Topics

- Craters in mars
- Nitrous Oxide
- Vaccine against HIV
- Elephant behaviour
- IEA Report on oil
- International energy agency
- Delos
- Mains

By saurabh Pandey

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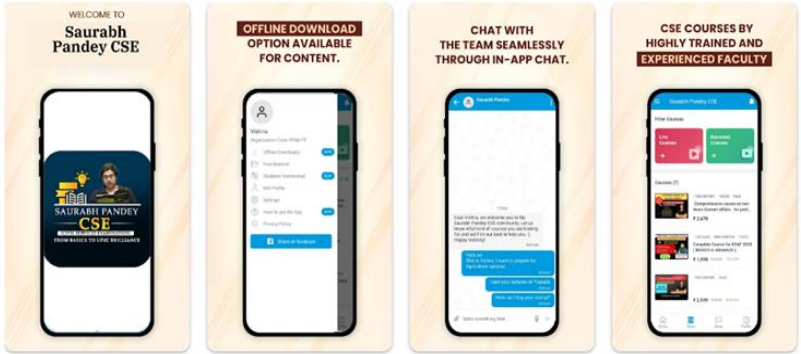

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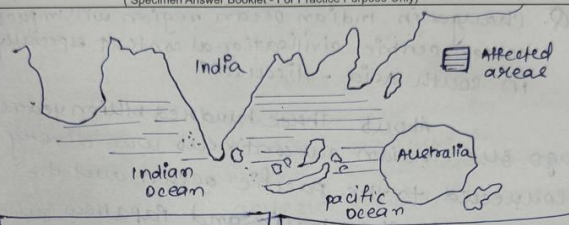
उम्मीदवारों को इस क्षेत्र में नहीं लिखना चाहिए Candidates must not write on this margin

Q. Changes in Indian ocean region will impact human centric civilisational context especially in south Asia - discuss.

About three hundred billion years ago the Indian subcontinent was direcly connected to the pacific ocean and the continents of Australia and Papa New Guinea were at southern most. However, today we see that these continents are moving north leading to changes in the overall oceanography of Indian and Pacific ocean.

The changes in the Indian ocean region are mainly due to heating of the ocean. Once upon time this area had a Permanent El-Nino effect, which now occurs in spans of years. Due to the hot water coming from eastern pacific ocean along with global warming, Jet streams flow and increase in salinity of the ocean, we see that the Indian ocean region is drastically impacted and its effects are seen on the human centric civilisation, such as →



The human settlements since time and again have shifted due to different weather conditions - leading instability

There rise in salinity and temperature has been disrupting the flaura and fauna leading to loss of habitat as well as ecosystem

Apart from this due to changing weather - affecting agriculture and global food production for eg - Heat waves affecting Production of wheat 2022-23

These are affecting not only agricultural but also the fishery sectors as majority of the coastal population and cities - major and main form of livelihood

To conclude it can be said that, the changing human weather phenomenon is due to the anthropogenic activities and today only humans themselves can prevent these oceans and weather from being destroyed.

Target Mains -2024/25 -

Q " Energy transition has its own transformational challenges " Discuss

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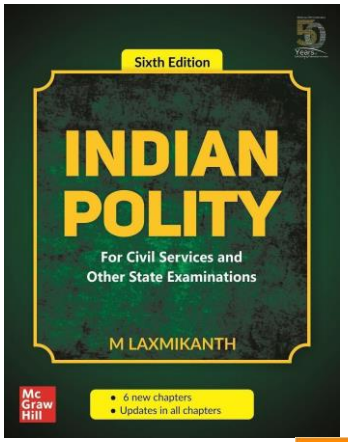

