

#METEOROLOGY

The Leap Second's Time Is Up

How, and whether, to keep atomic time in sync with Earth's rotation is still up for debate.



The practice of adding 'leap seconds' to official clocks to keep them in sync with Earth's rotation will be put on hold from 2035, the world's foremost metrology body has decided.

The decision was made by representatives of governments worldwide at the General Conference on Weights and Measures (CGPM) outside Paris on 18 November. It means that from 2035, or possibly earlier, astronomical time (known as UT1), which is determined by Earth's rotation, will be allowed to diverge by more than one second from Coordinated Universal Time (UTC), which is based on the steady tick of atomic clocks. Since 1972, whenever the two time systems have drifted apart by more than 0.9 seconds, a leap second has been added to UTC.

Stopping the adjustments is "a leap forward" for researchers who work on time and frequency, says Gergette Macdonald, director-general of the Metrology Research Centre in Halifax, Canada. "I'm pleased that our efforts got us to this moment."

Leap seconds aren't predictable, because they depend on Earth's natural rotation. They disrupt systems that are based on precise timekeeping. Macdonald says, and car-wreck havoc in the digital age. Facebook's parent company, Meta, and Google are among the tech companies that have called for leap seconds to be scrapped.

The CGPM - which also oversees the International System of Units (SI) - has proposed that no leap second should be added for at least a century, allowing UT1 and UTC to slide out of sync by about 1 minute. But it plans to consult with other international organizations and, by 2026, decide on what upper limit, if any, to put on how much the two should be allowed to diverge by.

Time For Change
Representatives from Canada, the United States and France were among those at the CGPM who called for the leap second to be scrapped before 2035. But Russia, which voted against the proposal, wants to

push back the date to 2040 or later to deal with technical issues in its satellite navigation system, GLONASS.

The Russian system incorporates leap seconds, whereas others, including the GPS satellite, already effectively ignore them. The decision means that Russia might need to install new satellites and ground stations, says Felicitas Arias, former director of the time department at the International Bureau of Weights and Measures (BIPM) in Sèvres, France.

Astronomers who rely on UT1 to align their telescopes will also need to adjust for the change, says Elizabeth Donley, who leads the time and frequency division at the National Institute of Standards and Technology in Boulder, Colorado. But the current situation is unsustainable and would continue to get worse, she adds. Different organizations handle the leap second differently (Google, for example, 'smears' out the extra second over a 24-hour period). This creates an ambiguity between time sources of as much as half a second, she says, "which is huge".

Although in the long term Earth's rotation is slowing as a result of the pull of the Moon, a speed-up since 2020 has also made the issue more pressing, because, for the first time, a leap second might need to be removed, rather than added. UTC has only ever had to slow by a beat to wait for Earth, not skip ahead to catch up with it. "It's kind of being described as a Y2K issue, because it's just something that we've never had to deal with," Donley says, referencing the computing errors once expected to occur at the start of the year 2000.

There is a chance that the International Telecommunications Union (ITU) could stymie plans to make the switch in 2035. The body effectively ceded decision-making about the leap second to the CGPM in 2015, and Arias says its working group agreed with the CGPM's proposal.

Subtle Difference
Although human timepieces have been calibrated with Earth's rotation for millennia, most people will feel no effect from the loss of the leap second. "In most countries, there is a one hour step between summertime and wintertime," says Arias. "It is much more than one second, but it doesn't affect you."

Future meteorologists might find more elegant ways than the leap second to realign UTC and UT1. By the time the difference becomes significant, "our ability to reconcile it will be better than our ability is right now," says Macdonald.



Theo with a Komodo dragon in Komodo Islands, Indonesia.



Shailaza Singh
Published author, poet and a YouTuber

#WANDERLUST

If you happen to meet Ellen McGregor Kortan (51) (Ellen) and Theodore Kortan (58) (Theo) at the first glance, this couple would seem like ordinary American tourists. However, when you start talking to them, you realize that they are way different than the other jet-setting, destination hopping tourists who frequent Rajasthan. They call themselves 'slow travellers' and have been travelling the world on a budget (less than \$200 per month) and been to more than 20 countries across four continents since 2015. They have visited Mexico, Belize, Guatemala in North America, Morocco in North Africa, Portugal, Italy, Spain, United Kingdom, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Greece in Europe, Singapore, Malaysia, Vietnam, Thailand, Cambodia, Indonesia, Philippines in South East Asia. Now they are on a tour of India and have visited Mumbai, Jaipur, Ajmer and are planning to visit Chennai, the whole of North East India and more.

