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- Almatti Dam
- Wolbachia bacteria
- Tra gene
- palimpsest.
- Two galaxies merging
- Supreme court on CBI Jurisdiction
- The SC ruling on portrayal of disability in films



By Saurabh Pandey



THE HINDU

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- New particle formation
- Island syndrome
- Monoclonal antibodies
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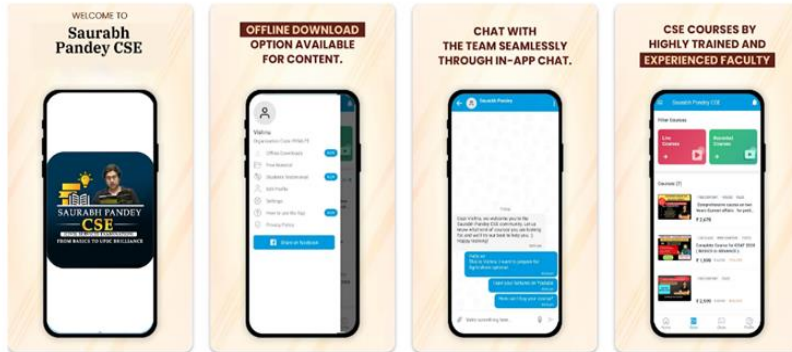
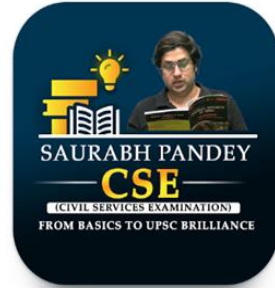
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Batch-1

Farmers, officials in Andhra Pradesh hopeful as water storage rises in Almatti Dam



G.V.R. Subba Rao

VIJAYAWADA

Rainfall in the catchment areas of the Krishna river has kindled the hopes of Water Resources Department (WRD) officials and farmers alike.

The water levels at the Almatti Dam in Karnataka are rising with considerable inflows of 23,678 cusecs as of July 13.

The water stored in the dam is 92.17 tmcft as against its total capacity of 129.72 tmcft. The full reservoir level is 1,705 ft.

The Narayanapur reservoir's storage was 25.5 tmcft. The two major reservoirs have 117.67 tmcft of water currently, as against 40.21 tmcft during the corresponding period last year. The Andhra Pradesh government has re-



Full flow: A view of the Lal Bahadur Shastri reservoir in Almatti over the Krishna river. FILE PHOTO

leased 1,500 cusecs of Krishna water from the eastern delta regulator on the Prakasam barrage last Wednesday.

To meet different needs

First, the water will be utilised to meet the drinking water needs in 11 Assembly constituencies and then will be used to cater to the Kharif crops. The farmers

have taken up seedbeds as part of their Kharif operations. Now, with heavy rain lashing upstream of Srisaigram, they are pinning hopes on the release of water from the Almatti Dam, which would fill up the reservoirs downstream.

According to WRD officials, as much as 92 tmcft of water is stored in Almatti Dam.

Almatti Dam

- The Lal Bahadur Shastri Dam is also known as Almatti Dam is a hydroelectric project on the **Krishna River** in **North Karnataka**, India which was completed in July 2005.

Scientists find that a bacteria tricked a wasp to get rid of its males

Shenyang Agricultural University researchers noticed that in the wild, *Encarsia formosa* wasps almost never produced males. In the laboratory, however, they found that if the female wasp was treated with tetracycline, an antibiotic, almost 70% of the progeny were male

D.P. Kasbekar

A hundred years ago, two American researchers named Marshall Hertig and Simeon Burt Wolbach discovered that mosquitoes harboured bacteria within their cells. Other researchers later found similar bacteria in the cells of most insects and many other arthropods. The genus to which the bacteria belonged was named *Wolbachia*.

Wolbachia bacteria are also present in insect eggs, but they are absent in the sperm. This means females can transmit *Wolbachia* to their offspring, whereas males can't – from the bacteria's point of view, an evolutionary dead end. As a result, *Wolbachia* have evolved ways to manipulate their insect hosts to produce more female than male progeny.

A new study reports that the bacteria may have taken it a bit too far this time. Researchers from Shenyang Agricultural University (SAU), China, published a paper in the June 3 issue of the journal *Current Biology* showing that *Wolbachia* bacteria had manipulated the wasp *Encarsia formosa* to entirely get rid of its males.

The farmer-friendly Amazon

E. formosa wasps are of interest to agricultural scientists because they provide an efficient way to control whiteflies. Whiteflies feed on the sap of plant leaves, causing productivity losses, and are thus a major agricultural pest. Whiteflies belong to the insect order *Hemiptera*, whereas wasps belong to the insect order *Hymenoptera*. The wasp seeks out the nymphs (or larvae) of whiteflies and lays its eggs on them. When the eggs hatch, the larvae that emerge penetrate the nymph, feed on its tissues, grow to adulthood, and in the process kill the nymph.

The progeny wasps emerge from the nymph's carcass. As a parasitoid of whiteflies, the female wasp is in effect a search and destroy weapon. The male wasps are superfluous in this role.

Doubling up with *Wolbachia*

Generally, among hymenopterans such as ants, bees, and wasps, the eggs fertilised by sperm cells develop into females, while unfertilised eggs develop into males. The males contain only one set of chromosomes, derived from the egg, and are thus said to be haploid. In contrast, the females are diploid because they contain two sets of chromosomes: one set derived from the egg and the other from the sperm.

The females use a specialised form of cell division called meiosis to transmit only one set of chromosomes to their eggs, while the males transmit their single



Tomato leaf with whitefly nymphs (white) parasitised by *Encarsia formosa* wasps (black). These wasps were among the world's first agents of biological pest control. GOLDLOCK (CC BY-SA 3.0)

chromosome set to all of their sperm by the more general cell-division process called mitosis. This, in a nutshell, is how haplo-diploid sex determination works.

The SAU researchers noticed that in the wild, the *E. formosa* wasp almost never produced males.

In the laboratory, however, they found that if the female wasp was treated with an antibiotic (usually tetracycline), almost 70% of the progeny were male. (They are easy to identify with the eye. The females are tiny – about 0.6 mm long – and are black with a yellow abdomen; the males are only slightly larger but completely black.)

The reason for this was that antibiotic treatment reduced the titre, or concentration, of the *Wolbachia* bacteria. As a result, the chromosome number remained undoubled and the eggs developed into males.

That is, normal titres of *Wolbachia* bacteria could induce unfertilised eggs to somehow double the chromosome number and enable the development of female wasps. We don't yet know how the bacteria do this, but again, this action rendered the males superfluous.

The findings are of interest even to scientists whose primary interest is not whitefly control.