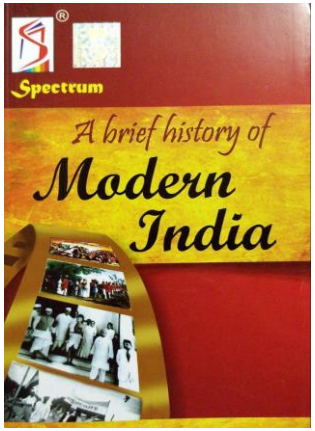

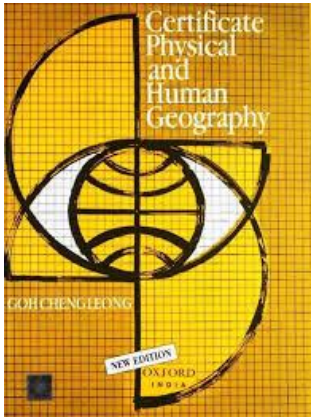

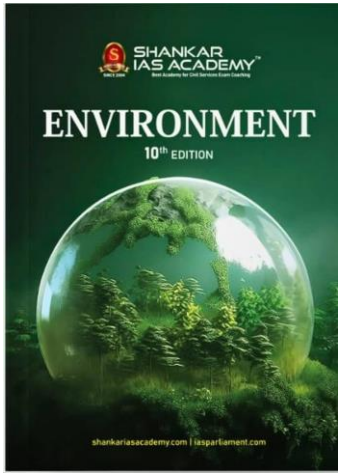

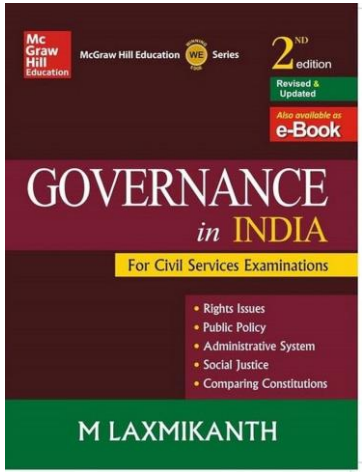

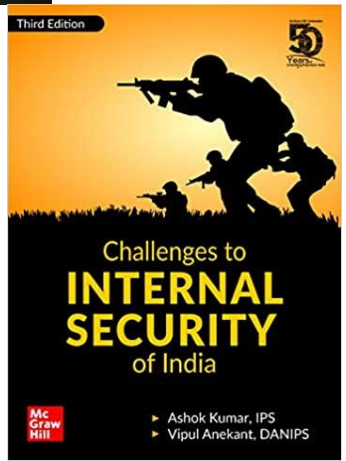

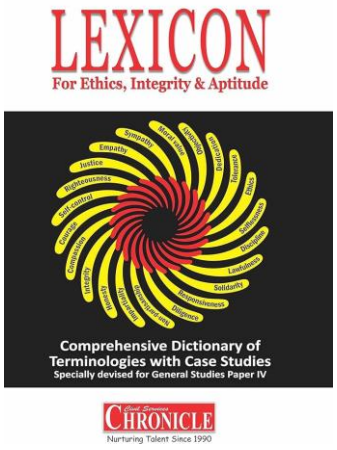

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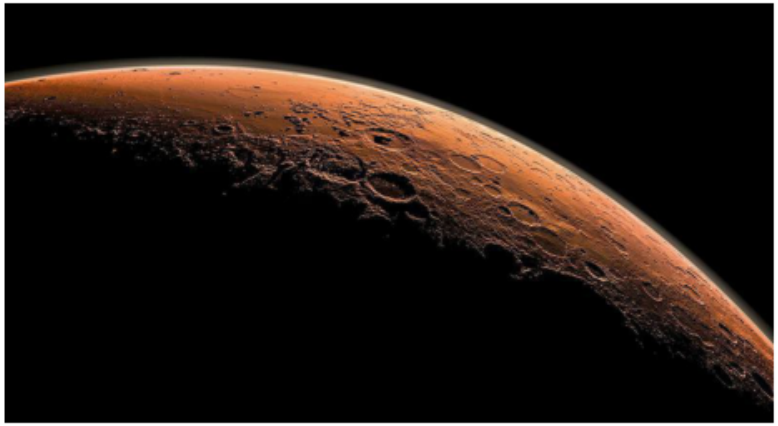
Physical Research Laboratory scientists find three new craters on Mars surface

The Hindu Bureau
BENGALURU

The scientists of the Ahmedabad-based Physical Research Laboratory (PRL) have discovered three new craters on Mars. They have been discovered in the Tharsis volcanic region on Mars.