My rendezvous with these slow travelling retired journalists happened in Jaipur, Rajasthan. I met them at a bakery where they were eating rice crackers and drinking milk. They had just gotten off the train from Udaipur and were looking for their Airbnb. When I met

them, Theo was trying to ask the bakery owner a question which the latter could not understand. I helped by translating for him. On a closer look, Theo faintly resembles the well-known actor Pierce Brosnan's older version. He and Ellen have a perpetual twinkle in their eye which makes people approach them and even taken photographs with them. Theo says, "I don't know what is it with us that people love to take selfies with us". He throws up his hands and says, "We are no celebrities!"

This couple has been together for more than a decade. When Cupid struck, Theo was a videographer in Channel 5 in USA while Ellen worked there as a producer. When they talked about their dream of world travel, it didn't take them long to realize that they were meant to be together. After marriage, they started planning their retirement and consciously decided not to have children. In Ellen's words, "We call ourselves 'Earth Vagabonds' as we love wandering on this planet. We didn't want to retire and relocate to one specific place. Instead, we chose to wander around and see the world. Theo retired at 52 and I retired at 43 in 2015."

So, where does the money to travel come from? Theo says, "From a very young age, my dream has been to travel the world. So, I have always lived frugally and well below my means. When Ellen and I started dating, I shared my dream with her and travelling the world on a budget became her dream too. We started saving very early. In America, you can ask your employer to save a

Everyone dreams of travelling the world after their retirement, however most of us get bogged down by our responsibilities, work and daily duties. But Ellen and Theo had made up their mind years ago. They decided to spend their lives travelling the world but on a budget!

Traveller Not a Tourist... (...1)



Theo in Guatemala.



Theo in Venice, Italy

percentage (in my case 19%) of your salary and put it in a different account, which can then be withdrawn as a lumpsum. We also made a lot of wise investments.Plus, we own a home in Cleveland, Ohio which we have rented out for a modest passive income of \$700 (INR 57,400) per year.

Ellen says, Theo is a very shrewd shopper. Whether in America or foreign countries, he always hunts for the best deals and the lowest prices, which makes saving easy. We often hunt for discounts. We don't buy a lot of clothes. We have a few pairs; we wear them out and then buy new ones. In America, I had just one car for most of my adult life as compared to other Americans who buy



Ellen and Theo at Parthenon Temple in Athens, Greece.



Acateanango Volcano in Guatemala.



Ellen after the hike to Acateanango Volcano with her two guides.

a coconut water. In fact, he even invited me to visit his home and I met his family!"

Theo agrees. "The one thing that we have realized in slow travel is that people are almost the same everywhere. No one is really bothered about politics or religion or caste and creed. All they really want to do is live a good life and raise their children well."

So, what has been their travelling experience like? "Oh! It's been an amazing experience, says Ellen. "We have walked the Sahara Desert, we swam with the whale sharks in La Paz in Mexico, we have hiked overnight to see the active Fuego volcano in Guatemala. We also lived with the elephants for eight nights and eight days in Thom

International Systems Engineer Day

With the world becoming more and more digitized every day, there is a group of people that has rather suddenly become one of the most important groups of people in the world: systems engineers. Systems engineers work on numerous complex projects: spacecraft design, computer chip design, robotics, software integration, and bridge-building. The computer you're using right now would not exist if it weren't for systems engineers, nor would the plane you're taking to go to your exotic holiday destination, and nor would the bridge you need to cross to get to work every day.

#PATHOLOGY

Fight Against Cancer

Memo1, by binding copper so that they can, protects the cancer cells when they need to continue to live and spread.