A coleoptera gene to the rescue

A gene named *tra* has an evolutionarily conserved role in promoting female



Wolbachia bacteria are also present in insect eggs, but they are absent in the sperm. This means females can transmit *Wolbachia* to their offspring, whereas males can't

development in insects. ('Evolutionarily conserved' means all insects have it.)

That is, if the *tra* gene mutates, cells won't be able to make a functional Tra protein, and progeny development proceeds along the default mode towards male production.

The SAU researchers found that the *tra* gene in the *E. formosa* genome was missing some 'pieces' important for its function. How then did the female wasps develop?

The researchers found the genome of the wasp's *Wolbachia* bacteria contained a functional version of *tra*. Ordinarily, bacteria don't have any reason to possess a *tra* gene. But the wasp's *Wolbachia* acquired one from a distantly related insect, one belonging to the order coleoptera, which includes beetles. That is, the bacteria had acquired the gene through horizontal gene transfer.

Having lost its own *tra* gene, the *E. formosa* wasps had to rely on their *Wolbachia*'s *tra* gene to allow their eggs to develop into females. This is the first

example of a bacterium using a horizontally transferred gene to manipulate female production in an insect.

No males, no species

The males produced by the SAU researchers after antibiotic treatment didn't mate with females and didn't inseminate them. This could be because the males were absent from *E. formosa* populations for so long that they have now lost their ability to mate. An alternative possibility is that the inability to mate was an unintended consequence of antibiotic treatment.

To resolve these two possibilities, scientists will now need to examine those rare naturally produced males to know whether at least a fraction of them can engage in sex with females. If sexual exchange is absolutely missing in the wasp, the species will no longer have the ability to purge bad mutations that accumulate in its genome. In this case, the wasp-*Wolbachia* duo faces a relatively early extinction.

The *Wolbachia* bacteria were shown to be smart enough to double the chromosome number in their host's unfertilised eggs and to supply them with *tra*. But are they also smart enough to occasionally allow a few males to emerge and enable sexual exchange and thus delay their own extinction?

(D.P. Kasbekar is a retired scientist.)

THE GIST

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Wolbachia bacteria



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- **Other researchers later found similar bacteria in the cells of most insects and many other arthropods.**
- **The genus to which the bacteria belonged was named Wolbachia.**
- **Wolbachia bacteria are also present in insect eggs, but they are absent in the sperm.**

- **This means females can transmit Wolbachia to their offspring, whereas males can't — from the bacteria's point of view, an evolutionary dead end.**
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E. formosa

- **E. formosa wasps are of interest to agricultural scientists because they provide an efficient way to control whiteflies.**
- **Whiteflies feed on the sap of plant leaves, causing productivity losses, and are thus a major agricultural pest.**
- **Whiteflies belong to the insect order Hemiptera, whereas wasps belong to the insect order Hymenoptera.**

- **The wasp seeks out the nymphs (or larvae) of whiteflies and lays its eggs on them. When the eggs hatch, the larvae that emerge penetrate the nymph, feed on its tissues, grow to adulthood, and in the process kill the nymph.**
- **The progeny wasps emerge from the nymph's carcass.**
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About 'Tra'



- A gene named tra has an evolutionarily conserved role in promoting female development in insects. ('Evolutionarily conserved' means all insects have it.)
- That is, if the tra gene mutates, cells won't be able to make a functional Tra protein, and progeny development proceeds along the default mode towards male production.
- Having lost its own tra gene, the *E. formosa* wasps had to rely on their *Wolbachia*'s tra gene to allow their eggs to develop into females.
- This is the first example of a bacterium using a horizontally transferred gene to manipulate female production in an insect

WHAT IS IT?

Palimpsest: a historic emblem of reuse

Vasudevan Mukunth

For a major part of history, people used parchment to write. Parchment was a writing material made from the untanned skins of animals, especially goats. Since it was expensive in many parts of the world, people often scraped or washed off any existing text on parchment and reused it to write. Any page that has been reused in this manner is called a palimpsest. Writers used many methods to remove existing text from parchment. Until the early Middle Ages, they used milk and oat bran. Older text would often reappear on palimpsests washed in this way and such text was called underwriting. Contemporary scholars have often been able to decipher the underwriting to reveal otherwise inaccessible historical texts; they are also beginning to use machine learning to glean more information from it. Towards the late mediaeval period, writers turned to scraping text away with pumice, permanently 'deleting' it. Many a famous textual work has survived only as palimpsests, including the Sana'a palimpsest, the Archimedes palimpsest, and Cicero's 'De re publica'. Other scholars have adopted this word to refer to analogous instances in their fields of study. For example, in astronomy, palimpsests refer to craters on planetary bodies



Many a famous work has survived only as palimpsests, including the Sana'a palimpsest, the Archimedes palimpsest, and Cicero's 'De re publica'. Image for representation only. GETTY IMAGES

— like other planets and moons — that have become eroded to barely resemble one. A palimpsest in geology is a natural feature created by different structures forming at the same location at different times.

