Ode to E Pluribus Unum for Sunday January 9 2022

Experiencing the Night Watch

https://beleefdenachtwacht.nl/en

The Rijksmuseum's online exhibit, "Experience the Night Watch," lets you explore absolutely everything about Rembrandt's 1642 painting.

This piece is one you'll want to tuck away for review. It contains details you would otherwise never have known…or even guessed.

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The Police

For most of their history the group’s line-up consisted of primary songwriter Sting (lead vocals, bass guitar), Andy Summers (guitar) and Stewart Copeland (drums, percussion). The Police became globally popular in the late 1970s and early 1980s. Emerging in the British new wave scene, they played a style of rock influenced by punk, reggae, and jazz.

Their final studio album, Synchronicity (1983), was No. 1 in the UK, Canada, Australia, Italy and the US, selling over 8 million copies in the US. Its lead single, "Every Breath You Take", became their fifth UK number one, and only US number one.

Synchronicity 11 https://youtu.be/o5FPPoLqkCk
Every Little Thing She Does is Magic https://youtu.be/aENX1Sf3fgQ
Every Breath You Take https://youtu.be/OMOGaugKpzs

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Spectacular Storm Photos by Mitch Dobrowner

I owe much to the great photographers of the past, especially Ansel Adams, for their dedication to the craft and for inspiring me in my late teens. Though I have never met them, their inspiration helped me determine the course my life would take.

I felt lost in my late teens. Worried about my future direction in life, my father gave me an old Argus rangefinder to fool around with. Little did he realize what an important gesture that would turn out to be for me.

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Orbits of Potentially Hazardous Asteroids

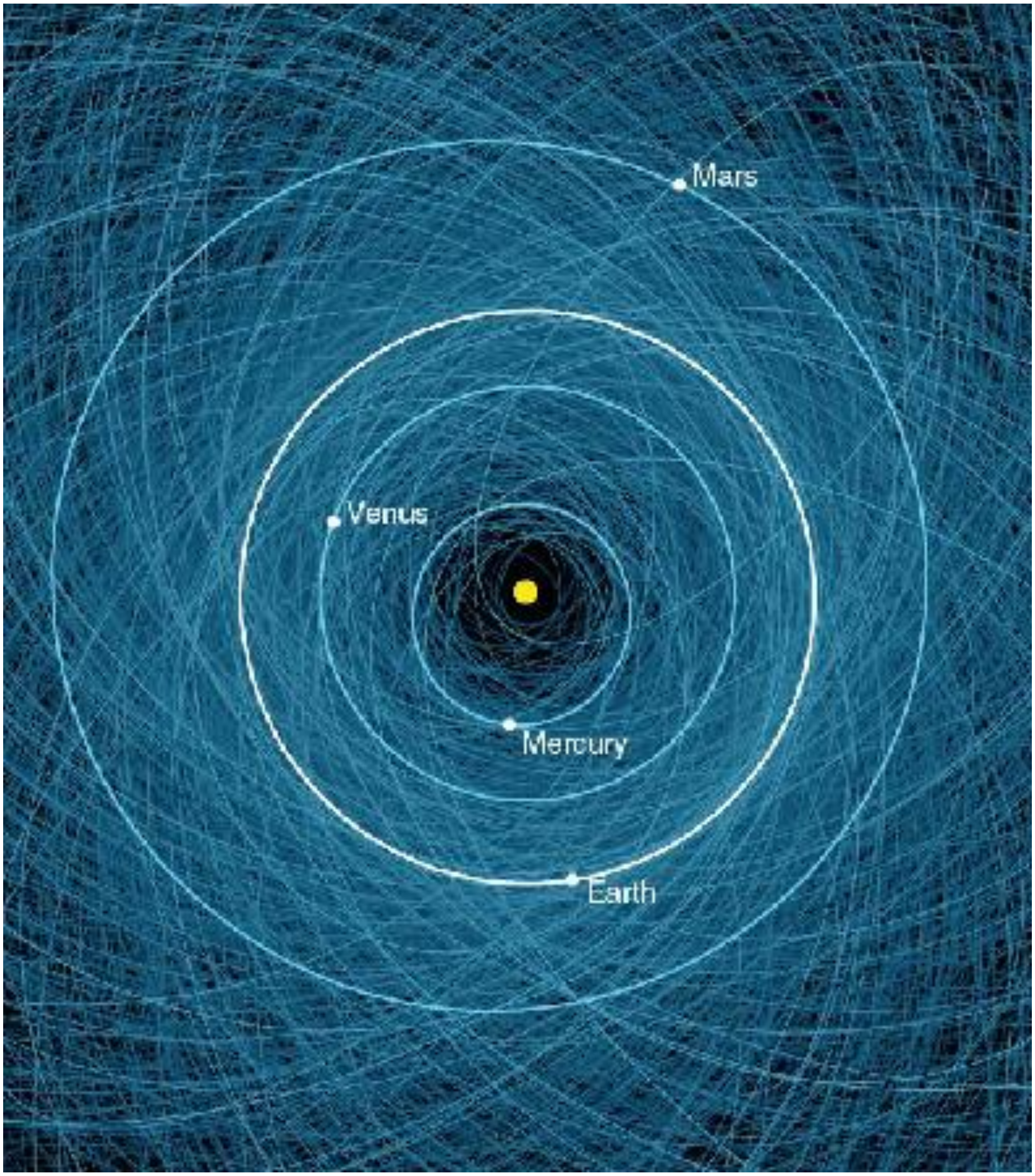

Image Credit: NASA, JPL-Caltech

Are asteroids dangerous? Some are, but the likelihood of a dangerous asteroid striking the Earth during any given year is low.

Because some past mass extinction events have been linked to asteroid impacts, however, humanity has made it a priority to find and catalog those asteroids that may one day affect life on Earth.

Pictured here are the orbits of the over 1,000 known Potentially Hazardous Asteroids (PHAs). These documented tumbling boulders of rock and ice are over 140 meters across and will pass within 7.5 million kilometers of Earth -- about 20 times the distance to the Moon. Although none of them will strike the Earth in the next 100 years -- not all PHAs have been discovered, and past 100 years, many orbits become hard to predict.

