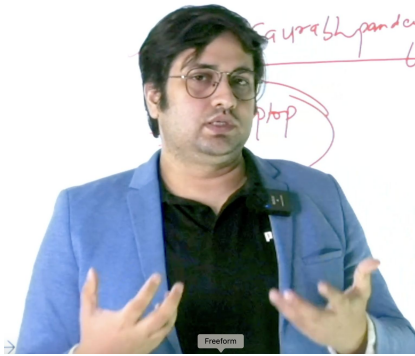
Topics - MINDS MAPS included (Daily current affairs)-- 11th October 2024

- Banni Festival
- Aurora
- Precision Medicine:
- Monte Carlo
- Gold Mining in Ghana
- Quad Meeting
- Right to Information (RTI) Act:
- X-band Radar



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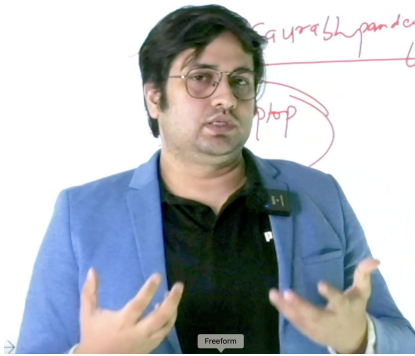
Topics - MINDS MAPS included (Daily current affairs)-- 14th October 2024

- NCP Symbol Dispute
- What are hurricanes?
- Bacteriophage
- Oropouche Virus (OROV)
- Antarctica WARMING
- Nobel Prize in Medicine: Discovery of MicroRNA
- Nobel Prize 2024: Celebrating Pioneers in Artificial Neural Networks
- Nobel Prize in Chemistry 2024: Advancements in Protein Research
-



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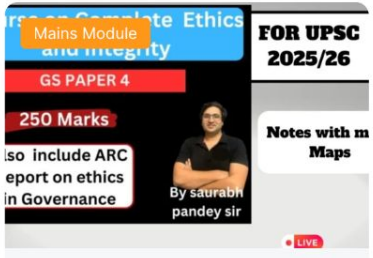

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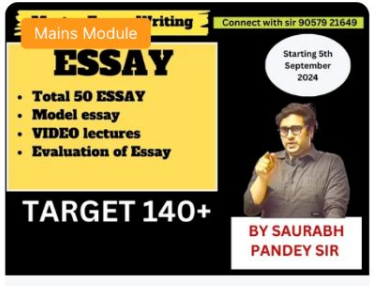

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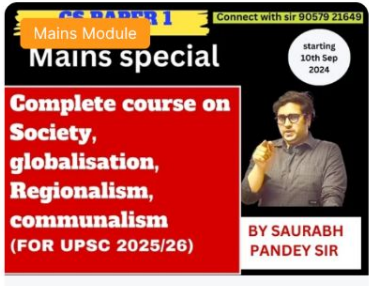

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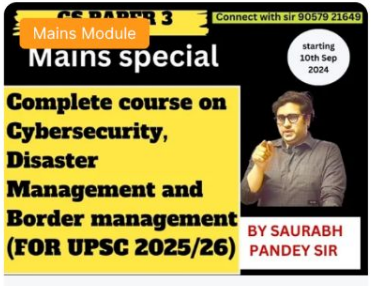

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Nearly 60 injured during Banni festival in A.P. village

The Hindu Bureau
KURNOOL

Nearly 60 persons were injured in the annual Banni festival organised at Devaragattu in Kurnool district on Saturday.

Popularly known as '*karrela samaram*', the festival involves a clash between stick-wielding people from 10 villages during a procession of the deities of Mala Malleswara Swamy on the night of Dasara. The traditional stick fight had been going on for hundreds of years.

Nearly four lakh people from Andhra Pradesh, Karnataka and Telangana thronged Devaragattu to watch the fete.

Nearly 8,000 people clashed with one another

Topic→ Banni Festival

Overview

Cultural Significance: Traditional celebration in Kurnool, Andhra Pradesh.

Activities: Stick fighting, community gatherings, and rituals.

Ladakh aurorae validate space weather tracking, scientists say

Press Trust of India
LADAKH

Solar signal: A rare red-coloured aurora was observed over the Hanle Dark Sky Reserve in Ladakh on May 11. PTI

Ladakh's recent sightings of aurora, marked by reddish or greenish light in the night sky and usually observed in the far-northern regions, is a validation of efforts in space weather monitoring, a team of astrophysicists that predicted the activity about 48-72 hours prior said.

The appearance of intense red-hued rays of light on the night of October 10-11 was the latest in a series of recent auroral sightings. Previous ones occurred on May 11 this year, and in November and May 2023.

All sky cameras operated by the Bengaluru-based Indian Institute of Astrophysics at Hanle and Merak in Ladakh captured the aurorae throughout the night.

Dibyendu Nandi, head of the Centre of Excellence in Space Sciences India (CESSI) at the Indian Institutes of Science Education and Research Kolkata, said, "The aurora sightings are a validation that we are on the right track. It boosts our confidence to predict extreme weather events in space that can potentially endanger all kinds of satellite-based services on the earth, bringing modern society to a standstill."

While aurorae are known for their scenic beauty, their occurrence in lower-latitude regions such as Ladakh is an indication of heightened solar activity in the form of solar storms, known as coronal mass ejections (CMEs), Mr. Nandi said.

Solar storms periodically occur as the sun's internal dynamo, which creates its magnetic field, intensifies and weakens. This activity cycle typically lasts 11 years.

In 2018, a CESSI team that included Mr. Nandi predicted the current solar activity cycle would peak in 2024.

Aurorae are a common sight in the planet's far-north, in countries near or within the Arctic Circle.

Topic→ Aurora

🌌 **Aurora Sightings:** Recent auroral sightings in Ladakh featured reddish and greenish lights, validating space weather monitoring efforts.

📅 **Recent Events:** The latest aurora appeared on October 10-11, following previous sightings in May and November 2023.

📷 **Monitoring Technology:** All-sky cameras from the Indian Institute of Astrophysics in Bengaluru captured the auroras throughout the night.

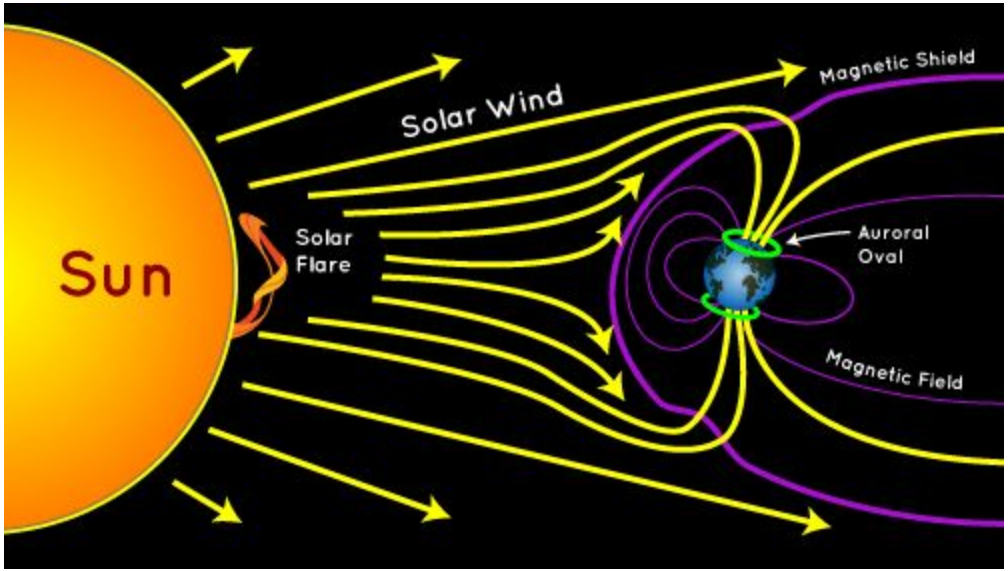
🔭 **Expert Validation:** Dibyendu Nandi from CESSI stated that these sightings boost confidence in predicting extreme space weather events that could disrupt satellite services.

☀️ **Solar Activity:** The occurrence of auroras in lower-latitude regions like Ladakh indicates heightened solar activity, particularly from coronal mass ejections (CMEs).

🔄 **Solar Cycle:** The sun's activity cycle, which affects aurora occurrences, typically lasts 11 years, with predictions indicating a peak in 2024.

🌍 **Geographical Context:** Auroras are typically seen in far-northern regions, near or within the Arctic Circle, making their appearance in Ladakh notable.

Summary: Recent auroral sightings in Ladakh validate space weather monitoring efforts and indicate heightened solar activity, with predictions of a peak solar cycle in 2024


Sun
Solar Wind
Solar Flare
Magnetic Shield
Auroral Oval
Magnetic Field

Solar Phenomena and Auroras

Overview of Solar Activity

☀️ The Sun emits heat, light, and energy along with small particles.
🛡️ Earth's magnetic field acts as a shield, protecting us from most of the Sun's energy and particles.
🌪️ Solar activity includes a constant solar wind and occasional solar storms like coronal mass ejections.

Coronal Mass Ejections and Their Impact

🌌 Coronal mass ejections release large bubbles of electrified gas traveling at high speeds through space.
🌈 When these solar storms reach Earth, particles can enter the atmosphere at the poles, creating stunning auroras.

Auroras Across the Solar System

🌍 Auroras are not exclusive to Earth; they can occur on any planet with an atmosphere and magnetic field, such as Jupiter and Saturn.

🎨 Different gases in Earth's atmosphere produce various colors in auroras: oxygen emits green and red, while nitrogen glows blue and purple.

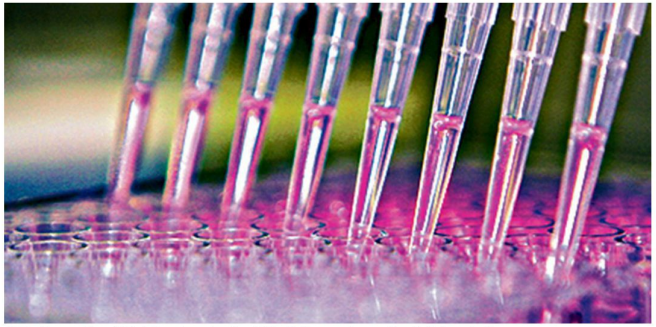
Summary

The Sun's energy and particles, influenced by solar storms, create beautiful auroras on Earth and other planets with atmospheres and magnetic fields.

Why precision medicine in India can't advance without biobank laws

A biobank is a repository of biological samples alongside their genetic data. These samples are collected from consenting individuals for use in research. For precision medicine to succeed, biobanks need to be large and diverse or only a small section of society will benefit from the findings of research

Manjeera Gowravaram



A biobank is a repository of biological samples, such as blood, DNA, cells, tissues, and organs, alongside their genetic data. GETTY IMAGES/ISTOCKPHOTO

THE GIST

Gene editing and mRNA also contribute to precision medicine. Researchers were able to restore vision using gene therapy. In the U.K., an individual's diabetes was reversed by transplanting reengineered stem cells

India's rulebook has many gaps. Participants do not know how data will be used, who will have access, for how long they will be stored, and when they will be used. Pharmaceutical companies, including those abroad, will have access to samples from India

Strong data and privacy protections will encourage more people to share samples and participate without worry. It will also allow research to happen on the right foundations instead of the findings becoming the fruits of a poisoned tree

Precision medicine is bringing in a new era of personalised healthcare. The field began to take concrete shape when scientists were wrapping up the Human Genome Project. Since then, genomics has played a major role in the diagnosis and treatment of various cancers, chronic diseases, and immunological, cardiovascular, and liver diseases.

Other emerging technologies, such as gene editing and mRNA therapeutics, also contribute to precision medicine. In a recent success story, researchers were able to restore vision in people who had lost it due to a genetic mutation using gene therapy. In a more recent and more notable example, researchers in the U.K. reversed an individual's diabetes by transplanting reengineered stem cells. During the COVID-19 pandemic, researchers were able to use the mRNA platform to develop new vaccines in record time, winning the technology a Nobel Prize last year.

Organ-on-chips is another area that promises precision medical solutions. These small microfluidic devices containing human cells can replicate the microenvironment of a tumour or an organ in a laboratory setting. They are expected to allow researchers to test drugs in settings more similar to the drugs' eventual users.

Precision medicine in India

The Indian precision medicine market is estimated to be growing at a CAGR of 16% and is expected to be worth more than $5 billion by 2030, according to industry estimates.

Currently, it contributes 36% of the national bioeconomy, alongside cancer immunotherapy, gene editing, biologics, etc. The development of precision therapeutics is also part of the new 'BioE3' policy.

In October 2023, the Central Drugs Standard Control Organization approved NexCAR19, India's domestically developed CAR-T cell therapy, and earlier this year the government opened a dedicated centre for it. Recently, the Apollo Cancer Centre and a collaboration between Siemens Healthineers and the Indian Institute of Science, Bengaluru, opened new facilities to deploy artificial intelligence for precision medicine.

Biobanks in precision medicine

A biobank is a repository of biological samples, such as blood, DNA, cells, tissues, and/or organs, alongside their genetic data. These samples are collected from consenting individuals and intended for use in research. For precision medicine to succeed, biobanks need to be large and diverse. Otherwise, only a small section of society will benefit from the findings of precision medicine.

Recently, researchers identified people with an undiagnosed rare genetic disorder using data from a biobank and comparing it to people who were already diagnosed with it. Their findings were published in *Nature Communications* on August 29.

In another study published in *Cell* on October 3, health researchers created the largest biobank of sarcoma patient-derived organoids to date. Organoids are miniaturised, synthetic versions of organs that can replicate tumours; the researchers used it to understand the sarcoma and identify potential therapies using high-throughput drug screening.

Biobanks in India

There are 19 registered biobanks in India that host many biological specimens, including cancer cell lines and tissues. Earlier this year, the 'Genome India' programme finished sequencing 10,000 genomes from 99 ethnic groups to identify treatments for rare genetic diseases, among others.

The pan-India 'Phenome India' project has collected 10,000 samples to create better prediction models for cardio-metabolic diseases. The Paediatric Rare Genetic Disorders (PRaGeD) mission could help identify new genes or variants to develop targeted therapies for genetic diseases that affect children.

However, biobank regulations in India are a significant hurdle to realising the full potential of precision medicine.

