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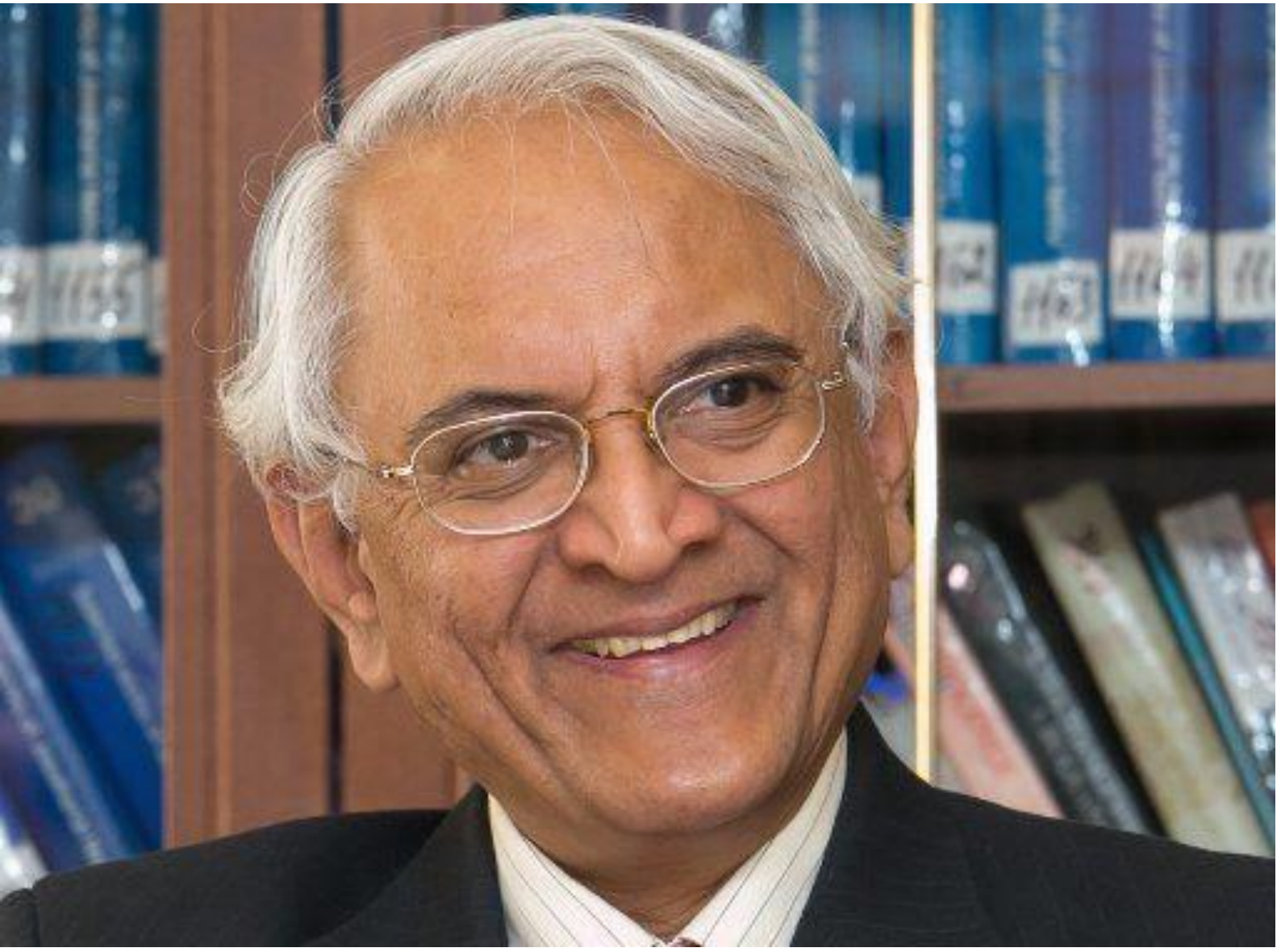
COVER STORY

Science Diplomacy: National and Global Perspectives

An interview with Ambassador PS Raghavan, former Chairman of India's National Security Advisory Board. Earlier, he was India's Ambassador to Russia, Ireland and Czech Republic.

By Harini Madhusudan, Rashmi Ramesh, Akriti Sharma, Avishka Ashok, and Ashwin Immanuel Dhanabalan



About STIR

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COVER STORY

Science Diplomacy:

National and Global Perspectives

An interview with Ambassador PS Raghavan, former Chairman of India's National Security Advisory Board. Earlier, he was India's Ambassador to Russia, Ireland and Czech Republic.

Avishka Ashok (AA): What are some of the challenges that India faces in its aim to promote science diplomacy? India doesn't have many science counsellors in its embassies abroad. Is there a reason why we are not able to encourage our scientists or diplomats to take up such positions?

Ambassador PS Raghavan (PSR): Having more scientific personnel in India's diplomatic missions abroad may not be the solution. The problems in international Science and Technology (S&T) cooperation are twofold. Governments can promote S&T cooperation only to a certain extent, because much of the S&T research is done by private entities, universities and commercial establishments. Within the government, it is done in defence establishments, which are not freely and easily accessible. In case of commercial cooperation, there is the issue of patents and commercial interests. These aspects change the nature of the S&T cooperation. In the case of private institutions, they have their connections which are built over time, and are pursued without the government being able to influence it. Governments cannot promote S&T cooperation in cases of restrictions to ensure the security of resources, protection of sensitive information, inability to cooperate with scientists from a hostile country and limitations in collaboration in a particular sub-area of technology. Thus, there is a limit to the extent that governments can promote S&T cooperation through science diplomats posted in missions abroad.