Were an asteroid of this size to impact the Earth, it could raise dangerous tsunamis, for example. To investigate Earth-saving strategies, NASA's Double Asteroid Redirection Test (DART) is planned for launch later this year. Of course rocks and ice bits of much smaller size strike the Earth every day, usually pose no danger, and sometimes creating memorable fireball and meteor displays.

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Brian Cox Breaks Down The Science Behind Don’t Look Up

https://youtu.be/ntaidEKs_Ks

Physicist Professor Brian Cox breaks down what would ACTUALLY happen if a gigantic comet really was hurtling towards planet Earth.

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Meet a Massive Sea Predator from the Triassic Period

Here's Cymbospondylus youngorum, the monster of the Triassic deep! Based off @fishboy86164577's reconstruction with a speculative thresher fin inspired by @DevHistoria. Hope ya'll enjoy!
pic.twitter.com/xbxetJZ72Z

By Joshua Hawkins

According to a new study, scientists believe the largest animals to ever live, lived in the sea. In fact, a new discovery has led them to believe that one of the largest animals was a Triassic period predator that was somewhat similar to modern-day whales.

Based on the new discovery, researchers believe that a 244-million-year-old fossil would have rivaled current cetaceans. The animal in question, an ichthyosaur, existed 8 million years after the first ichthyosaurs, at the most. Because of its massive size compared to other ichthyosaurs, scientists believe its evolution was expedited in some way.

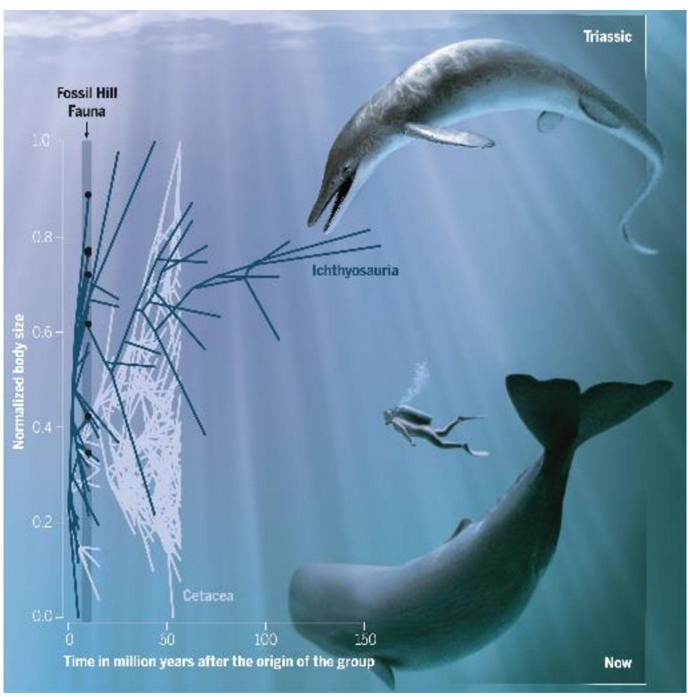
How this Triassic period predator grew so fast

The new study, which was published in Science on December 24, focuses heavily on the discovery of the fossil in Fossil Hill, Nevada. It also focuses on how the creature that left the fossil behind could have grown as large as it did. Based on the discovery, scientists believe that the ichthyosaur that they found had a two-meter-long skull. They also believe that it was a completely new species of Cymbospondylus.

Researchers say that this is the largest known tetrapod of the Triassic period, on land or in the sea. It's also the first in a series of massive ocean giants that would go on to rule the sea. They also believe that the creature was able to grow to the size it did as quickly as it did by eating ammonoids. These small, yet abundant prey, would have helped the ichthyosaur grow exponentially faster. Because of the time period, scientists feel the end-Permian mass extinction helped provide such an abundant source of ammonoids.

The discoveries they've found have also led scientists to believe that this Triassic period predator evolved much earlier than whales. Scientists currently consider whales to be the largest animals on Earth.

Diving deeper



Comparison of whales and ichtyosauria evolutions
image source: stephanie abramowicz / science

There is still a lot that we don't know about the evolution of marine animals. Scientists may be able to learn more from the discovery of this new ichthyosaur. Specifically, they may learn more about the evolutionary track that marine life followed. This particle Triassic period predator lived millions of years ago. However, its fossil could be a new door of understanding we haven't previously been able to achieve. And, it might not be the only one out there.

In the study's abstract and conclusions, the researchers noted that the environment of the time may have supported multiple creatures the same size. Additionally, the abundance of ammonoids could have helped fuel the exponential growth of the ichthyosaur shortly after its origins.

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Groundwater in California's Central Valley

Water resources could be pushed beyond recovery in a region that provides about a quarter of the U.S. food supply.

By Liza Lester, American Geophysical Union

A drone view of San Luis Reservoir with the storage at 38 percent of historical average in August 2021. The reservoir stores water diverted from the Sacramento-San Joaquin Delta for later deliveries to the Silicon Valley, San Joaquin Valley, the Central Coast, and Southern California.
(Image credit: Kelly M. Grow/California Department of Water Resources)

Groundwater in California's Central Valley is at risk of being depleted by pumping too much water during and after droughts, according to a study published October 5 in Water Resources Research.

The new study shows groundwater storage recovery has been dismal after the state's last two droughts, with less than a third of groundwater recovered from the drought that spanned 2012 to 2016.

Under a best-case scenario where drought years are followed by consecutive wet years with above-average precipitation, the researchers found there is a high probability it would take six to eight years to fully recover from groundwater overdraft, which occurs when more groundwater is pumped out than is supplied through all sources like precipitation, irrigation and runoff.

However, this best-case scenario where California has six to eight consecutive wet years is not likely because of the state's increasingly hot and dry climate. Under a more likely, drier climate, there is less than a 20 percent chance of full overdraft recovery over a 20-year period following a drought.

The Central Valley produces about a quarter of the nation's food and is home to around 6.5 million people. Using too much groundwater during and after droughts could soon push this natural resource beyond the point of recovery unless pumping restrictions are implemented. The study finds recovery times can be halved with modest caps on groundwater pumping in drought and post-drought years.