The Indian precision medicine market is estimated to be growing at a CAGR of 16% and is expected to be worth more than $5 billion by 2030, according to industry estimates

India's biobanking regulations

The U.K., the U.S., Japan, China, and many European countries have laws or comprehensive regulations that address several biobanking issues, including informed consent, withdrawal rights, privacy, and data protection. At present, India's regulation of biobanks is inconsistent, with gaps that could undermine public trust and limit the potential of precision medicine. In particular, there is no law to protect the rights of individuals.

The Indian Council for Medical Research handbook on 'National Ethical Guidelines For Biomedical And Health Research Involving Human Participants' and the Department of Biotechnology's (DBT) practices for data storage and analysis have many gaps. For instance, participants are expected to consent to providing samples without knowing how their data will be used, who will have access to it, for how long they will be stored, and when they will be used. Genetic information can provide details about a person, including their family, that also could result in discrimination.

Next, in the absence of a single authority to regulate biobanks and no penalty for misconduct, the risk of inconsistencies arising from sample mishandling and ethical violations like data or sample sharing for non-consenting purposes is nontrivial.

Without proper regulations, many pharmaceutical companies, including those abroad, will have access to samples from India. Research projects often require researchers and pharmaceutical companies to collaborate with biobanks during drug discovery and development.

In the absence of an overarching law, Indians could be deprived of the ownership of biological samples and/or the data thereof and the profits from the resulting research findings.

A leadership opportunity

Taken together, strong data and privacy protections and regulatory oversight by an expert committee will encourage more people to share samples and participate without worry. It will also allow research to happen on the right foundations instead of the findings becoming the fruits of a poisoned tree.

India is a part of international groups like the Quad and BRICS, and an important plank of its soft diplomatic efforts has been pharmaceuticals. It is a major supplier of generic drugs and is a hub of vaccine manufacturing, and it has plans to expand leadership to include next-generation therapeutics. To do this, it will have to align its biobanking laws with global standards to encourage public participation and trust.

(Manjeera Gowravaram has a PhD in RNA biochemistry and is a freelance science writer. gmanjeera@gmail.com)

Topic→ Precision Medicine: A New Era of Personalized Healthcare

Overview

Precision Medicine: Tailoring medical treatment to individual characteristics.

Key Technologies: Genomics, gene editing, mRNA therapeutics.

Importance of the Human Genome Project

Laid the foundation for genomics.

Enabled targeted diagnosis and treatment.

Role of Genomics

Major impact on:

- Cancers 🎗️
- Chronic diseases
- Immunological disorders
- Cardiovascular diseases ❤️

Emerging Technologies

Gene Editing: Corrects genetic mutations.

mRNA Therapeutics: Used in rapid vaccine development.

Success Stories

Gene Therapy: Restoring vision via genetic mutation correction.

Stem Cell Transplantation: Reversing diabetes in individuals.

Recent Advances

COVID-19 Vaccines: Developed rapidly using mRNA technology, awarded Nobel Prize 🏆.

Organ-on-Chips Technology

Microfluidic Devices: Mimic human organs for drug testing.

Benefits: More accurate predictions of drug efficacy.

🧬 **Definition of Biobank:** A biobank is a repository for biological samples (blood, DNA, cells, tissues, organs) and their genetic data, collected from consenting individuals for research purposes.

🌍 **Importance of Diversity:** For precision medicine to be effective, biobanks must be large and diverse to ensure benefits extend beyond a small section of society.

🔍 **Recent Research Findings:** Researchers recently identified individuals with an undiagnosed rare genetic disorder using biobank data, comparing it to diagnosed cases, with findings published in *Nature Communications* on August 29

🔗 **Role in Precision Medicine:** Biobanks play a crucial role in advancing precision medicine by providing essential data for research and therapy development.

Monte Carlo method: random to real

Vasudevan Mukunth

The Monte Carlo method is a type of algorithm that reveals a distribution by randomly sampling its elements again and again. For example, say there are 40 red marbles, 20 green marbles, 25 orange marbles, and 15 blue marbles in a bag. The bag is opaque and has a narrow opening; you dip your hand inside and pick up five marbles at random, note down their colours, and put them back. The Monte Carlo method is based on the idea that by repeating this process over and over again, you will develop a better idea of the marbles' colour distribution. The more times you randomly sample the marbles, the better your estimate.

Monte Carlo methods are frequently used to estimate the odds of an event occurring when doing so by other means is too difficult. If a sample is very complicated — e.g. the billions of particles produced during an experiment at the Large Hadron Collider — a Monte Carlo algorithm itself will require a lot of computing power. But its great advantage is that computers can sample and record multiple samples in parallel, keeping the power demand lower than other methods.

The method is named for a casino in Monaco, where Polish physicist Stanislaw Ulam was inspired by the way his uncle gambled to come up with the idea.
JONATHAN PETERSSON/UNSPLASH

Such algorithms have applications in aerodynamics, power plant design, quantum mechanics, several areas of engineering, computer graphics, artificial intelligence models, and risk-estimating in finance. The method is named for a casino in Monaco, where Polish physicist Stanislaw Ulam was inspired by the way his uncle gambled to come up with the idea.

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Topic→ Monte Carlo

🎲 Definition: The Monte Carlo method is an algorithm that estimates distributions by repeatedly sampling elements randomly.
🎨 Example: In a bag with marbles of different colors, repeatedly drawing and recording colors helps estimate their distribution.
🔄 Repetition: The accuracy of the Monte Carlo method improves with the number of samples taken.
💻 Computational Power: Monte Carlo methods can handle complex samples, like those from the Large Hadron Collider, using significant computing power but allowing parallel processing.

🌍 Applications: This method is used in various fields, including aerodynamics, power plant design, quantum mechanics, engineering, computer graphics, AI, and finance.

🎰 **Origin:** The method is named after a casino in Monaco, inspired by physicist Stanislaw Ulam's uncle's gambling habits.

⚖️ **Advantage:** The main advantage of Monte Carlo methods is their ability to estimate probabilities in complex scenarios where traditional methods are impractical.

Summary: The Monte Carlo method is a versatile algorithm for estimating distributions through repeated random sampling, with applications across various scientific and engineering fields.

An artisanal miner searches for gold using a metal detector at an illegal mining site in the Prestea-Huni Valley Municipal District, Western Region, Ghana, in August this year. Hundreds of people marched through Ghana's capital, Accra, on Friday in a peaceful protest against unlicensed gold mining, known locally as "galamsey," calling on authorities to act against the dangerous and environmentally damaging practice. REUTERS

Topic→Gold Mining in Ghana

- Ghana is Africa’s largest gold producer 🌍
- Significant contributor to the country's economy 💰
- Challenges include illegal mining and environmental issues ⚠️
- unlicensed gold mining, known locally as "galamsey,

China, India and New Delhi's Quad dilemma

M.K. Narayanan

a former Director, Intelligence Bureau, a former National Security Adviser, and a former Governor of West Bengal

In September this year, the Prime Minister Narendra Modi visited the United States to attend yet another meeting of the Quad nations (Australia, India, Japan and the U.S.). This turned out to be possibly the most significant meeting of the Quad to date, during which the quartet seemed to firm up what may be viewed as a security alliance.

The 'Wilmington Declaration' did not mention any country, least of all China by name, but left nothing to the imagination that it was aimed at the containment of China across the entire Indo-Pacific. Despite the absence of any reference to a formal mutual defence declaration, it was obvious that the "four maritime democracies" had a single objective, *viz.*, to checkmate China.

The state of India-China ties

The message from the Wilmington Declaration has certain overriding implications for India and India's security. India-China relations today are not merely stalemated but are also steadily deteriorating. In the northern border regions, the stalemate in the Galwan region continues despite some soothing statements by India's military and civilian leaders. Recently, India announced that it will maintain, if not increase, its vigilance in the border areas by inducting more forces despite the onset of winter. In the Depsang Plains and Demchok, there has been no breakthrough in negotiations regarding disengagement. In Ladakh alone, the number of 'friction points' has increased, with Indian forces unable to access several 'patrolling points' that they were previously accustomed to.

The military is currently in the process of further augmenting its fighting capabilities across the entire length of the China-India border. It is inducting new long-range firearms and heavy artillery, and has begun to deploy howitzers, missiles, rocket systems and 'loitering munitions'. While the Indian Army Chief has characterised the current situation along the Line of Actual Control as 'stable and sensitive', he has also stated that the Indian armed forces "are operational and fully prepared to deal with any contingency". While strengthening its border capabilities, China appears unfazed by India's moves, confident that given its defence budget (which dwarfs that of India), it can thwart any new Indian initiative.

China's arrogance, misplaced or otherwise, is legendary. It is again true that China greatly depends on the element of surprise to achieve the best results for itself. Hence, while it may look unfazed at this time by talk by India acquiring 'new alliance partners' from the West, China is unlikely to take such a situation lightly. Dealing with China is never a 'zero sum game', and India's leaders need to be wary and watchful of how China reacts to the developing situation. What is again worrying is that China under Xi Jinping seems increasingly willing in most situations to test the waters *vis-à-vis* its neighbours, including India.

It would be prudent for India to proceed with care in its dealings with China on the one hand and with its Quad partners on the other

An aggressive nationalism

It may, thus, be prudent for India to proceed with care in its dealings with China on the one hand, and with its Quad partners on the other. In the short term, it may be expedient not to be seen to align with countries that have openly declared their hostility to China, for Xi Jinping's China is almost certain to treat this as a provocation, compelling it to 'walk the talk'. In this context, it is worth recalling that as far back as 2017, Mr. Xi had ominously declared that 'China under Xi was different from China under Deng'. In 2021, the centenary year of the Chinese Communist Party (CPC), Mr. Xi had again made a series of pronouncements which included a stern warning to all external forces "seeking to bully, oppress or subjugate China". In 2022, in the course of the 20th National Congress of the CPC, statements made by China's leaders appeared to reveal an increasingly aggressive brand of Chinese nationalism. Rationality is not something to be expected of China in any situation. India must not overlook this aspect, and should 'read the tea leaves' correctly in its dealings with China.

Over the years, India's strategic experts had sought to differentiate between what in the Chinese mind constitutes a 'real' threat as distinct from peripheral dangers that haunt the Chinese psyche. From China's postures it can be inferred that the border issue with India in the Himalayas does not represent a real threat to China's sovereignty and to its future. This is notwithstanding that from the early 1950s, China has made territorial claims on several thousand square kilometres of Indian territory, in Ladakh and in Arunachal Pradesh. China is well aware that its claims here were based on maps that were at best 'non-official', created during predecessors' regimes. China itself tends to doubt their sanctity though it is not willing to give up its claims.

The situation existing as far as China's eastern seaboard is concerned, as also its claims in the Pacific to its east, fall into an entirely different category. Here, any attempt to tamper with what China believes is its territory, constitutes in its mind a real threat to China's very existence. Understanding the difference is important as far as the Chinese psyche is concerned.

India's strategic community has understood this for a long time and has dealt with China's quirky behaviour in a nuanced manner over the years. Lately, however, India does seem to have shifted its stance to an extent and it is possible that the Chinese read this as an outcome of India's growing alignment with the West, specifically with the U.S. Recent overtures by China, including statements of the Chinese Defence Ministry that China and India have been able to 'reduce differences and build some consensus' on disengaging troops from friction points to end the stand-off in eastern Ladakh, and have also agreed to a dialogue to reach a resolution acceptable to both sides, could well signal a shift in China's approach, but India does not seem to take this seriously.

Beijing's view

All this serves as a backdrop to China's increasing concerns over India's association with the Quad – seen by it as a U.S.-sponsored 'coalition of the willing'. Rumblings from China have grown stronger of late. To the fevered Chinese mind of today, India's membership of the Quad represents a far more serious threat to it than the occasional skirmishes on the Himalayan heights. The Wilmington Declaration, having given up any pretence that the Quad is not a defence alliance, could well be seen by China as an indication of a grand design by the U.S. and its enemies to encircle and contain China. With this, China's understanding of the threat posed by India will increase significantly.

India must take due care not to send out any wrong signals, as the consequences of this could be serious. Any resort to confrontational politics, in substance and as well as in style, can have adverse repercussions in the India-China context. History may not repeat itself, but as Mark Twain is reported to have said, "it rhymes" enough to make one uneasy. India must not, and need not, subscribe to Mr. Xi's notion of a 'community of shared future of mankind' (first mentioned almost a decade ago), but India must not also be seen to subscribe to the West's entrenched belief that China's rise is inimical to the future of mankind, and that nations across the globe should join together to post a challenge to it.

In the context of China, it would, hence, be prudent for India not to be seen to be increasing its security congruence with the U.S. and the West. Clearly, India has no intention of being part of any pincer movement directed at China and its future ambitions, but it is equally important that China understands this – and the world recognises this as well – and has no reason to doubt where India stands in terms of Asian and world security. Any impression that India has become part of the U.S. bandwagon, engaged in checkmating China's ambitions is best avoided. India's future is hardly dependent on checkmating China's ambitions or in aiding any U.S. attempts to prevent this from becoming a reality.

Topic→Quad Meeting and Geopolitical Dynamics

Prime Minister Modi's Visit 🇮🇳

Event: In September 2023, PM Narendra Modi participated in a crucial Quad meeting in the U.S.
Participants: Australia, India, Japan, and the U.S.

Wilmington Declaration 🛡️

Outcome: The Quad nations released the 'Wilmington Declaration'.
Purpose: Implicitly aimed at containing China's influence in the Indo-Pacific region.

Deteriorating India-China Relations ⚔️

Current Status: Relations between India and China are worsening.
Conflict Zones: Ongoing stalemates in border regions like Galwan and increased tensions in Ladakh.

Military Preparedness 🚧

India's Actions: Enhancing military capabilities along the China-India border.
Upgrades: Induction of long-range firearms, heavy artillery, and advanced munitions.

China's Confidence 🔍

Defense Budget: China remains confident due to its larger defense budget.
Strategic Response: Likely to respond strategically to India's alliances.

Need for Vigilance ⚠️

India's Strategy: Leaders must remain cautious and observant of China's reactions.
China's Tactics: Known for unpredictable strategies.

Geopolitical Implications 🌏

Regional Security: The Quad's actions and India's military enhancements indicate a shift in regional security dynamics.
China's Assertiveness: Particularly concerning China's assertive behavior.

Key Aspects of India-China Relations

🇮🇳 Cautious Diplomacy: India should approach its relations with China and Quad partners carefully to avoid provoking China.

🐉 Xi Jinping's Nationalism: Xi Jinping has signaled a shift towards aggressive nationalism in China, contrasting with previous leadership under Deng Xiaoping.

🗺️ Border Claims: China has longstanding territorial claims over parts of India, but these are not viewed as existential threats by China.