For cancer cells to grow and spread around the human body, they need proteins that bind copper ions. New research about how cancer-related proteins bind the metal and how they interact with other proteins, opens up potential new drug targets in the fight against cancer.

Human cells need small amounts of the metal copper to be able to carry out vital biological processes. Studies have shown that the level of copper in tumour cells and blood serum from cancer patients is elevated. And our conclusion is that cancer cells need more copper than healthy cells. Higher levels of copper also mean more active copper-binding proteins.

"Therefore, these proteins are highly important to study when it comes to understanding the development of cancer and deeper knowledge about them can lead to new targets for treatment of the disease," says Pernilla Wittung-Stafshede, Professor of Chemical Biology at Chalmers University of Technology, Sweden.

Most cancer-related deaths are due to the fact that metastases - secondary tumours - form in several places in the body, for example, in the liver or lungs. A protein called Memo1 is part of the signalling systems that cancer cells use to grow and spread around the body. Previous research has shown that when the gene for Memo1 is inactivated in breast cancer cells, their ability to form metastases decreases.

A research group from Chalmers wanted to take a closer look at the connection between Memo1 and copper. In a new study published in the scientific journal PNAS, the researchers examined the Memo1 protein's ability to bind copper ions through a series of test tube experiments. They discovered

that the protein binds copper, but only the reduced form of copper. It is this form of copper ions that is most common in living cells. It's an important discovery because reduced copper, while it is needed in the body also contributes to redox-reactions that damage - or even kill - the cells. The researchers found that when Memo1 interacted with copper, the metal's toxic redox reactions were blocked.

"This poses a risk for the tumour to be dependent on a lot of copper because it can provoke chemical reactions that are harmful to the cancer cells. We believe that Memo1, by binding copper when needed, protects the cancer cells so that they can continue to live and spread," says Pernilla Wittung-Stafshede, who is one of the study's lead authors.

The researchers also saw that Memo1 can form a complex with another copper-binding protein found in our cells - Atox1. It is a copper transporter inside human cells and the research team has previously shown that Atox1, with the help of copper, contributes to breast cancer cells being able to move and form metastases. Overall, the findings in the new study mean that copper and copper-binding proteins could be targets for future cancer treatment.

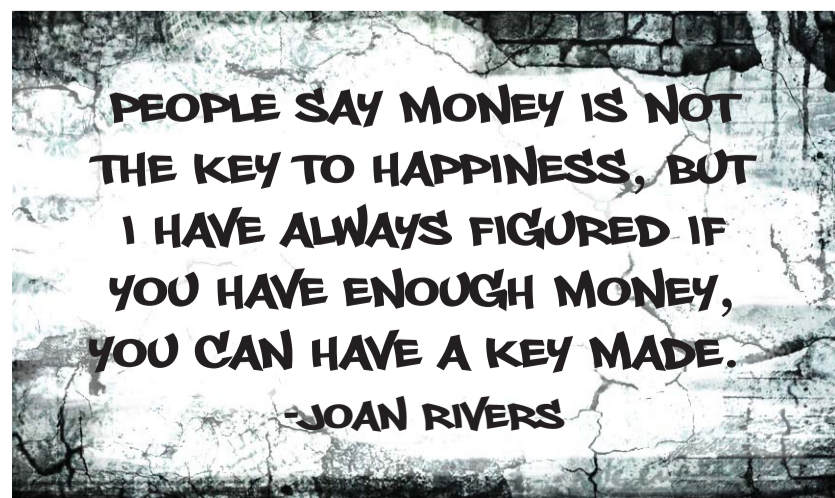
"We saw how copper ions could transfer between the proteins Memo1 and Atox1 in test tubes, and when we looked in breast cancer cells, we found that the two proteins were close to each other in space. Based on this, we conclude that the exchange of copper between these proteins can take place in cancer cells as well as in test tubes and thus be of biological relevance," says Pernilla Wittung-Stafshede.

The researchers now want to move forward with determining the copper ion binding sites in Memo1, and how the presence of copper affects Memo1's activities in cancer development.



Algeria Sahara Desert.

THE WALL



BABY BLUES



By Rick Kirkman & Jerry Scott

ZITS



By Jerry Scott & Jim Borgman