On the other hand, governments can promote joint projects through research institutions of the two countries, aid institution grants and foster cooperation. The government encourages programs that identify subjects that are strong in the research infrastructure in that country. The government looks into these subjects beforehand and gives a gentle push to look into these areas and call for joint investigations. For example, several European countries have many programs with India, but these programs are not the primary vehicle of S&T cooperation between countries. They lead the way, but eventually, the cooperation has to be done by institutions. The job of an embassy is to sensitise institutions in a particular country about what is available in the other country. This job doesn't particularly require a scientist. A diplomat who promotes trade or investment, can also promote scientific cooperation between countries. It is not only scientists who can do that. That being said, there have been times when scientists have done an exceptional job as science counsellors. Hence, science diplomacy can be pursued by diplomats. It is not essential to have scientists in this role as they can at most catalyse the cooperation.

AA: We often read about the two approaches to science diplomacy. One is science through diplomacy and the second is diplomacy through science. Is there any one approach that is better or more beneficial for India's national interests and can India profit from strengthening its

relations with third world countries through science?

PSR: The questions bring us to the root of the purpose of science diplomacy. In the case of India, we want scientific knowledge and technologies to come to us in such a way that we can absorb them, use them, develop them and upgrade them ourselves to create products which are of use to our population. So that is one of the purposes of diplomacy. The second one is enabling our researchers to participate in research being done in foreign institutions in a number of cutting-edge scientific disciplines. The third, is trying to get technologies in the defence field, which we can later indigenize.

Another purpose of science diplomacy is sharing our own technological solutions that helped solve specific developmental problems, with other developing countries to help them in their development. That's very much a part of our larger developmental assistance to developing countries. It's part of building our relations with them and influencing them which could be used subsequently in political, economic and commercial relations as well. Perhaps, this particular area is not as properly organised as it should be, but it is reaching its audience. For example, in Africa, India is trying to share its e-governance solutions with African countries. Similarly, we also share rural communications technologies. There is a conscious effort to share our scientific and technological knowledge which is specifically applicable to developing countries. This is because western countries may not be as equipped with understanding the issues and problems of the developing world, while India is able to relate more easily and provide solutions.

Rashmi Ramesh (RR): There are multiple states from different continents, interested in Arctic affairs. Is science the primary objective of states or is it a pretext on which states build further, to have geopolitical footprints? Do you foresee this science-induced peace continuing in the region, given the political rumblings that are slowly gaining traction?

PSR: International cooperation is overlaid with political, security, commercial and strategic interests of countries. Often these aspects overshadow the S&T dimension. If we look at the Arctic governance structure, it is the Arctic Council that dominates the landscape. It is a closed group of countries that are on the rim of the Arctic, to the extent that they do not tolerate any interference from the non-Arctic countries in terms of the governance structure. That is one area where the US and Russia are on the same page, despite all the daggers drawn in all other issues. They claim that the region belongs to them alone, though they might have differences within.

If we look at the interest of other countries, the Arctic is very important for scientific inquiry, especially climate change and its impact. The study of the Arctic can enable the understanding of weather patterns and climate change. It is a region where climate change is evident in the most dramatic fashion and yet is not being noticed by the world around. A look at why countries intend to get into the Arctic-science is an important reason, however, geopolitics dominates. China for example wants to call itself a ‘Near-Arctic country’. Additionally, commercial interest of the country with respect to accessible navigation also plays a role.

Geographically, Russia dominates the Arctic, with the longest coastline with the Arctic Ocean. It naturally feels the urge to control the regional interactions in all spheres, primarily the transit of commercial traffic, security and defence. Depending on the manner in which the US/West-Russia relations develop, the Arctic can increasingly become a bone of contention-one more area of confrontation between Russia and the West. Science,

unfortunately in this scenario, will take a backseat, even though it is very important.

RR: Science diplomacy is a uniting factor, while development of S&T in the defence sector can contribute to the security dilemma. How does this juxtaposition unfold in the Arctic?

PSR: S&T development in the defence sector at present, specifically does not affect the Arctic. What impacts the Arctic more, is the S&T development with regards to offshore drilling, the technology of extraction of oil and natural gas. That is a sector for advanced technology, with many climate-effective technologies in place. If these technologies are not shared between the states, it can have a negative impact on climate and environment processes, especially in the Russian arctic. It eventually depends on the state of relations between Russia and the West.

Akriti Sharma (AS): How can science diplomacy play an instrumental role in addressing global challenges like climate change, and natural/manmade disasters?

PSR: The science of climate change has developed pretty rapidly. But it is not always accepted by everyone. There are climate change sceptics. Another narrative is that the impact of climate change will be felt over a large period of time, whereas the impact of diseases, malnutrition, poverty, inequality, global inequality, will be felt much sooner. The mitigation issues have become political in terms of transfer of responsibilities to those who have historically contributed to emissions. It is an issue where countries pull up the drawbridge. They're not willing to help someone else at the expense of their own economies, so science takes a back seat. Cooperation in practical actions to implement the science is limited by selfish interests of the countries.

Natural disasters is a different category in which cooperation does exist and cooperation can develop because of mutual benefit. The best example is that of dealing with tsunamis where a number of technologies have been developed for its early warning. But international cooperation in technologies to avert national natural disasters is necessary. Space is an instrument to advance warning of natural disasters, and also to develop techniques for mitigating their impact.

AS: How can science diplomacy foster regional cooperation in the Himalayas that sustain South Asian livelihoods?

PSR: The cooperation among South Asian countries on the Himalayas includes China because China impacts the developments in the region. While the benefits of cooperation are obvious, the limits of cooperation are set by the relations between countries. There is rhetoric about the need to cooperate for mutual benefit. But eventually, whenever any mission is launched for scientific investigation, it gets bogged down in issues that South Asian countries have with each other. India's suspicions about Chinese presence in the Himalayas is a limiting factor for cooperation.