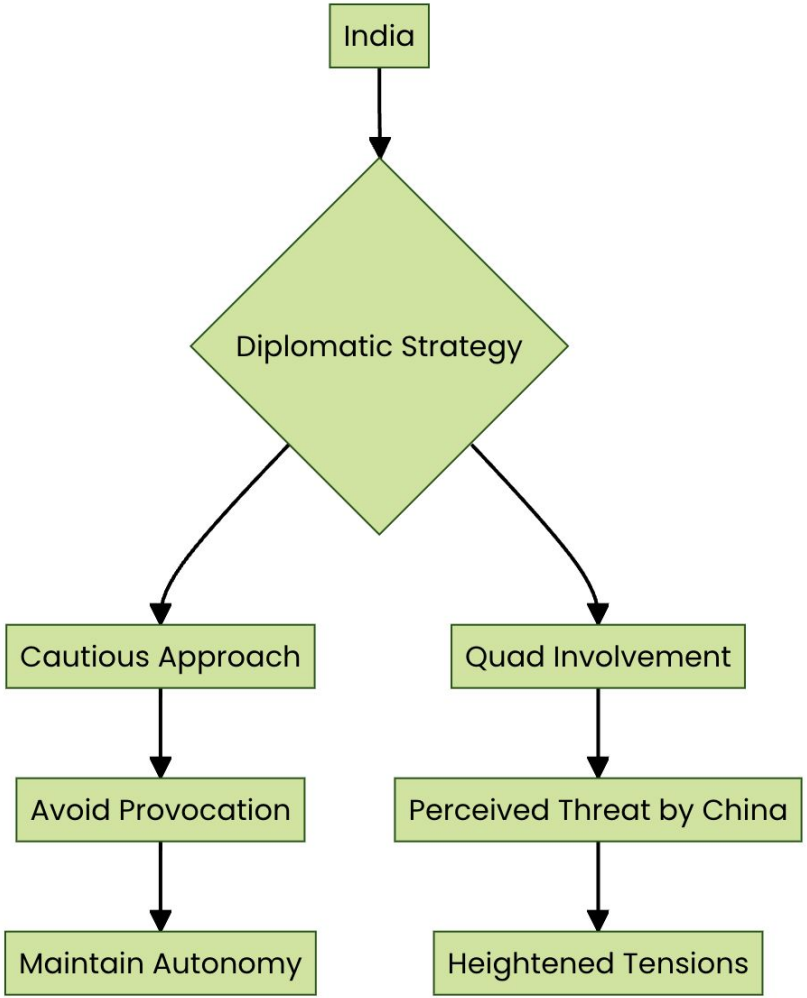
🌏 Quad Concerns: China's perception of India’s involvement in the Quad as a U.S.-led coalition heightens its sense of threat, more so than border skirmishes.

⚖️ Strategic Nuance: India’s strategic community has historically understood and navigated China's complex psyche, but recent shifts may be misinterpreted by China.

🚫 Avoiding Misinterpretation: India must avoid sending signals that could be construed as alignment with the West against China to prevent escalating tensions.

🔄 Future Relations: India’s future should not hinge on countering China’s ambitions or supporting U.S. strategies against it.

Strategic Dynamics.



Scuttling people's right to information

Anjali Bhardwaj

Transparency activist associated with the Satark Nagrik Sangathan and the National Campaign for the Peoples' Right to Information

Amrita Johri

Transparency activist associated with the Satark Nagrik Sangathan and the National Campaign for the Peoples' Right to Information

The Right to Information (RTI) Act, 2005, has been one of the most empowering laws for Indians. From exposing corruption in the delivery of basic rights to bringing to light the truth behind the opaque electoral bonds scheme, the law has been used by citizens to hold power to account. Therefore, it is no surprise that there is a severe backlash against both the legislation, which has just entered its 20th year, and those who use it.

Vacant posts

Governments are scuttling the RTI Act by not appointing information commissioners and allowing the commissions to crumble under the weight of mounting backlogs. A 2023-24 report of the Satark Nagrik Sangathan, a citizens group that campaigns for transparency in government functioning, shows that seven out of 29 information commissions were defunct for varying periods of time last year. The commission of Jharkhand has not been functional for over four years, while those of Tripura and Telangana have been defunct for three years and one and a half years, respectively.

Many information commissions were found to be functioning without an adequate number of commissioners, despite large backlogs. The information commission of Maharashtra, with a backlog more than 1 lakh appeals and complaints, is headless. Six out of 11 posts of commissioners are lying vacant. Since May 2015, not a single information commissioner has been appointed to the Central Information Commission by the Central government without citizens having to approach courts. Despite repeated directions by the Supreme Court, eight out of 11 posts are vacant in the Central Information Commission.

Under the RTI Act, information commissions are the final appellate authority and are mandated to safeguard and facilitate people's right to information. They have wide-ranging powers, including the power of direct disclosure of information which the government finds inconvenient. It is because adequate information commissioners have not been appointed that more than 4 lakh appeals and complaints are pending in information commissions across India. The report shows that it would take more than a year for an appeal or complaint to be disposed in 14 commissions. A fresh appeal filed in Chhattisgarh or Bihar would be disposed only in 2029. While hearing a petition regarding vacancies in information commissions across India, in 2023, the Supreme Court noted that the failure to fill vacancies is leading to a situation where "the right to information which is recognised under an Act of Parliament becomes a dead letter."

There is a severe backlash against the RTI Act, which has just entered its 20th year, and those who use it

Even when appointments are made, a majority of the appointees are either retired government officials or people who enjoy political patronage. They are often reluctant to act against violations of the transparency law. The report shows that commissions did not impose penalties in 95% of the cases where penalties could be imposed. This failure sends a signal that violating the law will not invite serious consequences. This destroys the basic framework of incentives and disincentives built into the RTI Act, promotes a culture of impunity, and exasperates applicants who seek information at a high cost and often against great odds. The laxity in enforcing accountability allows information officers to take liberties with the RTI Act, leading to many unanswered applications and an equal number of delayed or illegitimately refused ones.

Regressive amendments

In the last five years, there have also been regressive amendments to the RTI Act. In 2019, despite strong objections from civil society and Opposition parties, the government brought amendments which dealt a blow to the autonomy of information commissions by empowering the Central government to determine the tenure, salaries, pensions and post-retirement entitlements of all information commissioners.

The Digital Personal Data Protection (DPDP) Act, 2023, included an explicit provision to amend the RTI law to exempt all personal information from disclosure. The RTI Act of 2005 provided for protection of the privacy of individuals through section 8(1)(j). In order to invoke this section to deny personal information, at least one of the following grounds had to be proven: information sought had no relationship to any public activity or public interest; or information sought was such that it would cause unwarranted invasion of privacy, and the information officer was satisfied that there is no larger public interest that justified disclosure. The DPDP Act amended section 8(1)(j) to expand its purview and exempt all personal information from the ambit of the RTI Act. It also deleted a key provision in the law, which gave citizens a right to information at par with Members of Parliament and Members of Legislative Assemblies.

According to Transparency International India data, nearly 100 people have been killed for using the RTI Act, and thousands have been assaulted, threatened, and slapped with false cases. Though the Whistleblowers Protection Act was passed in 2014, it remains confined to the statute books as the Central government has failed to formulate rules to operationalise it. Every year, some 6 million information applications are filed in India. Evidence shows that the RTI law has initiated the vital task of redistributing power in a democratic framework and transforming the relationship between the government and citizens. An erosion of this fundamental right is an erosion of democracy.

Topic→Right to Information (RTI) Act: Challenges and Impact

Empowering Legislation

📜 The Right to Information (RTI) Act, enacted in 2005, empowers Indian citizens to hold the government accountable and expose corruption.

Backlog Crisis

🏛️ Defunct Information Commissions: Many commissions are either non-functional or understaffed.
Over 4 lakh pending appeals and complaints across India.

Lack of Accountability

🚫 Impunity Culture: Despite potential penalties, 95% of cases are not acted upon, fostering impunity among information officers.

Supreme Court Intervention

⚖️ Highlighting Vacancies: The Supreme Court notes that unfilled vacancies undermine the RTI Act's effectiveness, making it nearly useless.

Regressive Amendments

🔄 Weakened Autonomy: Recent amendments have reduced the autonomy of information commissions.

Expanded Exemptions: More personal information is now exempt, limiting access.

Threats to RTI Users

🛡️ Safety Concerns: Nearly 100 RTI users have been killed, with many facing threats and false accusations, as per Transparency International India.

Impact on Democracy

📈 Redistributing Power: The RTI Act enhances democratic engagement.
Erosion Threat: Its weakening poses a significant threat to democracy in India.

Summary: The RTI Act, while empowering citizens, faces severe challenges due to backlogs, lack of accountability, regressive amendments, and threats to users, jeopardizing its role in democracy.

What is Wayanad's new X-band radar?

What is a Doppler radar and how does it work? Why does Wayanad need an X-band radar? Where and when was the first indigenously designed and manufactured X-band installed? Is India increasing the procurement and instalment of radars?

EXPLAINER

Priyali Prakash

The story so far:

After devastating floods and landslides killed more than 200 people in Kerala's Wayanad district in July 2024, the Union Ministry of Earth Sciences approved an X-band radar to be installed in the district. A torrential downpour triggered the landslide in the valley above Punchirimattom, near the Mundakkai region; its effects were compounded by a massive debris flow triggered by the rains.

How do radars work?

Radar is short for 'radio detection and ranging'. The device uses radio waves to determine the distance, velocity, and physical characteristics of objects around the device. A transmitter emits a signal aimed at an object whose characteristics are to be ascertained (in meteorology, this could be a cloud). A part of the emitted signal is echoed by the object back to the device, where a receiver tracks and analyses it.

Weather radar, also known as a Doppler radar, is a common application of this device. The Doppler effect is the change in frequency of sound waves as their source moves towards and away from a listener. In meteorology, Doppler radars can reveal how fast a cloud is moving and in which direction based on how the cloud's relative motion changes the frequency of the radiation striking it.

A pulse-Doppler radar can measure the intensity of, say, rainfall by emitting radiation in pulses and tracking how often they're reflected to the receiver.

This way, modern Doppler radars can monitor weather conditions and anticipate new wind patterns, the formation of storms, etc.

What is an X-band radar?

Doppler radar relies on Rayleigh scattering, when the scatterer is much smaller than the wavelength of the radiation. A radar trying to 'see' smaller particles like rain droplets or fog will need to use radiation of lower wavelengths, like in the X-band. An X-band radar is radar that emits radiation in the X-band of the electromagnetic spectrum: 8-12 GHz, corresponding to wavelengths of around 2-4 cm (this is in the microwave part of the spectrum.)

The smaller wavelengths allow the radar to produce images of higher resolution. However, the greater the frequency of some radiation, the faster it will be attenuated. So X-band radars have a relatively shorter range.

Weather blues: The complex housing an S-Band Doppler Weather Radar at the Meteorological Centre in Begumpet, Hyderabad. FILE PHOTO

In Wayanad, the new radar is expected to be able to monitor the movements of particles, such as soil, to inform landslide warnings. The device will also perform high temporal sampling, that is, rapidly sample its environs, allowing it to spot particle movements happening in shorter spans of time.

How many radars does India have?

The India Meteorological Department (IMD) started using radar for weather applications in the early 1950s. The first indigenously designed and manufactured X-band storm detection radar was installed in 1970 in New Delhi. In 1996, IMD replaced 10 outdated X-band radars with digital X-band radars.

In its X-band radar network, India has both wind-finding and storm-detecting radars, and some with dual capabilities. The country also uses S-band radars (2-4 GHz) for long-range detection. The first S-band cyclone detection radar was installed in Visakhapatnam in 1970 and the first locally made variant was commissioned in Mumbai in 1980.

In September 2024, the Ministry of Earth Sciences said India is set to have 56 additional Doppler radars in a few years. On September 11, the Union Cabinet cleared the ₹2,000-crore 'Mission Mausam' to upgrade meteorological infrastructure in the country. This includes installing up to 60 meteorological radars until 2026 under the Mission's first phase.

Minister of State for Earth Sciences Jitendra Pradhan said in August in Parliament that the government has started the process to procure and install 10 X-band Doppler radars to improve weather forecasting in the northeast States and in Himachal Pradesh's Lahaul and Spiti district.

The initiative to install an X-band radar in Wayanad included installing a C-band radar (4-8 GHz) with an observational range of 250 km in Mangaluru.

What is NISAR?

NASA and the Indian Space Research Organisation (ISRO) are currently developing a satellite called NISAR, short for 'NASA-ISRO Synthetic Aperture Radar'. It will use radar imaging to produce a high-resolution map of the earth's landmasses.

Its payload consists of an L-band radar (1.25 GHz, 24 cm) built by NASA and an S-band radar (3.2 GHz, 9.3 cm) built by ISRO. Together they will track and record changes in the earth's various natural processes.

It is currently expected to be launched onboard an ISRO GSLV Mk II rocket in 2025, at a total cost of $1.5 billion, the bulk of it borne by NASA.

THE GIST

- Radar is short for 'radio detection and ranging'. The device uses radio waves to determine the distance, velocity, and physical characteristics of objects around the device.
- The India Meteorological Department (IMD) started using radar for weather applications in the early 1950s. The first indigenously designed and manufactured X-band storm detection radar was installed in 1970 in New Delhi.
- The initiative to install an X-band radar in Wayanad included installing a C-band radar (4-8 GHz) with an observational range of 250 km in Mangaluru.

Topic→ X-band Radar Installation in Wayanad, Kerala

Overview of Recent Events

🌧️ Devastating Floods and Landslides: In July 2024, Kerala's Wayanad district experienced severe floods and landslides, resulting in over 200 fatalities.
📡 X-band Radar Installation: The Union Ministry of Earth Sciences has approved the installation of an X-band radar in Wayanad to enhance environmental monitoring.

Radar Functionality

Definition: Radar stands for 'radio detection and ranging.'
Purpose: Utilizes radio waves to measure distance, velocity, and characteristics of objects.

🌧️ Weather Radar

Type: Doppler radar is commonly used in meteorology.
Function: Tracks cloud movement and predicts weather patterns.

🎶 Doppler Effect

Description: Change in frequency of waves as the source moves relative to the observer.
Importance: Crucial for determining cloud speed and direction.

🌧️ Pulse-Doppler Radar

Measurement: Measures rainfall intensity.
Method: Emits pulses and analyzes the frequency of their reflections.

📏 X-Band Radar

Frequency: Operates at 8-12 GHz.

Capability: High-resolution imaging of smaller particles like rain droplets.

