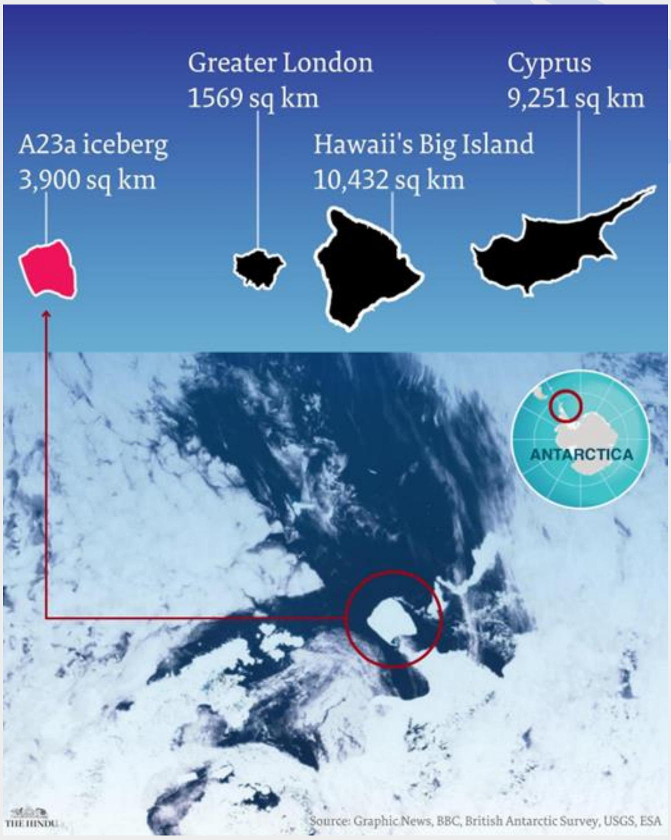
1. After breaking free, why the world's largest iceberg is stuck spinning in circles

Why in News?

For more than 30 years, the world's largest iceberg was stuck in the Antarctic. Five times the size of New York City's land area and more than 1,000 feet deep, the mammoth piece of ice finally became loose in 2020 and began a slow drift toward the Southern Ocean.

Now, A23a, as it's known, is spinning in place. After leaving Antarctic waters, the iceberg got stuck in a vortex over a seamount, or an underwater mountain. Imagine a piece of ice about 1,500 square miles in area and as deep as the Empire State Building spinning slowly but steadily enough to fully rotate it on its head over the course of about 24 days.



Where is the A23 iceberg?

The iceberg is spinning near the South Orkney Islands, about 375 miles northeast of the Antarctic Peninsula, "maintaining a chill 15 degree rotation per day.

What exactly is the A23?

A23, which was even bigger than A23a, was one of three icebergs that broke off, or calved, from the Filchner Ice Shelf in 1986. At the time of the calving, A23 was home to a Soviet Union research center and researchers eventually had to abandon the base. A23a broke off later that year and hit bottom in the Weddell Sea, where it would remain for 34 more years.