Harini Madhusudan (HM): What stops countries from taking collective initiatives like planetary exploration, resource collection and analysis, and radio inferences? Additionally, there are also space-aiding technologies for areas which depend on assets in outer space, for example disaster management and weather forecasting, where it would be useful if we get data from satellites of our neighbouring countries for better predictions? What is restricting this cooperation within the Indian neighbourhood?

PSR: There are two aspects which have impeded the flow of such cooperation. First, the information and data for space has been centralised in one body in India – ISRO. ISRO has a very large canvas of

objectives, and due to this, the ability to focus more strongly on each of these areas has been limited. This major impediment has been removed recently because the government has decided to free both data, and the use of data, to enable private players to be a part of the process. This comes from the recent announcement by the Finance minister and the Department of Space that data can be downloaded and used by anybody with no restrictions and no licensing requirements. Almost all of the data is now available commercially. This will give a fillip to the rise of organisations that use data from our satellites, and enable them to integrate data from other satellites to provide far better services. This does not require cooperation among countries because these are satellites in space, and one only needs to download the data. This is a major reform that has taken place and I expect it will have an impact.

To see why there is no broader cooperation on space we come back again, to political strategic security issues, perceptions of dominance, and either the desire for dominance or the perception that somebody else wants to dominate. When a country does a space test other countries complain about debris and how it can impede the orbit of other satellites. Everything revolves around the desire to dominate, a desire for weaponization, or prevention of weaponization, of space, or to take up defensive actions in space. So, increasingly, space has become a domain of competition, rather than cooperation. And the more space becomes involved in war fighting plans, military doctrines actively incorporate space as one of the domains of war fighting. Space debris is one of those subjects where there is cooperation but it got diverted because of this debate about anti satellite weapons.

HM: The Chinese White Paper talks about how China wants to set up a launch site in Pakistan. Should India see this as an immediate security threat? If not, how do we perceive the China-Pakistan cooperation in outer space?

PSR: With China and Pakistan, it is not very clear how a launch site in Pakistan is a scientifically and technologically viable proposition. Launch sites need certain environments, certain free space, in order to be able to function in an untrammelled fashion. This is why the Russians have to go all the way to Kazakhstan in order to launch, and why the others go to French Guiana to launch satellites. So it is not simple like setting up a nuclear power plant. So, this may be more of a declaration of intent than a financially viable proposition. But from a larger perspective, it essentially articulates the Chinese desire to have a presence in Pakistan in every possible domain. It is the Chinese socio-economic domination of Pakistan that India should be worried about. Our concerns about Chinese investments in Pakistan are much more than a launch site that they may or may not set up there. So that is an ongoing challenge.

HM: Since India has a strong scientific aspect in outer space, should India be using outer space for science diplomacy?

PSR: India has launched multiple satellites for different countries. These are services that are available, but the problem has been the limited launch capabilities of ISRO. When I say limited, I don't mean limited in technology, but capacity, as to how many satellites you can launch in a year. Or how many satellites do you require for different actors and for your own purposes?
Additionally, strategic purposes of satellites need to be kept in mind. For instance, during the standoff in Ladakh, India required high resolution, real-time images of those areas. We were unable to get it from our own satellites. Hence, much of it was actually intelligence shared from other countries, as well as satellite images bought from other satellites. This highlighted the need of India’s own

satellites for strategic and defence purposes.

Similarly, India should seek more launch sites in and outside the country. If we cannot find possible launch sites on land within the country, there are options for launch sites from the sea. And once we throw it open to private sector participation, India will attract investment. With the possibility of ISRO willing to share the technology with other private sector players, or other companies, India will have a thriving business, with India launching multiple satellites, multiple satellites in a single launcher, and satellites coming from different countries for various applications. Since India is one of the pioneers in space technologies, we should benefit from its applications as fully as we are capable of.

Ashwin Immanuel Dhanabalan: Given the complexity of cyberattacks and the need for supercomputers, do you think India can use science diplomacy for acquiring advanced supercomputers to secure its national interests?

PSR: The solution does not lie in having more supercomputers, as that is not the main impediment to cyber defence. India is already developing supercomputers of sufficient capacity. Currently, the issue is not developing supercomputers, but of dealing with the power usage of these computers. Therefore, developing these supercomputers with lower power usage is a challenge at hand.

But, what India urgently needs today is the training of cyber specialists and cyber skills in specific disciplines to deal with cyber security issues. The Indian government is dealing with two issues. First, the critical infrastructure hardware imported for communication and defence needs to be from trusted sources and free of potentially exploitable malware. Second, the country requires a large body of skilled cyber specialists. Although India is perceived as the IT capital of the world, we do not have a sufficient number of cyber specialists in areas that are required to make the network safe and protect it from being attacked.

I was involved in an initiative of IIT Madras to promote awareness of the need for creating cyber specialists and to establish mechanisms for training, certification and accreditation of cyber specialists in different sectors. It is sometimes not well understood that a cyber expert who handles attacks on banking networks or ATMs may not be best equipped to deal with the cyber protection of, say, a nuclear power plant or a transport infrastructure network. According to estimates, India needs at least half a million cyber specialists across various disciplines, in a very short timeframe, to protect various sectors of our economy, as it absorbs new technologies, which will be vulnerable to cyberattacks.

About the interviewers
Harini Madhusudan, Rashmi Ramesh and Akriti Sharma are PhD Scholars at the School of Conflict and Security Studies, NIAS. Avishka Ashok is a research associate at NIAS. Ashwin Immanuel Dhanabalan is a research assistant at NIAS.

COVER STORY

China's White Paper on Space: Three major takeaways

While the 2016 paper highlighted the need for Chinese progress in space at par with the other space powers, the 2021 document offers to work with/alongside these powers. The tone of the 2021 paper is remarkably different from the previous ones, and offers more clarity on the Chinese plans.

By Harini Madhusudan

Introduction

On 28 January 2022, China's State Council Information Office released its fifth five-year space exploration plan titled "China's Space Program: A 2021 Perspective." The document outlines China's priorities and the plans for outer space exploration and spaceflight.