Limitation: Shorter range due to higher frequency.

🌍 Application in Wayanad

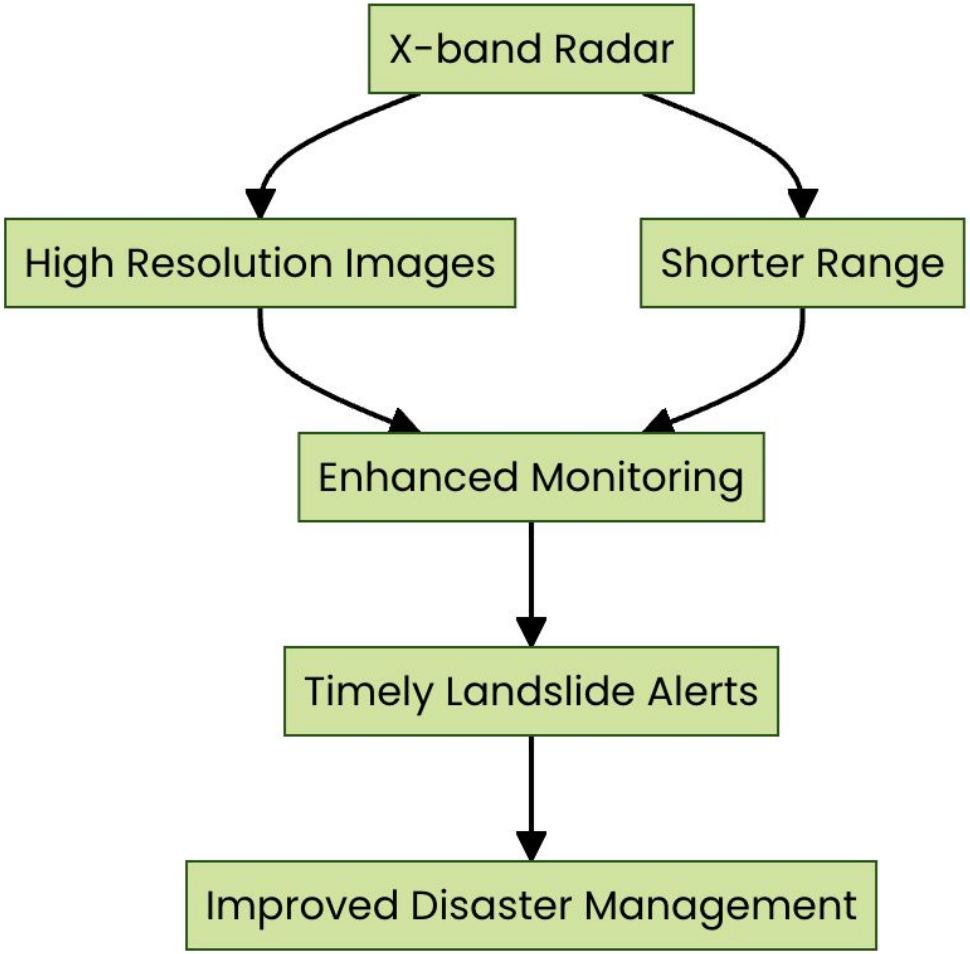
Purpose: Monitors soil particle movements for landslide warnings.

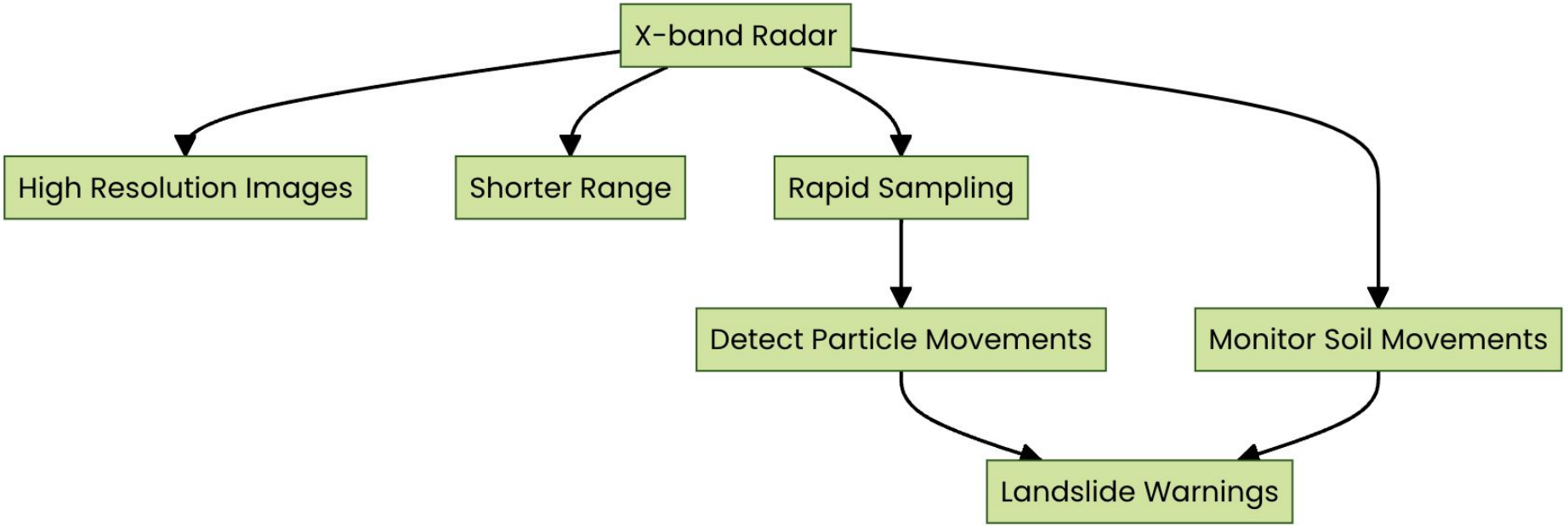
Feature: Samples rapidly for real-time data.

⏱️ High Temporal Sampling

Advantage: Enables detection of quick changes in particle movements.

Summary: Radar technology, particularly Doppler and X-band radars, is essential for weather monitoring and environmental safety, with applications like landslide warnings in Wayanad.


X-band Radar
High Resolution Images
Shorter Range
Enhanced Monitoring
Timely Landslide Alerts
Improved Disaster Management


X-band Radar
High Resolution Images
Shorter Range
Rapid Sampling
Detect Particle Movements
Monitor Soil Movements
Landslide Warnings

🌧️ India's Radar History: The India Meteorological Department (IMD) began using radar for weather applications in the early 1950s, with the first X-band radar installed in 1970.

🔄 Radar Upgrades: In 1996, IMD replaced 10 outdated X-band radars with digital versions, enhancing storm detection capabilities.
🌪️ Radar Types: India employs both X-band (for wind and storm detection) and S-band radars (for long-range detection), with the first S-band radar installed in 1970.

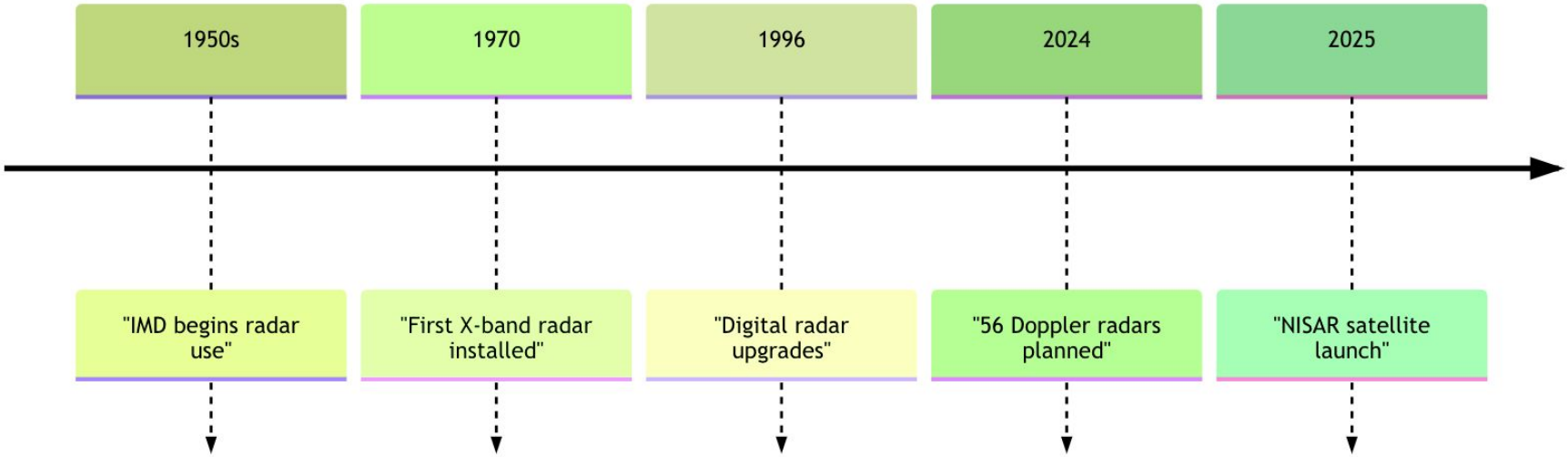
🚀 Future Expansion: By September 2024, India plans to add 56 Doppler radars, supported by the ₹2,000-crore ‘Mission Mausam’ initiative to upgrade meteorological infrastructure.

🛰️ NISAR Satellite: NASA and ISRO are developing the NISAR satellite, which will utilize L-band and S-band radars to create high-resolution maps of Earth's landmasses.

💰 NISAR Launch Details: The NISAR satellite is expected to launch in 2025 aboard an ISRO GSLV Mk II rocket, with a total cost of $1.5 billion, primarily funded by NASA.

🌍 Environmental Monitoring: NISAR will track and record changes in Earth's natural processes, contributing to environmental monitoring and research.

India's Radar Development



Who gets the preferred symbol when there are two factions?

Why has the Nationalist Congress Party (SP) filed a plea to restrain the use of the 'clock' symbol?

Rangarajan. R

The story so far:

Nationalist Congress Party (NCP) founder Sharad Pawar has filed a plea in the Supreme Court, seeking a direction to restrain the Ajit Pawar faction from using the 'clock' symbol in the upcoming assembly polls in Maharashtra.

How are symbols allotted?

Symbols are allotted to political parties as per the provisions of the Symbols Order by the Election Commission of India (ECI). In the largest democracy where a sizeable population is still illiterate, symbols play a crucial role in canvassing and voting process. A national or State recognised political party has a reserved symbol that is not allotted to any other candidate in any constituency.

What is the present issue?

The NCP at present is a State recognised party in Maharashtra and Nagaland. In July 2023, there was a split in the NCP with the Ajit Pawar faction claiming the support of 41 MLAs out of 53 in the Maharashtra assembly. The ECI in February 2024 recognised Ajit Pawar faction as the real NCP and allotted to it the 'clock' symbol reserved for NCP during the Lok Sabha elections in April-May 2024. The NCP (Sharadchandra Pawar) [NCP(SP)] was allotted a common symbol of 'man blowing turha.' The present plea claims that during the Lok Sabha election, voters were confused as to which faction represented the real NCP. The NCP (SP) therefore has sought a direction to freeze the 'clock' symbol and allot a new symbol to Ajit Pawar faction.

What are past instances?

As per the Symbols Order, in case of split in a recognised political party, the ECI decides as to which faction or group is the recognised political party. It allots the reserved symbol to such faction. However, the ECI has also frozen symbols in the past before determining the dispute. The 'two leaves' symbol of the AIADMK party in Tamil Nadu was frozen in January 1989 and April 2017 due to competing claims. The 'bow and arrow' symbol of Shiv Sena was also frozen before a bye-election in October 2022.

What can be the way forward?

The Supreme Court in *Sadiq Ali versus the ECI* (1971), laid down the 3-test formula for determining which faction is to be recognised as the original political party. These are the aims and objectives of the party; its affairs as per the party's constitution that reflect inner party democracy; and majority in the legislative and organisation wings.

The ECI in its order in February 2024 held that there was no dispute between the two factions on the first test and that neither of the factions followed the party's constitution rendering the second test redundant. Since the organisational election of NCP in the year 2022 was shrouded with doubt, it went on to decide the issue solely based on majority in the legislature as a majority of legislators supported the Ajit Pawar faction.

However, in the Maharashtra Lok Sabha elections, the NCP (SP) faction despite fighting with its new symbol won eight seats as against just one seat won by the NCP led by Ajit Pawar that fought on its traditional 'clock' symbol. The Supreme Court generally does not interfere in the poll process as it is the domain of the ECI. Nevertheless, in exceptional circumstances, it has given directions to the ECI for ensuring a fair election process. In the instant case, because of the performance of the NCP (SP) in the recent Lok Sabha election, the third test of legislative majority can again be disputed. The decision of the ECI to recognise the Ajit Pawar faction as the real NCP has also been challenged in the SC by NCP(SP). Considering these factors, the court may direct the ECI to freeze the 'clock' symbol for the assembly elections to be held in November 2024. The real reform required is institutionalising internal democracy through regular inner-party elections in our political parties. Various experts are of the view that the ECI should not be involved in monitoring these elections as it will drag a constitutional authority into the muddle of party politics. It is the members of various political parties as responsible citizenry who need to demand and operationalise such internal democracy.

Rangarajan R is a former IAS officer and author of 'Polity Simplified'. Views expressed are personal.

THE GIST

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- The Supreme Court in *Sadiq Ali versus the Election Commission of India* (1971), laid down the 3-test formula for determining which faction is to be recognised as the original political party.

_Topic → NCP Symbol Dispute and Supreme Court Plea

🕰️ Supreme Court Plea

Sharad Pawar of the NCP has approached the Supreme Court to prevent the Ajit Pawar faction from using the 'clock' symbol in the upcoming Maharashtra assembly polls.

🗳️ Symbol Allotment Process

Political symbols are allocated by the Election Commission of India (ECI) based on the Symbols Order.
These symbols are crucial for voter recognition, especially in a largely illiterate population.

📊

🔄 NCP Split

The NCP experienced a split in July 2023.
The Ajit Pawar faction claimed support from 41 out of 53 MLAs.
The ECI recognized this faction as the real NCP in February 2024.