On the recommendation of the PRL, the International Astronomical Union (IAU) Working Group for Planetary System Nomenclature approved naming the three craters on Mars.

One crater has been named "Lal crater" after Devendra Lal, a renowned Indian geophysicist and Director of the PRL from 1972 to 1983. It is 65-km wide, centered at -20.98° and 209.34°.



This computer-generated view depicts a part of Mars at the boundary between darkness and daylight. NASA

The second crater has been named "Mursan crater" after a town in Uttar Pradesh. Mursan is a 10-km wide crater superimposed on the eastern side of the rim of the Lal crater.

The third is "Hilsa crater". It is a 10-km wide crater superimposed on the western side of the rim of the Lal crater. It is named after a town in Bihar.

Explaining the scientific importance of Lal crater, the PRL stated that its entire area, in the Tharsis volcanic region on Mars, is covered with lava.

Thick sediment

There is geophysical evidence of material other than lava in this crater, with a 45-metre thick sedimentary deposit in its subsurface. This discovery provides compelling evidence that water has moved large volumes of sediment into the Lal crater.

This finding also confirms that Mars was once wet, and water had flown on the surface.

Crater in Mars

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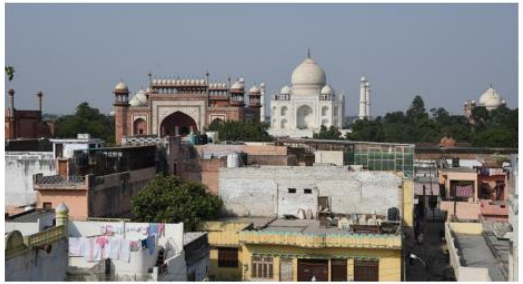
Study ranks India second in nitrous oxide emissions

Jacob Koshy
NEW DELHI



Monumental change: The Taj Mahal on a clear day after rain washed away pollution in Agra, Uttar Pradesh. SANDEEP SAXENA

India is the world's second largest source of nitrous oxide (N2O), a greenhouse gas that heats up the atmosphere far more than carbon dioxide. Nearly 11% of such global man-made emissions in 2020 were from India, topped only by China at 16%.

The major source of these emissions comes from fertilizer usage, according to a global assessment of N2O emissions published in the journal *Earth System Science Data* on Wednesday.

In 2022, the concentration of atmospheric N2O reached about 25% above the levels seen before the industrial age. In comparison, the concentration of carbon dioxide was 417 parts per million in 2022.

This means that the current level of carbon dioxide in the atmosphere is a thousand times more than that of nitrous oxide, making carbon dioxide reduction the bigger priority among countries trying to contain climate change. However, because nitrous oxide stays longer in the atmosphere and is rising rapidly, scientists in recent years have been warning that it must also be tackled with a greater sense of urgency.

N2O emissions from human activities have increased by 40% (three million metric tonnes of N2O per year) in the past four decades, with growth rates between 2020 and 2022 higher than in any previous period since 1980, when reliable measurements began.

Agricultural production using nitrogen fertilizers, such as ammonia, and animal manure contributed 74% of the total anthropogenic N2O emissions in the last decade. N2O emissions from human activities, responsible for 6.4% of the effective radiative forcing of greenhouse gases, have added about 0.1 degree Celsius to current global warming.

"This report on the nitrous oxide budget is timely and alarming. It is time India took this wake-up call seriously and changed cropping systems and production practices," said G.V. Ramanjaneyulu, director of the Centre of Sustainable Agriculture.