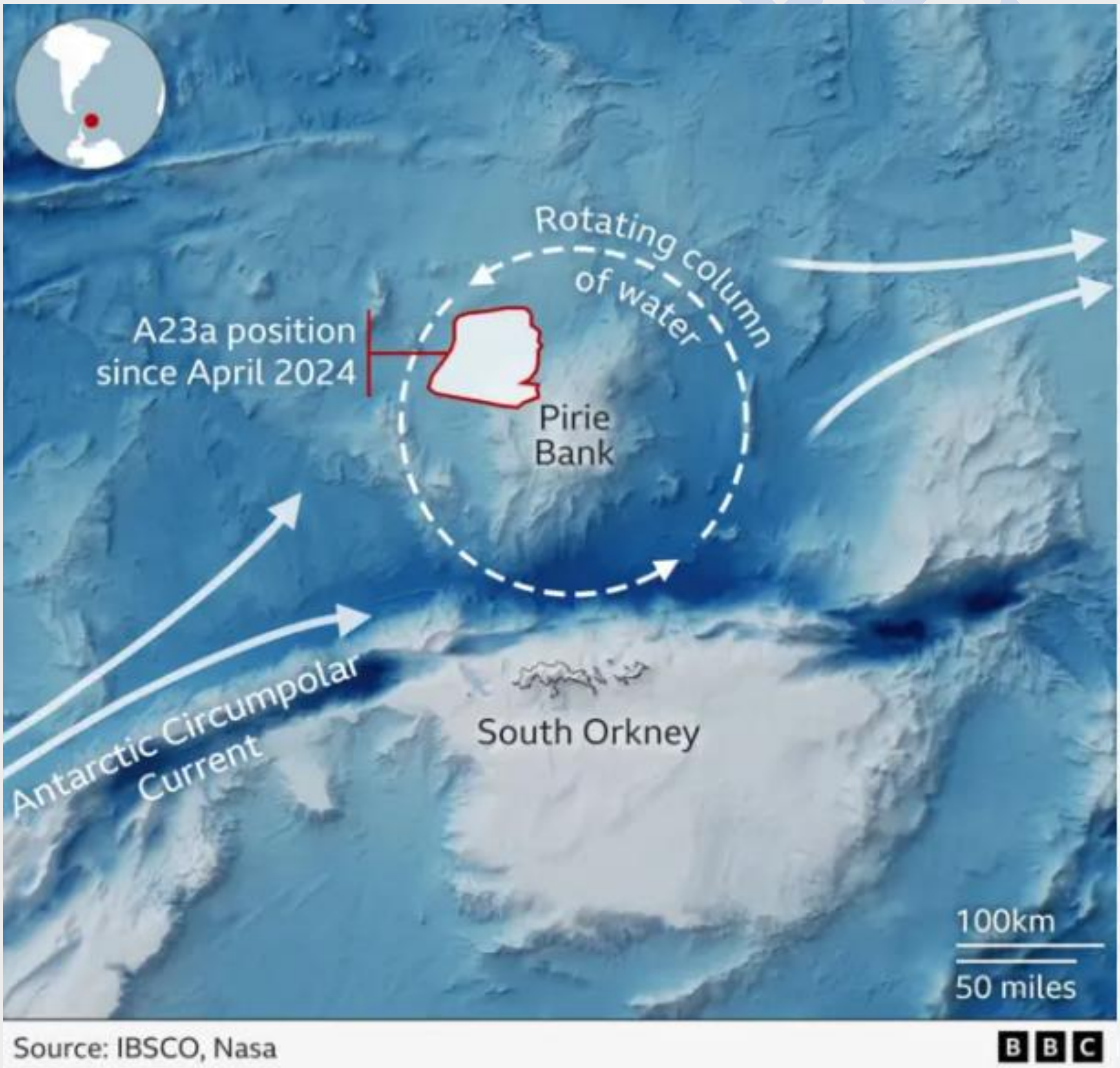
In 2020, A23a finally freed itself, and in December, it began to move out of Antarctic waters on a long meander through the Southern Ocean.

Large Antarctic icebergs are designated by A, B, C and D depending on where in Antarctica they originate, and they receive a number only once they've reached a big enough size. Their sequential order shows how long A23a has topped the list of world's biggest icebergs: A76 calved in 2021, for instance, but melted two years later.

So why did the A23 begin 'spinning'?

The iceberg is in an area of the Southern Ocean known as Iceberg Alley, a popular spot for icebergs. Typically, large icebergs move through quickly and get sucked into the Antarctic Circumpolar Current, the largest ocean current in the world. The blocks of ice eventually get shot out eastward to warmer waters, where they begin to melt and disintegrate. Brearley described the transition as "a warm bath of water" only a couple of degrees above freezing.

Not A23a. Instead, the gigantic iceberg got caught in what's known as a Taylor column, a current that forms around seamounts. Standard flow diverges around the underwater mountain and creates a stagnant cylinder of fluids above the seamount, slowly rotating the water counterclockwise around the bump.