⚖️ Past Symbol Freezes

The ECI has previously frozen symbols during disputes, such as:

- AIADMK's 'two leaves'
- Shiv Sena's 'bow and arrow'

Supreme Court's Role

The Supreme Court in Sadiq Ali versus the ECI (1971), laid down the 3-test formula for determining which faction is to be recognised as the original political party. These are the aims and objectives of the party; its a□airs as per the party's constitution that re□ect inner party democracy; and majority in the legislative and organisation wings

The Supreme Court has established a three-test formula for recognizing political factions:

- Focus on party aims
- Adherence to the constitution
- Legislative majority

🔍

Call for Internal Democracy

Experts advocate for institutionalizing internal democracy within political parties through regular elections.

Suggestion that the ECI should not oversee these processes to avoid entanglement in party politics.

Summary: The NCP's internal conflict over symbol recognition has led to a Supreme Court plea, highlighting the complexities of party politics and the need for internal democracy.

Determination to rebuild follows Florida's hurricanes

Associated Press
VENICE

U.S. President Joe Biden meets with officials in the wake of Hurricanes Milton and Helene in Florida on Sunday. REUTERS

No sooner had residents of the Bahia Vista Gulf condominium complex dug out and from Hurricane Helene than they were faced with the same daunting cleanup from new damage inflicted by Hurricane Milton.

The beachfront units had been gutted, treated, and dried out after Hurricane Helene and mounds of sand that had blown in from the beach had been removed. Then, less than two weeks later, Hurricane Milton barreled in and undid all the progress.

"They have got to start the whole process over, cleaning, sanitising, bringing in drying equipment, getting them all dried, and prepped for renovations," lamented Bill O'Connell, a board member at the complex in Venice, about an hour's drive south of Tampa. The second hurricane "brought all the sand back on our property."

Some longtime Floridians have grown accustomed to the annual cycle of storms that can shatter and upend lives in a State known mostly for its balmy weather, sunshine, and beaches. "It is the price you pay to live in paradise," Mr. O'Connell said. "If you want to live here with this view, beautiful sunsets, be able to go out on your boat, enjoy what Florida has to offer, you have to be willing to accept that these storms are going to come."

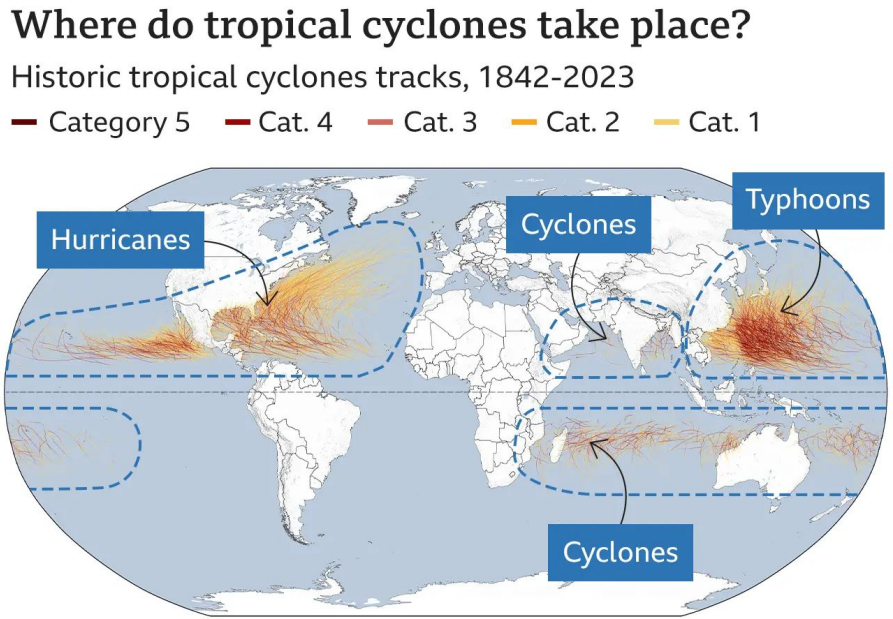
President Joe Biden visited the Gulf Coast on Sunday to survey the devastation inflicted on the region.

Hurricane Milton killed at least 10 people after it made landfall as a Category 3 storm, flooding barrier islands and spawning deadly tornadoes. Officials say the toll could have been worse if not for the widespread evacuations.

Topic→What are hurricanes?

Hurricanes are powerful storms which develop in warm tropical ocean waters.

In other parts of the world, they are known as cyclones or typhoons. Collectively, these storms are referred to as "tropical cyclones".



How do hurricanes form?

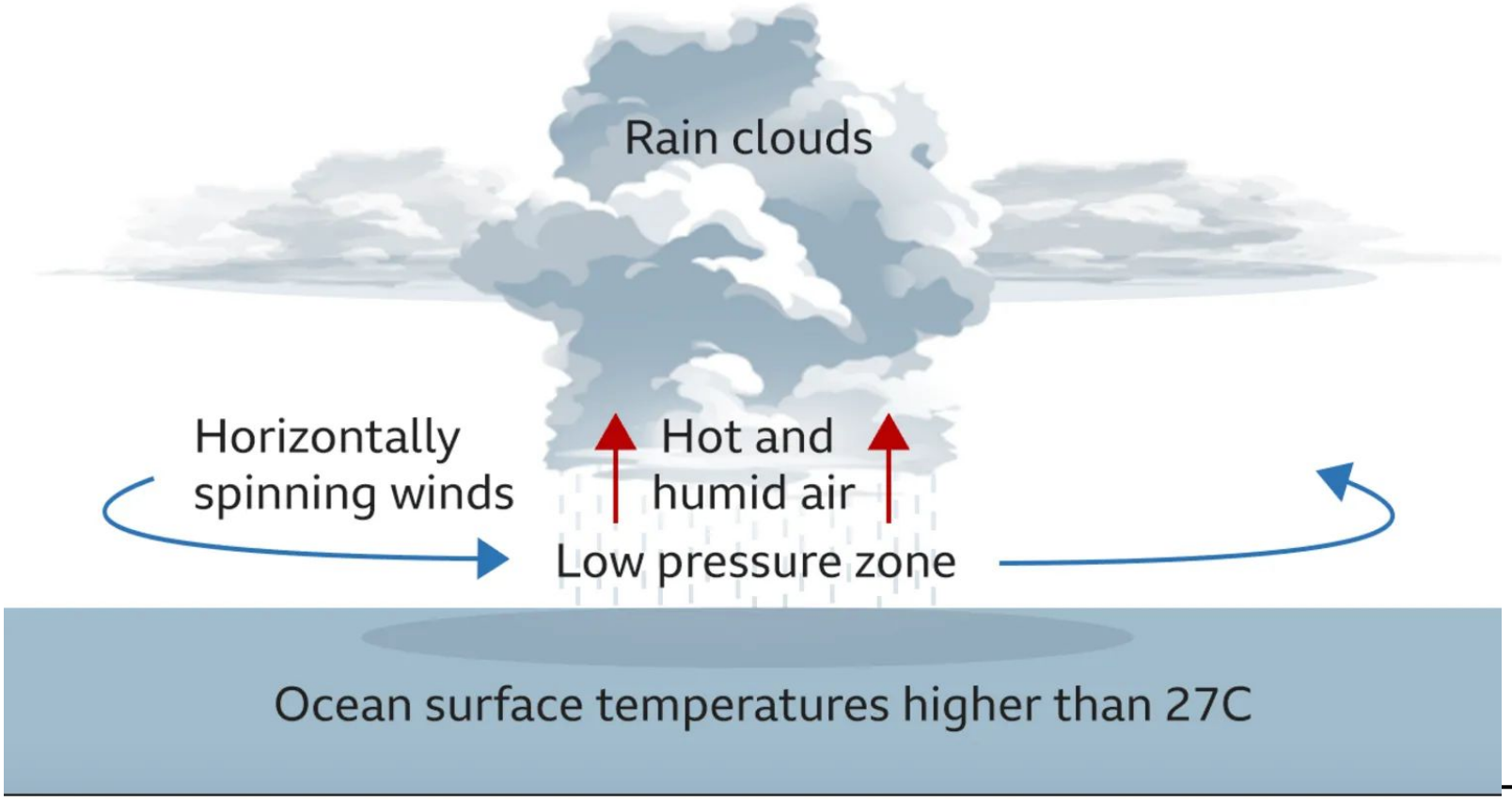
Hurricanes, typhoons and cyclones begin as atmospheric disturbances - such as, for example, a tropical wave, an area of low pressure where thunderstorms and clouds develop.

As warm, moist air rises from the ocean surface, winds begin to spin. The process is linked to how the Earth's rotation affects winds in tropical regions just away from the equator.

For a hurricane to develop and keep spinning, the sea surface generally needs to be at least 27C to provide enough energy, and the winds need to not vary much with height.

If all these factors come together, an intense hurricane can form, although the exact causes of individual storms are complex.

Basic ingredients of a hurricane



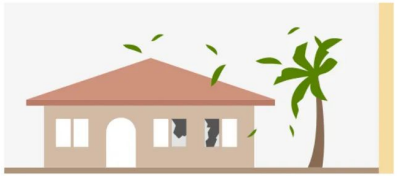
- Hurricanes Helene and Milton – which have devastated parts of the south-east United States – have bookended an exceptionally busy period of tropical storms.
- In less than two weeks, five hurricanes formed, which is not far off what the Atlantic would typically get in an entire year.
- The storms were powerful, gaining strength with rapid speed.
- It was thought that exceptionally warm Atlantic temperatures – combined with a shift in regional weather patterns – would make conditions ripe for hurricane formation.

- the total number of tropical storms – which includes hurricanes but also weaker storms – has been around average, and less than was expected at the start of the year.
- Across the Main Development Region for hurricanes - an area stretching from the west coast of Africa to the Caribbean - sea surface temperatures have been around 1C above the 1991-2020 average, according to BBC analysis of data from the European climate service.
- Atlantic temperatures have been higher over the last decade, mainly because of climate change and a natural weather pattern known as the Atlantic Multidecadal Oscillation.

- The recipe for hurricane formation involves a complex mix of ingredients beyond sea temperatures, and these other conditions were not right.
- Researchers are still working to understand why this was the case, but likely reasons include a shift to the West African monsoon and an abundance of Saharan dust.
- These both hampered storm development by creating unfavourable conditions in the atmosphere.
- But even during this period, scientists were warning that the oceans remained exceptionally warm and that intense hurricanes were still possible through the rest of the season.

- Warmer oceans make stronger hurricanes - and rapid intensification - more likely, because it means storms can pick up more energy, potentially leading to higher wind speeds.
- There is also the likely development of the natural La Niña weather phenomenon in the Pacific, which often favours Atlantic hurricane formation as it affects wind patterns.
- But further activity will rely on other atmospheric conditions remaining favourable, which are not easy to predict.
- Either way, this season has already highlighted how warm seas fuelled by climate change are already increasing the chances of the strongest hurricanes – something that is expected to continue as the world warms further.

Saffir-Simpson hurricane scale explained



Category 1

Winds 74-95 mph (119-153 km/h)

Some damage and power cuts

Category 2

Winds 96-110 mph (154-177 km/h)

Extensive damage

Category 3

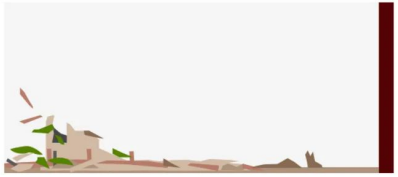
Winds 111-129 mph (178-208 km/h)

Well-built homes suffer major damage

Category 4

Winds 130-156 mph (209-251 km/h)

Severe damage to well-built homes



Category 5

Winds 157+ mph (252+ km/h)

Many buildings destroyed, major roads cut off

Is climate change affecting hurricanes?

- Assessing the precise influence of climate change on individual tropical cyclones is challenging. The storms are relatively localised and short-lived, and can vary significantly in any case.
- But rising temperatures do affect these storms in several measurable ways.
- Firstly, warmer ocean waters mean storms can pick up more energy, leading to higher wind speeds.
- Record high sea surface temperatures were a key reason why US scientists forecast an above-normal Atlantic hurricane season for 2024.
- The high temperatures are mainly due to long-term greenhouse gas emissions.
- Secondly, a warmer atmosphere can hold more moisture, leading to more intense rainfall.

- Finally, sea-levels are rising, mainly due to a combination of melting glaciers and ice sheets, and the fact that warmer water takes up more space.
- Local factors can also play a part. This means storm surges happen on top of already elevated sea levels, worsening coastal flooding.

Toothbrush, showerhead are breeding places for viruses

The Hindu Bureau

A study by Northwestern University researchers has found that showerheads and toothbrushes are teeming with an extremely diverse collection of viruses – most of which have never been seen before. Although this might sound ominous, the good news is these viruses don't target people. They target bacteria.

The microorganisms collected in the study are bacteriophage, or "phage," a type of virus that infects and replicates inside of bacteria. Although researchers know little about them, phage recently has garnered attention for their potential use in treating antibiotic-resistant bacterial infections. The previously unknown viruses lurking in our bathrooms could become a treasure trove of materials for exploring those applications. The study was published in the journal *Frontiers in Microbiomes*.

"The number of viruses that we found is absolutely wild," said Northwestern's Erica M. Hartmann, who led the study said in a release. "It's amazing how much untapped biodiversity is all around us. And you don't even have to go far to find it; it's right under our noses." The study is an offshoot of previous research, in which Dr. Hartmann and her colleagues at the University of Colorado. The researchers asked people to submit used toothbrushes and swabs with samples collected from their showerheads.

Inspired by concerns that a flushing toilet might generate a cloud of aerosol particles, Dr. Hartmann called the toothbrush study, "Operation Pottymouth."

"This project started as a curiosity," Dr. Hartmann said. "Microbes prefer environments with water. And where is there water? Inside our showerheads and on our toothbrushes."

After characterising bacteria, she used DNA sequencing to examine the viruses. Altogether, the samples comprised more than 600 different viruses – and no two samples were alike.

While they found few patterns among all the samples, Dr. Hartmann and her team did notice more mycobacteriophage than other types of phage. Mycobacteriophage infect mycobacteria, a pathogenic species that causes diseases like leprosy, tuberculosis, and chronic lung infections. Dr. Hartmann imagines that, someday, researchers could harness mycobacteriophage to treat these infections and others.

Dr. Hartmann cautions people not to fret about the invisible wildlife living within our bathrooms. Instead of grabbing for bleach, people can soak their showerheads in vinegar to remove calcium buildup or simply wash them with plain soap and water. And people should regularly replace toothbrush heads, she says.

Topic→Bacteriophage Overview

Key Concepts of Bacteriophage

Definition: Bacteriophages, or phages, are viruses that infect and replicate within bacteria.
Structure: Composed of genetic material (DNA or RNA) surrounded by a protein coat.
Types:

- *Lytic phages*: Destroy host bacteria.
- *Lysogenic phages*: Incorporate their DNA into host genome.