Nitrous oxide

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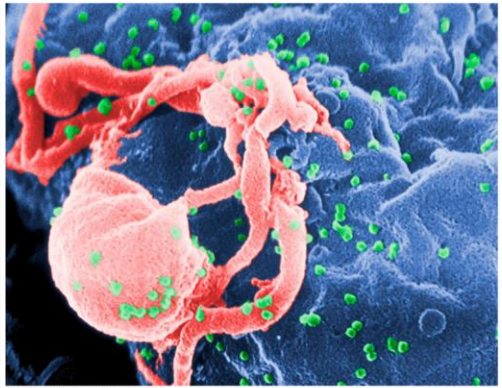
Four new studies report progress towards long-awaited HIV vaccine

Researchers at the Scripps Research Institute and the Massachusetts Institute of Technology have outlined two nanoparticle-based vaccine candidates: N332-GT5 and eOD-GT8. These novel vaccines could help the body make two classes of broadly neutralising antibodies to attack HIV

Arun Panchapakesan



A false-coloured scanning electron micrograph of HIV-1 budding (in green) from cultured lymphocyte, 1984. HIV has more variants circulating in a single patient at any given point of time than influenza cumulatively generates in one year in all influenza patients around the world combined, creating a vaccine development nightmare. U.S. CDC

In early 1981, Michael Gottlieb, an assistant professor at the University of California Los Angeles Medical Centre, wanted to teach some tenets of immunology to a post-doctoral fellow in his laboratory. Dr. Gottlieb asked the post-doc to select a patient from the hospital who displayed some immunological features that they might find interesting. The post-doc found a patient who had a relatively rare infection called pneumocystis pneumonia and had been admitted after sudden, unexplained weight loss.

During the course of their discussion, the hospital doctors referred four more patients with the same infection. Dr. Gottlieb published a paper detailing these five cases in a small American journal called *Morbidity and Mortality Weekly*. At the time, Dr. Gottlieb had no idea his paper was about to change the field of immunology forever.

That paper was the first report of acquired immunodeficiency syndrome (AIDS).

No vaccine for AIDS

Today, nearly half a century after Dr. Gottlieb's landmark publication, AIDS still has no vaccine or cure. This anomaly in humanity's otherwise remarkable track record in tackling major infectious diseases is a result of several factors. Chief among them is that the replication of the human immunodeficiency virus (HIV), which causes AIDS, is an incredibly error-prone process that results in multiple variants of the virus circulating.

The sheer number of all the different strains circulating in the world is in fact the biggest challenge to an HIV vaccine today.

To put it in perspective, HIV has more variants circulating in a single patient at any given point of time than influenza cumulatively generates in one year in all influenza patients around the world *combined*. And influenza is the second-best virus in terms of genetic variation.

Starring role for B-cells

When the immune system encounters a virus, one of its responses is to produce antibodies highly specific to proteins on the virions' surface. Each antibody is unique to a small piece of a given protein, and the immune system can generate antibodies against any given fragment of any protein.

The immune system does this by starting with a pool of specialised cells that produce antibodies, called B-cells. Each B-cell produces an antibody unique to one protein fragment. When a B-cell encounters a similar protein fragment on a foreign object – say, a virus or a bacteria – it begins to divide and refine the antibody until it binds perfectly to the target. These antibodies then bind to their corresponding pieces on the viral surface, rendering them incapable of further infection. The body then retains some of these specific antibody-producing cells in case of a future infection.

A vaccine aims to generate these antibodies prior to viral infection so that whenever a virus enters the body, the antibodies can neutralise the virus and prevent it from initiating an infection. The vaccine basically provides the immune system with a head-start by allowing the body to make antibodies without an infection with the real virus.

bNAb, a sliver of hope

However, when multiple variants of the same virus exist, generating antibodies against all the different variants simultaneously becomes very difficult. In the case of most viruses, the immune system ultimately does catch up. But against HIV, it doesn't because of the sheer volume of different variants that are circulating, overwhelming the immune system's ability to generate new antibodies. In fact, by the time the immune system makes antibodies against a few strains, the virus will have produced hundreds more.

In the early 1990s, scientists noticed that in a small subset of HIV-infected individuals, a new kind of antibody was being produced that could neutralise a large number of circulating viral strains. These broadly neutralising antibodies (bNAb) worked by targeting areas of the viral proteins that the virus couldn't afford to change, since doing so would make it lose infectivity. Scientists have since discovered many bNAbs, and they are classified into different groups based on the region of HIV they target. Some of these bNAbs can effectively neutralise more than 90% of circulating strains.