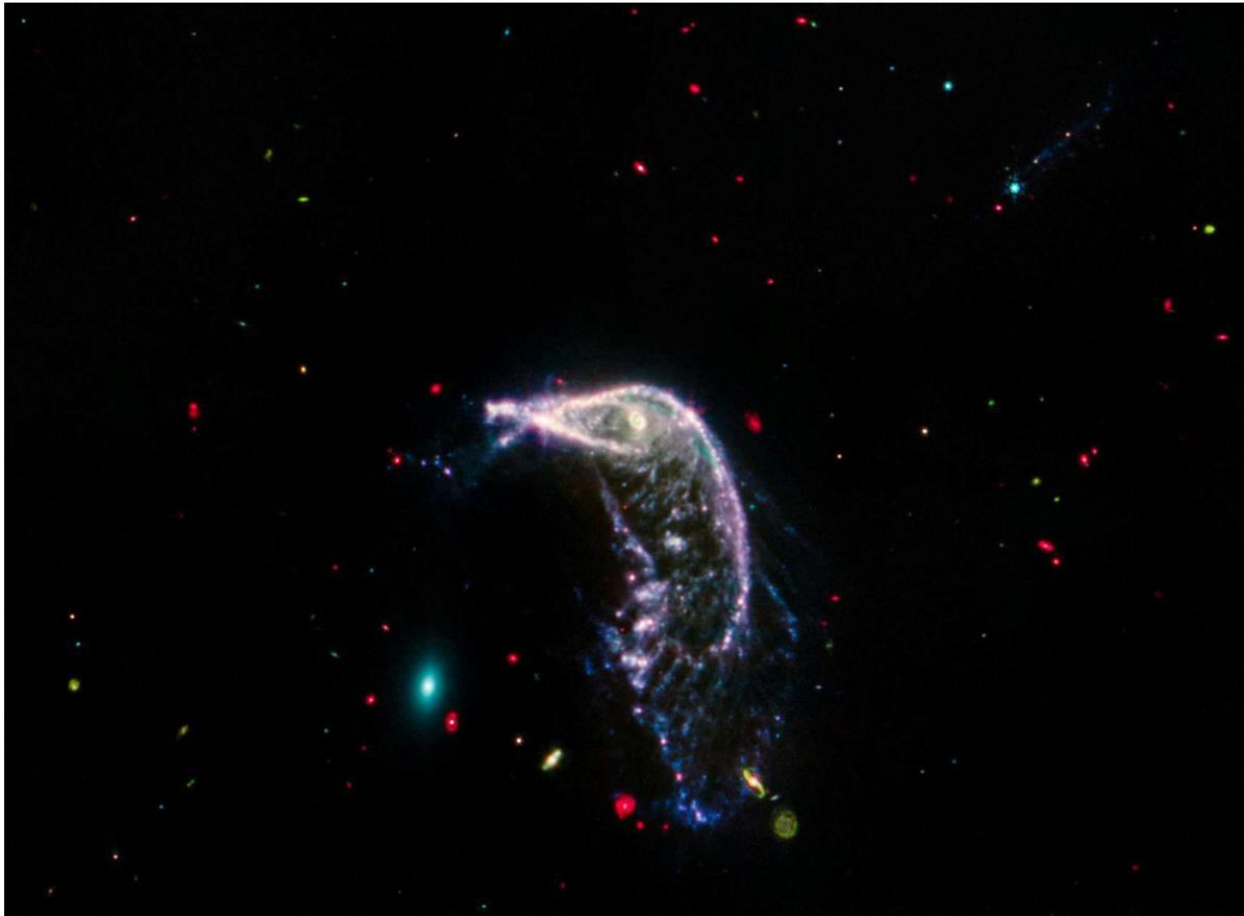


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BIG SHOT



Two galaxies interact in an image taken by the James Webb Space Telescope using its Mid-Infrared Instrument (MIRI). It was released by NASA on Friday. At left is NGC 2937, an elliptical galaxy that looks like a tiny teal oval and is nicknamed the Egg. At right is NGC 2936, a distorted spiral galaxy nicknamed the Penguin, which is larger. NASA, ESA, CSA, STSCL

Two galaxies merging

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- NGC 2937, an elliptical galaxy that looks like a tiny teal oval and is nicknamed the Egg.
- NGC 2936, a distorted spiral galaxy nicknamed the Penguin, which is larger.

On the jurisdiction of the CBI

Is the Central Bureau of Investigation an independent agency or does it come under the control of the Union government? Does the CBI need the permission of the State to carry out investigation in its territory? Which are the States that have withdrawn general consent to the central agency?

EXPLAINER

Aaratiika Bhanuik

The story so far

The Supreme Court on July 10 upheld the maintainability of the West Bengal government's suit accusing the Union government of "constitutional overreach" by employing the Central Bureau of Investigation (CBI) to register and investigate cases in the State despite its withdrawal of general consent on November 16, 2008. A Bench comprising Justices B. R. Gavai and Sandeep Khosla rejected the Centre's preliminary objections that it was wrongly made a defendant in the suit as it did not control the CBI, which was an "independent agency." Parsing various provisions of the Delhi Special Police Establishment (DSPE) Act, 1946, under which the CBI functions, the Bench concluded "the very establishment, exercise of powers, extension of jurisdiction, the superintendence of the DSPE [Act], all vest with the Government of India. Accordingly, the Court ruled that the suit discloses a valid cause of action and must be heard on merits. It pointed the next hearing on August 13.

What is general consent?

Under Section 6 of the DSPE Act, the CBI is required to obtain consent from the concerned State government before initiating an investigation within its jurisdiction.

"This permission is crucial since 'police' and 'public order' are subjects that fall within the State List under the seventh schedule of the Constitution. However, no such prior consent is necessary in Union territories or railway areas. General consent is given by States to facilitate the agency's seamless investigation into corruption charges against Central government employees in their territories. However, since 2015, several States such as Chhattisgarh, Jharkhand, Kerala, Mizoram, Punjab, Rajasthan, Telangana, Meghalaya and West Bengal have revoked their general consent alleging that the Centre is misusing the federal agency to unfairly target the Opposition. "In the absence of such an omnibus consent, the CBI will be unable to register any fresh cases in these States without the explicit permission of the respective State governments," P. D. T. Achary, former Secretary General, Lok Sabha told *The Hindu*.

What does the case filed by the West Bengal government allege?

In August 2021, the West Bengal government filed an original suit under Article 131 of the Constitution arguing that the actions of the Union government and the involvement of the CBI in the State infringed upon its sovereignty. The suit highlighted that despite the withdrawal of general consent for CBI investigations by the Trinamool Congress government on November 16, 2008, the agency proceeded to register 12 new cases. Bearing this to be a "constitutional overreach," the State sought the annulment of these 12 cases and a restraint on the agency from lodging any further cases.

The framers of the Constitution envisioned such conflicts between the Centre and the States owing to the existing quasi-federal structure and dual polity. As a result, they conferred original and exclusive jurisdiction upon the Supreme Court to address such disputes, under Article 131. For a suit to be maintainable under this provision, two conditions have to be satisfied — it should



SHYAMGANG

relate to a dispute between the Government of India and one or more State Governments, (ii) between one or more State Governments, and (iii) must involve a question of law or fact crucial to the determination of legal rights. In *State of Karnataka vs Union of India* (1977), the Supreme Court observed that Article 131 is a feature of federalism and should be "widely and generously interpreted" to advance the intended remedy. Similarly, in *State of Rajasthan & Ors vs Union of India* (1977), the top Court cautioned against taking a very "restrictive or a hyper technical view of the State's rights".

What was the Union government's argument?

Solicitor-General Tushar Mehta, appearing for the Union government, pressed the Court to dismiss West Bengal's suit by raising preliminary objections to its maintainability. He pointed out that original suits under Article 131 of the Constitution exclusively involve the Union and States as parties. "It is the CBI which has registered the cases in question. But the CBI is not a defendant in this suit, and it cannot be made one, as the CBI is not a 'State' under Article 131," Mr. Mehta contended.

He further argued that the CBI was an "independent agency" since it did not function under the direct control of the Union government. "The Union does not supervise the registration of offences or investigation or closure or filing of charge-sheet or conviction or acquittal of cases by the CBI," he reasoned. However, later in the proceedings, Mr. Mehta finally conceded that the agency cannot initiate

any investigation without the express authorisation of the Union government under Section 5 of the DSPE Act.

On the contrary, senior advocate Kapil Sibal highlighted that the case extended beyond the Centre's control over the CBI to the fundamental question of whether the agency could disregard a specific notification issued by the West Bengal government in 2008, withdrawing its consent. Mr. Sibal asserted that once a State grants and then withdraws its consent, the CBI lacks jurisdiction to exercise its powers within that State.

What did the verdict state?