Recent Developments

Targeting biofilms for effective treatment against antibiotic-resistant bacteria.
Personalized phage therapy showing positive outcomes in clinical trials.
Research on phage structural insights and their interactions with host bacteria.

Example Applications

Phage Therapy: An alternative to antibiotics, especially for resistant infections.
Biocontrol: Using phages to manage bacterial populations in agriculture and food safety.

Current Research Trends

Understanding phage adaptability and evolution in various environments.
Exploring the use of phages in gut microbiome management.

OROV virus in semen 16 days after symptom onset

R. Prasad

A study published in the U.S. CDC's journal *Emerging Infectious Diseases* has found evidence for prolonged shedding of the Oropouche virus (OROV) in a person who had recently travelled to Cuba. The virus was found in blood, serum, and urine, samples, and virus replication was seen in semen samples collected on day 16 after symptom onset. While the researchers detected virus shedding at higher levels in semen than in urine and blood on day 32, they were not able to demonstrate replication competence of the virus collected on day 32. OROV virus is spread mainly by biting midges and *Culex quinquefasciatus* mosquitoes.

On day 16, the researchers were able to obtain infectious viruses from semen confirmed by the appearance of clear cytopathic effects after five days and increased OROV-RNA levels in the spent cell growth medium, they write. While the patient had recovered and was free of symptoms on day 10, virus replication in semen samples was found on day 16.

According to them, adverse pregnancy outcomes associated with OROV infection have been identified in Brazil, and investigations are currently under way to ascertain possible vertical transmission of the virus. "In the 1980s, spontaneous abortions in pregnant women with OROV antibodies already suggested that OROV infection might be harmful during pregnancy," they write. This year, a report of a possible vertical transmission of OROV in Brazil was reported and is under

OROV virus capable of replicating was found in semen sample collected on day 16 after symptom onset. REUTERS

RT-PCR remained positive in whole blood and urine samples obtained on days 10, 16, and 32 after symptom onset. While serum was positive for the virus on day 10, it was not positive on day 16. The researchers detected OROV virus RNA in fresh, unfractionated semen samples on days 16, 32, and 58. According to them, viral RNA levels were higher in semen blood. On day 58, while the virus was not detectable in urine samples, the virus was still detectable in whole blood and semen.

Persistence and shedding of viruses in semen days after symptoms onset is not unusual. Virus persistence and shedding in semen have been seen in 40 viruses, including Zika and Ebola viruses.

"Detectable OROV RNA replication in the male genital tract but also from passive diffusion of OROV. In the patient we report, blood could not be excluded as a cause for a positive RT-PCR in semen, but cross-contamination from the urine seems unlikely because OROV RNA shedding persisted longer in semen than in urinez," they write.

Though the researchers found evidence for prolonged shedding of the OROV virus RNA was able to in whole blood, serum, urine, and semen and they also detected replication-competent virus in semen sample on day 16 in one patient, the researchers caution against overinterpretation of the findings. "Because we did not separate seminal fractions, we cannot establish an association with the cellular fraction or spermatozoa. detectable OROV from semen does not exclude the possibility of prolonged shedding of infectious virus," they note.

Men infected with Zika virus are advised to refrain from indulging in unprotected sex for three months from the date of symptom onset. Similarly, based on the presence of OROV virus RNA that is replication-competent in semen samples, researchers caution that the findings raise concerns over the potential for person-to-person transmission of OROV via sexual encounters. "Pending further evidence (e.g., longitudinal studies to establish the frequency and kinetics of infectious OROV shedding in semen to assess its clinical relevance), we recommend use of barrier protection when engaging in sexual intercourse if OROV is confirmed or suspected," they

TAOPIC→Oropouche Virus (OROV)

Overview of Oropouche Virus

Definition: A viral infection caused by the Oropouche virus.
Transmission: Primarily through mosquitoes and midges.
Symptoms: Fever, headache, joint pain, and rash.
Geographical Spread: Endemic to tropical regions, especially in South America.

Impact and Outbreaks

Recent Outbreaks:
- Novel reassortant Oropouche virus in Brazil.
- 2024 Oropouche outbreak reports.

Imported Cases: Rising cases in the US.

Public Health Concerns: Potential for increased transmission and outbreaks.

Prevention and Control

Preventive Measures: Use of insect repellent, protective clothing, and mosquito nets.

Public Awareness: Education on symptoms and transmission routes.

Research and Monitoring: Ongoing studies to understand the virus and its effects.

Question Corner

Greening

How rapidly is Antarctica warming?

The Antarctic Peninsula, like many polar regions, is warming faster than the global average, with extreme heat events in Antarctica becoming more common. A study which used satellite data to assess how much the Antarctic Peninsula has been "greening" in response to climate change found that the area of vegetation cover across the Peninsula increased from less than one sq. km in 1986 to almost 12 sq. km by 2021. It found this greening trend accelerated by over 30% in recent years (2016-2021) relative to the full study period (1986-2021). This study uses satellite imagery to confirm that a widespread greening trend, across the Antarctic Peninsula, is under way and accelerating. The researchers are now investigating how deglaciated (ice-free) landscapes are colonised by plants, and how the process might proceed into the future. Antarctica has very little to no soil. However, the increase in plant life in the ice continent will add organic matter, which will facilitate soil formation, thereby potentially paving the way for other plants to grow.

Readers may send their questions / answers to questioncorner@thehindu.co.in

Topic- Antarctica WARMING

🌡️ Warming Trend: The Antarctic Peninsula is experiencing a warming rate that surpasses the global average, marked by an increase in extreme heat events.

🌱 Vegetation Growth: There has been a notable expansion in vegetation cover, growing from less than 1 sq. km in 1986 to nearly 12 sq. km by 2021.

📈 Accelerated Greening: The greening trend has intensified by over 30% from 2016 to 2021, compared to the entire study period (1986-2021).

🛰️ Satellite Data: Satellite imagery has been instrumental in confirming the widespread and accelerating greening trend across the Peninsula.

🌍 Future Research: Ongoing research is focused on understanding how deglaciated landscapes are being colonized by plants and the future implications of this process.

🌿 Soil Formation: The increase in plant life contributes organic matter, aiding in soil formation and potentially supporting further plant growth.

❄️ Unique Environment: The scarcity of soil in Antarctica makes the greening process particularly significant for the ecosystem.

Summary

The Antarctic Peninsula is undergoing rapid warming and a significant increase in vegetation, which is accelerating and may lead to soil formation.

Why is microRNA discovery a big leap?

What have the Nobel laureates for medicine, Victor Ambros and Gary Ruvkun, achieved by unlocking a secret on how different types of cells develop? How will it help in the field of molecular biology? Why is an understanding of genes important?

Ramya Kannan

The story so far:

The Nobel Committee announced on October 7 that the Nobel Prize for Medicine or Physiology would be shared by Victor Ambros and Gary Ruvkun "for the discovery of microRNA and its role in post-transcriptional gene regulation," thereby unlocking a secret on how different types of cells develop.

What is microRNA?

The human body is probably the most complex puzzle that humans are still trying to make sense of. Every time there is a better understanding and a piece slides into place with a resounding click, then it is an occasion for celebration. For a Nobel Prize too perhaps. This year's awardees of the Nobel Prize for Medicine – Ambros and Ruvkun – did slide in a couple of pieces into the right slots in the massive puzzle that suddenly opened our eyes to understanding how different cell types develop.

Consider this: Every cell in the body contains the same chromosome, so every cell contains exactly the same set of genes and presumably, the same instructions. But different cell types have different, unique characteristics. It confounded the imagination until Ambros and Ruvkun came along. Their discovery offered a plausible explanation for the conundrum. The piece of the puzzle was called microRNA, a new class of tiny RNA molecules that play a crucial role in gene regulation. As the Nobel announcement statement said, their groundbreaking discovery revealed a completely new principle of gene regulation essential for multicellular organisms, including humans.

It is now known that the human genome codes for over one thousand microRNAs. Genetic information flows from DNA to messenger RNA (mRNA), via a process called transcription, and then on to the cell for production of protein. There, mRNAs are translated so that proteins are made according to the genetic instructions stored in DNA.

Abnormal regulation by microRNA may contribute to cancer

The key is in the precise regulation of gene activity so that only the correct set of genes is active in each specific cell type. Additionally, gene activity must be continually fine-tuned to adapt cellular functions to changing conditions in our bodies and environment. If gene regulation goes awry, it can lead to serious diseases. Therefore, understanding the regulation of gene activity has been an important goal for many decades.

Triumph together: Victor Ambros and Gary Ruvkun. REUTERS

What is the work that led to the Nobel prize?

Ambros and Ruvkun, both American biologists, were together in their post-doctoral period at the H. Robert Horvitz lab in the 1980s, and their interest in cell development probably had its spark there. "It was the moment," Ruvkun said later, "when recombinant DNA was just starting to take off and it was obvious that it was a revolution and I wanted to be part of that." As they say, great achievements have humble beginnings, and this duo started appropriately enough with a humble 1 mm long roundworm. This creature was not an odd choice though: it possessed many specialised types of cells, such as nerve and muscle cells, making it a convenient model to study a complex genetic regulation process across species, one that was conserved throughout evolution.

After that, both scientists branched off on their own, though they remained focused on the same theme, obsessively, as great scientists are wont to, but exchanging data with each other, a task assigned great value in the modern scientific world.

The study of mutant strains that disrupt cellular processes offers great insights into gene function, and Ambros and Ruvkun took this path. They studied two mutant strains of worms, lin-4, and lin-14, that displayed defects in the timing of activation of genetic programmes during development.

After his post-doctoral research, Ambros analysed the lin-4 mutant in his laboratory. He managed to clone the gene which revealed that the lin-4 gene produced an unusually short RNA molecule that lacked a code for protein production. This suggested that the small RNA from lin-4 was responsible for inhibiting lin-14.

Concurrently, Ruvkun investigated the regulation of the lin-14 gene at Massachusetts General Hospital and Harvard Medical School. Ruvkun showed that the inhibition occurred at a later stage in the process of gene expression, through the shutdown of protein production. Experiments also revealed a segment in lin-14 mRNA necessary for its inhibition by lin-4. There were therefore complementary sequences in lin-4 and lin-14 mRNA, and the former binds to such sequences in the latter, blocking protein production in lin-14.

The two laureates compared their findings, which resulted in a breakthrough discovery. A new principle of gene regulation, mediated by a previously unknown type of RNA, microRNA, had been discovered. The results were published in 1993 in two articles in the journal *Cell*. Incidentally, Ambros' wife Rosalind Lee was his colleague and the first author of the *Cell* paper cited by the Nobel Committee. As Iorio and Croce wrote in their paper *Causes and consequences of microRNA dysregulation*, in the *Cancer Journal*, "microRNAs represent indeed an entire novel level of gene regulation that forced scientists to revise and somehow reorganise their view of the molecular biology."

While these results were met with initial silence from the scientific community, perception changed and euphoria took over, after Ruvkun's research group published their discovery of another microRNA encoded by the let-7 gene, seven years later. This gene was highly conserved and present throughout the animal kingdom, unlike lin-4. Over the following years, different microRNAs were identified. As a result of this work, researchers are today aware of the presence of more than 1,000 genes for different microRNAs and that gene regulation for microRNA is present in all multicellular organisms.

What are the applications for the future?

As Iorio and Croce list, since the first discovery, there have been remarkable advances in the understanding of microRNA biology. These include the identification of hundreds of microRNA genes; the dissection of microRNA biogenesis pathways; the identification of numerous microRNA targets and the establishment of principles of target regulation; and more importantly, there have been vigorous studies of their biological functions in physiological and pathological conditions.

Researchers found that a single microRNA can regulate the expression of many different genes, and conversely, a single gene can be regulated by multiple microRNAs, thereby coordinating and fine-tuning entire networks of genes. Extensive research has also yielded knowledge that cells and tissues do not develop normally without microRNAs. Abnormal regulation by microRNA can contribute to cancer, and mutations in genes coding for microRNAs have been found in humans, causing conditions such as congenital hearing loss, eye and skeletal disorders. Mutations in one of the proteins required for microRNA production result in the DICER1 syndrome, a rare but severe syndrome linked to cancer in various organs and tissues.

Topic → Nobel Prize in Medicine: Discovery of MicroRNA

Overview

🏆 The Nobel Prize for Medicine or Physiology was awarded to Victor Ambros and Gary Ruvkun on October 7 for their groundbreaking discovery of `microRNA`.

🧬 MicroRNA is a class of tiny RNA molecules crucial for post-transcriptional gene regulation. miRNAs are non-coding RNA molecules that are 21–23 nucleotides long. They are found in cells, the bloodstream, and some viruses

🔍 This discovery elucidates how different cell types develop despite having the same genetic material.

