



14 October, 2023

Planetary Cataclysm

Context: The afterglow of a massive collision between two giant planets may have been detected for the first time.

- In December 2021, astronomers observed the star ASASSN-21qj, located 1,800 light years from Earth, exhibiting unusual fluctuations in visible light.
- Such light fluctuations are often due to material passing between the star and Earth, a common occurrence in astronomy.
- ASASSN-21qj had emitted significantly increased levels of infrared light about two and a half years before its visible light dimmed.
- Infrared light is emitted by objects at relatively high temperatures, typically in the range of a few hundred degrees Celsius.
- This observation suggests a possible connection between the star's dimming and a collision or interaction, potentially leading to the formation of a new planet.
- The event offers a unique opportunity to witness the birth of a world and gain insights into the process of planetary formation.

What is it?

- It is a cataclysmic collision between two planets known as giant impacts.
- Such impacts are common in the final stages of planet formation and play a crucial role in determining planetary sizes, compositions, and orbital characteristics.
- In our solar system, giant impacts are responsible for the tilt of Uranus, Mercury's high density, and the creation of Earth's Moon.
- The collision in question would have released more energy in its initial hours than the star itself emits, superheating and vaporizing material from the colliding planets.
- The impact would have formed a hot, glowing mass of material, hundreds of times larger than the original planets, observed using NASA's WISE space telescope.
- The post-impact body would take millions of years to cool and shrink to resemble a new planet.
- The presence of this debris could explain the erratic dimming of the star's visible light.
- Key insights include the post-impact body being hundreds of times the size of Earth and the colliding planets possibly being as large as Uranus and Neptune.
- The estimated temperature of the post-impact body is around 700°C, suggesting that the colliding bodies were not entirely composed of rock and metal.

Ice giants

- Ice giants are a type of giant planet found in the Solar System, which includes Uranus and Neptune.
- These planets are primarily composed of elements heavier than hydrogen and helium, such as oxygen, carbon, nitrogen, and sulfur.
- In astrophysics, the term "ice" refers to volatile compounds with freezing points above 100 K, including water, ammonia, and methane.
- The classification of Uranus and Neptune as ice giants was established in the 1990s, distinguishing them from gas giants like Jupiter and Saturn, which are mainly composed of hydrogen and helium.
- Unlike gas giants, ice giants lack well-defined solid surfaces and are predominantly made up of gases and liquids.
- During their formation, the compounds that make up Uranus and Neptune were either in the form of ice or trapped in water ice.
- Today, very little of the water in these planets remains in the form of ice; instead, it exists as a supercritical fluid due to the high temperatures and pressures within them.
- Uranus and Neptune contain only about 20% hydrogen and helium by mass, in contrast to Jupiter and Saturn, which are over 90% hydrogen and helium by mass.

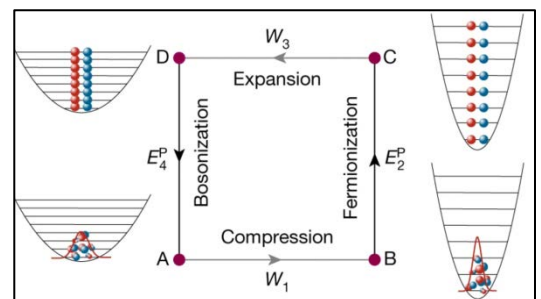
Quantum Engine

Context: German physicists have devised a method to transform the energy gap between two quantum states in a cluster of atoms into usable work.

- The device applies classical engine principles to the subatomic domain, allowing for the exploration of quantum thermodynamics.
- This innovation provides physicists with an opportunity to delve deeper into the emerging field of quantum thermodynamics.
- Additionally, it has the potential to contribute to the improvement of quantum computers.