"This is really threatening," said lead study author Sarfaraz Alam, a postdoctoral researcher in geophysics at Stanford's School of Earth, Energy & Environmental Sciences (Stanford Earth). "There are many wells that people draw water from for drinking water. Since [groundwater is] always going down, at some point these wells will go dry and the people won't have water."

Measuring depletion

The researchers combined NASA satellite data, well level data, detailed groundwater models and calculations of water inflows versus outflows to create a reliable assessment of groundwater storage data. They then used those data to predict how long it would take groundwater to fully recharge after droughts in the region under different climate scenarios.

California has faced three major droughts since 2000: from 2007 to 2009, 2012 to 2016 and the state's current drought period, which began in 2020. Researchers found that of the 19 cubic kilometers of groundwater (about 10 percent of the water volume in Lake Tahoe) lost during the 2006-2009 drought, only 34 percent was recovered after the drought. For the 2012-2016 drought, only 19 percent of 28 cubic kilometers lost were recovered.

The researchers attributed especially low recovery in the post-2016 drought period to significant overdraft compared to limited water availability.

"It's very hard to [measure] the volume of groundwater being pumped by humankind, and we really want to know that because we really want to know how much we're depleting the groundwater," said Donald Argus, a geophysicist who researches water resources at the NASA Jet Propulsion Laboratory who was not associated with the study. "If we start to understand how much water is replenished each year or each rainy season, then we get an idea of how much groundwater we're pumping out, and whether we can sustain it or not."

Opportunities for management

Despite the grave predictions of recovery time, researchers found that there is hope for increased water recovery when management practices are put into place. If California's climate remains at historical levels, rather than worsening with climate change, groundwater extraction caps could significantly improve aquifer resistance to drought. Overdraft recovery times could be reduced by about two times if pumping restrictions are put in place during no-drought years and could be reduced by up to four times with pumping restrictions, according to the study.

However, these management practices can create complicated trade-offs for laborers in the region, according to Alam. The livelihoods of those for those who depend on the region's agricultural industry is threatened when pumping for agricultural purposes is capped to prioritize drinking water. But finding a balance of water supply and demand will be necessary to continue to use the Central Valley's aquifer resource.

"Drought comes, groundwater goes. It's super fast," Alam said. "The policymakers and decision-makers need to ensure they are making the right decision to make sure groundwater use is well managed."

Study coauthors are affiliated with University of California, Los Angeles; The University of Texas at Austin; and the U.S. Geological Survey Earth Resources Observation and Science Center (EROS).

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Cleared Tropical Forests Can Regain Ground Surprisingly Fast

Abandoned agricultural lands can recover by nearly 80 percent on average in just 20 years

A young tropical forest regrows on abandoned pasture in Brazil. Such forests can recover surprisingly fast, new research suggests.
Rens Brouwer

By Jonathan Lambert for Science News

Tropical forests are disappearing at an alarming clip across the globe. As lush land is cleared for agriculture, climate-warming carbon gets released and biodiversity declines. But when farmland is left alone, nature can make a surprisingly quick comeback.

After just 20 years, forests can recover by nearly 80 percent in certain key areas, including biodiversity and soil health, researchers report in the Dec. 10 Science.

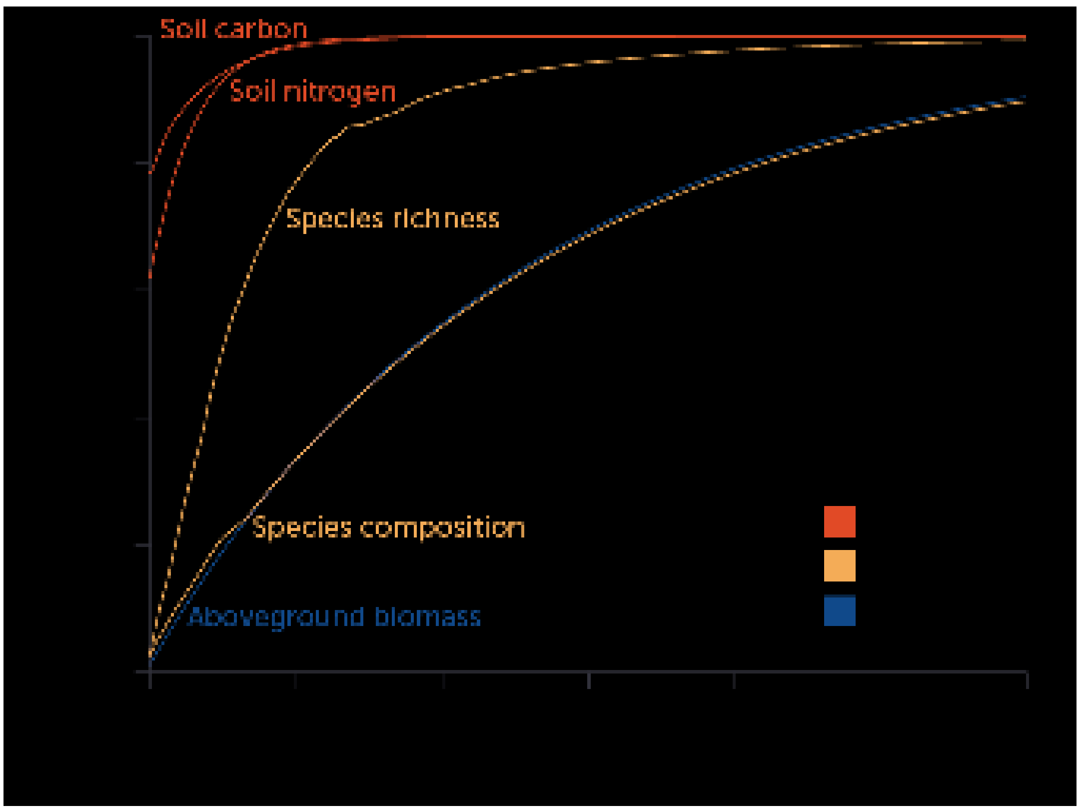
Keeping existing forests intact is crucial for curbing climate change and stemming species loss (SN: 7/13/21), says ecologist Lourens Poorter of Wageningen University in the Netherlands. But this research shows “there’s tremendous [climate] mitigation potential” in letting forests regenerate.

