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Thu, 26 May 2022

Demystifying the army chief's appointment

The government promoted Lt Gen Manoj Pande to the rank of General and appointed him Chief of the Army Staff (COAS or Army Chief) recently. This promotion-cum-appointment is a “first” because Gen Pande is an officer who was commissioned into the Corps of Engineers (known in the army as “Engineers”) and he is the first Engineers officer to be appointed COAS. Incidentally, “Corps” should be pronounced as “core”, not as “corpse”! This writer, a veteran Engineers officer, has received queries from people who ask questions like: #When only a soldier can command the Army, how has an engineer been appointed as its Chief? #If an engineer can be Army Chief, why cannot a medical officer be Army Chief? #What command experience would an engineer have that can make him eligible for the post of Army Chief?

These are valid questions or doubts arising from not knowing about our Army. This brief article attempts to answer the questions. First of all, who is a soldier? After successfully completing basic military training and taking oath to protect and defend the nation and the Constitution of India, every Jawan (Sepoy) and every Officer (Lieutenant) begins life as a professional soldier. In order to fight battles and wars, the Army is organised into “Arms” and “Services”. There are six Arms, namely, Infantry, Armoured Corps, Artillery, Engineers, Corps of Signals, and Aviation Corps. Soldiers of these Arms are trained for their respective specialised roles, which are directly connected with combat. The actual fighting is done by Infantry and Armoured Corps soldiers, supported during combat by the other Arms.

The soldiers of the Services are trained to provide essential logistic cover in the field, to enable the Arms to fight – by the Army Ordnance Corps (AOC) providing weapons, vehicles, equipment and ammunition, the Army Service Corps (ASC) for fuel and food supplies and transport, the Army Medical Corps (AMC) for medical cover, and the Corps of Electrical & Mechanical Engineers (EME) for repair of all military hardware. Units of all Arms and Services are commanded by officers of the respective Arms and Services. Fighting formations – Brigades, Divisions, Corps and Army Commands – are commanded by officers from the Arms. The Services do not need such formations; so, after commanding their respective units, officers of the Services are posted in headquarters of fighting formations, to advise and assist the formation commander regarding their respective Services.

Even though soldiers of these Services may also serve in a battle zone, their functioning is focussed on providing vital logistic and medical cover, without which effective combat is

impossible. Thus, officers of the Services are not trained for professional exposure and experience of combat situations and deployments, and it is not possible for them to assume command of fighting formations. Reverting to the questions concerning Gen Manoj Pande's promotion, providing some details of the role of Engineers in combat is necessary. Soldiers who are posted in the Corps of Engineers (Engineers) are primarily organised, equipped and trained for combat engineering tasks. Combat engineering tasks are executed in active combat situations, when bullets are flying, and artillery shells and bombs are exploding, to assist and support infantry and tanks to move and to fight. The tasks are such as, rapid bridge construction for immediate passage of armoured tanks and other vehicles (and later guns, reinforcements, etc.) across obstacles, or clearing safe lanes through enemy minefields, for our fighting forces to penetrate enemy defences in strength and engage with the enemy. Combat engineering tasks depend upon particular operational phases and requirements.

Some officers from Artillery, Engineers or Signals may be placed in command of fighting formations – beginning with a brigade and then division, corps and army command – if they satisfy time-tested, specific command, staff, training and performance standards. These same standards also apply to officers of Infantry and Armoured Corps. Only officers who have held these command appointments are eligible to be promoted to the rank of General, as Army Chief. Gen Manoj Pande has had a brilliant career as a soldier, having successfully commanded fighting formations of infantry brigade, infantry mountain division, corps, joint services command and army command. In between these critical command appointments, he has held key staff appointments at different rank levels and was Vice COAS at the time of his promotion as Army Chief.

Several Engineers officers had in past years reached the rank of Lt Gen and commanded army commands, making them eligible for elevation to Army Chief. However, for one or the other reason, they were not promoted. All Army Chiefs so far have been from Infantry, Armoured Corps or Artillery. Thus, Gen Manoj Pande being promoted to the Indian Army's top appointment is a proud moment for the Corps of Engineers.