Pauli's Principle

- Subatomic particles fall into two categories: fermions and bosons.
- Fermions are fundamental particles that constitute matter, while bosons mediate the forces between particles.
- When particles are cooled to near absolute zero, their quantum nature becomes prominent.
- At such low temperatures, particles seek the lowest possible energy state, but they are subject to Pauli's exclusion principle.
- Pauli's exclusion principle dictates that no two particles in a system can have the same set of four quantum numbers, preventing them from occupying the same energy level.
- Fermions adhere to this principle, sequentially filling available energy levels.
- In contrast, bosons are not constrained by the exclusion principle and can all occupy the same lowest energy level.
- This property of bosons underpins phenomena like superconductivity.



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Quantum Mechanics

- Quantum mechanics is a field in physics focused on the behavior of matter and light at the subatomic and atomic scale.
- Its purpose is to elucidate the characteristics of atoms, molecules, and their constituent particles such as protons, neutrons, electrons, gluons, and quarks.
- Quantum mechanics seeks to explain the interactions between these particles as well as their interactions with electromagnetic radiation.
- Two essential points to understand before delving into quantum mechanics are the behavior of subatomic particles and their interactions with each other and with light.

Classical IC Engines

- An internal combustion engine (IC engine) is a type of heat engine.
- It operates by igniting an air-fuel mixture inside a combustion chamber, generating high temperatures and gas pressure.
- The resulting gas pressure drives a piston, which moves a distance, transforming the chemical energy into thermal energy used for performing mechanical work.
- **Working:**
 - Four-stroke engines are the most common type of internal combustion engines used in automobiles, such as cars, trucks, and some motorcycles (while many motorcycles use two-stroke engines).
 - A four-stroke engine delivers one power stroke for every two cycles of the piston, which amounts to four piston strokes in total.
 - The four-stroke engine cycle consists of **four phases**:
 - **Intake stroke:** The piston moves downward to increase the chamber's volume, allowing a fuel-air mixture to enter.
 - **Compression stroke:** The intake valve closes, and the piston moves upward to compress the fuel-air mixture. A spark plug provides the ignition energy.
 - **Power Stroke:** Combustion of the compressed fuel-air mixture generates heat, increasing pressure, which forces the piston down, producing power.
 - **Exhaust stroke:** As the piston reaches the bottom, the exhaust valve opens, and the piston pushes out the remaining exhaust gases as it moves back upwards.

Australia's Indigenous Voice Referendum

Context: On October 14, a referendum in Australia will determine whether the country's indigenous communities should have an official role in the legislative process.

- The referendum question reads: "A Proposed Law: to alter the Constitution to recognize the First Peoples of Australia by establishing an Aboriginal and Torres Strait Islander Voice. Do you approve this proposed alteration?"
- The referendum addresses the issue of recognizing indigenous Australians in the country's Constitution.
- It also considers the establishment of an advisory body called the "Voice to Parliament," tasked with providing guidance to lawmakers on matters affecting indigenous communities.

First Peoples of Australia

- The term "aboriginal" refers to the original, indigenous inhabitants of Australia.
- These are the people who inhabited the Australian mainland and surrounding islands for tens of thousands of years before the arrival of Europeans in the early 17th century.
- The referendum question mentions the "Torres Strait Islands," which are a group of small islands located in the Torres Strait, a narrow body of water situated between the northern tip of Queensland (an Australian state) and the larger island of Papua New Guinea.

Aboriginals

- Ancient rock carvings provide evidence of human habitation in Australia dating back around 45,000 years.
- The first documented European landing in Australia was made by Dutch explorer Willem Janszoon in 1606, on the western side of the Cape York peninsula.
- Europeans had earlier knowledge of a southern hemisphere landmass they referred to as Terra Australia Incognita or Unknown South Land, but there is no confirmed evidence of any earlier European landings.
- Captain James Cook's famous voyages to Australia occurred in the latter part of the 18th century.
- The initial European settlers in Australia were primarily convicts and criminals who were transported there to serve their prison sentences.
- Between 1788 and 1868, over 162,000 convicts who had committed crimes in Britain and Ireland were sent to Australia as part of the penal colony system.
- Notably, Australia's 122-year-old Constitution does not mention Aboriginal people.
- Aboriginal individuals comprise approximately 3.2% of Australia's population and often lag behind national averages in various socio-economic indicators.
- According to a government booklet aimed at informing voters about their choice, indigenous Australians face several challenges, including:
 - A life expectancy that is 8 years shorter than that of non-Indigenous Australians.
 - Higher rates of disease and infant mortality.
 - A suicide rate twice as high as non-Indigenous Australians.