The Court observed that a bare perusal of the provisions of the DSPE Act reveals that right from the constitution of the CBI, the classes of offences which are to be investigated by it, its administration and powers, it is the "Central government that is truly concerned with."

"Under Section 5 of the DSPE Act, except the offences under the Prevention of Corruption Act, in which the superintendence will be with the Central Vigilance Commission, the superintendence of the DSPE [in all other matters] would rest with the Central government," Justice Gavai, who authored the verdict, noted. The judge also reminded the Centre that Section 5 of the DSPE Act mandates the prior consent of the State government to a CBI probe within its jurisdiction.

While the Court recognised that the CBI would always be entitled to investigate innocent individuals, it underscored that this autonomy "would not water down" its administrative control and superintendence that vests

with the Centre. It thus proceeded to conclude that the Solicitor General's argument that the CBI is an "independent agency" holds no water.

The verdict, however, clarified that these observations were only made to meet the preliminary objections raised by the Union government and would not have any bearing on the merits of the suit.

What are the implications?

According to Mr. Achary, if the CBI is permitted to initiate investigations in States that have revoked their general consent, it would be an affront to federalism. "This could strain Centre-State relations, particularly since the police is a State subject under the Constitution. Allowing the CBI to register cases would effectively control upon it the same powers as the State police forces," he adds. While the Supreme Court has so far only addressed preliminary objections to the maintainability of West Bengal's suit, the constitutional aspect pointed out that the final ruling on its merits will have a significant bearing on other similar pending cases.

Another Bench of the top Court is tackling a similar question of law related to the State of Tamil Nadu in the case of *Anish Tnani vs Enforcement Directorate* (ED) officer against whom the Tamil Nadu Directorate of Vigilance and Anti-Corruption had launched a criminal prosecution for bribery. A Bench of Justices Surya Kant and V. Ramaswami had recommended judicial oversight over the cross-free of criminal cases filed between Central agencies like the ED and not water down "its administrative control and superintendence that vests

THE GIST

The Supreme Court on July 10 upheld the maintainability of the West Bengal government's suit accusing the Union government of "constitutional overreach" by employing the Central Bureau of Investigation (CBI) to register and investigate cases in the State despite its withdrawal of general consent on November 16, 2018.

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Supreme court on CBI Jurisdiction

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- **General consent is given by States to facilitate the agency's seamless investigation into corruption charges against Central government employees in their territories.**
- **However, since 2015, several States such as Chhattisgarh, Jharkhand, Kerala, Mizoram, Punjab, Rajasthan, Telangana, Meghalaya and West Bengal have revoked their general consent alleging that the Centre is misusing the federal agency to unfairly target the Opposition**

About Verdict



- **The Court observed that a bare perusal of the provisions of the DSPE Act reveals that right from the constitution of the CBI, the classes of offences which are to be investigated by it, to its administration and powers, it is the “Central government that it is vitally concerned with.”**
- **“Under Section 4 of the DSPE Act, except the offences under the Prevention of Corruption Act, in which the superintendence will be with the Central Vigilance Commission, the superintendence of the DSPE in all other matters would vest with the Central government,” Justice Gavai, who authored the verdict, noted.**

- **The judge also reminded the Centre that Section 6 of the DSPE Act mandates the prior consent of the State government to a CBI probe within its jurisdiction.**
- **While the Court recognised that the CBI would always be entitled to investigate offences independently, it underscored that this autonomy “would not water down” its administrative control and superintendence that vests with the Centre**

The court on portrayal of disability in films

Are the laws governing rights of differently abled persons being implemented properly?

Sreyama Chakrabarty

The story so far:

On 1 July, while hearing a plea to ban the film *Asaad Mehoi* for derogatory portrayal of people with disabilities, the Supreme Court in a landmark ruling laid down comprehensive guidelines to prevent stereotyping and discrimination of persons with disabilities (PwD) in visual media, including film and documentaries.

What is the framework?

The Supreme Court's framework focuses on the prevention of stigmatisation and discrimination, recognising their profound impact on the dignity and identity of persons with disabilities. Among the guidelines it calls to avoid work that cultivate institutional discrimination, such as "trippin' and 'spacin'", as they contribute to negative self-image and perpetuate discriminatory attitudes. A bench headed by the Chief Justice of India J.V. Chandrachud said stereotyping differently abled persons in visual media and films must end, asking creators to provide an accurate representation of disabilities rather than mocking them. Language that individualises the impairment and overlooks disabling social barriers, for example, words like "afflicted," "suffering" and "victim," should be avoided, it said. The court also asked creators to practice the principle of "nothing about us, without us," and involve persons with disabilities in the creation and assessment of visual media content.

What are laws which grant disability rights?

The law which comprehensively deals with disability rights is the Rights of Persons with Disabilities (RPWD) Act which came into force from April 19, 2017. It replaced the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995. The National Trust Act (1999), Rehabilitation Council of India Act (1992), Mental Health Care Act (2017) are the other laws that govern disability rights.

According to Shashank Pandey, a lawyer based out of Delhi and a founder of the Politics and Disability Forum, there are broadly two models under which disability rights are upheld. The first model, which is based on medical and social models, at, namely medical and social models. The human rights model, which is a recent one, is an evolution of the social model which says that people with disability are a part of society and have the same rights as everyone else. The Supreme Court's emphasis on the human rights model is significant as it makes the government and private parties obliged to facilitate full and effective participation of persons with disabilities in society. The advantage is that it places individuals in a sphere where all human rights principles which are applicable to everyone can be claimed by the disabled populace. The disadvantage is that it is an abstract idea and difficult to implement, says Mr. Pandey. The framework is also limited, as it is only for visual media, he adds, pointing out that the guidelines could have been sent by the SC to all departments for sensitisation.

V. Manoharan of the National Platform for the Rights of the Disabled welcomed the ruling, adding that the framework has stressed on the guidelines which were in place in the 2006 legislation. He rues the fact that the law is not being implemented properly. "However, we cannot lose sight of the conditions prevailing in the country. Disabled people are still considered objects of charity. Even the government's concept of 'divyang' looks at disability through the lens of charity. It is regressive and reinforces a patronising mindset. Also, the use of words like 'pappu' and 'halak bhalak' by the ruling party to paint its opponents in a poor light only shows how big the hurdle is," he points out.

What about creative freedom?

Creative expression doesn't have absolute power when it operates in the context of marginalised communities. It has to be looked at from the overall context of the expression and intent behind the expression. The Supreme Court said "the creative freedom of the filmmaker cannot include the freedom to lampoon, stereotype, misrepresent or disparage those already marginalised". In determining these aspects, the "intention" and "overall message" of the film have to be considered.

What is the way forward?

The court emphasised on collaboration with disability advocacy groups to gain valuable insights and guidance on respectful and accurate portrayals, ensuring the content aligns with the lived experiences of persons with disabilities. It has also said that implementing training programmes for writers, directors, producers, and actors to emphasise the impact of portrayals on public perception and the lived experiences of persons with disabilities is a necessity.