<http://www.indiandefensenews.in/2022/05/demystifying-army-chiefs-appointment.html?m=1>



Thu, 26 May 2022

26-year-old Abhilasha Barak from Haryana becomes Indian Army's first woman combat aviator

Having grown up in military Cantonments across the country, joining the forces was a natural career choice for Captain Abhilasha Barak. On Wednesday, the 26-year-old from Haryana became the first woman combat aviator of the Indian Army. Captain Abhilasha Barak graduated at a ceremony held at the Combat Army Aviation Training School in Nashik. D G of Army Aviation, A K Suri, was the chief guest at the event. "While growing up in military Cantonments, and being surrounded by people in uniform, it always seemed like an ordinary affair. I never realised it (that it was different) until our family moved out of the military life, after my father's retirement in 2011. The feeling only

grew stronger after seeing my elder brother's passing out parade at Indian Military Academy in 2013. That was the moment I knew what I wanted to do for the rest of my life," Captain Barak said in an in-house interview shared recently by the Indian Army.

Captain Barak is an alumnus of The Lawrence School, Sanawar. She completed her graduation in B Tech in Electronics and Communication Engineering from Delhi Technological University in 2016 and was placed at Deloitte, USA. In 2018, she was commissioned into the Indian Army from the Officers Training Academy, Chennai. During her attachment with Corps of Army Air Defence, she was selected as a Contingent Commander for Presentation of Colours to Army Air Defence by President Ram Nath Kovind. She attained 'A' grading in Army Air Defence Young officers course, 75.70 per cent in Air Traffic Management and Air Laws course and passed the promotional exam, Part B, in her first attempt.

"After completing my training from Officers Training Academy, Chennai, in 2018, I opted for Army Aviation Corps. As I was filling the form, I knew I was eligible for only ground duty role but I ended up mentioning that I had qualified Pilot Aptitude Battery Test and computerised pilot selection system. Somewhere in my heart, I always knew that the day was not far away when Indian Army would start inducting women as combat pilots," she said in the interview.

After two years, when the induction of women as pilots was announced, it all came full circle for Captain Barak. "Not many people know this, but in 1987, during Operation Meghdoot, my father was leading a patrolling party from Amar Post to Bana Top Post (earlier Quaid Post). Owing to bad weather, he suffered from Cerebral Odema and was brought back to Amar Post, from where he was evacuated right in time. He owes his life to the Army Aviation Corps and hence, so do I," according to excerpts of the interview.

<https://indianexpress.com/article/cities/mumbai/captain-abhilasha-barak-becomes-first-woman-pilot-of-indian-army-7936108/>



Wed, 25 May 2022

नॉर्थ कोरिया और चीन के साइबर हैकर्स के निशाने पर है भारत, रक्षा तकनीकियों में सेंध की कोशिश

चीनी हैकर्स देश के अहम ठिकानों में रक्षा और सेंसिटिव इंस्टालेशन से जुड़े कंप्यूटर्स में सेंध लगाने की लगातार कोशिश में लगे हुए हैं. सुरक्षा एजेंसियों से जुड़े सूत्रों के मुताबिक पिछले कुछ महीनों में नॉर्थ कोरिया, चीन और पाकिस्तान में स्थित साइबर हैकर्स लगातार भारतीय सुरक्षा से जुड़ी जानकारियों को हैक करने में लगे हैं.

भारत से क्या जानना चाहता है चीन?

सूत्रों के मुताबिक सबसे ज्यादा चीन से साइबर अटैक के मामले सामने आ रहे हैं. चीनी हैकर लगातार ये जानने की कोशिश में हैं कि भारत-चीन सीमा पर चीन और पाकिस्तान के खिलाफ क्या रक्षा तैयारियां हैं. सुरक्षा

एजेंसियां लगातार चीन और नॉर्थ कोरिया के साइबर हमले के खतरे को नाकाम करने के लिए केंद्र सरकार के अहम विभागों के साथ राज्यों को ऐसे खतरे आए बचने के लिए आगाह कर रहीं हैं.