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Languages and Division

- Many Aboriginal people in Australia primarily speak English but incorporate Aboriginal phrases and words, resulting in Australian Aboriginal English.
- Aboriginal languages have influenced Australian Aboriginal English, impacting its phonology and grammatical structure.
- Some Aboriginal individuals, particularly those in remote areas, are multilingual, speaking multiple languages.
- Australia originally had 250-400 distinct Aboriginal languages (over 250 languages and about 800 dialectal varieties), but many of them are now endangered or extinct.
- Efforts are being made to revive some of these languages.
- As of 2016, only 13 traditional Indigenous languages were still being learned by children, while approximately 100 were spoken exclusively by older generations.
- Over time, Aboriginal people dispersed across the Australian continent, leading to the development of distinct cultural groups, each with its own language and culture.
- There are more than 400 distinct Australian Aboriginal groups, identified by ancestral languages, dialects, or speech patterns.
- Historically, they can be categorized into three main cultural areas: Northern, Southern, and Central, with varying population densities based on resource availability.
- Geographically-based names, called **demonyms**, are used to identify groups from specific regions, such as **Anangu** in northern South Australia or **Noongar** in southern Western Australia.
- Sub-groups within the Aboriginal population often have names based on their language group or dialect, corresponding to various geographical areas. Examples include **Anindilyakwa**, **Arrernte**, **Pitjantjatjara**, and **Yamatji**, among others.

NEWS IN BETWEEN THE LINES

Kanwar Lake

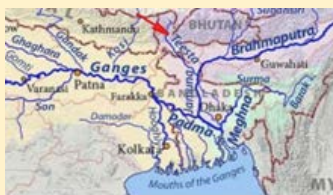


Recently, the Kanwar Lake is facing neglect and is at risk of drying up.

About the Kanwar Lake:

- Kanwar Lake, also known locally as **Kanwar Jheel**, is the **largest oxbow lake** at the **Begusarai** district of **Bihar** in India.
- Kanwar Lake is the only **Ramsar site** in Bihar.
- It is signifying its **international importance** for **wetland** conservation.
- It is a **freshwater lake**, making it vital for the local ecosystem.
- Kanwar Lake is a **residual oxbow** lake formed due to the geological **meandering** of the **Burhi Gandak River**, a **tributary of the Ganga**.
- In **1984**, Kanwar Lake covered an area of **6,786** hectares.
- However, by **2004**, it had shrunk to **6,044** hectares.

Teesta River



Recently, on **October 4**, a **song's prophecy** became strikingly accurate, not for the **Rangeet River** but for the **Rungnyu River**, commonly recognized as the **Teesta**.

About the Teesta River

- The Teesta River is a significant tributary of the **Brahmaputra River**, known as the **Jamuna** in **Bangladesh**.
- It originates in the **Himalayas near Chunthang, Sikkim, India** and flows southward through **West Bengal** before entering Bangladesh.
- Originally, the Teesta River continued southward to directly **join the Padma River**.
- Around **1787**, the river changed its course, flowing eastward to join the **Jamuna River** instead.

Teesta Barrage Dam:

- The Teesta Barrage dam plays a crucial role in providing irrigation for the plains situated between the **upper Padma** and the **Jamuna** rivers.
- Two major large barrages have been constructed on the Teesta River, including the **Gajoldoba barrage in West Bengal** and the **Duani barrage in Bangladesh**.
- The Teesta River water conflict is a highly contentious issue between **India and Bangladesh**.

Pontus Tectonic Plate



Recently, scientists studying ancient rocks in **Borneo** made an accidental discovery of a **long-lost tectonic plate** named '**Pontus**'.