During 2016-20, China has made noteworthy achievements including reaching the far side of the moon, collecting moon samples, successful Mars mission, beginning the assembly of the space station, completion of the Beidou navigation satellite and the China high-resolution earth observation systems (CHEOS). Moreover, there has been consistent technological and industrial growth. Between 2016 and 2021, China launched 207 successful missions, out of which 186 were long march launches among more than 400 attempts.

According to the paper, China aims the following in the next five years: integrate space science, technology and applications; pursue a new development philosophy; build a new development model; and meet the requirements for high-quality development. The paper is divided into six sections that look at the various focus areas. This begins with the need to establish a strong space presence and ends with a strong emphasis on international cooperation and introduces the principles and measures of their space exploration strategy.

I
Three major takeaways

First, manned spaceflight, expansion of technological capacities, and strengthening space environment governance are among the report's key focus areas. The paper has listed space transport system, manned spaceflight, improving space infrastructure, expansion in the space launch sites, innovations and experiments with new technologies, deep space exploration, telemetry, tracking and command, and space environment governance as a priority for China. For example, the country has placed a special emphasis on improving its space debris monitoring systems, strengthening space traffic management, and introducing a space-ground space climate monitoring system. It also shows a keen interest in exploring the moon's polar regions and aims at a manned landing on the moon. China plans to study building a near-earth object defence system. The paper also indicates an interest in sample collection and its research.

The paper refers to the development and engagement of new technologies and systems like the smart self-management of spacecraft, in-orbit tests of new space materials, mission extension vehicles, in-orbit servicing, and innovative space

propulsion. The country is also working on navigation-communication integration, low-orbit augmentation, and new technologies for the next-gen Beidou system.

Second, China's call for international space cooperation. Through the paper, China attempts to call on all countries to cooperate and carry out in-depth exchanges based on mutual benefit, equality, peaceful utilisation, and inclusive development. China offers strong cooperation with its international lunar research station project and seeks help with astronaut selection, training, and joint flights. The paper indicates that the Chinese attempts to participate/spearhead the formulation of international rules would continue to work together with countries for the long-term sustainability of the activities in outer space.

Third, emphasis on commercial space applications. Unlike the previous four versions, this paper emphasises commercial space applications and activities. In 2014, China made policy changes to allow the increased participation of commercial space actors in their outer space industry. One of the core visions of China's Space Strategy has been the expansion of the space application industry. A competitive private-commercial ecosystem would be the driving force of this applications industry. From commercialising communications and broadcasting services to offering products and services like data processing, high-accuracy maps which use remote-sensing data, and application software are included in the plans for the next five years. The commercial industry in China would play an essential role in the Chinese space vision.

II
2021: What's new?

The 2021 report marks the fifth such White Paper related to outer space from China. It indicates increased confidence in their capabilities and plans for the upcoming years. The previous papers had up to five sections; this report has six. This paper has placed greater emphasis on common efforts by the space industries to explore and utilisation of resources. There is a shift/upgradation in strategies from single product collaboration to more complicated systems and from a single typical scenario application to a more comprehensive one. In the past, the international cooperation undertaken by China would mainly consist of minor tasks like carrying payloads onboard, which they hope to expand to mission-planning stages as well. China has made its progress in the space sector known and now seeks to work with other countries with inherent confidence in its capabilities.

While the 2016 paper highlighted the need for Chinese progress in space on par with the other space powers, the 2021 document offers to work with/alongside these powers. The tone of the 2021 paper is remarkably different from the previous ones and provides more clarity on the plans. However, a significant part of the paper only focuses on the civilian and technological parts and misses the role of diplomatic and military sectors. Projects and initiatives outside the purview of the China National Space Administration and China Aerospace Science and Technology Corporation get a minimal mention.

China is also known to be working on its "satellite internet" mega constellation project but it has not been mentioned. Hence, the steady Chinese presence in outer space would continue in the next five years, with a greater and more integrated role in the commercial sector. For the first time, the paper refers to the commercial companies and their products by name.

There have been mentions of increased cooperation with Pakistan's Space Centre and Egypt's Space City. The paper also re-emphasises the core values of outer space engagement, that is, use for peaceful purposes and the exploration for the benefit of all mankind.

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Huaxia, "China releases white paper on space program," *XinhuaNet*, 28 January 2022

Andrew Jones, "China presents space plans and priorities in new white paper," *SpaceNews*, 28 January 2022

"Ushering in a New Era of Chinese Space: the 2021 White Paper," *Dongfang Hour.com*, 31 January 2022

Deng Xiaoci, "China details future space ambition in white paper, calls for formulating UN-centered space rules," *Global Times*, 28 January 2022)

About the author
Harini Madhusudan is a doctoral scholar at NIAS. Her doctoral research is on the issue of militarization in outer space. As part of the Europe Studies at NIAS, her research focuses on Russian geopolitics and diplomacy along with a coverage of the European Islands & Oceans. She mainly researches on issues relating to science and technology, such as new innovations, outer space, and cybersecurity. She is currently working on Gazprom and the energy crisis in Europe.

In brief

By Abigail Miriam Fernandez, Jeshil Samuel J, Akriti Sharma and Avishka Ashok

Xenotransplantation: First pig-to-human heart transplantation

On 14 January, *Nature* reported that the man who was transplanted with a modified pig heart was doing well. On 7 January 2022, a genetically modified pig heart was transplanted into a 57-year-old man by a team of surgeons from the University of Maryland School of Medicine (UMSOM). The first of its kind operation was led by Bartley Griffith, director of the cardiac transplant programme at the university, and the patient was suffering from terminal heart disease and arrhythmia. The team at UMSOM had filed a petition to the US Food and Drug Administration (FDA) for a procedure known as xenotransplantation which involved transplanting a genetically modified pig heart into the patient, claiming that this experimental procedure was the only option to extend his life. They received an emergency authorization on 31 December 2021.