Land cleared of tropical forests often is abandoned after a few years of low-intensity agricultural use, Poorter says, allowing nature to creep back in. To see how such areas recover, he and colleagues studied 77 sites across the Americas and West Africa that are regrowing forests that vary in age. Using 51 old-growth sites, those that show no signs of human use in at least 100 years, as a baseline, the researchers investigated 12 forest attributes related to soil health, ecosystem functioning, forest structure and plant biodiversity, analyzing how quickly those things recovered.

On the mend

Tropical forests can re-establish themselves on abandoned agricultural lands faster than expected, recovering by nearly 80 percent on average in just 20 years, new research suggests. But different forest attributes, related to soil (red), diversity (orange) and structure (blue), recover at different rates. Soil carbon and nitrogen levels rapidly recovered, reaching levels close to those found in old-growth forests in about 20 years. Plant species richness, or the number of species, in regrowing forests takes longer to come close to old-growth levels — about 40 years — while species composition, or the relative abundances of those species, takes more than a century. Likewise, total aboveground biomass will take 120 years to approach old-growth levels, the scientists estimate.

Predicted relative recovery rates for tropical forest attributes



chang. source: l. poorter et al/ science 2021

Soil bounced back fastest, its carbon and nitrogen levels nearly reaching those of old-growth forests within a decade after abandonment. After 38 years, regrowing forests had nearly as many plant species on average as similar old-growth forests, though it will take 120 years for the relative abundances of the species to rebound to 90 percent of old-growth levels, the researchers estimate. Total aboveground biomass will also take 120 years to near untouched forest levels, the data suggest.

Overall, “recovery was way faster than we expected it to be,” Poorter says. Seeds and stumps that remained after clearing probably accelerated the process. Recovery time could be slower on land that has experienced more intense agricultural use, he says, but protecting regrowing forests can be a “cheap, natural solution,” to help address the climate and biodiversity crises.

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Frustrated Quantum Spin Atoms Make a Messy Uncertainty Soup

Physicists create new state of matter from quantum soup of magnetically weird particles

By Ben Turner for Live Science

The new material works by forming triangles out of an atom's spin states.
(Image credit: Phillip Tur via Shutterstock)

Scientists have spotted a long hypothesized, never-seen-before state of matter in the laboratory for the first time.

By firing lasers at an ultracold lattice of rubidium atoms, scientists have prodded the atoms into a messy soup of quantum uncertainty known as a quantum spin liquid.

The atoms in this quantum magnetic soup quickly became connected, linking up their states across the entire material in a process called quantum entanglement. This means that any change to one atom causes immediate changes in all of the others in the material; this breakthrough could pave the way for the development of even better quantum computers, the researchers said in a paper describing their findings Dec. 3 in the journal Science.

"It is a very special moment in the field," senior author Mikhail Lukin, a professor of physics at Harvard University and the co-director of the Harvard Quantum Initiative, said in a statement. "You can really touch, poke, and prod at this exotic state and manipulate it to understand its properties. It's a new state of matter that people have never been able to observe."

First theorized in 1973 by the physicist Philip Anderson, quantum spin liquids emerge when materials are cajoled into disobeying the usual rules that govern their magnetic behaviour.

Electrons have a property called spin, a type of quantum angular momentum, that can point either up or down. In normal magnets (like the ones people put on the fridge), the spins of neighboring electrons orient themselves until they all point in the same direction, generating a magnetic field. In non-magnetic materials, the spins of two neighboring electrons can flip to oppose each other. But in either case, the tiny magnetic poles form a regular pattern.

In quantum spin liquids, however, the electrons refuse to choose. Instead of sitting next to each other, the electrons are arranged into a triangular lattice, so that any given electron has two immediate neighbors. Two electrons can align their spins, but a third will always be the odd one out, destroying the delicate balance and creating a constantly switching jumble of agitated electrons.

This jumbled state is what the researchers call a "frustrated" magnet. As the spin states no longer know which way to point, the electrons and their atoms are instead thrown into a weird combination of quantum states called a quantum superposition. The ever-fluctuating spins now exist simultaneously as both spin up and spin down, and the constant switching causes atoms all the way across the material to entangle with each other in a complex quantum state.

The researchers couldn't directly study the ideal quantum spin liquid, so they created a near perfect facsimile in another experimental system. They chilled an array of 219 trapped rubidium atoms — which can be used to minutely design and simulate various quantum processes — to temperatures of roughly 10 microkelvins (close to absolute zero or minus – 273.15 degrees Celsius° Celsius).

Occasionally one of the electrons in an atom is in a much higher energy level than the others, putting the atom in what is known as a Rydberg state. Much like with spin states, the spooky rules of quantum mechanics ensure that an atom does not want to be in a Rydberg state if its neighbor is. By firing lasers at certain atoms within the array, the researchers mimicked the three-way tug-of-war seen in a traditional quantum spin liquid.

Following the creation of their quantum Rydberg soup, the researchers conducted tests on the array and confirmed that its atoms had become entangled across the entire material. They had created a quantum spin liquid.

The scientists then turned their attention to a proof of concept test for its potential application: designing the qubits, or quantum bits, of a quantum computer. While ordinary computers use bits, or 0s and 1s to form the basis of all calculations, quantum computers use qubits, which can exist in more than one state at once. Qubits, however, are incredibly fragile; any interaction with the outside world can easily destroy the information they carry.

But the special nature of the quantum spin liquid's material-wide entanglement, however, could allow for far more robust information storage. That's because instead of encoding quantum information into just one qubit, it could allow for information to be contained in the shape — or the topology — that the entangled spin states make throughout the material itself; creating a "topological qubit." By encoding information in the shape formed by multiple parts rather than one part alone, the topological qubit is much less likely to lose all of its information.

The researchers' proof of concept created only a tiny topological qubit, just a few tens of atoms long, but in the future, they hope to create much larger, more practical ones.

"Learning how to create and use such topological qubits would represent a major step toward the realization of reliable quantum computers," co-author Giulia Semeghini, a quantum physicist at Harvard University, said in the statement. "We show the very first steps on how to create this topological qubit, but we still need to demonstrate how you can actually encode it and manipulate it. There's now a lot more to explore."