But there is a catch: a body usually takes years to make bNAbs, and by then, the virus has already evolved to escape them. It takes years because the parental B-cell that makes the bNAbs is incredibly rare in the starting pool.

Light at the tunnel's end?

The challenge, therefore, has been to make the immune system produce these bNAbs in large numbers in response to a vaccine. The route to doing this, called germline targeting, has three steps.

> Researchers demonstrated the efficacy of their vaccine candidates in mice and macaques. These can now be used as model systems for future studies. The candidate vaccines are currently being evaluated in a phase-I clinical trial to assess their performance in humans

In the first step, those B-cells that can mature into cells that can produce bNAb are identified and engaged to increase their population and prepare them for the second-step, where a booster dose will guide these cells into generating stronger bNAbs against HIV. The third and final step is to refine these bNAbs such that they can neutralise a wide range of HIV strains.

After years of painstaking failures, researchers have established a possible roadmap for the first two steps of germline targeting for two groups of bNAbs. Four papers recently published in *Science* Journals outlined two promising nanoparticle-based vaccine candidates: N332-GT5 and eOD-GT8. The teams, based out of the Scripps Research Institute and the Massachusetts Institute of Technology, both in the U.S., showed that using these novel vaccines, it may be possible to engage B-cells to make two different classes of bNAbs.

The teams demonstrated the efficacy of their vaccine candidates in two forms, protein and mRNA. The latter is important because mRNA vaccines are easy to develop and produce. In both cases, the antibodies generated in response to the vaccine were shown by structural analysis to bind to the HIV proteins in a manner similar to that of established bNAbs. Further, the groups also demonstrated the efficacy of their vaccine candidates in two different animal models, mice and macaques. These animals can now be used as model systems for future studies. The candidate vaccines are currently being evaluated in a phase-I clinical trial to assess their performance in humans.

The research groups have also reported a possible candidate for step II of germline targeting. A protein fragment called g28v2 appears to be able to guide the cells into making bNAbs. Further research in this direction to evaluate its properties is ongoing.

HIV demands patience

While these four papers do imply progress in developing a B-cell based vaccine for HIV after decades of frustrating wait, we must refrain from celebrating too early. Results from mouse and macaque models don't always translate to positive results in the human system. The strategies reported by these publications do have enormous potential for vaccine development against other RNA viruses such as influenza, various coronaviruses, and hepatitis C – but our past failures have also taught us to remain sceptical with HIV until the very end.

(Arun Panchapakesan is an assistant professor at the Y.R. Gaithonde Centre for AIDS Research and Education, Chennai.)

Vaccine against HIV

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An African elephant matriarch leads her calves away from danger in northern Kenya. AP

Elephants call each other by name, study suggests

Reuters

Over the years, researchers who study elephants have noticed an intriguing phenomenon. Sometimes, when an elephant makes a vocalisation to a group of other elephants, all of them respond. Yet, sometimes, when that same elephant makes a similar call to the group, only a single individual responds.

Could it be that elephants address each other by the equivalent of a name? A new study involving wild African savannah elephants in Kenya supports this idea.

The researchers analysed vocalisations — mostly rumbles generated by elephants using their vocal cords, similar to how people speak — made by more than 400 elephants in Amboseli National Park and Samburu National Reserve.

Using a machine-learning model, researchers identified what appeared to be a name-like component in these calls identifying a specific elephant as the intended addressee. The researchers then played audio for 17 elephants to test how they would respond to a call apparently addressed to them as well as to a call apparently addressed to some other elephant.

The elephants responded more strongly on average to calls apparently addressed to them. When they heard such a call, they tended to behave more enthusiastically, walk toward the audio source and make more vocalisations than when they heard one apparently meant for someone else.

Elephants are highly intelligent, have keen memory, are known for their problem-solving skills, and engage in complicated behaviour while socialising

The study's findings indicate elephants "address one another with something like a name", according to behavioural ecologist Mickey Pardo of Cornell University and formerly of Colorado State University, lead author of the study published on Monday in the journal *Nature Ecology & Evolution*.