नवंबर में हुए थे कंप्यूटर हैक

IB की साइबर थ्रेड की रिपोर्ट के मुताबिक पिछले साल नवंबर महीने देश में रक्षा के साथ साथ सेंसिटिव इंस्टालेशन से जुड़े 11 कंप्यूटर्स को हैक किया गया जिसमें दिल्ली के भी दो कंप्यूटर्स हैक हुए और ऐसे 63 वेब एप्लीकेशन की जानकारी आई है जिसके जरिए कंप्यूटर्स में सेंध लगाने की कोशिश की जा रही है. चीन, पाकिस्तान और नॉर्थ कोरिया के साइबर हैकर्स देश के न्यूक्लियर और डिफेंस प्रोडक्शन से जुड़े कम्प्यूटर को हैक करने की फिराक में हैं.

भारत की रक्षा नीति से परेशान हैं चीन और पाक

चीन और पाकिस्तान भारत की लगातार हो रहीं रक्षा तैयारियों से परेशान हैं. पिछले कुछ सालों में फ्रांस से राफेल, अमेरिका से आए अपाचे, चिनूक हेलिकॉप्टर और Defence Research and Development Organization (DRDO) की तरफ से लगातार नए-नए मिसाइलों की टेस्टिंग से चीन और पाकिस्तान के चिंताएं बढ़ गई हैं और यही वजह है कि पिछले कुछ महीनों में चीन और पाकिस्तान के साइबर हैकर भारत के रक्षा ठिकानों से जुड़े कंप्यूटर्स के साथ-साथ-साथ अहम इंस्टॉलेशन पर भी साइबर अटैक कर रहे हैं, जिससे देश की रक्षा से जुड़ी जानकारी को हासिल किया जा सके.

सरकारी कंप्यूटर्स पर चीन की नजर

सूत्रों के मुताबिक चीन ये पता लगाने की कोशिश में है कि भारत एंटी मिसाइल डिफेंस सिस्टम के साथ-साथ अपने फाइटर जेट्स से लेकर दूसरे हथियारों को कहां-कहां तैनात कर रहा है. चीन की तरह पाकिस्तान भी साइबर हैकर्स के जरिए भारत की जासूसी कर रहा है. चीन के साइबर हैकर्स डिफेंस सेक्टर के साथ-साथ देश के दूसरे क्रिटिकल सेक्टर जैसे कि पावर, बैंक, सेंट्रल पैरामिलिट्री फोर्स और पुलिस डिपार्टमेंट के कंप्यूटर्स को भी हैक करने की कोशिश में हैं. साइबर थ्रेड इंटेलिजेंस रिपोर्ट के सूत्रों के मुताबिक राज्यों की स्टेट पुलिस, को-ऑपरेटिव बैंक, पैरामिलिट्री फोर्स सिविल एविएशन और गवर्नमेंट डिपार्टमेंट्स को भी साइबर हैकर ने टारगेट किया है.

<https://zeenews.india.com/hindi/india/india-is-the-target-of-cyber-hackers-from-north-korea-and-china-trying-to-break-into-defense-technologies/1196696>

Wed, 25 May 2022

India-UAE to enhance defence cooperation, talk joint defence production and R&D

In an effort to enhance defence industry cooperation, India and UAE have agreed to identify new areas for setting up joint ventures. This was the outcome of the 11th India-UAE Joint Defence Cooperation Committee meeting that took place in New Delhi on Wednesday (May 25, 2022). The two sides also focussed on further expansion of scope and complexities of the existing joint exercises between the armed forces of both sides. According to an official statement issued by the Ministry of Defence (MoD) on May 25, the visiting Chief of the Force Development Authority at Ministry of Defence, UAE Major General Staff Hassan Mohamed Sultan Bani Hammad had a meeting with Defence Secretary Dr Ajay Kumar. The focus was on deepening defence cooperation between the two countries.