The SC ruling on portrayal of disability in films



- while hearing a plea to ban the film *Aaankh Micholi* for derogatory portrayal of people with disabilities, the Supreme Court in a landmark ruling laid down comprehensive guidelines to prevent stereotyping and discrimination of persons with disabilities (PwDs) in visual media, including films and documentaries.

What is the framework?

- **The Supreme Court’s framework focuses on the prevention of stigmatisation and discrimination, recognising their profound impact on the dignity and identity of persons with disabilities.**
- **Among the guidelines is a call to avoid words that cultivate institutional discrimination, such as “cripple” and “spastic,” as they contribute to negative self-image and perpetuate discriminatory attitudes.**

- **A Bench headed by the Chief Justice of India D.Y. Chandrachud said stereotyping differently abled persons in visual media and films must end, asking creators to provide an accurate representation of disabilities rather than mocking them.**

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How is India's hunt for critical minerals going?

Why are lithium, copper, cobalt, graphite and others essential for the economy's green transition? In which States have reserves been found? Why have there been hiccups in the auction process? What lies ahead? Which country dominates global supplies?

Vikas Dhoot

The story so far:

In late June, the Centre declared the winning bidders for mining rights in six blocks of critical minerals, including graphite, phosphorite and lithium, for which India largely relies on imports. These are the first private players awarded such rights under the revamped Mines and Minerals law.

Why are critical minerals important?

Minerals such as copper, lithium, nickel, cobalt are known as critical minerals, as they along with some rare earth elements, are essential for the world's ongoing efforts to switch to greener and cleaner energy. As per the International Energy Agency (IEA), lithium demand rose by 30% in 2023, followed by nickel, cobalt, graphite and rare earth elements which saw an 8% to 15% growth, with the aggregate value of such minerals pegged at \$325 billion. In its Global Critical Minerals Outlook 2024 report, the agency has flagged that the world's goal to limit global warming to 1.5 degrees Celsius in the net zero emissions scenario, would translate into very rapid growth in demand for these minerals. By 2040, the demand for copper is expected to rise 50%, double for nickel, cobalt and rare earth elements, quadruple for graphite and

India has natural reserves of some of these minerals, but they haven't been explored or tapped fully

eightfold for lithium, which is crucial for batteries. The development of sustainable supply chains for such minerals is, therefore, an unavoidable task. In India, the lack of ready reserves of critical minerals has resulted in 100% import dependence for minerals like lithium, cobalt, and nickel. Late last month, Union Mines Minister G. Kishan Reddy highlighted that 95% of India's copper requirements are met through imports. China is a key supplier or processor of many of these items.

What is being done to spur production?

While India has natural reserves of some of these minerals, they haven't been explored or tapped fully. For instance, India holds 11% of the world's deposits of ilmenite, the main source of titanium dioxide used in many applications, but still imports a billion dollars of titanium dioxide a year, former Mines Secretary Vivek Bharadwaj once pointed out. Then there is the "lucky" discovery of lithium reserves in the Union Territory of Jammu and Kashmir (J&K) while the Geological Survey of India (GSI) was exploring the State's terrain for limestone, which triggered hope of some self-sufficiency in the mineral. Announced as the first discovery of lithium in the country last February, these reserves were pegged at 5.9 million tonnes, enthusing the government to expedite its tapping.

Acknowledging that reliance on a few nations for the ores and processing of these minerals could pose significant vulnerabilities for Indian supply chains, the central government amended the Mines and Minerals (Development and Regulation) Act, 1957 in August 2023 to enable it to grant mining concessions for 24 critical and strategic minerals. By November, the first auctions of 20 critical mineral blocks, with the lithium block identified in J&K's Reasi district on the list, were launched, followed by two more tranches with 18 more blocks offered this February and March. However, investor interest has been tepid – the auction of most of the first 20 blocks was scrapped for lack of adequate bidders. After a delayed process, the Mines Ministry on June 24, announced six winners from the maiden auction tranche for three blocks in Odisha, and one each in Tamil Nadu,

U.P. and Chhattisgarh. The outcomes of the second and third round of auctions are still awaited, while the Ministry has initiated a fourth tranche, which includes 10 blocks that are being offered for the second time.

Why are some blocks not finding takers?

Among the first attempt blocks offered in the latest auction, two phosphorite blocks along with a glauconite block are in Chhattisgarh, while two blocks each are up for grabs in U.P. (phosphorite and rare earth elements), Karnataka (phosphate and nickel), and Rajasthan (potash and halite). A graphite block is being auctioned in Jharkhand and Arunachal Pradesh, with five additional blocks of graphite, tungsten and vanadium offered in the northeastern State for the second time. The 'second attempt' blocks also include a tungsten reserve in Tamil Nadu's Madurai district, a cobalt and manganese block in Karnataka's Shimoga, and a chromium and nickel block in Sindhudurg, Maharashtra.

As per industry experts, the reasons for low interest among miners for some of these blocks include the lack of adequate data on the potential reserves buried within them.

Technology challenges also affect outcomes. For instance, the lithium block in J&K has clay deposits, and the technology for the mineral's extraction from clay remains untested globally, pointed out Girishkumar Kadam, senior vice-president and group head for corporate sector ratings at ICRA.

When is domestic production likely to begin?

Given the preliminary stage of exploration for most of the domestic blocks being auctioned, their commercialisation and associated benefits are unlikely to fully accrue in the current decade ending 2030, ICRA said. "India's manufacturing is thus likely to remain exposed to potential future supply shocks of these minerals till then," it concluded. Apart from spurring exploration and attracting more miners, the Centre is looking to acquire overseas assets from key resource-rich regions as a parallel measure to bolster mineral security. The first such mine, for lithium brine, was acquired in Argentina this year by Khanij Bidesh India Limited, a joint venture of NALCO, Hindustan Copper, and Mineral Exploration Company. While it scouts for more assets, India has also joined the U.S.-led Mineral Security Partnership, a block consisting of large buyers and sellers of critical minerals.