Significance of MicroRNA

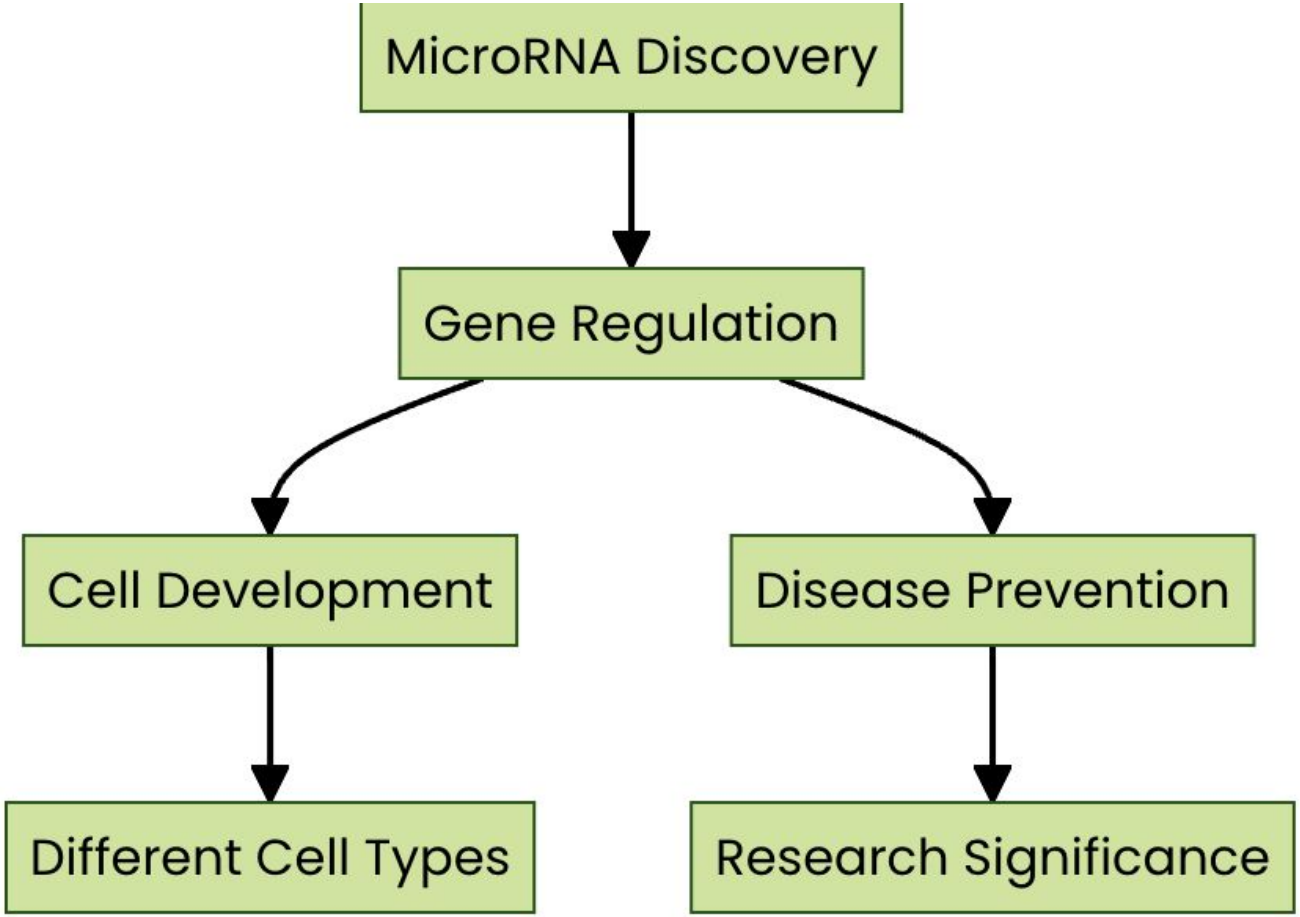
📊 The human genome encodes over one thousand microRNAs, underscoring their importance in gene regulation.

⚙️ Gene regulation is vital for ensuring that only the correct genes are active in specific cell types and for adapting to changing conditions.

⚠️ Disruptions in gene regulation can lead to serious diseases, making its understanding a critical area of research.

Impact

🎉 The discovery of microRNA marks a significant advancement in our understanding of gene regulation in multicellular organisms.


MicroRNA Discovery
Gene Regulation
Cell Development
Disease Prevention
Different Cell Types
Research Significance

MicroRNA: A Deep Dive into Biological Functions

🧬 Advancements in MicroRNA Biology

Significant progress in understanding microRNA biology.
Identification of hundreds of microRNA genes.

🔍 MicroRNA Biogenesis Pathways

Dissection of pathways for microRNA production.
Enhanced understanding of microRNA functions.

🎯 Target Regulation

Identification of numerous microRNA targets.
Establishment of principles for gene expression regulation.

⚖️ Gene Regulation Dynamics

A single microRNA can regulate multiple genes.
A single gene can be influenced by various microRNAs.
Indicates a complex regulatory network.

Role in Development

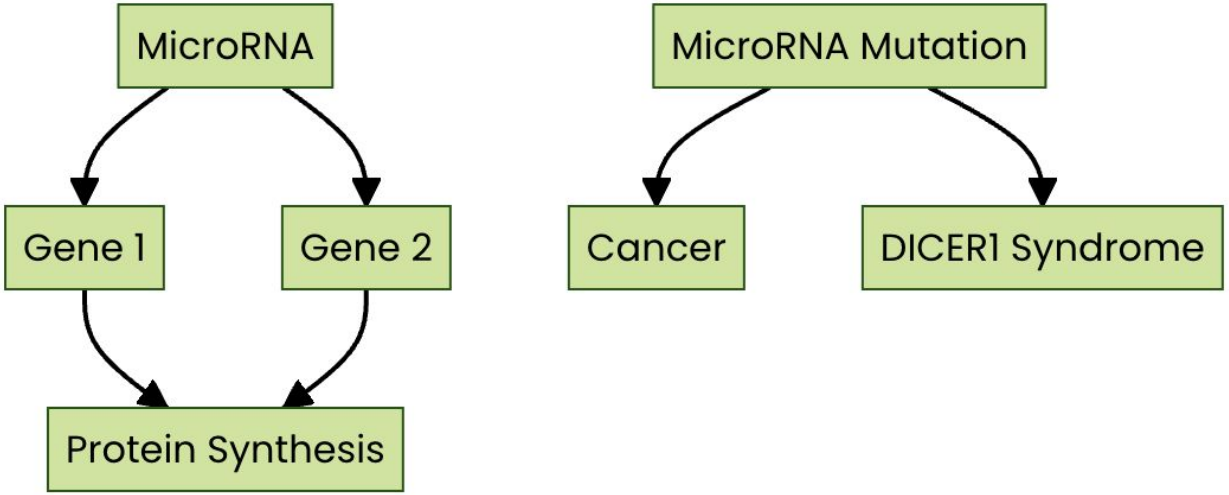
Essential for normal cell and tissue development.
Absence can lead to developmental issues.

🎗️ Cancer Connection

Abnormal microRNA regulation linked to cancer.
Mutations in microRNA-coding genes contribute to health conditions.

🧑‍⚕️ DICER1 Syndrome

- Mutations in proteins necessary for microRNA production.
- Leads to DICER1 syndrome, associated with cancer.
- Summary: The study of microRNAs has revealed their critical roles in gene regulation, development, and disease, including cancer and genetic disorders


MicroRNA
Gene 1
Gene 2
Protein Synthesis
MicroRNA Mutation
Cancer
DICER1 Syndrome

How are the physics laureates impacting AI?

How did John Hopfield and Geoffrey Hinton lay the foundation for machine learning with their inventions on artificial neural networks? What technologies did they develop that use structures in networks to process information?

Vasudevan Mukunth

The story so far:

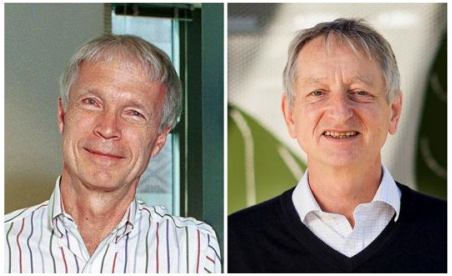
On October 8, John Hopfield and Geoffrey Hinton won the 2024 Nobel Prize for Physics "for foundational discoveries and inventions that enable machine learning with artificial neural networks". Their work lies at the roots of a large tree of work, the newest branches of which are seen today as apps like ChatGPT.

Both physicists have tried to spread awareness of AI's risks

What is AI?

An accessible AI today is likely to be an implementation of an artificial neural network (ANN) – a collection of nodes designed to operate like networks of neurons in animal brains. Each node is a site where some input data is processed according to fixed rules to produce an output. A connection between nodes allows them to transfer input and output signals to each other. Stacking multiple layers of nodes, with each layer performing a specific task with great attention to detail, creates a machine capable of deep learning.

The foundations of contemporary AI, for which Hopfield and Hinton received this year's physics Nobel Prize, are in machines that started off doing things humans were better at – pattern recognition – and based on ideas in statistical physics, neurobiology, and cognitive psychology.



Nobel legacy: John Hopfield and Geoffrey Hinton. AP

What is the Hopfield network?

In 1949, Canadian psychologist Donald Hebb introduced a neuropsychological theory of learning to explain the ability of connections between neurons to strengthen or weaken. Hebb posited that the connection between two neurons becomes more efficient if the neurons constantly talk to each other. In 1983, Hopfield developed an ANN whose nodes used Hebb's postulate to learn by association. For example, if a node is exposed to many texts, one set in English and the other its Tamil translation, it could use Hebbian learning to conclude "hand" and "*kai*" are synonymous because they appear together most often.

Another feature of Hopfield network is information storage. When the network is 'taught' an image, it stores the visual in a 'low-energy state' created by adjusting the strengths of the nodes' connections. When it encounters a noisy version of the image, it produces the denoised version by progressively moving it to the same low-energy state. The use of 'energy' here is an echo of the fact that the Hopfield network is similar in form and function to models researchers have used to understand materials called spin glasses. A low-energy state of a Hopfield network – which corresponds to its output – could map to the low-energy state of a spin glass modelled by the same rules. Hopfield's mapping was a considerable feat because it allowed researchers to translate ideas from statistical physics, neuro-psychology, and biology to a form of cognition.

What is a Boltzmann machine?

Hinton's share of the Nobel Prize is due to his hand in developing the first deep-learning machines. In 1872, Austrian physicist Ludwig Boltzmann published an equation to predict, say, the possible behaviours of a tub of fluid with one end hotter than the other. Whereas the first guess of a simple logic would be that all the possible states this system can take would be equally probable, Boltzmann's equation predicts that some states are more probable than others because the system's energy prefers them.

In the mid-1980s, Hinton and his peers developed an ANN with a tendency to move towards some outcomes over others by using Boltzmann's equation to process its inputs. Their network had visible nodes, which could input and output information, and a set of hidden nodes that only interacted with other nodes. The visible nodes worked like a Hopfield network whereas the hidden nodes modelled new possibilities using Boltzmann's equation. This was the dawn of generative AI. In another breakthrough in the 2000s, Hinton and others devised a form of the Boltzmann machine where the hidden nodes were connected only to visible nodes, and vice versa. These restricted Boltzmann machines (RBMs) could learn more efficiently, using the contrastive divergence algorithm Hinton *et al.* developed. Hinton, Simon Osindero, and Yee-Whye Teh also found that 'layers' of ANNs could be trained using RBMs and then stacked to create a deep learning model.

Where are ANNs today?

Technologies evolve through successive levels of abstraction. The individual computer of the late 1980s is today part of the cloud, a distributed network of computing sites linked by data networks and managed using software and hardware controls. ANNs are the product of a similar abstraction, which Hopfield and Hinton helped achieve, and have further transformed. Thus they are within the reach of millions of people but also less resemble their ancestors.

Advances in this area have benefited from the work of multiple teams and ideas, so much so that drawing a straight line from Hopfield's and Hinton's work to ChatGPT is impossible. One new form of ANN is the transformer, a two-part neural network that encodes and then decodes information, with valuable applications in object detection and recognition. Other developments include back-propagation, a technique that allows ANNs to upgrade themselves as they learn, and the long short-term memory that enables ANNs to 'remember' some information for a fixed number of steps.

ANNs are also on our minds. Hinton has said he is "worried the overall consequence... might be systems more intelligent than us that eventually take control." He left Google in 2023 to spread awareness of AI's risks. Hopfield has expressed similar sentiments. Why do it then? Presumably because the tree is big and it is impossible to see the branches sitting at the roots.

Topic→Nobel Prize 2024: Celebrating Pioneers in Artificial Neural Networks

Key Contributions to AI

🏆 John Hopfield and Geoffrey Hinton were honored with the 2024 Nobel Prize for Physics on October 8 for their groundbreaking work in machine learning using artificial neural networks.

🌳 Their research forms the backbone of modern AI technologies, including tools like ChatGPT.

Understanding Artificial Neural Networks

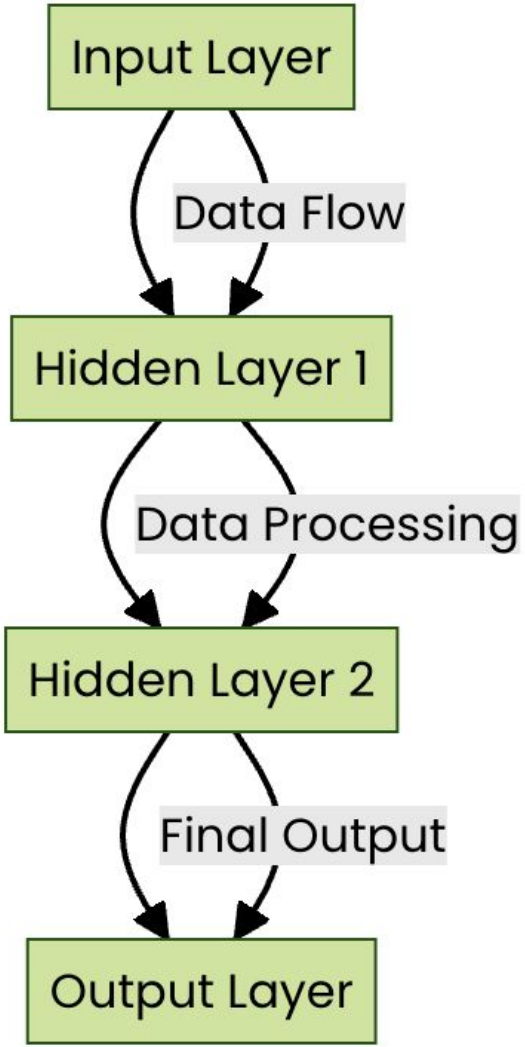
🧠 Artificial Neural Networks (ANNs) simulate the behavior of neurons in animal brains, processing input data through a network of interconnected nodes.
🔄 Each node processes data based on predefined rules, facilitating signal transfer between nodes.

📊 By stacking multiple layers of nodes, deep learning is achieved, enhancing the machine's capability to execute complex tasks.

The Foundation of Modern AI

🔍 The evolution of contemporary AI is deeply rooted in pattern recognition and is influenced by disciplines such as statistical physics, neurobiology, and cognitive psychology.

📅 The Nobel Prize acknowledges the importance of these foundational discoveries in shaping today's AI landscape.


Input Layer
Data Flow
Hidden Layer 1
Data Processing
Hidden Layer 2
Final Output
Output Layer

🌐 Evolution of Technology: ANNs have transitioned from standalone computers in the late 1980s to being integrated into cloud-based distributed networks.

🧠 Contributors to ANN Development: Influential figures such as Hopfield and Hinton have played pivotal roles in the abstraction and transformation of ANNs.

🔄 Complexity of Progress: The development of ANNs is marked by contributions from various teams and ideas, complicating the tracing of a direct path from early work to modern applications like ChatGPT.

🔍 Transformers: This new form of ANN encodes and decodes information, proving effective in tasks like object detection and recognition.

📈 Learning Techniques: Methods such as back-propagation and long short-term memory enable ANNs to learn and retain information over time.

⚠️ Concerns About AI: Hinton has expressed worries about AI systems potentially surpassing human intelligence, leading to a loss of control.