About Pontus Tectonic Plate:




- A **long-lost tectonic plate** known as the **Pontus Plate** was recently rediscovered in the **Borneo** region.
- This plate had vanished from geological records approximately **20 million** years ago.
- This Plate is currently situated beneath the **South China Sea**.
- It exhibited **complex movement** over its geological history.
- It gradually **shrank in size** over time, and its remnants were eventually pushed beneath two major neighboring plates:
- **Southward**, it subducted under the **Australian Plate**.
- **Northward**, it subducted under the **Eurasian Plate** (including the Chinese landmass).
- This movement and subduction hold great significance for understanding the geological evolution and seismic activity in the **South China Sea** region.
- The rediscovery of the Pontus Plate offers valuable **insights into Earth's paleogeography** and continental drift over millions of years.

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<p>NASA's Psyche Mission</p> 	<p>Recently, NASA's Psyche spacecraft was launched from Florida using a Falcon-Heavy rocket</p> <p>About:</p> <ul style="list-style-type: none"> NASA's Psyche mission aims to explore 16 Psyche, a unique metal-rich asteroid in the Solar System. 16 Psyche is composed of up to 60% iron and nickel, possibly representing the core of a planet-like object. The Psyche spacecraft launched from Florida on a six-year, 3.5 billion km journey to reach its destination between Mars and Jupiter. The mission will study Psyche's shape, internal structure and composition, potentially revealing its unique surface features.
<p>Diverse Epigenetic Epidemiology Partnership</p> 	<p>About:</p> <ul style="list-style-type: none"> Diverse Epigenetic Epidemiology Partnership (DEEP) represents an ambitious research initiative integrating genomics and epigenomics. It is dedicated to unraveling the genetic underpinnings of Non-Communicable Diseases (NCDs), with a particular focus on diverse populations, including South Asians. This five-year international project extends its investigation to explore the interplay of genetics and environment in disease risks on a global scale. It encompasses diverse populations across Asia, Africa and North and South America. Researchers within DEEP will delve into the intricacies of DNA methylation patterns in individuals, each representing unique genetic and environmental contexts. DNA methylation is an intricate process wherein chemical modifications attach to DNA, regulating the activation and deactivation of genes. It is a vital epigenetic mechanism that enables the body to respond to environmental cues, significantly influencing overall health and susceptibility to diseases.
<p>Place in News</p> <p>Rosebank Oil Field</p>	<p>Recently, the UK approved a major North Sea oil project despite environmental concerns and the commitment to achieve net-zero carbon emissions by 2050.</p> <p>Location:</p> <ul style="list-style-type: none"> The Rosebank oil field is situated in the North Sea, northwest of the Shetland Islands. <p>Oil Reserves:</p> <ul style="list-style-type: none"> It holds significant untapped oil reserves with the potential to yield around 300 million barrels of oil. <p>UK Oil Production:</p> <ul style="list-style-type: none"> The project is expected to contribute 8% of the UK's total oil production and generate jobs until 2051. <p>Environmental Concerns:</p> <ul style="list-style-type: none"> Approval of the project has raised environmental concerns, given the UK's commitment to achieving net-zero carbon emissions by 2050. <p>North Sea Geography:</p> <ul style="list-style-type: none"> The North Sea is a shallow sea connecting multiple European countries and is a critical location for the oil and gas industry. It connects to the Atlantic Ocean through the English Channel in the south and the Norwegian Sea in the north. 

POINTS TO PONDER

- ❖ What was the man-made famine in Ukraine from 1932 to 1933 called? - Holodomo
- ❖ What are particles with a diameter of less than 0.1 micrometer sometimes called? - Aitken nuclei
- ❖ What is India's rank in the Global Hunger Index (GHI) 2023? - 111
- ❖ After carbon dioxide, which greenhouse gas is the second largest contributor to climate change? - Methane
- ❖ Where is International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) headquartered? - Hyderabad

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