Big discovery: The lithium stones found in Reasi, Jammu in 2023. PTI

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CRITICAL MINERALS: INDIA'S NET IMPORT RELIANCE (2020)

Critical Mineral	%age	Major import sources
Lithium	100%	Chile, Russia, China, Ireland, Belgium
Cobalt	100%	China, Belgium, Netherlands, US, Japan
Nickel	100%	Sweden, China, Indonesia, Japan, Philippines
Vanadium	100%	Kuwait, Germany, South Africa, Brazil, Thailand
Niobium	100%	Brazil, Australia, Canada, South Africa, Indonesia
Germanium	100%	China, South Africa, Australia, France, US
Rhenium	100%	Russia, UK, Netherlands, South Africa, China
Beryllium	100%	Russia, UK, Netherlands, South Africa, China
Tantalum	100%	Australia, Indonesia, South Africa, Malaysia, US
Strontium	100%	China, US, Russia, Estonia, Slovenia
Zirconium (zircon)	80%	Australia, Indonesia, South Africa, Malaysia, US
Graphite (natural)	60%	China, Madagascar, Mozambique, Vietnam, Tanzania
Manganese	50%	South Africa, Gabon, Australia, Brazil, China
Chromium	2.5%	South Africa, Mozambique, Oman, Switzerland, Turkey
Silicon	<1%	China, Malaysia, Norway, Bhutan, Netherlands

Source: 'Unlocking Australia-India Critical Minerals Partnership Potential', Australian Trade and Investment Commission, July 2021

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Air pollution harms pollinators more than pests, study finds

The Hindu Bureau

Bees and other beneficial bugs are disproportionately harmed by air pollution compared to crop-destroying pests, according to a new study. Researchers from the University of Reading analysed data from 120 scientific papers to understand how 40 types of insects in 19 countries respond to air pollutants like ozone, nitrogen oxides, sulfur dioxide and

particulate matter. The study published in the journal *Nature Communications* found that pollinators – including bees and some moths and butterflies – experienced a 39% decline in foraging efficiency after being exposed to elevated air pollution levels. In contrast, plant-eating aphids and other pests were not significantly impacted.

The researchers suggest that beneficial insects – such as bees and wasps –

are more affected by air pollution due to their reliance on scent-based communication. Many beneficial insects use airborne chemical signals to locate flowers, find mates, or hunt their prey.

Air pollutants can chemically alter these scent trails or interfere with insects' ability to detect them, essentially disrupting their sensory landscape. In contrast, many pests rely less on long-dis-

tance scent cues and more on direct contact or visual cues, making them less vulnerable to air pollution's effects on airborne chemical signals.

The study focused on how air pollution impacts various insect behaviour and biological aspects, including feeding, growth, survival, reproduction, and ability to locate food sources. Of all these factors, insects' ability to find food was most severely im-

paired by air pollution, declining by about one-third on average.

Among air pollutants, ozone emerged as particularly harmful to beneficial insects, reducing their ability to thrive and carry out their roles in the ecosystem by 35%. Ozone pollution has the most detrimental impacts and even low ozone levels below current air quality standards can cause significant damage. Nitrogen oxides

also substantially impaired beneficial insects.

“Changes in invertebrate performance are not dependent on air pollutant concentrations, indicating that even low levels of pollution are damaging. Predicted increases in tropospheric ozone could result in unintended consequences to global invertebrate populations and their valuable ecological services,” the researchers write.

Air pollution harms pollinators more than pests,

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Nobel laureate supports India's pursuit for a neutrino lab

Nobel laureate Takaaki Kajita opens up about the parallels and contrasts between Japan and India's quests to further research on enigmatic elementary particles called neutrinos

Nandita Jayaraj

If the obstacle-ridden India-based Neutrino Observatory (INO) ever becomes a reality, it will be one of the largest basic science projects in the country. Nobel laureate and neutrino researcher Takaaki Kajita is convinced that the proposed underground laboratory is still worth fighting for.

Neutrinos are abundant particles that may be relevant to our understanding of the origin of matter in the universe. About 60 years ago, historic science experiments inside a goldmine in Kolar, Karnataka, led to the 1965 discovery of atmospheric neutrinos.

This was a collaboration between Indian, Japanese and British scientists. Japan continued with experiments in the underground Kamioka Observatory situated under Mount Ikeno. Japan established a dedicated neutrino observatory, Super-Kamiokande, which began operation in 1996.

The INO would be located a kilometre underground, and hence would have minimal impact on wildlife and the ecosystem.

India's INO dream is worth salvaging

Over a decade after a proposal was drawn, the fate of INO is still uncertain

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• The INO would be located a kilometre underground, and hence would have minimal impact on wildlife and the ecosystem

• The experiments to be will neither produce any radioactivity nor can it function well where there is radiation.

• In fact, the main reason for locating the laboratory underground is to create an environment free of the radiation that abounds on the Earth's surface

Nobel laureate Takaaki Kajita is convinced that the proposed underground laboratory is still worth fighting for.

PHOTO: NANDITA JAYARAJ



derway. After extensive deliberations, a proposal was drawn and in 2011, the Indian government announced its intention to set aside about Rs.1,350 crores for an India-based Neutrino Observatory, which would be situated 1.3 km underground in Tamil Nadu. Over a decade later, there has been no progress. Today, the fate of INO is uncertain.

Meanwhile, Japanese researchers received the first evidence for a phenomenon called neutrino oscillation within a year of the Super-Kamiokande. This discovery would go on to (jointly) win Koshiba's student Takaaki Kajita, another Nobel in 2015.

Having spent his entire research career in Japan, Takaaki Kajita is a living example of how much is to be gained by having a neutrino laboratory close to home. "We can easily ac-

cess the laboratory and the detector is nearby," he said, in an interview with this reporter during the 73rd Lindau Nobel Laureate Meeting which concluded on July 5.

Two of the main reasons for opposition to INO are adverse environmental impacts and the fear of radioactivity. This is despite INO scientists repeatedly stating that the observatory would be located a kilometre underground and hence would have minimal impact on wildlife and the ecosystem. What about radioactivity? "The experiment will neither produce any radioactivity nor can it function well where there is radiation," they point out on INO's website. The whole point of housing the detector underground is to protect it from the natural radiation that hits the surface of Earth.

According to Kajita, the

Japanese project did not face as much opposition. "We decided to construct the detector in an active mine, so there was no need for additional excavation," he pointed out. Besides, the original experiment was designed to search not for neutrinos but for a hypothetical phenomenon called proton decay. "That was nothing to do with radiation," he said. The biggest stroke of luck for the Japanese neutrino scientists was the timing of a supernova that was observed in February 1987. The Supernova 1987A happened while the Kamiokande-II detector was online, leading to the discovery of cosmic neutrinos by the team led by Koshiba. "This had a great impact. People suddenly knew neutrinos, and had only a good image about them," said Kajita, who was Koshiba's PhD student.

A neutrino observatory at home is envisioned to give the Indian scientific community, including students of particle physics, the opportunity to work with a world-class detector without needing to travel outside national borders. Back in the 1980s, the young Kajita greatly benefited from this privilege. He recalled the excitement during the construction of the Kamiokande detector. "It's the young postdocs involved in the Kamiokande and Super-Kamiokande experiments who first saw and analysed the data," he said.