"Certainly, in order to address one another in this way, elephants must learn to associate particular sounds with particular individuals and then use those sounds to get the attention of the individual in question, which requires sophisticated learning ability and understanding of social relationships," Dr. Pardo said.

"The fact that elephants address one another as individuals highlights the importance of social bonds — and specifically, maintaining many different social bonds — for these animals," he added.

Elephants are the planet's largest land animals and are highly intelligent. They are known for keen memory, their problem-solving skills, and sophisticated communication. Previous research has shown that they engage in complicated behaviour — visual, acoustic, and tactile gestures — when greeting each other.

Why would an elephant call another elephant by "name"?

"We don't know exhaustively but from our analysis it appears commonly during contact calls where an elephant calls to another individual, often by name," said Colorado State University conservation biologist and study co-author George Wittemyer, chair of the scientific board of the conservation group Save the Elephants.

"It was also common among a mother's rumbles to her calves, often to calm them down or check in with them. We thought we would find it in greeting ceremonies, but it was less common in those types of vocalisations," Dr. Wittemyer added.

Elephant behaviour

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- Sometimes, when an elephant makes a vocalisation to a group of other elephants, all of them respond.
- Yet, sometimes, when that same elephant makes a similar call to the group, only a single individual responds.
- The study’s findings indicate elephants “address one another with something like a name”

Mapping

- **Amboseli National Park is in southern Kenya. It’s known for its large elephant herds and views of immense Mount Kilimanjaro, across the border in Tanzania.**
- **The Samburu National Reserve is a game reserve on the banks of the Ewaso Ng'iro river in Kenya. On the other side of the river is the Buffalo Springs National Reserve.**

World will amass 'major' oil surplus by '30: International Energy Agency

Agence France-Presse
PARIS

The world is likely to have a major surplus of oil by 2030 as production is ramped up while clean-energy transition tempers demand, the International Energy Agency said on Wednesday.

Global demand is expected to "level off" at 106 million barrels per day (bpd) towards the end of this decade while overall supply capacity could reach 114 million bpd, the IEA said in an annual report.

This would result in a "staggering" surplus of eight million bpd that oil markets should prepare for, the agency said.

Pockets of demand: Asian countries like China, India along with aviation and petrochemical sectors would still drive oil demand. AP

"As the pandemic rebound loses steam, clean energy transitions advance, and the structure of China's economy shifts, growth in global oil demand is slowing down and set to reach its peak by 2030," said IEA Executive Director Fatih Birol.

With "a major supply surplus emerging this decade," Mr. Birol said, "oil companies may want to make sure their business strategies and plans are prepared for the changes taking place."

The forecast comes days after the OPEC+ group of major crude producers signalled they would start to unwind output cuts this autumn to support prices.

In its report, the IEA noted that fast-developing Asian countries like China and India along with the aviation and petrochemical sectors would still drive oil demand, which stood at 102 million bpd in 2023.

But the shift toward electric cars along with fuel efficiency gains for conventional vehicles and declining use of oil by West Asia for electricity production, would help limit the overall demand increase to around 4% by 2030.

IEA Report on oil

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International energy Agency

- **THE *INTERNATIONAL ENERGY AGENCY* IS AN INTERNATIONAL ENERGY FORUM COMPRISED OF 29 INDUSTRIALIZED COUNTRIES UNDER THE ORGANIZATION FOR ECONOMIC DEVELOPMENT AND COOPERATION (OECD).**
- **The IEA was established in 1974, in the wake of the 1973-1974 oil crisis, to help its members respond to major oil supply disruptions, a role it continues to fulfill today.**
- **IEA's mandate has expanded over time to include tracking and analyzing global key energy trends, promoting sound energy policy, and fostering multinational energy technology**

- **As the global energy picture has changed, the IEA has sought to engage key non-members in its activities, including Brazil, China, India, Indonesia, South Africa, Thailand, Singapore, Morocco and accession countries Mexico and Chile.**

Scientists say the archaeological site of Delos could be gone forever within decades, due to rising sea levels. AFP

Island sanctuary for Greek artefacts may soon vanish

Agence France-Presse
ISLAND OF DELOS

A brief boat ride from the thrumming nightclubs of Mykonos in Greece lies the UNESCO heritage site of Delos, one of the most important sanctuaries of the ancient Greek and Roman world.