🌳 Complexity of AI Risks: The intricate nature of AI development poses challenges in fully understanding its implications and risks.

Key Developments and Concerns

Technological Evolution: From individual computers to cloud-based networks.

Influential Contributors: Hopfield and Hinton's significant roles.

Progress Complexity: Diverse contributions complicate tracing development.

Transformers: Effective in encoding, decoding, and recognition tasks.

Learning Techniques: Back-propagation and memory retention methods.

AI Concerns: Risks of AI surpassing human intelligence.

AI Risks Complexity: Challenges in understanding AI implications.

How will tech reshape protein studies?

Why is the work of the chemistry laureates, David Baker, Demis Hassabis, and John Jumper, significant?

Privali Prakash
Vasudevan Mukunth

The story so far:

The 2024 Nobel Prize for Chemistry was jointly awarded to David Baker for his work on computational protein design and to Demis Hassabis and John Jumper for developing technologies to predict the structure of proteins.

Why are proteins important?

The chemistry prize concerns two areas in the field of protein research: design and structure.

All life (as is known) requires proteins and all proteins are made of amino acids. While there are many types of amino acids in nature, only 20 of them in different combinations make up all the proteins in the human body and in most life forms. Amino acids are found in tissues that provide structural support; they are catalysts in biochemical reactions; move molecules across biological membranes; control muscle contraction that lets us move around and have our hearts beat; and help cells communicate to perform their tasks.

What is the protein-folding problem?

A protein has many identities and one of them depends on the arrangement of its amino acids in the three dimensions of space – in other words, its 3D structure. In 1962, University of Cambridge researchers John Kendrew and Max Perutz won the Chemistry Nobel Prize for elucidating the first 3D models of hemoglobin and myoglobin, both proteins, using X-ray crystallography.

In 2022, Baker's team developed an antiviral nasal spray to treat COVID-19. At its heart were proteins the team designed using computational methods to stick to vulnerable sites on the viral surface and target the spike protein

One breakthrough arrived in 1969 when scientists found that a protein does not try to bend into different shapes. It somehow knows the shape it needs to have and rapidly folds itself to acquire it. The mysterious nature of this 'knowledge' of the protein is called the protein-folding problem.

By the late 2010s, scientists had worked out the structures of around 17 lakh proteins – a large number yet still small compared to the roughly 200 million proteins in nature. This situation changed drastically around 2018.

What is AlphaFold?

Hassabis co-founded DeepMind in 2010 which Google acquired in 2014. Here, Hassabis and his colleagues unveiled AlphaFold in 2018. AlphaFold is a deep-learning model to predict the structures of almost all proteins. DeepMind launched its successor AlphaFold 2 in 2020, when it was able to predict the structure of proteins with an accuracy comparable to that of X-ray crystallography.

Jumper led the work on AlphaFold 3, which can predict the structures of various proteins and how two proteins and/or a protein and another molecule might interact. These models are capable of deducing the 3D shapes of most proteins in a matter of hours. However, they have not been able to say why a protein prefers a particular structure. Scientists have thus said it can help them test their hypotheses; making sense of them is still the task of humans.

As Derek Lowe, a pharmaceutical researcher and author of a column in *Science*, put it to *The Hindu* in June 2024, "If the protein folding problem was set to us by God to teach us how to learn molecular interactions from first principles, we cheated."

What is protein design?

Baker developed tools scientists use to design new proteins with specific shapes and functions. His first notable work was in 2003 when he led a team to create a novel protein and determined its structure using a bespoke computer program they had developed in 1999 called 'Rosetta'. The researchers compared Rosetta's output with that obtained from X-ray crystallography studies and found them remarkably similar.

According to the Nobel Committee for Chemistry, "Rosetta was designed to be a general program both for protein structure prediction and design, and it has continuously been developed since its inception, with a large cadre of users and co-developers."

The ability to design proteins has far-reaching implications. For example, in 2022, Baker's team developed an antiviral nasal spray to treat COVID-19. At its heart were proteins the team designed using computational methods in the laboratory to stick to vulnerable sites on the viral surface and target the spike protein.

Teams involving Baker have also designed new enzymes to support organic chemistry reactions of commercial value, including the aldol reaction (used to make atorvastatin) and the Diers-Alder reaction (to make vitamin B6). Recently, scientists have been exploring novel protein designs for use as biosensors to monitor, say, blood glucose levels in people with diabetes.

Topic → Nobel Prize in Chemistry 2024: Advancements in Protein Research

Key Highlights

🏆 Award Recipients: The 2024 Nobel Prize for Chemistry was awarded to David Baker, Demis Hassabis, and John Jumper for their groundbreaking work in protein research.
🔬 Proteins: Essential for all known life forms, proteins are composed of 20 different amino acids that combine in various ways.

💪 Amino Acids: These play crucial roles in structural support, biochemical reactions, muscle contraction, and cellular communication.

🧬 Protein-Folding Problem: This refers to how proteins determine their correct 3D structure and fold accordingly without trial and error.

📊 Protein Structures: By the late 2010s, scientists had determined the structures of approximately 170,000 proteins, a small fraction of the estimated 200 million proteins in nature.

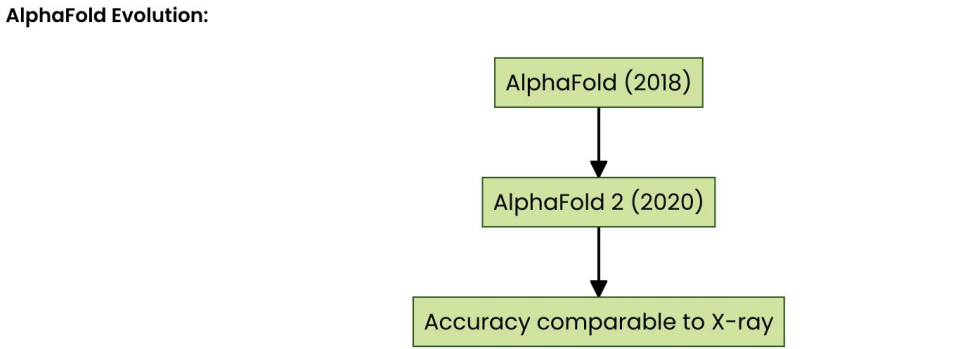
📅 Research Progress: Significant advancements in understanding protein structures began around 2018, enhancing research capabilities in this field.

🏅 Historical Context: The first 3D models of proteins were created in 1962 by John Kendrew and Max Perutz, earning them the Nobel Prize for their pioneering work.

AlphaFold and Protein Design Advancements

Overview of AlphaFold

🧬 AlphaFold Overview: AlphaFold, a deep-learning model by DeepMind, was introduced in 2018 to predict protein structures.
🚀 AlphaFold 2 Launch: Released in 2020, AlphaFold 2 achieved accuracy on par with X-ray crystallography for protein structure prediction.

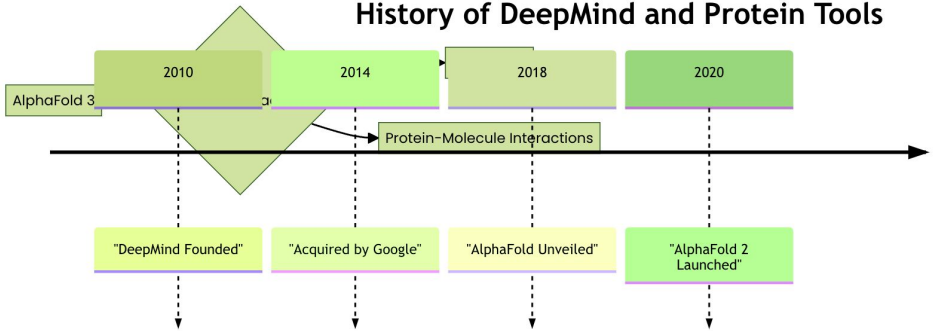


Development and Limitations

🔍 AlphaFold 3 Development: Led by Jumper, AlphaFold 3 predicts interactions between proteins and molecules, determining 3D shapes swiftly.

🧪 Limitations of AlphaFold: While predicting structures, AlphaFold does not explain the preference for specific structures, leaving interpretation to scientists.

AlphaFold 3 Capabilities:



Historical Context and Tools

📅 Historical Context: DeepMind, co-founded by Hassabis in 2010, was acquired by Google in 2014, marking AI advancements in protein research.

💻 Protein Design Tools: Baker's tools, using the Rosetta program since 2003, have achieved results comparable to X-ray crystallography

Scientific Implications

📊 Scientific Implications: The progress in protein folding and design underscores the synergy between AI and molecular biology, aiding hypothesis testing but necessitating human interpretation.

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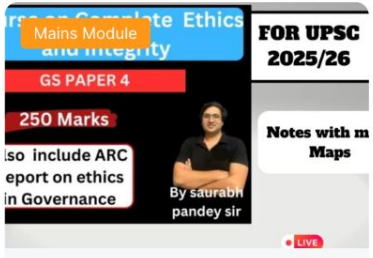

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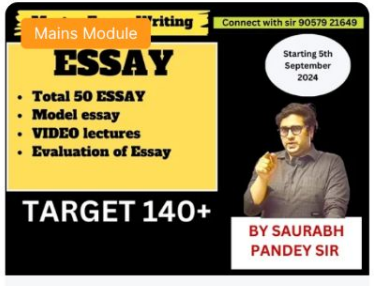

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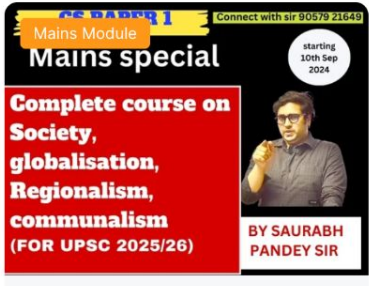

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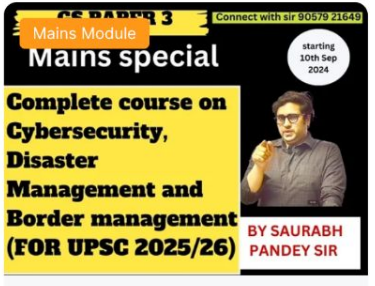

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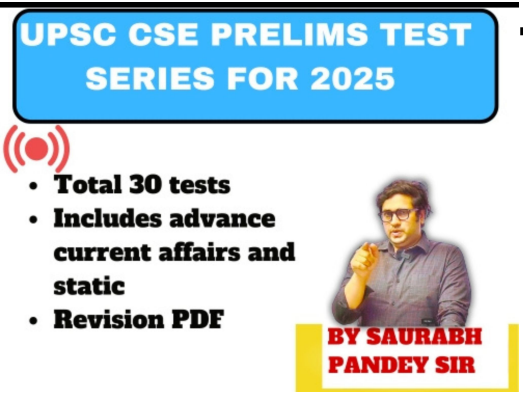

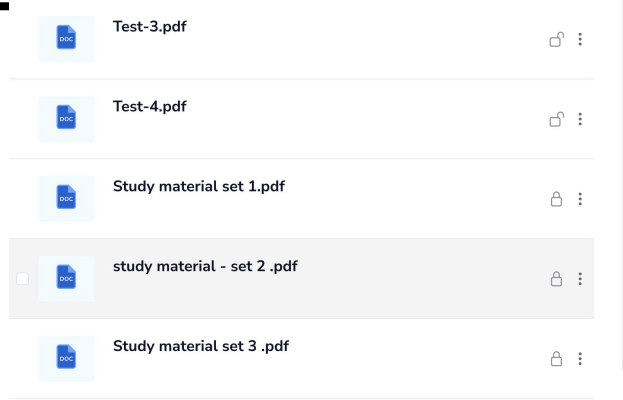

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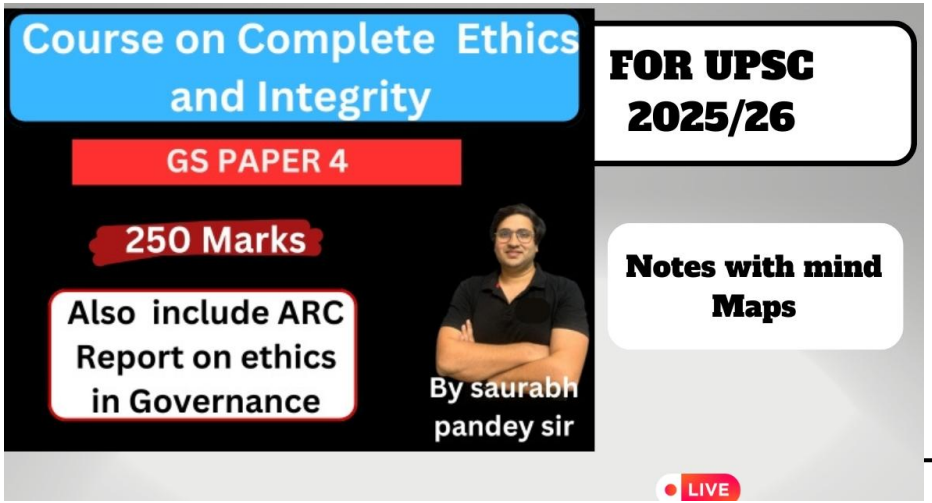

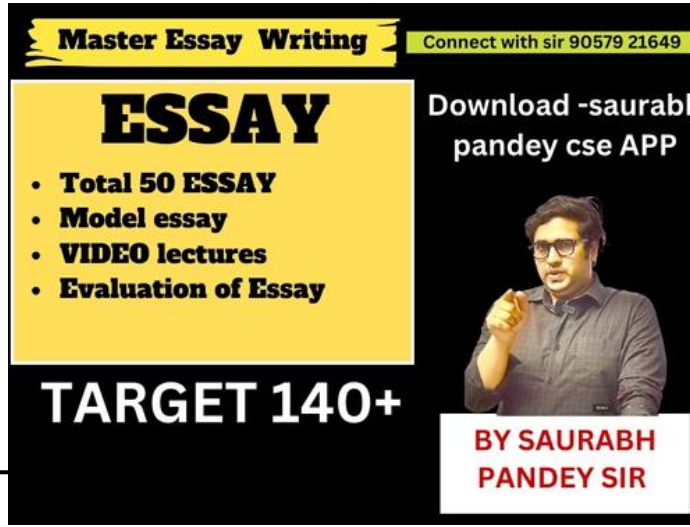

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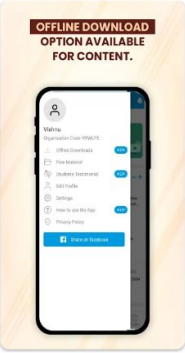

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