The UAE General in his meeting with India's Defence Secretary also briefed about the 11th meeting of India-UAE Joint Defence Cooperation Committee (JDCC) held earlier. The visiting delegation from UAE also met with Deputy Chief of Integrated Defence Staff (Policy Planning and Force Development) Lt Gen Atulya Solankey at Headquarters, Integrated Defence Staff and later interacted with Indian defence Industries and also visited Bharat Electronics Limited, located in NCR.

Outcome of the JDCC

This meeting was co-chaired by Joint Secretary (Armed Forces) Dinesh Kumar and Chief of the Force Development Authority at Ministry of Defence, UAE. The progress made in military-to-military engagements, joint exercises with the armed forces, R&D, Expert Exchanges, and deepening Industry Cooperation were all reviewed. The next meeting of the JDCC is expected to be held in UAE in 2023 and the dates will be confirmed later. The Defence ministries of both countries through this body review and provide guidance in all aspects of bilateral defence cooperation.

Defence Relations between the two countries

The cooperation between the two countries has witnessed significant progress over the years and as has been reported by Financial Express Online earlier, the Gulf nation had helped in overflight of Rafales fighter jets from France to India. It had provided support by sending its own Airbus MRTT refuelling aircraft to support new Rafale fighters on their journey over 7,000-km flight from France to India. In 2020 and 2021, former Army Chief Gen MM Naravane and the former Chief of Air Staff Air Chief Marshal Bhadauria had visited that country respectively.

In IDEX and NAVDEX 2021 India significant participation in both exhibitions based in Abu Dhabi. Also, IAF had participated in Dubai Air show in 2021, and for the fourth time in five years had participated in a major multinational air combat exercise in the UAE "Desert Flag".

BrahMos Missile & Akaash Missile.

As has been reported earlier, discussions related to the BrahMos Missile to the UAE is in advanced stages. This was among one of the first countries from the Gulf region to express interest in BrahMos and the indigenous Akaash Missile.

<https://www.financialexpress.com/defence/india-uae-to-enhance-defence-cooperation-talk-joint-defence-production-and-rd/2537679/lite/>



Wed, 25 May 2022

European Defence Fund: €1 billion to boost the EU's defence capabilities and new tools for defence innovation

Today, the Commission announced the adoption of the second annual work programme of the European Defence Fund (EDF). The EDF 2022 work programme will allocate up to a total of €24 billion in funding. One week after the Joint Communication on Defence investment gaps, the Commission unlocks new funding to invest together and better in strategic defence capabilities. Additionally, the 2022 work programme introduces a series of new tools to promote defence innovation, all under one new umbrella called the EU Defence Innovation Scheme (EUDIS). Already announced in the Commission's Defence Package of 15 February 2022, EUDIS will work in close partnership with EDA's Innovation Hub.

Margrethe Vestager, Executive Vice-President for a Europe Fit for the Digital Age, said: *“Innovation is at the core of our response to current evolving threats. Today, the Commission unlocks new funding and takes an important step with new attractive instruments to spur defence innovation by leveraging the experience it has developed for decades in civil innovation, by promoting cooperation from all across our Union.”* Thierry Breton, Commissioner for Internal Market, said: *“Today, we decided to mobilise €1 billion of EU budget this year to develop common defence projects notably in space, cyber and various high-end capabilities. In our new security context, these investments will contribute to closing the European defence gap. We are also launching a €2 billion EU Defence Innovation Scheme to make Europe a defence innovation hub. Complementing the EDF investment effort in capability development, we must now progress towards joint defence procurement as we just proposed in our communication to EU leaders.”*

Providing continued investment for collaborative defence R&D in Europe's industry

The EDF helps reduce the fragmentation of the European defence capability development landscape. It also enhances industrial competitiveness and promotes interoperability throughout Europe. The 2022 EDF work programme addresses in total 33 topics structured along eight calls for proposals – to be opened in early June - to kick-start a number of large emblematic projects. It targets relevant defence technologies and capabilities in line with the EU capability priorities commonly agreed by Member States and further elaborated in the Strategic Compass.

In addition, the 2022 EDF work programme also ensures continuity of funding for some important projects initiated under the two EDF precursor programmes.