Originally published on Live Science.

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Khushwant Singh (1915 - 2014)

Singh was an Indian author, lawyer, diplomat, journalist and politician. His experience in the 1947 Partition of India inspired him to write Train to Pakistan in 1956 (made into film in 1998), which became his most well-known novel..

A poem by Khuswant Singh at 92!

The horse and the mule live for 30 years,
And know nothing of wines and beers;

The goat and sheep at 20 die,

And never get a taste of Scotch and rye.

The cow drinks water by the tonne,
And at 18 is mostly done,
Without the aid of gin and rum.

The cat in milk and water soaks,
And then in 12 short years it croaks.

The modest, sober, bone-dry hen,
Lays eggs for others, then dies at 10.

All animals are strictly dry,
They sinless live and swiftly die.

But sinful, ginful, rum-soaked men,
Survive for three score years and ten,

And some of them, though very few,
Stay pickled till they're 92!

So, never shed a tear,
drink a beer...
Celebrate the past,
toast the future ..
and

Have a Rocking Happy New Year !!!

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Ten Things You Might Not Know About Antimatter

By Diana Kwon

Antimatter has fueled many a supernatural tale. It's also fascinating all by itself.

Illustration of Antimatter Blam
Sandbox Studio, Chicago with Ana Kova

Antimatter is the stuff of science fiction. In the book and film Angels and Demons, Professor Langdon tries to save Vatican City from an antimatter bomb. Star Trek's starship Enterprise uses matter-antimatter annihilation propulsion for faster-than-light travel.

But antimatter is also the stuff of reality. Antimatter particles are almost identical to their matter counterparts except that they carry the opposite charge and spin. When antimatter meets matter, they immediately annihilate into energy.

While antimatter bombs and antimatter-powered spaceships are far-fetched, there are still many facts about antimatter that will tickle your brain cells.

1. Antimatter should have annihilated all of the matter in the universe after the big bang.

According to theory, the big bang should have created matter and antimatter in equal amounts. When matter and antimatter meet, they annihilate, leaving nothing but energy behind. So in principle, none of us should exist.

But we do. And as far as physicists can tell, it's only because, in the end, there was one extra matter particle for every billion matter-antimatter pairs. Physicists are hard at work trying to explain this asymmetry.

2. Antimatter is closer to you than you think.

Small amounts of antimatter constantly rain down on the Earth in the form of cosmic rays, energetic particles from space. These antimatter particles reach our atmosphere at a rate ranging from less than one per square meter to more than 100 per square meter. Scientists have also seen evidence of antimatter production above thunderstorms.

But other antimatter sources are even closer to home. For example, bananas produce antimatter, releasing one positron—the antimatter equivalent of an electron—about every 75 minutes. This occurs because bananas contain a small amount of potassium-40, a naturally occurring isotope of potassium. As potassium-40 decays, it occasionally spits out a positron in the process.

Our bodies also contain potassium-40, which means positrons are being emitted from you, too. Antimatter annihilates immediately on contact with matter, so these antimatter particles are very short-lived.

3. Humans have created only a tiny amount of antimatter.

Antimatter-matter annihilations have the potential to release a huge amount of energy. A gram of antimatter could produce an explosion the size of a nuclear bomb. However, humans have produced only a minuscule amount of antimatter.

All of the antiprotons created at Fermilab's Tevatron particle accelerator add up to only 15 nanograms. Those made at CERN amount to about 1 nanogram. At DESY in Germany, approximately 2 nanograms of positrons have been produced to date.

If all the antimatter ever made by humans were annihilated at once, the energy produced wouldn't even be enough to boil a cup of tea.

The problem lies in the efficiency and cost of antimatter production and storage. Making 1 gram of antimatter would require approximately 25 million billion kilowatt-hours of energy and cost over a million billion dollars.

4. There is such a thing as an antimatter trap.

To study antimatter, you need to prevent it from annihilating with matter. Scientists have created ways to do just that.

Charged antimatter particles such as positrons and antiprotons can be held in devices called Penning traps. These are comparable to tiny accelerators. Inside, particles spiral around as the magnetic and electric fields keep them from colliding with the walls of the trap.

But Penning traps won't work on neutral particles such as antihydrogen. Because they have no charge, these particles cannot be confined by electric fields. Instead, they are held in Ioffe traps, which work by creating a region of space where the magnetic field gets larger in all directions. The particle gets stuck in the area with the weakest magnetic field, much like a marble rolling around the bottom of a bowl.

Earth's magnetic field can also act as a sort of antimatter trap. Antiprotons have been found in zones around the Earth called Van Allen radiation belts.

5. Antimatter might fall up.

Antimatter and matter particles have the same mass but differ in properties such as electric charge and spin. The Standard Model predicts that gravity should have the same effect on matter and antimatter; however, this has yet to be seen. Experiments such as AEGIS, ALPHA and GBAR are hard at work trying to find out.

Observing gravity's effect on antimatter is not quite as easy as watching an apple fall from a tree. These experiments need to hold antimatter in a trap or slow it down by cooling it to temperatures just above absolute zero. And because gravity is the weakest of the fundamental forces, physicists must use neutral antimatter particles in these experiments to prevent interference by the more powerful electrical force.

6. Antimatter is studied in particle decelerators.

You've heard of particle accelerators, but did you know there were also particle decelerators? CERN houses a machine called the Antiproton Decelerator, a storage ring that can capture and slow antiprotons to study their properties and behavior.

In circular particle accelerators like the Large Hadron Collider, particles get a kick of energy each time they complete a rotation. Decelerators work in reverse; instead of an energy boost, particles get a kick backward to slow their speeds.

7. Neutrinos might be their own antiparticles.

A matter particle and its antimatter partner carry opposite charges, making them easy to distinguish. Neutrinos, nearly massless particles that rarely interact with matter, have no charge. Scientists believe that they may be Majorana particles, a hypothetical class of particles that are their own antiparticles.

Projects such as the Majorana Demonstrator and EXO-200 are aimed at determining whether neutrinos are Majorana particles by looking for a behavior called neutrinoless double-beta decay.