The process of xenotransplantation involves the transplantation of animal cells, tissues, and organs into human recipients. The procedure is mainly aimed at resolving the issue of the organ shortage crisis. Surgeon Bartley Griffith said the surgery would bring the world "one step closer to solving the organ shortage crisis."

In this case, the heart used was a genetically modified pig developed by a biotechnology company, Revivicor. The company has disabled the effect of three genes in the donor pig so that its cells could not produce certain membrane-bound sugars that human antibodies would recognize as foreign, causing an immune reaction. They also deleted a gene in the pig genome that prevents growth hormones so that the heart does not continue to grow in the human host.

Additionally, six human genes were inserted into the pig genome to reduce inflammation, protect blood vessels, maintain regular blood coagulation, and suppress antibody responses in the recipient's body. The transplantation procedure was successful; however, it is still too early to determine how the recipient's body functions with the new heart. Dr Griffith, on the recovery process, said, "It is very similar to a human heart transplant in terms of rehabilitation and lifestyle as far as we know at this point," adding, "He is on an anti-rejection medication regimen that includes an experimental drug. We do not know the full extent of the side effects of that drug."

This procedure has been hailed as a medical breakthrough that helps shorten the transplant waiting period. There has been significant research and advancement in xenotransplantation in the recent past with the start of CRISPR–Cas9 genome editing, making it easier to create pig organs that are less likely to be rejected by human immune systems.

However, criticism of the procedure includes medical, logistic, and ethical issues. Additionally, there still exist several lacunas in xenotransplantation research. (Talha Burki, "Pig-heart transplantation surgeons look to the next steps," *The Lancet*, 22 January 2022; Pamela Alamilla, "The first ever pig-to-human heart transplant," *The Varsity*, 23 January 2022; Sara Reardon, "First pig-to-human heart transplant: what can scientists learn?," *Nature*, 14 January 2022; "Man gets genetically-modified pig heart in world-first transplant," *BBC*, 11 January 2022; "Three ethical issues around pig heart transplants," *BBC*, 11 January 2022; Laura Beil, "Will animal-to-human organ transplants overcome their complicated history?," *Science News*, 31 January 2022;

Corrie Pelc, "First successful pig-to-human heart transplant may offer new options for patients," *Medical News Today,* 18 January 2022)

Ukraine faces large-scale cyberattack

On 14 January, nearly seventy Ukrainian government websites were hit in a large-scale cyberattack. The hackers who carried out the attack hijacked the websites and displayed messages threatening to upload the private data of Ukrainians (on public domains) for their actions in the past, present and future. The hackers also warned the Ukrainians to "expect the worst". However, according to officials, no data has been stolen from the attack. The ministry of external affairs, the education ministry and members of the Ukrainian cabinet were among the many who were forced to shut down their sites. A few sites were brought online immediately, while others had difficulty recovering from the attack. European Union (EU) diplomat Josep Borrell assured that the EU would be mobilising all its resources to help Ukraine solve this problem.

This massive cyberattack comes when Russia and Ukraine are engaged in a military standoff within their borders. Russia has stationed nearly 1,00,000 soldiers on its borders with Ukraine. NATO allies have started sending their troops to aid Ukraine. The recent cyberattack was also conducted a few hours after the EU had decided to extend sanctions on Russia for another six months. This is not the first time Russia has been accused of conducting large-scale cyberattacks. In 2008, weeks before Russia launched a physical invasion in Georgia, a massive cyberattack forced multiple government sites to be shut down. Similarly, in 2014, before Russia entered Crimea, various online infrastructures in the region were targeted through a coordinated cyberattack that halted essential services.

The attribution of cybercrimes has always been a problem for the international community and law enforcement agencies. Despite the advancements in digital forensics, it takes a long time to attribute a cybercrime to an actor (state or non-state). Punishing the perpetrator is longer since it depends on the extradition treaties shared between the two countries. In the case of Ukraine, the government would not be able to extradite and punish Russian hackers even if they manage to provide solid evidence. Therefore, the Ukrainian government can only take a defensive approach and strengthen its cybersecurity measures to prevent future attacks. (Luke Harding, "Ukraine hit by massive cyber-attack on government websites", *The Guardian*, 14 January 2022; James Vincent, "Massive cyber attack hits Ukraine government websites as tensions with Russia escalate", *The Verge*, 14 January 2022; Pavel Polityuk, "Massive cyberattack hits Ukrainian government websites as West warns on Russia conflict", *Reuters*, 14 January 2022; Clara Assumpção, "The problem of cyber attribution between states", *E-International Relations*, 06 May 2020)

Peru: Oil spill, an ecological disaster

On 15 January, Peru witnessed an oil spill in the La Pampilla refinery due to the waves linked to a volcanic eruption in Tonga. On 22 January, Peru's government declared a 90-day environmental emergency. Declaration of the emergency would allow increased restoration, remediation work and sustainable management of the affected areas. Peruvian Environment Minister said that "almost 12,000 barrels of oil leaked into the sea" on the same day. The leakage has harmed 18,000 square kilometres of protected zones containing rare plants and

animals. Many sea animals, including the otters, penguins, and fish, were coated with oil on the beaches. According to the estimates, the damage caused to the marine ecosystems can take up to two decades to recover.

La Pampilla, the county's largest refinery, is owned by Spanish oil company Repsol, which initially reported a tiny leakage of some gallons of oil. Peru has demanded an investigation and compensation for the spill. Repsol said in a statement: "Our main concern is cleaning up the environment. Repsol is putting all its efforts into cleaning up as quickly as possible," the Peruvian Foreign Ministry tweeted: "This is the worst ecological disaster that has occurred around Lima in recent times and has seriously damaged hundreds of fishermen's families," It added: "Repsol must immediately compensate for the damage," Peru's energy regulator, Osinergmin said that it had closed one of the four terminals of the refinery because of the ongoing investigation into the causes of the spill.