This year, with a budget of more than €120 million for each, two critical domains will be put in the spotlight to support capability developments:

- Space, where funding will be provided for the development of space-based missile early warning capabilities and innovative multi-sensor space-based Earth observation capabilities for intelligence, surveillance and reconnaissance. In addition, funding will be foreseen for research for a responsive space system able to place small satellites in various types of orbits swiftly.
- Naval combat, where funding will be provided for (i) actions related to the development of a vessel class particularly suitable for small and medium-sized navies; and (ii) the development of a European naval collaborative surveillance capability that will enable navies to face smaller, faster and more diverse new evolving threats.

In addition, €70 million will be allocated to R&D efforts in each of the two following categories:

- Cyber, in order to improve the European capabilities in terms of cyber situational awareness, cybersecurity and resilience, and to develop a defence cyber and information warfare toolbox.
- Information superiority, for projects contributing to the development of a European Command and Control system and a deployable special-operations command post. In the research domain, funding efforts will focus on interoperability and data exchange between civil and military control centres in the context of the Single European Sky.

High-end defence capabilities and enabling technologies are also addressed through different categories of actions. These include the development of a medium-size tactical cargo aircraft contributing to military mobility, airborne electronic warfare, collaborative combat for land forces, technologies and sustainable components for underwater applications, including underwater manned-unmanned teaming and swarms.

Supporting the €2 billion EU Defence Innovation Scheme

The EU Defence Innovation Scheme will bring under one umbrella relevant EU initiatives in support of defence innovation and entrepreneurship. Proven practices originating from civil innovation will be used for the defence sector. In the 2022 EDF work programme, the Commission launches a set of actions to support innovative entrepreneurs, start-ups and SMEs and bring them into the defence industrial ecosystem:

- A defence equity facility: the Commission intends to invest €20 million per year into the equity facility, with a total of €100 million. This investment aims at generating a total of €500 million investment capacity during the lifetime of the Fund for the benefit of the defence industry, including by involving the European Investment Fund (EIF) and private investors.
- Technological challenge: this challenge aims at attesting and maturing technologies for hidden-threats detection.
- Chemical, biological, radiological and nuclear (CBRN) Framework Partnership Agreement: the new work programme introduces a call to set up a four-year partnership for the development of defence medical countermeasures against CBRN threats.

These new measures will complement the current support to disruptive technologies and SMEs through recurrent dedicated calls for proposals aimed at fostering innovation. The aim of the Commission is to generate until 2027 a total investment of up to €2 billion into defence innovation, triggered by the EDF, under the EU Defence Innovation Scheme. The Scheme will help implement the EU's Action Plan on synergies between civil, defence and space industries.

Background

The EDF is the Commission's flagship instrument to support defence cooperation in Europe. Without substituting Member States' efforts, it promotes cooperation between companies of all sizes and research actors throughout the EU. The EDF supports competitive and collaborative defence projects throughout the entire cycle of research and development, focusing on projects leading to state-of-the-art and interoperable defence technologies and equipment. It also fosters innovation and incentivises the cross-border participation of SMEs. Projects are defined based on the defence capability priorities agreed by Member States within the framework of the Common Security and Defence Policy (CSDP), and particularly in the context of the Capability Development Plan (CDP).

The EDF is endowed with a budget of €7,953,000,000 in current prices for the period 2021-27. This financial envelope is divided into two pillars:

- €2,651,000,000 will be allocated to funding collaborative defence research to address emerging and future security threats; and
- €5,302,000,000 to co-finance collaborative capability development projects.

Between 4% and 8% of the EDF budget is devoted to development or research for disruptive technologies having the potential to create game-changing innovations.

