



**A little science...A touch of fiction...A lot of adventure...**

## News from the Den

Last month I added a 'Word of the Month' section as a lead-in to this month's science news. I was all ready to move ahead with a definition of Anthropocene and a geologic-focused letter when everything changed. The mideast erupted in war. The Ukrainian conflict and related crises continue. The US House of Representatives is without a Speaker, halting all ability to distribute funds: to keep the US government running, to provide needed aid to Israel and Gaza, and to continue military and domestic aid to Ukraine. We live in difficult times as everyone is inundated with crises, conflict and unrest from climate change, oppression, or ongoing conflicts. But I realized science continues, researchers struggle on despite funding issues and resource limitations, but they are not deterred in their efforts. So I will attempt to keep calm and carry on.

This is Nobel Prize month and a number of deserving scientists, economists and humanitarians received this great honor. This year four women and seven men received the award. Discoveries and contributions recognized included: the smallest slice of time ever produced—an attosecond (one billionth of a billionth of a second), used to measure electron motion; the discovery and synthesis of quantum dots-semiconducting nanoparticles; nucleoside modifications that led to the mRNA vaccines; Norwegian plays and prose that challenge and question existence; the study of gender-based pay disparities; and for combating the oppression of women by the Iran regime. [Read more.](#)

Reading through the contributions of these amazing individuals gives one hope that humanity may survive and flourish in the future.

## Latest and Greatest - Let's Rock and Roll

Have you ever wondered why time seems to pass so quickly when you're having fun? Time is actually a steady-state but when having fun our perception of time changes. Ever wonder how a rock perceives time? Rocks experience a much different time scale than humans do. Rocks live in 'deep-time'. Deep time is measured in hundreds of thousands, millions or even billions of years, not hours, days, and years.

Our universe is 13.7 billion years old. Our solar system is 4.55 billion years old. The oldest known rocks on Earth—4.0 billion years (the Acasta Gneiss, NW Territories, Canada), oldest known life on Earth—3.7 billion years (microbes in Apex chert, Australia), age of the North American tectonic plate—200 million years, age of the first mammals—205 million years, first humanoid species—4.4 million year (Ardipithecus, Ethiopia), first members of the genus Homo—2.8 million years (Afar region, Ethiopia), emergence of Homo sapiens—160,000 years ago. All of this tells us in the greater scheme of geologic time, the human species is a less than a tick on the deep time clock.

Most geologic events occur over millions of years—e.g. the movement of continents (the San Andreas fault moves just 2.5cm/year), the erosion of mountain ranges, the evolution of life. But volcanic

eruptions, earthquakes, and now the impact of the modern species *Homo sapiens* happen instantaneously within the geologic time scale. So fast in fact that geologists have stated the Holocene epoch is over and we have entered a new epoch of geologic time - the Anthropocene. This new epoch is defined by the presence of indicators of global pollution and human activity. The epoch is a time when humans began to alter the planet with the advent of industrial and radioactive materials. [Read more.](#)

Obviously, these observable changes to our planet are significant and have long-lasting effects on life into the future. But, what about the other instantaneous geologic events which have occurred throughout the 4.55 billion years of Earth history?

We've seen significant examples of these events in the last two years—the Hunga Tonga-Hunga Ha'apai volcanic eruption in 2022. The power of this eruption was so large, the sound of the eruption was heard 10,000 kilometers away in Alaska, the explosion was greater than 61 megatons of TNT, the shock wave from the eruptions moved at 300m/second, the volcanic ash plumb rose into the mesosphere (58k up in the atmosphere), the eruptions added an additional 10% more water to the stratosphere of the entire planet. Although most volcanic eruptions lead to a cooling of the planet, the amount of water and other gases erupted into the upper levels of the earth's atmosphere will likely warm the planet for years to come. [Read more.](#)

Two significant earthquakes have occurred in the last year with significant impact on humans—a 7.8 magnitude supershear earthquake and its follow-on 7.5 aftershock occurred across a triple junction (the intersection of three tectonic plates). These earthquakes occurred in Syrian on the East Anatolia Fault system within the Dead Sea Transform system. These events impacted more than 15.3 million people with more than 59,000 casualties. 30,000 aftershocks have been recorded since the initial fault rupture in February 2023. The ground rupture along the fault is visible from space. [Read more.](#)