Surrounded by piercing azure waters, Delos's 2,000-year-old buildings offer a microcosm of information on daily life during the Hellenistic and Roman periods.

But within decades, because of rising sea levels brought about by climate change, the site known for its temples guarded by stone lions could be gone forever, scientists say.

"Delos is condemned to disappear in around 50 years," said Veronique Chankowski, head of the French archaeological school of Athens, which has been excavating the site for the past 150 years under licence from the Greek state.

The worst structural damage was visible in an area that once housed trade and storage buildings in the first and second centuries BCE and was not accessible to visitors.

To the ancient Greeks, Delos was the birthplace of Apollo, god of light, arts and healing, and of his sister Artemis, goddess of the hunt.

At the height of its acclaim during the Roman era, Delos attracted pilgrims and traders from across the ancient world and ultimately grew to a bustling city of some 30,000 people.

For now, wooden support beams have been used to shore up some walls, Ms. Chankowski said.

But more robust measures are complex and will require a multi-disciplinary response, she added.

Delos

- **According to Greek mythology, Apollo was born on this tiny island in the Cyclades archipelago. Apollo's sanctuary attracted pilgrims from all over Greece and Delos was a prosperous trading port.**
- **The island bears traces of the succeeding civilizations in the Aegean world, from the 3rd millennium B.C. to the palaeochristian era.**
- **The archaeological site is exceptionally extensive and rich and conveys the image of a great cosmopolitan Mediterranean port.**
- **Delos is a Greek island and archaeological site in the Aegean Sea's Cyclades archipelago, near Mykonos.**

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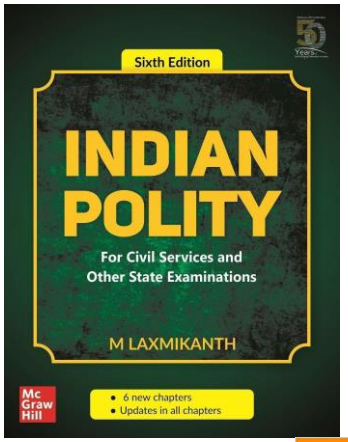