The EDF is implemented through annual work programmes structured along 17 stable thematic and horizontal categories of actions during the Multiannual Financial Framework period 2021-2027, focusing on:

- Emerging challenges to shape a multidimensional and holistic approach to the modern-day battlespace, such as defence medical support, CBRN, biotech and human factors, information superiority, advanced passive and active sensors, Cyber and Space;
- Boosters and enablers for defence to bring a key technology push to the EDF and which are relevant across capability domains, such as digital transformation, energy resilience & environmental transition, materials & components, disruptive technologies and open calls for innovative and future-oriented defence solutions, including dedicated calls for SMEs;
- Excellence in warfare to enhance the capability pull and support ambitious defence systems, such as air combat, air and missile defence, ground combat, force protection and mobility, naval combat, underwater warfare and simulation & training.

https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3283



Thu, 25 May 2022

FDA-approved drug could combat middle-aged memory loss

Scientists Identify How the Brain Links Memories

HIV drug could combat middle-aged memory loss, research suggests.

Our brains seldom record single memories—instead, they store memories into groups so that the recollection of one significant memory triggers the recall of others connected by time. However, as we age, our brains gradually lose this ability to link related memories. Now University of California, Los Angeles (UCLA) researchers have discovered a key molecular mechanism behind memory linking. They've also identified a way to restore this brain function in middle-aged mice – and an FDA-approved drug that achieves the same thing. Published today (May 25, 2022) in the journal *Nature*, the findings suggest a new method for strengthening human memory in middle age and a possible early intervention for dementia.

“Our memories are a huge part of who we are,” explained Alcino Silva, a distinguished professor of neurobiology and psychiatry at the David Geffen School of Medicine at UCLA. “The ability to link related experiences teaches how to stay safe and operate successfully in the world.” A bit of Biology 101: cells are studded with receptors. To enter a cell, a molecule must latch onto its matching receptor, which operates like a doorknob to provide access inside. The UCLA team focused on a gene called CCR5 that encodes the CCR5 receptor—the same one that HIV hitches a ride on to infect the brain cell and cause memory loss in AIDS patients.

Silva's lab demonstrated in earlier research that CCR5 expression reduced memory recall. In the current study, Silva and his colleagues discovered a central mechanism underlying mice's ability to link their memories of two different cages. A tiny microscope opened a window into the animals' brains, enabling the scientists to observe neurons firing and creating new memories. Boosting CCR5 gene expression in the brains of middle-aged mice interfered with memory linking. The animals forgot the connection between the two cages. When the scientists deleted the CCR5 gene in the animals, the mice were able to link memories that normal mice could not.

Silva had previously studied the drug, maraviroc, which the U.S. Food and Drug Administration approved in 2007 for the treatment of HIV infection. His lab discovered that maraviroc also suppressed CCR5 in the brains of mice. “When we gave maraviroc to older mice, the drug duplicated the effect of genetically deleting CCR5 from their DNA,” said Silva, a member of the UCLA Brain Research Institute. “The older animals were able to link memories again.” The finding suggests that maraviroc could be used off-label to help restore middle-aged memory loss, as well as reverse the cognitive deficits caused by HIV infection. “Our next step will be to organize a clinical trial to test maraviroc's influence on early memory loss with the goal of early

intervention,” said Silva. “Once we fully understand how memory declines, we possess the potential to slow down the process.”

Which begs the question: why does the brain need a gene that interferes with its ability to link memories? “Life would be impossible if we remembered everything,” said Silva. “We suspect that CCR5 enables the brain to connect meaningful experiences by filtering out less significant details.”

<https://scitechdaily.com/fda-approved-drug-could-combat-middle-aged-memory-loss/amp/>



Thu, 25 May 2022

New low-cost battery-like device captures CO₂ emissions while it charges

Researchers have developed a low-cost device that can selectively capture carbon dioxide gas while it charges. Then, when it discharges, the CO₂ can be released in a controlled way and collected to be reused or disposed of responsibly. The supercapacitor device, which is similar to a rechargeable battery, is about the size of a quarter, and is made in part from sustainable materials including coconut shells and seawater.

Designed by scientists from the University of Cambridge, the supercapacitor could help power carbon capture and storage technologies at a much cheaper cost. Every year, around 35 billion tonnes of CO₂ are released into the atmosphere, and solutions are urgently needed to eliminate these emissions and address the climate crisis. The most advanced current carbon capture technologies are quite expensive and require large amounts of energy. The supercapacitor consists of two electrodes of positive and negative charge. In work led by Trevor Binford while completing his Master’s degree at Cambridge, the team tried alternating from a negative to a positive voltage to extend the charging time from previous experiments. This improved the supercapacitor’s ability to capture carbon.