The Peruvian government has put the onus of the disaster on Repsol; on the other hand; the company has blamed volcanic eruption for the spill. The company also blamed Peru's navy for not issuing a timely alert. When the government suspended all operations at the refinery, the company called it "disproportionate and unreasonable." The government has also barred some of the refinery officials from leaving the country and vowing to hold Repsol responsible for the ecological disaster. As the refinery meets Peru's half of its energy needs, the government assured that it would do its best to avoid energy shortages after suspending all operations in the refinery. This is not the first time that the company has faced a leakage. In 2013, Repsol's first oil leak was caused due to a corroded pipeline which resulted in 196 barrels of oil leakage and the company was fined USD 200,000. ("Peru oil spill after Tonga eruption bigger than previously thought" *BBC,* 30 January 2022; "Peru oil spill after Tonga eruption an ecological disaster", *BBC,* 20 January 2022; Mitra Taj, "Its Beaches Mired in Crude Oil, Peru Vows to Make Refinery Pay", *The New York Times,* 3 February 2022)

Kosovo: Ban on crypto-mining due to energy shortage

On 21 January, the *Balkan Insight* reported that numerous crypto miners in Kosovo were selling their equipment. Many were opting to move to neighbouring countries, while a few planned to wait for the government to take back the ban on crypto mining. Post the ban on crypto mining, the government has confiscated over 430 mining devices that used electricity consumed by 500 homes in one month.

On 4 January, the government in Kosovo implemented a total ban on cryptocurrency mining to deal with the energy shortage and manage electricity consumption. The head of the Department for Energy at the Ministry of Economy said: "The first and only reason was the option of saving energy where it is possible and for the available energy to be preferably used for legal activities."

The country is powered by two coal-powered plants, which are 45 years and 32 years old, in 2022. Over 97 per cent of the electricity is produced by the two plants, which rely entirely on a non-renewable and limited energy source. The government tried to secure its coal reserves by buying a village in Kosovo home to 14 billion tons of coal but could not close the deal with the villages, leading to an acute shortage of energy and frequent blackouts in the country. With the heightened energy shortage, it became difficult for cryptocurrency miners to continue their mining operations.

Another contributing factor to the energy crisis is the lack of funds which has risen since the Serbs refused to pay electricity bills in the northern part of the country in 1999. The government agreed to pay the bills for six more months in May 2021 and pledged to look for a solution to the issue. The unpaid electricity bills have added to the energy crisis. Northern Kosovo essentially became the region that hosted most crypto miners due to the free electricity, leading to extremely high usage and expensive electricity bills.

Most cryptocurrencies are mined by solving complex maths questions, leading to unearthing more crypto resources. The process is time-consuming and requires a continuous power supply to keep the computers running. It also involves connecting the computers to other devices and mining machines to the internet, which also uses electricity. Kosovo is not the first country to ban mining. Other countries such as China and Iran have also passed laws to ban mining entirely to prevent further draining of their energy resources. ("Panic as Kosovo pulls the plug on its energy-guzzling bitcoin miners | Cryptocurrencies," *The Guardian*, 16 January 2022; "Kosovo bans cryptocurrency mining to save electricity," *Reuters*, 5 January 2022; "After Ban, Kosovo's Crypto Miners Weigh Options," *Balkan Insight*, 21 January 2022; "Kosovo to End Free Energy Supplies to Serb-Majority Municipalities," *Balkan Insigh*t, 23 November 2021; "Used To Free Electricity, Kosovo's Bitcoin Miners Are Now Facing Difficult Times After Ban," *Radio Free Europe*, 12 January 2022)

S&T Nuggets

By Akriti Sharma and Harini Madhusudan

CLIMATE AND ENVIRONMENT

The US: Bomb cyclone hits eastern coast

On 30 January, a major winter storm with hurricane-like winds and blizzards hit the eastern coast of the US. The storm is what meteorologists call a "bomb cyclone" – a term given to cyclones with access to optimal ingredients for strengthening, such as high amounts of heat, moisture and rising air. Experts have predicted that the east coast of the US is susceptible to such conditions in the winter due to significant temperature contrasts between the cool land and the warm Gulf stream current. The storm led to the loss of electric power, thousands of flight cancellations, and snow showers of more than one foot in the region, with local authorities urging residents to stay at home. A state of emergency was declared for New York, New Jersey and Boston. (Esther Mullens, "What Is a Bomb Cyclone?", *Scientific American*, 28 January 2022; "Bomb cyclone' blizzard blankets the eastern US in snow" *AlJazeera*, 30 January 2022)

India: New parasitic plant found in Nicobar islands

On 30 January, scientists published the discovery of a new genus of a parasitic flowering plant found in the Nicobar islands in the *Journal of Botanical Taxonomy and Geobotany Feddes Repertorium*. The genus, named "Septemeranthus" has distinctive morphology and characteristics and is endemic to the Nicobar group of islands. The plant contains green leaves to perform photosynthesis and thus belongs to the category of "hemiparasites", unlike parasites, which are only partially dependent on host plants for nutrition. Hemi-parasites are important in forest ecology, pathology, and medicine and play an important role as food for many fruit-eating birds. Four other endemic hemi-parasite plants have been discovered earlier in the Nicobar group of islands, showcasing the region's ecological importance. (Shiv Sahay Singh, "New genus of parasitic flowering plant discovered from Nicobar Islands", 29 January 2022)