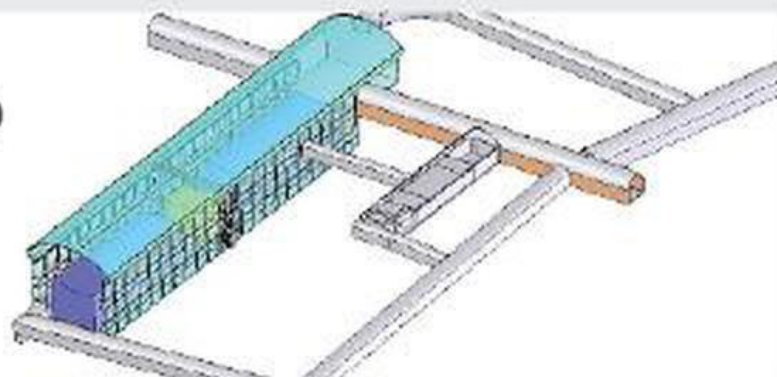
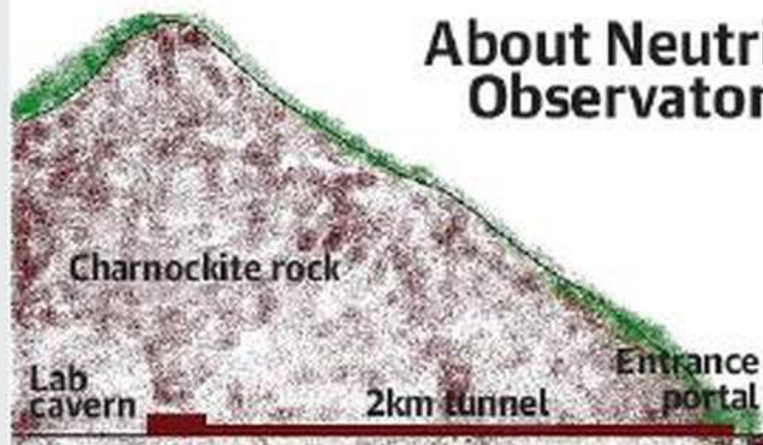
Today, the Super-Kamiokande facility continues to train new generations of particle physicists. While some of them secure positions abroad, many choose to stay back in Japan. After he won his Nobel in 2015, Kajita himself declined invitations to take up new positions in other countries.

"As an experimental physicist, it is very important that I am near the detector," he explained. Aware of the setbacks his Indian colleagues have suffered, Kajita insists that the INO dream is worth salvaging.

"It may be a bit late to start the construction of the detector, but it is very important to continue working towards an underground lab. There are a lot of things [yet] to be done [in the field of neutrino physics]."

(Nandita Jayaraj is a freelance science writer and co-author of *Lab Hopping: A Journey to Find India's Women in Science*)

About Neutrino Observatory



A SCHEMATIC VIEW OF THE PROPOSED INDIA-BASED NEUTRINO OBSERVATORY UNDERGROUND LAB

Where

At Pottipuram village in Theni district, on the Tamil Nadu-Kerala border

Why

The initial goal of India-based Neutrino Observatory (INO) is to study neutrinos

Neutrino

Neutrinos are the smallest particles that form the universe

Highlights

Two underground laboratory caverns with a rock cover of over 1000 metres; access tunnel of 2 km length

Where else

Underground
SNO, Canada; Kamioka, Japan; Gran Sasso, Italy

Underwater
Amundsen - Scott South Pole Station, Antarctica;
Antares - under Mediterranean sea off the coast of Toulon, France

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PHOTO:
NANDITA
JAYARAJ





New atmospheric particles form in upper troposphere

New atmospheric particles form when stratospheric air intrudes into the troposphere below, revealing a previously unrecognised mechanism for new particle formation (NPF) in the upper troposphere. The finding suggests that NPF aloft occurs frequently and over large geographic regions. Aerosol particles smaller than one micron in diameter are abundant in the troposphere. They serve as condensation sites for water vapor, contributing to cloud formation, and play a role in Earth's radiative balance.

new particle formation (NPF)

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What is Nipah virus?



NIPAH VIRUS (NiV) INFECTION IS A NEWLY EMERGING ZOOONOSIS THAT CAUSES SEVERE DISEASE IN BOTH ANIMALS AND HUMANS

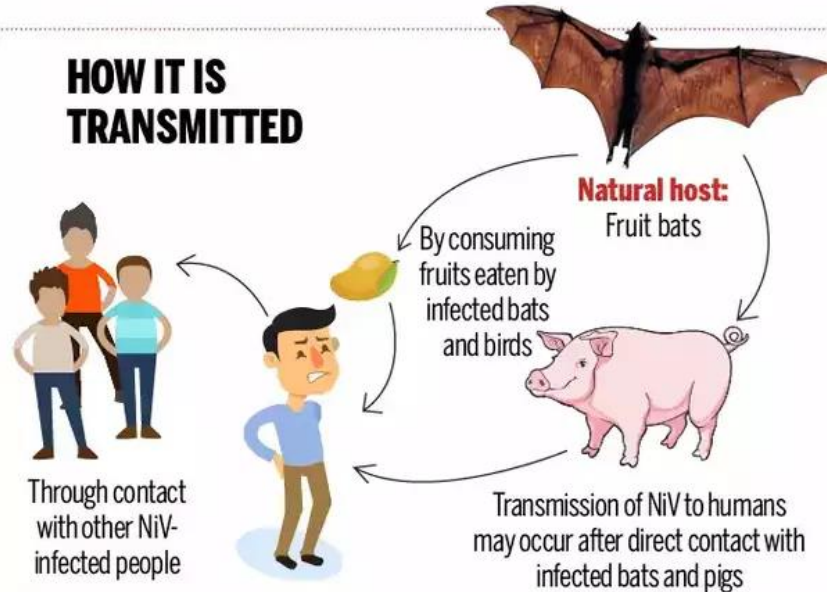


NiV first identified in 1998 during an outbreak in Malaysia



Fruit bats are natural hosts of NiV

HOW IT IS TRANSMITTED





Island vertebrates are at risk of human-driven extinction

A study involving 2,813 species of tetrapod vertebrates shows that island-dwelling species have slower relative metabolic rates than their mainland counterparts. Moreover, this slow pace of life puts insular species at a higher risk of anthropogenic extinction. Island evolution is a balancing act. Species must adapt to a limited space with finite resources, leading to unique characteristics, such as dwarfism or gigantism. This phenomenon is called 'island syndrome'.

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Nipah monoclonal antibody trials may begin in India in 2025

R. Prasad

If the Indian drug regulator greenlights it, a human clinical trial to test the safety and efficacy of a novel Nipah monoclonal antibody MBPIF5, which might offer immediate protection to people at risk of infection against the deadly disease, might begin next year. A similar trial will be carried out in Bangladesh as well. Though trials on many vaccines are currently under way, there is no approved vaccine against the Nipah virus anywhere in the world. The Nipah virus has a 40% to 75% mortality rate in people who are infected.