“We found that by slowly alternating the current between the plates we can capture double the amount of CO₂ than before,” said Dr. Alexander Forse from Cambridge’s Yusuf Hamied Department of Chemistry, who led the research. “The charging-discharging process of our supercapacitor potentially uses less energy than the amine heating process used in industry now,” said Forse. “Our next questions will involve investigating the precise mechanisms of CO₂ capture and improving them. Then it will be a question of scaling up.”

The results were published on May 19, 2022, in the journal *Nanoscale*. A supercapacitor is similar to a rechargeable battery but the main difference is in how the two devices store charge. A battery uses chemical reactions to store and release charge, whereas a supercapacitor does not rely on chemical reactions. Instead, it relies on the movement of electrons between electrodes, so it takes longer to degrade and has a longer lifespan. “The trade-off is that supercapacitors can’t store as much charge as batteries, but for something like carbon capture we would prioritize

durability,” said co-author Grace Mapstone. “The best part is that the materials used to make supercapacitors are cheap and abundant. The electrodes are made of carbon, which comes from waste coconut shells.

“We want to use materials that are inert, that don’t harm environments, and that we need to dispose of less frequently. For example, the CO₂ dissolves into a water-based electrolyte which is basically seawater.” However, this supercapacitor does not absorb CO₂ spontaneously: it must be charging to draw in CO₂. When the electrodes become charged, the negative plate draws in the CO₂ gas, while ignoring other emissions, such as oxygen, nitrogen, and water, which don’t contribute to climate change. Using this method, the supercapacitor both captures carbon and stores energy.

Co-author Dr. Israel Temprano contributed to the project by developing a gas analysis technique for the device. The technique uses a pressure sensor that responds to changes in gas adsorption in the electrochemical device. The results from Temprano’s contribution help narrow down the precise mechanism at play inside the supercapacitor when CO₂ is absorbed and released. Understanding these mechanisms, the possible losses, and the routes of degradation are all essential before the supercapacitor can be scaled up. “This field of research is very new so the precise mechanism working inside the supercapacitor still isn’t known,” said Temprano.

<https://scitechdaily.com/new-low-cost-battery-like-device-captures-co2-emissions-while-it-charges/amp/>

The New York Times

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‘Quantum Internet’ inches closer with advance in data teleportation

Scientists have improved their ability to send quantum information across distant computers — and have taken another step toward the network of the future. From Santa Barbara, Calif., to Hefei, China, scientists are developing a new kind of computer that will make today’s machines look like toys. Harnessing the mysterious powers of quantum mechanics, the technology will perform tasks in minutes that even supercomputers could not complete in thousands of years. In the fall of 2019, Google unveiled an experimental quantum computer showing this was possible. Two years later, a lab in China did much the same.

But quantum computing will not reach its potential without help from another technological breakthrough. Call it a “quantum internet” — a computer network that can send quantum information between distant machines. At the Delft University of Technology in the Netherlands, a team of physicists has taken a significant step toward this computer network of the future, using a technique called quantum teleportation to send data across three physical locations. Previously, this was possible with only two. The new experiment indicates that scientists can stretch a quantum network across an increasingly large number of sites. “We are now building small quantum networks in the lab,” said Ronald Hanson, the Delft physicist who oversees the team. “But the idea is to eventually build a quantum internet.”

Their research, unveiled this week with a paper published in the science journal Nature, demonstrates the power of a phenomenon that Albert Einstein once deemed impossible. Quantum teleportation — what he called “spooky action at a distance” — can transfer information between locations without actually moving the physical matter that holds it. This technology could profoundly change the way data travels from place to place. It draws on more than a century of research involving quantum mechanics, a field of physics that governs the subatomic realm and behaves unlike anything we experience in our everyday lives. Quantum teleportation not only moves data between quantum computers, but it also does so in such a way that no one can intercept it.