In September, a 6.8 magnitude event was recorded in the high Atlas Mountains of Morocco. The event occurred on a previously unmapped steeply-dipping thrust fault at the shallow depth of 19km. This fault is part of the complex boundary between two major tectonic plates (Eurasia to the north and Africa to the south). More than 2000 casualties were recorded. [Read more.](#)

But a word about earthquakes, its not the quake which kills its the building standards, the population density, the accessibility to rapid medical and trauma care which kills. There exists only one MRI scanner for 4.7 million people in the Syrian region of the Anatolia quake ([read more](#)) and in Morocco mud-brick buildings collapsed during the intense shaking along the shallow fault. Another significant fact is the role plate boundaries play in the generation of significant quake events. [Read more.](#)

Now lets speak about future earthquakes and the faults they may occur on. Predicting earthquakes is still in its infancy. Many have suggested numerous prediction methods—from the restlessness of animals to gases emitting from wells. But at this time, we cannot adequately predict their occurrence. AI may help predict them and will be a tool for predicting the occurrence and magnitude of aftershocks once a quake occurs. [Read more.](#)

Our best predictive method may be determining the frequency and estimated magnitude of past quakes along a particular fault. Although this is an estimate of future quakes, it does identify faults which can produce significantly large quakes, depth of potential rupture and size of the cone of damage, and estimated impact on civilization. Once potential risks are identified, we can be prepared by improving building standards, population preparedness and evacuation plans, infrastructure liability, and availability of emergency resources.

One of the areas of greatest potential for a large (magnitude at or above 8) event is along the coast of Oregon and Washington states. A group of linked-faults ruptured between 923 and 924C.E. producing a mega-quake. The event swept forests into lakebeds and created new lakes along a 100km swath of

the Pacific Northwest. The Salish people tell of the spirit a'yahos shaking the earth, creating new caves and lakes, while removing forests from the ground.

The Pacific Northwest is underlain by a significant tectonic boundary—the Cascadia Subduction Zone where the Farallon Plate is moving east underneath the west-moving North American plate. This boundary exists beneath a heavily populated area from Vancouver, BC, Canada to Portland, Oregon. Paleoseismologists (geologists who study ancient earthquakes) have sampled drowned fir trees recovered from deep lakes and measured their preserved tree rings to determine the date of inundation. Their study shows a magnitude 7.8 or greater event occurred along a linked-fault system in 923 C.E. A tsunami was created by this event and is recorded in village records in the northern islands of Japan. This shows a potential frequency and magnitude for future events in the region. [Read more.](#)

As the continents continue to move and grind against one another, volcanoes will erupt and earthquakes will shake the ground. Geologists continue to improve our forecasting, but communities need to be prepared.

## Photos of the Month - OSIRIS-REx



Credit: Keegan Barber/NASA via Getty

Pieces of the asteroid Bennu, arrived back on Earth, landing safely in the Utah desert. Initial analyses show the asteroid contains water and carbon, key building-blocks for life.

## Historical Foundations - In case I die...

The adage of publish or perish was brought to life on the battlefields of eastern Ukraine this past year. Neuroscientist Sergiy Sylantyev left his research position in the UK to join his country's army and fight against the Russian invaders. While fighting in a unit with a 50% casualty rate, he continued his research on an amino-acid treatment for stroke victims. His paper was published while he was at the front. His story of hardship and gained insight into how science is connected to the politics of war is a

heart-wrenching read. He is now back in his laboratory in Scotland, continuing his work but forever changed. [Read more](#).

## Book of the Month - *Assembling California*, John McPhee and *The Map The Changed the World*, Simon Winchester

Two books this month, one about the geologic evolution of one of the most complex geologic provinces in the US, the State of California. McPhee takes the reader across diverse geologic terrains and over major tectonic plate boundaries and tells us about what happens at those boundaries. McPhee writes in an educated, entertaining way on topics ranging from canoes to oranges to geology. [Available on Amazon](#).

William Smith is now considered the Father of modern geology, Winchester chronicles his life, struggles and losses in this biographic picture of a visionary. Smith established the guiding principles of deep time, stratigraphy and sedimentary continuity, from an amazing observational ability and by asking the simple question of 'Why'. [Available on Amazon](#).

## Minutiae

Next month we'll travel across the universe and learn about Euclid, CERN and more from the James Webb. So in preparation for this journey, my question for you to ponder is - Does antimatter fall up or down?

And our word of the month is antihydrogen.

My thoughts are with those suffering in the Middle East and in Eastern Ukraine.

Be kind. CA



keep being curious

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