India and Bangladesh have been chosen for the trial as Nipah virus outbreaks have been reported in these two countries in recent years. Nipah outbreaks have occurred in Kerala in 2018, 2019, 2021 and 2023. In the case of

Bangladesh, Nipah outbreaks have been occurring since 2001; the virus has been reported from 34 of 64 districts in Bangladesh with 341 cases detected so far and 242 deaths.

The novel Nipah monoclonal antibody is currently undergoing a phase-1 clinical trial in the U.S., which is carried out by the U.S. Department of Defence.

A spokesperson of the Coalition for Epidemic Preparedness Innovations (CEPI), which is funding the human trials, told *The Hindu* that the trial led by ServareGMP (a non-profit biotechnology organisation based in California) and supported by Mapp Biopharmaceutical, which is also located in California, will work with local clinical research networks to carry out the trial in India and Bangladesh.

The trial in India and Bangladesh will begin



Fruit bats are natural reservoirs of Nipah virus. VELANKANNI RAJ B

“upon completion of the U.S. Department of Defence Phase-1 trial in the U.S”. “ServareGMP, Mapp and CEPI have already initiated discussions with public health and regulatory authorities in India and Bangladesh about the desire to conduct this trial,” he says.

According to the CEPI spokesperson, the trial in India is planned to begin in 2025, pending regulatory review. The assessment made by the Indian drug

regulator will determine “whether the Phase-1 trial data carried out by the U.S. Department of Defence will be sufficient to continue onwards with Phase-2 trials in India, or whether Phase-1 data should also be collected from the Indian population”.

The number of participants who will be recruited for the clinical trial will depend on whether the clinical trial begins as a phase-1 or phase-2 trial in India. “But the intention is to recruit at least 200 participants,” says the spokesperson.

While the trial will be conducted in multiple sites in both countries, the decision on the location and number of sites appropriate to generate data that demonstrate the safety and tolerability of the monoclonal antibody will be taken based upon consultation with public health and regulatory authorities, he says.

“Preclinical studies for pre-exposure prophylaxis have been completed. In these studies, conducted in animal models, the monoclonal antibody has demonstrated high potency against the Nipah virus, proving it effective at preventing the virus from entering the host cell and causing Nipah virus disease. In preclinical studies, this Nipah monoclonal antibody has been shown to be safe at all dose levels

tested,” he says.

The monoclonal antibody is designed to bind to the Nipah virus F protein, preventing the virus from entering a host cell and causing infection in people. “This mechanism will offer protection against both known strains of Nipah virus (Bangladesh and Malaysia) and its closely related viral cousin, Hendra virus, for at least six months – enough time for vaccine immunity to build,” says a CEPI release.

In response to a question about equitable access to monoclonal antibodies, once the trial results are positive, he says: “Alongside ensuring pricing commitments for Global South countries, a reserve of monoclonal antibody doses will be stored in a Nipah-affected country, helping to enable rapid availability in the event of an outbreak and accessibility for those most in need.”

. Monoclonal antibodies

- **A type of protein that is made in the laboratory and can bind to certain targets in the body, such as antigens on the surface of cancer cells.**
- **There are many kinds of monoclonal antibodies, and each monoclonal antibody is made so that it binds to only one antigen.**
- **Monoclonal antibodies are being used in the diagnosis and treatment of many diseases, including some types of cancer.**
- **They can be used alone or to carry drugs, toxins, or radioactive substances directly to cancer cells.**

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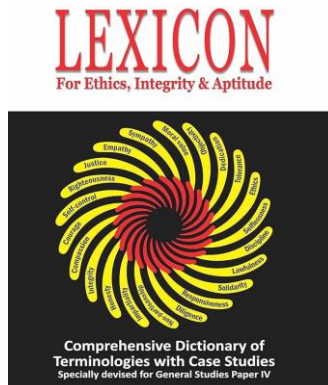
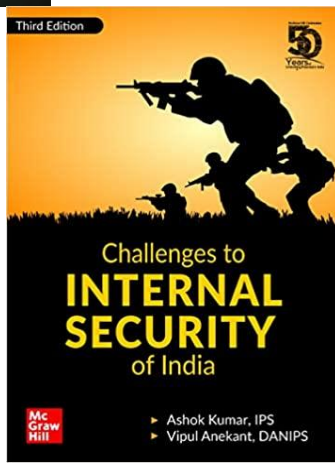
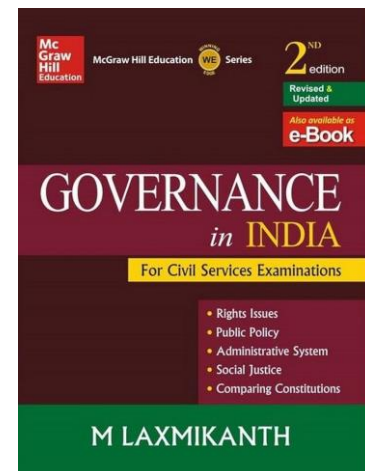
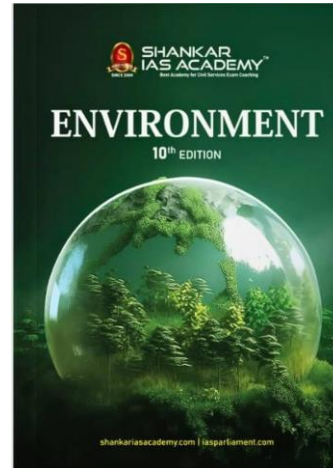
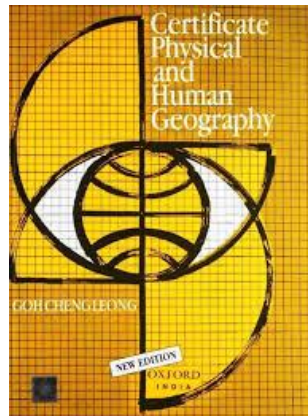
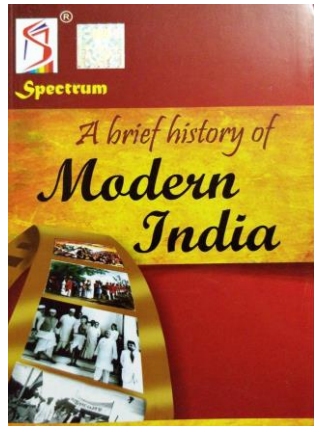
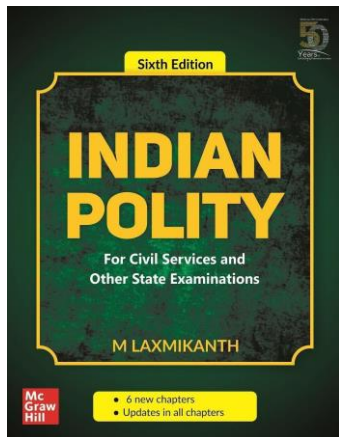
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