“This not only means that the quantum computer can solve your problem but also that it does not know what the problem is,” said Tracy Eleanor Northup, a researcher at the University of Innsbruck’s Institute for Experimental Physics who is also exploring quantum teleportation. “It does not work that way today. Google knows what you are running on its servers.” A quantum computer taps into the strange ways some objects behave if they are very small (like an electron or a particle of light) or very cold (like an exotic metal cooled to nearly absolute zero, or minus 460 degrees Fahrenheit). In these situations, a single object can behave like two separate objects at the same time. Traditional computers perform calculations by processing “bits” of information, with each bit holding either a 1 or a 0. By harnessing the strange behavior of quantum mechanics, a quantum bit, or qubit, can store a combination of 1 and 0 — a little like how a spinning coin holds the tantalizing possibility that it will turn up either heads or tails when it finally falls flat on the table.

This means that two qubits can hold four values at once, three qubits can hold eight, four can hold 16 and so on. As the number of qubits grows, a quantum computer becomes exponentially more powerful. Researchers believe these devices could one day speed the creation of new medicines, power advances in artificial intelligence and summarily crack the encryption that protects computers vital to national security. Across the globe, governments, academic labs, start-ups and tech giants are spending billions of dollars exploring the technology. In 2019, Google announced that its machine had reached what scientists call “quantum supremacy,” which meant it could perform an experimental task that was impossible with traditional computers. But most experts believe several more years will pass — at the very least — before a quantum computer can actually do something useful that you cannot do with another machine.

Part of the challenge is that a qubit breaks, or “decoheres,” if you read information from it — it becomes an ordinary bit capable of holding only a 0 or a 1 but not both. But by stringing many qubits together and developing ways of guarding against decoherence, scientists hope to build machines that are both powerful and practical. Ultimately, ideally, these would be joined into networks that can send information between nodes, allowing them to be used from anywhere, much as cloud computing services from the likes of Google and Amazon make processing power widely accessible today. But this comes with its own problems. In part because of decoherence, quantum information cannot simply be copied and sent across a traditional network. Quantum teleportation provides an alternative.

Although it cannot move objects from place to place, it can move information by taking advantage of a quantum property called “entanglement”: A change in the state of one quantum system instantaneously affects the state of another, distant one. “After entanglement, you can no longer describe these states individually,” Dr. Northup said. “Fundamentally, it is now one system.” These entangled systems could be electrons, particles of light or other objects. In the

Netherlands, Dr. Hanson and his team used what is called a nitrogen vacancy center — a tiny empty space in a synthetic diamond in which electrons can be trapped.

The team built three of these quantum systems, named Alice, Bob and Charlie, and connected them in a line with strands of optical fiber. The scientists could then entangle these systems by sending individual photons — particles of light — between them.

First, the researchers entangled two electrons — one belonging to Alice, the other to Bob. In effect, the electrons were given the same spin, and thus were joined, or entangled, in a common quantum state, each storing the same information: a particular combination of 1 and 0. The researchers could then transfer this quantum state to another qubit, a carbon nucleus, inside Bob's synthetic diamond. Doing so freed up Bob's electron, and researchers could then entangle it with another electron belonging to Charlie. By performing a specific quantum operation on both of Bob's qubits — the electron and the carbon nucleus — the researchers could then glue the two entanglements together: Alice plus Bob glued to Bob plus Charlie.

The result: Alice was entangled with Charlie, which allowed data to teleport across all three nodes. When data travels this way, without actually traveling the distance between the nodes, it cannot be lost. "Information can be fed into one side of the connection and then appear on the other," Dr. Hanson said. The information also cannot be intercepted. A future quantum internet, powered by quantum teleportation, could provide a new kind of encryption that is theoretically unbreakable. In the new experiment, the network nodes were not that far apart — only about 60 feet. But previous experiments have shown that quantum systems can be entangled over longer distances. The hope is that, after several more years of research, quantum teleportation will be viable across many miles. "We are now trying to do this outside the lab," Dr. Hanson said.

<https://www.nytimes.com/2022/05/25/technology/quantum-internet-teleportation.html>