Thailand: Beach declared a disaster area due to oil spill

On 25 January, a pipeline owned by Star Petroleum refining leaked into the ocean about 12 km from the country's eastern coast. The leak was brought into control within 24 hours. The oil spill's aftermath continued as some of the oil reached the shoreline at Mae Ramphueng beach in Rayong province, blackening the shore. The area was declared a disaster area. Around 350 personnel of the petroleum company and the Thailand navy were deployed to clean the beach, and barriers were set up to control the spill. The deputy commander of the first naval area command said: "We and the company are still working at sea to reduce the amount of oil by cornering the spill and sucking up the oil and spraying dispersant". (Panu Wongcha-um, "Thai beach declared disaster area due to oil spill", *Reuters*, 29 January 2022)

Climate change: Marine heatwaves are a "new normal" for the oceans

On 1 February, a study titled "The recent normalisation of historical marine heat extremes" was published in PLOS Climate journal. The study highlights the change in the oceans post-industrial revolution. The researchers of the study used historical temperatures from 1800 to evaluate the frequency of the marine heatwaves. The second study assesses the impact of future marine warming on coral reefs. Prolonged heat can result in the bleaching of the colourful algae living inside them. These algae are instrumental in providing the corals with nutrients. Bleached reefs revive within ten years if the marine heatwave does not recur, but the increasing frequency of the marine heatwaves hinders the

revival. (Emma Newburger, "Extreme heat driven by climate change is 'new normal' for oceans, study finds", *CNBC*, 2 February 2022)

Climate change: Satellites map methane emissions from fields

On 24 January, the Carbon Mapper and Environmental Defense Fund released three-year data (2019-2021) of airborne surveys using advanced remote sensing technology. The project has tracked methane emissions from oil and gas plants in the Permian Basin across Texas and New Mexico. Satellites are capable of broad vision and continuous coverage over some time. Using European satellites, carbon Mapper mapped huge emissions (more than 25 tons an hour). The sites emit 9 million tons per year. The quantity of methane produced is equivalent to 275 million tons of carbon dioxide is the potential total carbon footprint of 40 million people, based on the global average per capita. However, the study does not include some areas where it was impossible to map the large individual sources of methane due to extremely high emissions. (Henry Fountain, "Seen From Space: Huge Methane Leaks", *The New York Times*, 4 February 2022; "Dozens of "super-emitting" oil and gas facilities leaked methane pollution in Permian Basin for years on end", *Carbon Mapper*, 24 February 2022)

Indonesia: Relocation of the capital due to environmental concerns

On 18 January, the Indonesian House of Representatives passed a bill to relocate the country's capital from Jakarta to East Kalimantan, named Nusantara. The relocation results from many environmental concerns such as flooding, air pollution and congestion. President Joko Widodo announced the relocation in 2019 but was delayed due to the pandemic. The country plans to build a low carbon hub in the new capital which will aid pharmaceutical, health and technology sectors and sustainable growth. ("Indonesia passes law to relocate capital to remote Kalimantan", *The Jakarta Post*, 18 January 2022)

HEALTH

COVID-19: Scientists report NeoCov variant could evolve to infect humans

On 28 January, researchers from the Wuhan University in China published a study reporting that small changes in the molecular structure of the NeoCov variant could allow it to infect humans in the future efficiently. The NeoCov variant, first identified in 2011 in bats, is a coronavirus that is about 85 per cent similar to the Middle Eastern Respiratory Syndrome (MERS) and is expected to be more lethal than other coronavirus variants. However, NeoCov cannot inherently interact with human receptors and is currently not expected to be dangerous to humans. The scientists caution through their study that introducing small changes in the molecular structure in the lab led to its efficiency to interact with human receptors increasing by 15-30 times. They suggest that such changes could happen naturally through mutations of the current NeoCov variant and is a potential cause for worry. WHO said, "Whether the virus detected in the study will pose a risk for humans will require further study" and that they are in touch with the World Organization for Animal Health and the Food and Agriculture Organization to respond to this. (Jackob Koshy, "NeoCov coronavirus found in bats may pose threat to humans in future, scientists caution", *The Hindu*, 28 January 2022)

COVID-19: First molecular-level analysis of Omicron conducted

On 22 January, a team of researchers at the University of British Columbia (UBC), Canada, conducted the first molecular-level analysis of the structure of the Omicron spike protein and published their results in the journal *Science*. The structural analysis was done using a state-of-the-art cryo-

electron microscope and finds that this variant has undergone mutations that show substantial antibody evasion and stronger binding to human cells. The team claims that this highlights the reasons for the rapid transmission of the Omicron variant. A professor at UBC and a member of the research team said: "Our experiments confirm that the Omicron spike protein is far better than other variants at evading monoclonal antibodies that are commonly used as treatments, as well as evading the immunity produced by both vaccines and natural infection". The study will help develop more effective treatments against Omicron and related variants in the future. ("Indian-origin scientist among UBC researchers unveil world's first molecular-level analysis of Omicron, *The Hindu*, 22 January 2022)

The US: Last resort CAR-T cell cancer therapy successful

On 2 February, *Nature* published a report on CAR-T cell therapy that has worked on leukaemia. The patient was diagnosed with chronic lymphocytic leukaemia, and in 2010, he was the first person to receive the experimental CAR-T treatment. After more than ten years, the treatment has successfully destroyed cancer cells in the patient. CAR-T therapy involves removing immune T cells from the body by genetically altering them to produce chimeric antigen receptors (CAR)- a protein that recognises cancer cells. So far, the US has approved five such therapies to treat leukaemias, lymphomas and myelomas. However, the therapy is technically demanding and expensive. After all other treatments have failed, it can only be used as a last resort. Two patients have survived cancer after receiving experimental therapy in 2010. However, there is a need for more research to learn about the potential side effects of the therapy. (Heidi Ledford, "Last-resort cancer therapy holds back disease for more than a decade", *Nature*, 2 February 2022)