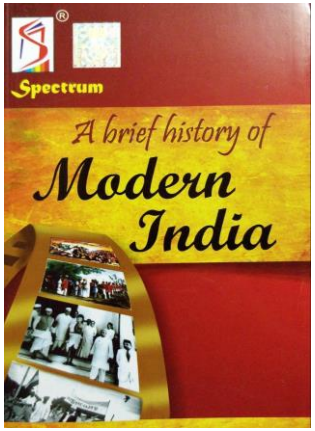

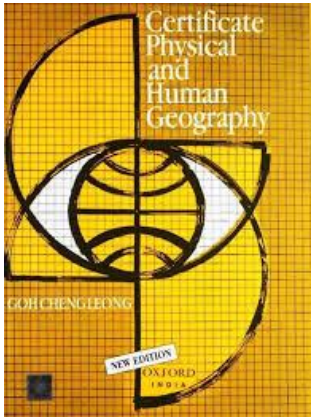

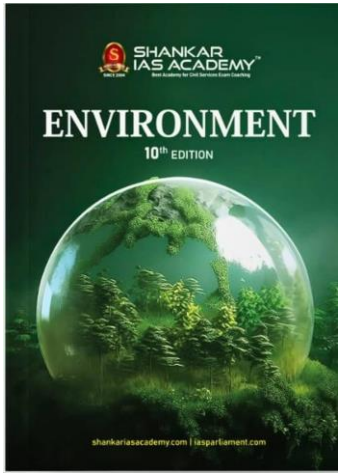

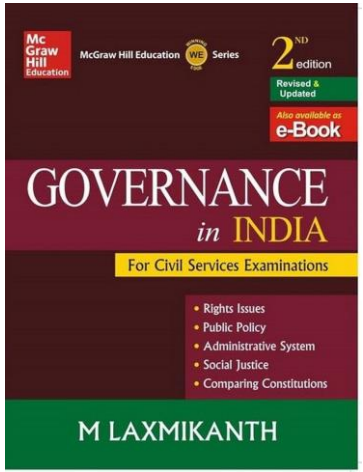

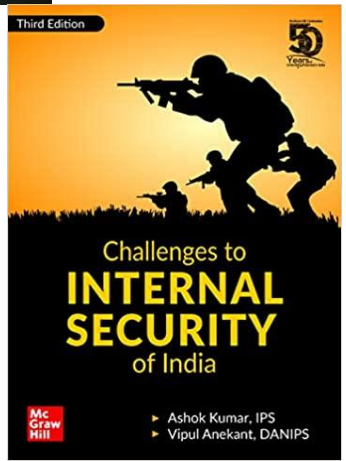

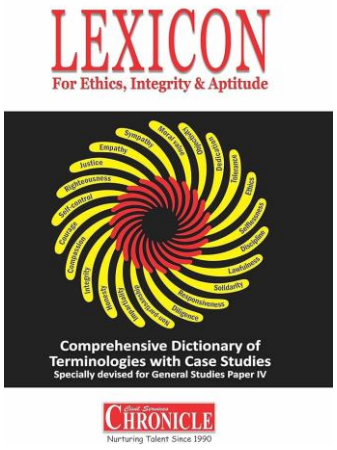

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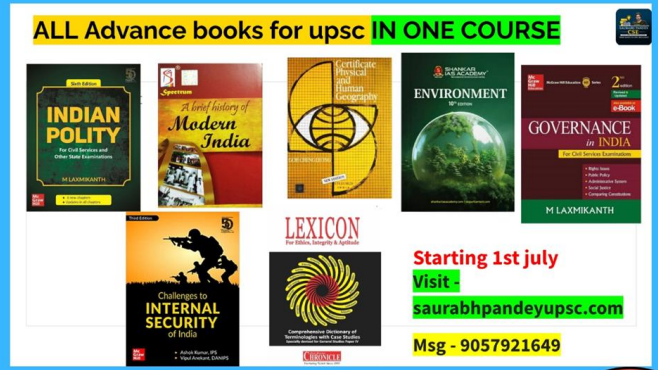

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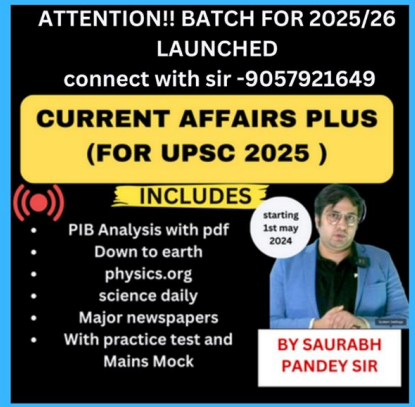

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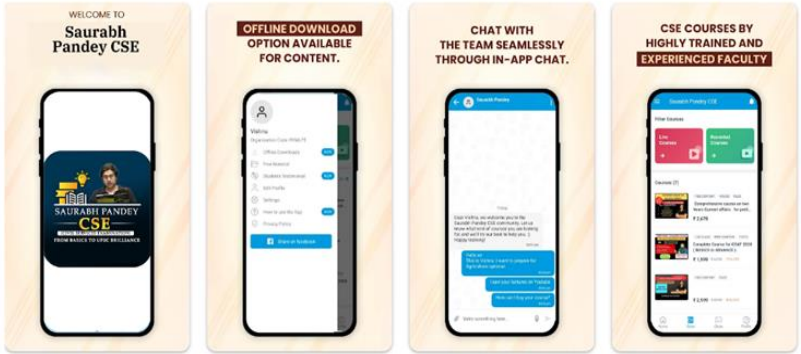

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