein pore. The signal sequence is clipped off by a signal peptidase, leaving the remaining polypeptide to fold into its final three-dimensional shape.

Polypeptides that insert into the ER membrane have one or more internal stop-transfer sequences, instead of or in addition to a terminal ER signal sequence. Most proteins made in the ER are glycosylated; some of these oligosaccharide side chains serve as targeting signals that direct the proteins to other parts of the endomembrane system.

In the other sorting pathway, proteins destined for the nuclear interior, mitochondria, chloroplasts, or

peroxisomes are synthesised on cytosolic ribosomes (as are proteins that remain in the cytosol) and are then imported post-translationally into the targeted organelle.

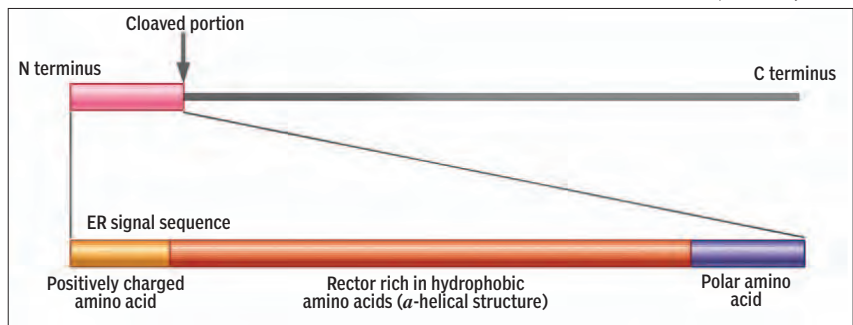
Polypeptides destined for peroxisomes contain a special targeting sequence near the C-terminus, whereas those targeted to the nucleus contain nuclear localisation signals that promote their entry through the nuclear pores.

Targeting to mitochondria and chloroplasts involves a transit sequence located at the N-terminus. Polypeptides are transported into these organelles at contact sites where the inner and outer membranes of the organelle are close together. In this pathway, receptor proteins in the outer membrane recognise the transit sequence directly.

The energy needed to transport the unfolded polypeptide into the mitochondrion is provided by ATP hydrolysis associated with chaperone release, and by the electrochemical gradient across the inner membrane. In chloroplasts, transport of unfolded polypeptides into the organelle is driven by ATP hydrolysis alone, but the proton gradient plays a role in driving the transport of some extensively folded proteins into the thylakoid lumen.

Because mitochondria and chloroplasts have multiple compartments (four and six, respectively) to which polypeptides may be targeted, mitochondrial and chloroplast polypeptides often require more than one signal to arrive at their proper destinations. Such polypeptides usually possess an N-terminal transit sequence to direct them to the organelle plus a hydrophobic sorting signal to target the polypeptide to its final destination.

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## Herbs to heal cattle

IN THE ABSENCE OF VETERINARY SERVICES, TRADITIONAL MEDICAL PRACTICES FOR TREATING LIVESTOCK REMAIN POPULAR IN TRIBAL VILLAGES, WRITES APARNA PALLAVI

All veterinary doctors will agree that treating ruminant typhoid disease (bloated rumen or paunch of the cattle) is difficult. After all, it is responsible for 20 per cent of cattle mortality in the country. But a study on the use of ethno-veterinary practices — traditional practices of veterinary medicine using local plants and herbs — claims local cattle herders cure the lethal disease with good old tamarind. The paper, "Use of Ethno-Veterinary Medicines from Vidarbha Region, India", published in *Bioscience Discovery* in July 2014 found that the use of plants



Neem (*Azadirachta indica*) is used to fumigate cattle sheds.

to heal cattle diseases is a common practice in the tribal parts of Nagpur, Chandrapur and Gadchiroli districts of Maharashtra.

It identified 46 plants used to cure different diseases in livestock used by 60 herbalists and cattle herders experienced in administering such medicines. The paper found EVM to be highly effective in curing 20 conditions, ranging from serious ailments such as foot and mouth disease, fractures and abortions to common conditions such as reduced lactation, eye or teeth problems and snake or scorpion bites.

EVM, however, have their limitations with contagious diseases and emergent conditions such as viral diseases, goat plague (*peste des petits ruminants*) and blue tongue, the report said. But the system, it said, was indispensable for ensuring livestock health. The first reason for this was the cost. While ethno-veterinary services are provided in the community for free, veterinary treatment is expensive, said Ajay Gawde, an artificial insemination worker with the Pune-based NGO, BAIF Development Research Foundation, from Sironcha tehsil in Gadchiroli district. Ranjeet Maraskolhe, a farmer from Tuyiappar village in Nagpur district, said, "Hoof infections are common in our village during the rains. If we get veterinary treatment, it costs Rs 100-200, but our local cures cost nothing." He added that transporting a sick animal to the treatment centre — available only in large gram panchayats or taluka headquarters — was more expensive than the treatment itself. "In case of emergencies, the animal is likely to die during transportation."

The paper pointed out that village residents believed EVM were more effective than modern medicines. "In our system, three doses of herbs over a period of one-and-a-half days are enough to cure any

disease," said Maraskolhe. "Conventional medicine takes longer."

Gawde agreed. "These treatments are effective. To cure tympany through EVM, one needs to just mix tamarind pulp or crushed leaves, a bit of oil and ash from cooking fires with water and give it to the animal to drink. Within 20 minutes, the most severe case of tympany is eased," he said.

"Ethno-veterinary practices have been part of livestock rearing for ages and are deeply rooted in the rural way of life," said Sajal Kulkarni, lead author of the study and a livestock researcher with BAIF. "Most cattle-herders have some knowledge of herbs. In case of complicated problems, they take help from others in the community. This has led to a system based on mutual understanding and trust."

Gawde said the EVM network was dynamic. "Usually, there are a few experienced ethno-veterinary practitioners in every village. If any disease is beyond the expertise of those available, people usually know whom to contact in nearby villages. A cluster of villages is usually self-sufficient in its veterinary requirements." The practices documented in the paper are both curative and preventive. Herders, for instance, regularly fumigate cattle sheds with neem or common wormwood (*Artemisia vulgaris*) leaves to remove insects and germs. Simple treatments for healing wounds, improving lactation and deworming are usually carried out by the herders themselves. The help of traditional herbalists is taken only in curing complex diseases that require the use of different herbs that need to be boiled, dried and burnt.

The paper noted that a plant was used for different problems in different areas. It said different parts of a plant were used for different conditions. An example is mahua (*Madhuca longifolia*), whose fruit is used in the Vidarbha region for treating malarial fever in cattle. Liquor from the flower is used in western Maharashtra for a prolapsed uterus.

The report found that while some herbs were commonly used, others were known only to a few herbalists. It was observed that while 48 of 60 herbalists used *Daturametal* for healing wounds, only five used *Ficus Bengal* genesis roots for dental problems.

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