Some radioactive nuclei simultaneously decay, releasing two electrons and two neutrinos. If neutrinos were their own antiparticles, they would annihilate each other in the aftermath of the double decay, and scientists would observe only electrons.

Finding Majorana neutrinos could help explain why antimatter-matter asymmetry exists. Physicists hypothesize that Majorana neutrinos can either be heavy or light. The light ones exist today, and the heavy ones would have only existed right after the big bang. These heavy Majorana neutrinos would have decayed asymmetrically, leading to the tiny matter excess that allowed our universe to exist.

8. Antimatter is used in medicine.

PET (positron emission tomography) uses positrons to produce high-resolution images of the body. Positron-emitting radioactive isotopes (like the ones found in bananas) are attached to chemical substances such as glucose that are used naturally by the body. These are injected into the bloodstream, where they are naturally broken down, releasing positrons that meet electrons in the body and annihilate. The annihilations produce gamma rays that are used to construct images.

Scientists on CERN's ACE project have studied antimatter as a potential candidate for cancer therapy. Physicians have already discovered that they can target tumors with beams of particles that will release their energy only after safely passing through healthy tissue. Using antiprotons adds an extra burst of energy. The technique was found to be effective in hamster cells, but researchers have yet to conduct studies in human cells.

9. The antimatter that should have prevented us from existing might still be lurking in space.

One way that scientists are trying to solve the antimatter-matter asymmetry problem is by looking for antimatter left over from the big bang.

The Alpha Magnetic Spectrometer is a particle detector that sits atop the International Space Station searching for these particles. AMS contains magnetic fields that bend the path of cosmic particles to separate matter from antimatter. Its detectors assess and identify the particles as they pass through.

Cosmic ray collisions routinely produce positrons and antiprotons, but the probability of creating an antihelium atom is extremely low because of the huge amount of energy it would require. This means the observation of even a single antihelium nucleus would be strong evidence for the existence a large amount of antimatter somewhere else in the universe.

10. People are actually studying how to fuel spacecraft with antimatter.

Just a handful of antimatter can produce a huge amount of power, making it a popular fuel for futuristic vehicles in science fiction.

Antimatter rocket propulsion is hypothetically possible; the major limitation is gathering enough antimatter to make it happen.

There is currently no technology available to mass-produce or collect antimatter in the volume needed for this application. However, a small number of researchers have conducted simulation studies on propulsion and storage. These include Ronan Keane and Wei-Ming Zhang, who did their work at Western Reserve Academy and Kent State University, respectively, and Marc Weber and his colleagues at Washington State University. One day, if we can figure out a way to create or collect large amounts of antimatter, their studies might help antimatter-propelled interstellar travel become a reality.

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Why Computers Don’t Need to Match Human Intelligence

With continuing advances in machine learning, it makes less and less sense to compare AI to the human mind.

illustration of computer in a dark room and three people outside in a backyard seated at a table
illustration: haley tippman

SPEECH AND LANGUAGE are central to human intelligence, communication, and cognitive processes. Understanding natural language is often viewed as the greatest AI challenge—one that, if solved, could take machines much closer to human intelligence.

In 2019, Microsoft and Alibaba announced that they had built enhancements to a Google technology that beat humans in a natural language processing (NLP) task called reading comprehension. This news was somewhat obscure, but I considered this a major breakthrough because I remembered what had happened four years earlier.

In 2015, researchers from Microsoft and Google developed systems based on Geoff Hinton's and Yann Lecun's inventions that beat humans in image recognition. I predicted at the time that computer vision applications would blossom, and my firm made investments in about a dozen companies building computer-vision applications or products. Today, these products are being deployed in retail, manufacturing, logistics, health care, and transportation. Those investments are now worth over $20 billion.

Quantum Computing Expert Explains One Concept in 5 Levels of Difficulty

So in 2019, when I saw the same eclipse of human capabilities in NLP, I anticipated that NLP algorithms would give rise to incredibly accurate speech recognition and machine translation, that will one day power a "universal translator" as depicted in Star Trek. NLP will also enable brand-new applications, such as a precise question-answering search engine (Larry Page's grand vision for Google) and targeted content synthesis (making today's targeted advertising child's play). These could be used in financial, health care, marketing, and consumer applications. Since then, we've been busy investing in NLP companies. I believe we may see a greater impact from NLP than computer vision.

What is the nature of this NLP breakthrough? It's a technology called self-supervised learning. Prior NLP algorithms required gathering data and painstaking tuning for each domain (like Amazon Alexa, or a customer service chatbot for a bank), which is costly and error-prone. But self-supervised training works on essentially all the data in the world, creating a giant model that may have up to several trillion parameters.

This giant model is trained without human supervision—an AI "self-trains" by figuring out the structure of the language all by itself. Then, when you have some data for a particular domain, you can fine-tune the giant model to that domain and use it for things like machine translation, question answering, and natural dialog. The fine-tuning will selectively take parts of the giant model, and it requires very little adjustment. This is somewhat akin to how humans first learn a language and then, on that basis, learn specific knowledge or courses.

Since the 2019 breakthrough, we have seen giant NLP models increase rapidly in size (about 10 times per year), with corresponding performance improvements. We have also seen amazing demonstrations—such as GPT-3, which could write in anybody's style (such as Dr. Seuss-style), or Google Lambda, which converses naturally in human speech, or a Chinese startup called Langboat that generates marketing collateral differently for each person.

Are we about to crack the natural language problem? Skeptics say these algorithms are merely memorizing the whole world's data, and are recalling subsets in a clever way, but have no understanding and are not truly intelligent. Central to human intelligence are the abilities to reason, plan, and be creative.

One critique of deep-learning-based systems runs like this: "They will never have a sense of humor. They will never be able to appreciate art, or beauty, or love. They will never feel lonely. They will never have empathy for other people, for animals, or the environment. They will never enjoy music or fall in love, or cry at the drop of a hat." Makes sense, right? As it turns out, the quotation above was written by GPT-3. Does the technology's ability to make such an accurate critique contradict the critique itself?