The bump A23a is swimming over is about 100 kilometers across (about 62 miles) and rises up from the deep sea floor to a height of about 1,000 meters (3,280 feet).

If A23a spends an extended time in the vortex, the iceberg could melt significantly and affect plankton and other organisms in the marine food chain in the area, Brearley said.

Relevance: GS Prelims; Science & Technology
Source: Indian Express

2. Breakthrough in Hemostatic Dressing Technology

Why in News?
Researchers at Agharkar Research Institute (ARI) in Pune, India, have developed a highly porous xerogel dressing that can accelerate blood clotting and reduce blood loss in trauma cases. This innovation could be a game-changer in both civilian and military medical care.

Addressing the Hemorrhage Problem
Uncontrolled hemorrhage is a leading cause of death in traumatic injuries, accounting for more than 40% of trauma-related fatalities. Conventional methods, such as gauze and the body's natural clotting mechanisms, are often insufficient to stop severe bleeding. This has created an urgent need for improved hemostatic materials.

How the Xerogel Dressing Works
The newly developed xerogel dressing is a spongy composite material that incorporates silica nanoparticles (SiNPs) and calcium. These substances enhance the clotting process by interacting with platelet activation and calcium release, two critical components of the body's blood clotting pathway.

Enhanced Blood Clotting
In studies, this xerogel dressing increased blood clotting capacity by 13-fold compared to commercial dressings. The porous structure, with pores of around 30 μm, allows for high blood absorbance, speeding up clot formation. The silica nanoparticles and calcium in the composite also help in platelet aggregation and activation, which are essential for effective clotting.

Molecular Mechanisms Behind Its Effectiveness
The dressing enhances platelet activation by stimulating the release of calcium and upregulating the protease-activated receptor 1 (PAR1) gene, which is crucial for platelet shape change and aggregation. These molecular interactions contribute to the dressing's ability to rapidly stop bleeding.

Potential Impact on Trauma Care
This innovative xerogel dressing has the potential to significantly reduce blood loss, disability, and mortality in trauma and surgical care. If widely adopted, it could revolutionize emergency medical treatments, military applications, and surgeries where hemorrhage control is critical.

Relevance: GS Prelims; Science & Technology
Source: PIB

3. Breakthrough in 2D Electron Gas for Ultra-Fast, Low-Power Electronics

Why in News?

Researchers at the Institute of Nano Science and Technology (INST), Mohali, India, have made a significant breakthrough by creating a transparent interface that allows electrons to move in two dimensions at room temperature. This development could lead to ultra-fast, low-power electronic devices and advanced quantum data storage systems.

Revolutionizing Spintronics

The innovation leverages the concept of spintronics, where both the charge and the spin of electrons are used to create new functionalities in electronic devices. Until now, spintronics was more of a theoretical field, but advancements in material science have made it possible to manipulate spin in practical ways, opening the door to next-generation electronics.

The 2D Electron Gas Discovery

Prof. Suvankar Chakraverty and his team at INST developed a two-dimensional electron gas (2DEG) with room temperature spin polarization at the interface of two insulating materials: $LaFeO_3$ and $SrTiO_3$. This 2DEG shows unique properties like negative magnetoresistance and the anomalous Hall effect, which are key for the development of spintronic devices.

Implications for Quantum Devices

This discovery is significant for the future of quantum devices, especially in the field of transparent electronics. The ability to create spintronic devices that can be integrated into displays, solar cells, and other transparent technologies could revolutionize how we design electronic devices. Transparent phones that process information with spin currents or solar cells that generate electricity while manipulating spin for advanced functionalities are just some of the potential applications.

Future of Quantum Computing and Data Storage

This transparent 2DEG interface opens new possibilities for dissipationless electronics and quantum computing. By harnessing spin polarization at high temperatures, researchers could develop the next generation of data storage media and quantum devices, pushing the boundaries of current technology.

Relevance: GS Prelims; Science & Technology
Source: PIB