COVID-19: Pfizer has developed an effective anti-covid pill

On 4 February, Chemists at Pfizer's research facility announced that they had developed a consumable form of COVID-19 remedy and helped prevent the next pandemic. Still, the cost of it is expensive and is short in supply. As the first COVID-19 vaccines were authorised in the US in December 2020, animal studies were underway on the drug called Paxlovid. Human trials began in March 2021. By the Fall of 2021, the company was ready to declare success, despite a monitoring body trying to stop the human study. Paxlovid has set the record of the fastest any drug company has ever moved from synthesising a new chemical to proving safety. The Biden government has pre-purchased 10 million courses in December and demanded 20 million courses for the US, creating a shortage of access for the rest. (Antonio Regalado "How Pfizer made an effective anti-covid pill," *Technology Review*, 4 February 2022)

SPACE

Space: China displayed de-orbiting and satellite manoeuvrable capabilities

On 22 January, a satellite tracking firm funded by the US Space Force observed a Chinese satellite Shijian-21 disappear from orbit. It is believed to have pulled a dead satellite from its normal geosynchronous orbit to the graveyard orbit, which is a few hundred miles away. This "large manoeuvre" took a dead BeiDou navigation satellite and escorted it to the orbit meant for satellites that have completed their lifespan. The space superpowers have displayed satellite manoeuvre capability in the past. The satellite was launched atop a Long March-3B and is seen as an on-orbit servicing satellite. The space tugs are known for their dual-use capabilities; while they can perform peaceful extraction of defunct satellites, in the wrong hands, they could be used to de-orbit any satellite adversary or own. This test by China came

a few weeks after the US announced its DART mission. (Chris Young, "China used a satellite to pull another one out of its orbit," *Interesting Engineering*, 28 January 2022)

The US: A classified satellite launched by SpaceX for US National Reconnaissance Office

On 2 February, a Space X Falcon 9 rocket launched a spy satellite for the US government, designated as NROL-87. This mission marks the 105th booster that was recovered by SpaceX, after the rocket's first stage landed back after the successful liftoff. The mission is part of a contract between the US Air Force and SpaceX, and the recovered booster will be refurbished for future missions. The first of the seven planned missions for this year, in a mix of commercially procured and NSSL launches. This shows that the security sector has begun seeking commercial contracts for their high-impact assets. (Sandra Erwin, "SpaceX launches classified satellite for the US National Reconnaissance Office," *Space News,* 2 February 2022)

The US: Near Space Labs offers 10-centimetre good resolution imagery

On 3 February, the New Space labs revealed that it was upgrading its instruments mounted on its high-altitude balloons called Swiftly to capture images over Texas, California, and Arizona with a resolution of 10 centimetres per pixel. The expansion in the plan hopes to cover up to 100 populous cities in the US. So far, the company has offered 30-centimetre resolution imagery. With the new resolution, customers would see objects as small as soccer balls on the ground. This would help users from city planners looking for potholes, conservation groups for tracking wildlife, surveying damaged roofs, or evaluating highway conditions. This upgrade by the labs would offer high-resolution and high-frequency imagery at an affordable cost. (Debra Werner, "Near Space Labs offers 10-centimetre resolution imagery," *Space News,* 3 February 2022)

Space: Startup Quantum Space unveils its plans for cislunar platforms

On 3 February, Quantum space announced that it plans to start work on a spacecraft platform that would operate at the Earth-moon L-1 Lagrange point and host various payloads. This platform would further be serviced by another spacecraft to deliver and install payloads. Quantum Space is an in-space services company and those services are enabled by a platform called outpost, which consists of two components, one for plug-and-play and another is the installation using robotic manipulators. The planned platform would start operations at the Earth-moon L1 point, up to 60,000 kilometres from the moon in the direction of Earth. The project would provide support to NASA in their Artemis Program. (Jeff Foust, "Quantum Space unveils plans for cislunar platforms," *Space News,* 3 February 2022)

Space: New Centre for mitigating effect of satellite constellations on astronomy

On 3 February, the International Astronomical Union selected a proposal to work with the National Optical-Infrared Astronomy Research Laboratory, or NOIR Lab, run by the National Science Foundation, and the Square Kilometre Array Observatory (SKAO) to operate its Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference. The centre hopes to bring together astronomers and other experts in various efforts to address the radio inferences and visible inferences caused by constellations like OneWeb and Starlink. The discussion is to ensure steps are taken by these satellites to ensure they do not affect earth/ star observation. For this, they propose using steps such as coating reflective surfaces or reducing the brightness of the assets. (Jeff Foust, "New centre to coordinate work to mitigate effect

of constellations on astronomy," *Space News,* 5 February 2022)

TECHNOLOGY

Europe: Oil facilities hit by cyberattacks
On 5 February, it was reported that multiple oil transport companies across Europe dealt with cyberattacks. Oiltanking Germany, SEA-Invest in Belgium, and Evos in the Netherlands, have their IT systems disrupted along with dozens of terminals with oil storage and transport worldwide. It is being assumed as a coordinated attack. Though experts are cautioning against taking that these efforts are intended to disrupt the European energy sector, a conclusion is being drawn that it is related to the crisis between Ukraine and Russia and would impact the rising prices in the European Energy Sector. However, one explanation could be that the companies have all used the same software, making it easier for hackers to access. (Joe Tidy, "European oil facilities hit by cyber-attacks," *BBC,* 5 February 2022)

Technology: Google-owned AI Company's big achievement in computer programming
On 3 February, it was reported that DeepMind, an AI company owned by Google, announced a big achievement in computer programming. With a simulation from more than 5,000 participants and ten contests, AlphaCode, the AI system, has ranked in the top 54 per cent of its competitors. Using the tools of critical thinking, logic, algorithms, coding, and natural language understanding, the system can find ways to place roads, buildings or find strategies for complex board games. This is a good sign for solving competitive programming problems with good coding skills and problem-solving creativity. (Jane Wakefield, "DeepMind AI rivals average human competitive coder," *BBC,* 3 February 2022)

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