Many believe true intelligence will require a greater understanding of the human cognitive process. Others advocate "neuromorphic computing," which is building circuitry that more closely resembles the human brain, along with a new way of programming. Still others call for elements of "classical" AI (that is, rule-based expert systems) combined with deep learning in hybrid systems.

I believe it's indisputable that computers simply "think" differently than our brains do. The best way to increase computer intelligence is to develop general computational methods (like deep learning and self-supervised learning) that scale with more processing power and more data. As we add 10 times more data every year to train this AI, there is no doubt that it will be able to do many things we humans cannot do.

Will deep learning eventually become "artificial general intelligence" (AGI), matching human intelligence in every way? I don't believe it will happen in the next 20 years. There are many challenges that we have not made much progress on—or even understood—such as how to model creativity, strategic thinking, reasoning, counterfactual thinking, emotions, and consciousness.

I would suggest that we stop using AGI as the ultimate test of AI. Soon deep learning and its extensions will beat humans on an ever larger number of tasks, but there will still be many tasks that humans can handle much better than deep learning. I consider the obsession with AGI to be a narcissistic human tendency to view ourselves as the gold standard.

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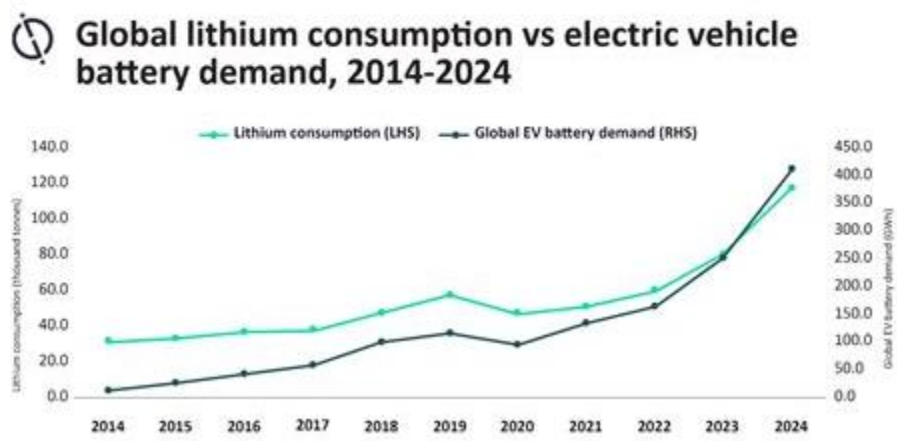
Demand For Lithium Will Reach an Inflection Point in 2022 As Geopolitical, Economic, and Environmental Forces Collide.



Demand for lithium is growing rapidly, fueled by proliferation of electric vehicles and climate goals to reduce emissions. The International Energy Agency (IEA) expects electric car sales to jump from $3 million in 2017 to $23 million in 2030, with lithium touted as the "new oil" among electric vehicle manufacturers—and investors are taking note. In the first three months of 2021, US lithium miners raised $3.5 billion from Wall Street—seven times the amount raised in the prior 36 months. High demand for the metal is generating pressure within nations to build self-sufficiency in lithium production. The United States, for example, is home to extensive lithium reserves, but only produces two percent of the global total (see figure 3). Most lithium is produced in Latin America and Australia, then processed into battery cells in China and other Asian markets.

Despite broad use cases and its contribution to the economies of many key markets, the lithium extraction process is damaging to the environment. It takes two million liters of water to produce one ton of lithium—a striking statistic, especially given the sharp rise in water dislocations we expect to see over the next few years. All too aware of this reality is Chile's Salar de Atacama, where mining activities have consumed 65 percent of the region's water. Further, hard rock mining leaves scars in the landscape and releases 15 tons of carbon dioxide for every ton of lithium sourced. The impact of lithium sourcing on people and animals is also notable. In Tibet, toxic chemicals including hydrochloric acid from lithium evaporation pools have leaked into the water supply. And research in Nevada found deleterious impacts on fish as far as 150 miles downstream from a lithium processing operation. These harsh realities demonstrate the mounting tensions between those extracting lithium to support market demand versus the environmentalists and local farmers who say the costs of extraction are too high.

We predict that as these competing geopolitical, economic, and environmental considerations surrounding lithium converge, public support will grow for complementing traditional mining practices with green practices. With the lithium mining market expected to reach $1.81 billion by 2022, growing at a cumulative annual growth rate of 7.0 percent, the push for green lithium solutions will reach a tipping point in 2022.

Some promising green lithium extraction technologies are already gaining ground. Recovering lithium from geothermal brine, for instance, is less destructive than hard rock mining. This process, called direct lithium extraction (DLE), uses nanofiltration or ion-exchange resins to selectively collect just lithium chloride, leaving other salts in the water. The Rhine Valley in Germany, Cornwall in the United Kingdom, and Salton Sea in California represent potential locations for geothermal brine extraction. There are also opportunities to reduce the carbon footprint of lithium batteries themselves. Many batteries are taken out of commission when they become inefficient for a particular use (for example, powering a car), but they still have plenty of life in them for less-intensive applications, such as renewable-energy storage. Some businesses are capitalizing on these recycling capabilities. For example, Canadian firm Li-Cycle Holdings—recently listed on the New York Stock Exchange—dissolves and recovers the metals in lithium batteries, leaving a black mass of metallic foils and low-density plastics that can be further processed into useable materials. As more companies such as Li-Cycle come online in 2022 and beyond, lithium will be better able to reach its economic potential while limiting its more damaging environmental impact.

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Simone Biles in Slow Motion

https://twitter.com/bubbaprog/status/1401010235251298309?utm_source=join1440&utm_medium=email&utm_placement=newsletter

The greatest gymnast of our time may slip from public notice because of her concentration difficulties at this year's Olympic Games, but here's proof positive she can do things no other woman (or man) on the planet can.

Ms. Biles, You're the greatest. Thank you for the pleasure of your amazing talent and hard work.

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A TV Weatherman Who Knows Low Pressure from Hot Air

https://youtu.be/nAiE9fJbVd4

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Best Christmas Ever

https://youtu.be/4WvwX18oMR4

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The Blues as You've Never Seen Them

https://youtu.be/HLWFOdVtYFM

This isn't about the Blues but of tribal people seeing them for the first time.

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My Walking Thoughts for January 9 2022

Binary Thinking: Can We Change the Experiment?

I've spent a great deal of my life grappling with…what?

Inconsistencies? Dichotomies? The inability to get at the underlying causes of my discontent?

Of course the answer lies in my ignorance of what really drives the speed and enormity of change that today assault the verities that for more than half a century conditioned—better still, controlled—the boundaries of my life. Worse still, the situation is becoming less and less tenable as I find the limits of my rational abilities shrinking.

But it's not just me, or put another way, I may not be alone in waging war with change guided by rules and assumptions implicit in either/or thinking…what Gideon Lichfield, Global Director of Wired online publication calls Binary Thinking.

I like the term and its implications because it seems to define the limitations in our ability to broaden our horizons beyond the Boolean logic we've come to accept as gospel and thus remove from consideration the factors that really matter in coming to grip with change.

As 2021 came mercifully to an end, Lichfield presented a very provocative piece that I'd like lay before you (and me) as a way to thread our way through the rocks and shoals of dramatic change that despite the valiant rear-guard efforts of those struggling to salvage the stranded values of another age, will succeed only in throwing up temporary barriers to the tides that surround and move us.

Says Mr. Lichfield:

In the next few decades, virtually every financial, social, and governmental institution in the world is going to be radically upended by one small but enormously powerful invention: the blockchain.

Do you believe that? Or are you one of those people who think the blockchain and crypto boom is just a massive, decade-long fraud—the bastard child of the Dutch tulip bubble, Bernie Madoff's Ponzi scheme, and the wackier reaches of the libertarian internet? More likely, you—like me—are at neither of these extremes. Rather, you're longing for someone to just show you how to think about the issue intelligently and with nuance instead of always falling into the binary trap.

Binaries have been on my mind a lot since I took over the editor's chair at Wired last March. That's because we're at what feels like an inflection point in the recent history of technology, when various binaries that have long been taken for granted are being called into question.

When Wired was founded in 1993, it was the bible of techno-utopianism. We chronicled and championed inventions that we thought would remake the world; all they needed was to be unleashed. Our covers featured the brilliant, renegade, visionary—and mostly wealthy, white, and male—geeks who were shaping the future, reshaping human nature, and making everyone's life more efficient and fun. They were more daring, more creative, richer and cooler than you; in fact, they already lived in the future. By reading Wired, we hinted, you could join them there!

If that optimism was binary 0, since then the mood has switched to binary 1. Today, a great deal of media coverage focuses on the damage wrought by a tech industry run amok. It's given us Tahrir Square, but also Xinjiang; the blogosphere, but also the manosphere; the boundless opportunities of the Long Tail, but also the unremitting precariousness of the gig economy; mRNA vaccines, but also Crispr babies. Wired hasn't shied away from covering these problems. But they've forced us—and me in particular, as an incoming editor—to ponder the question: What does it mean to be Wired, a publication born to celebrate technology, in an age when tech is often demonized?

To me, the answer begins with rejecting the binary. Both the optimist and pessimist views of tech miss the point. The lesson of the last 30-odd years is not that we were wrong to think tech could make the world a better place. Rather, it's that we were wrong to think tech itself was the solution—and that we'd now be equally wrong to treat tech as the problem. It's not only possible, but normal, for a technology to do both good and harm at the same time. A hype cycle that makes quick billionaires and leaves a trail of failed companies in its wake may also lay the groundwork for a lasting structural shift (exhibit A: the first dotcom bust). An online platform that creates community and has helped citizens oust dictators (Facebook) can also trap people in conformism and groupthink and become a tool for oppression. As F. Scott Fitzgerald famously said, intelligent people should be able to hold opposed ideas in their minds simultaneously and still function.

Yet debates about tech, like those about politics or social issues, still seem to always collapse into either/or. Blockchain is either the most radical invention of the century or a worthless shell game. The metaverse is either the next incarnation of the internet or just an ingeniously vague label for a bunch of overhyped things that will mostly fail. Personalized medicine will revolutionize health care or just widen its inequalities. Facebook has either destroyed democracy or revolutionized society. Every issue is divisive and tribal. And it's generally framed as a judgment on the tech itself—"this tech is bad" vs. "this tech is good"—instead of looking at the underlying economic, social, and personal forces that actually determine what that tech will do.

There's been even more of this kind of binary, tech-centered thinking as we claw our way out of the pandemic. Some optimists claim we're on the cusp of a "Roaring 2020s" in which mRNA and Crispr will revolutionize disease treatment, AI and quantum computers will exponentially speed up materials science and drug discovery, and advances in battery chemistry will make electric vehicles and large-scale energy storage (and maybe even flying taxis) go mainstream. If you want to see a gloomy future, on the other hand, there's no shortage of causes: Digital surveillance is out of control, the carbon footprint of cryptocurrency mining and large AI models is expanding, the US–China tech arms race is accelerating, the gig-work precariat is swelling, and the internet itself is balkanizing.

This tug-of-war between optimism and pessimism is the reason why I said this feels like an inflection point in the history of tech. But even that term, "inflection point," falls into the binary trap, because it presumes that things will get either worse or better from here. It is, yet again, a false dichotomy. This kind of thinking helps nobody make sense of the future that's coming. To do that—and to then push that future in the right direction—we need to reject this 0-or-1 logic.

Former president of the Solid Waste Association of North America, The International Solid Waste Association, founder of the Delaware Solid Waste Association, friend, and Odester, N.C. Vasuki passed along his thoughts on dealing with plastics that illustrates Mr. Lichfield's thesis in a real-world manner.

> *Having grown up in the age of plastics, I thought the article presented challenges posed by discarded plastics. Just as use of chemistry launched plastics, it requires chemistry to resolve the side effects of the use of plastics. Banning plastics or taxing plastics, by governmental fiat is not a good proposition. It will not solve the problem.*
>
> *There are reasonable technical means to resolve the discard problem, but politicians and environmental advocacy groups will look for the "perfect" solution. There is no such "perfect" solution. All actions have risks and a rational way to proceed is to minimize risks.*

I’d like your thoughts on change, binary thinking, and even inflection points to guide my walking thoughts.

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