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## Reality bites make-in-India defence dream

**Even India's 30 per cent indigenous capacity is suspect. It is based mostly on transfer of imported technology and a buy-and-assemble principle. Indian defence scientists and engineers must develop indigenous capabilities.**

For several months now the Modi Government has been pegging its emphasis on the need for developing greater self-reliance in defence equipment on the mantra of "Make in India". Coining of slogans apart, successive governments in New Delhi have been emphasising this necessity for a nation that aspires to be a major power and is among the world's fastest-growing economies. Instead, India in recent years has earned the dubious distinction of being among the world's largest importer of defence equipment.

**Largest importer of arms** - Consider the following: India was the world's largest importer of major arms from 2010 to 2014, accounting for 15 per cent of the global total. This amounted to three times more imports than China and Pakistan, both of which are nuclear weapon states, major adversaries and the country's biggest neighbours. In monetary terms, between 2010 and 2014, India paid a staggering Rs 1,03,535 crore for capital acquisitions from foreign vendors. In contrast, India earned a paltry Rs 1,644 crore on defence exports in the three-year period from 2010 to 2012. A major defence export contract that India signed in recent years is the sale of seven indigenously produced Dhruv advance light helicopters to Ecuador for \$45 million in 2008. And this has run into trouble. Within six years, four of these helicopters crashed, forcing the Ecuadorian government to place restrictions on flying the remaining three thus putting a question mark on Brand India as a maker of defence equipment. Dhruv's flight safety record has been even worse in India with the armed forces losing as many as 16 Dhruv helicopters in an 11-year period, from 2005 to 2015. Overall, India's self-reliance index has remained static at about 30 per cent for the last two-and-a-half decades, with 70 per cent of the country's defence requirements being sourced to foreign vendors making the Indian armed forces overly import-dependent. Even India's 30 per cent indigenous capacity is suspect as it is based mostly on transfer of imported technology and a "buy-and-assemble" principle. This has led defence scientists and engineers to derive comfort rather than pursue a quest to create indigenous capabilities. It is not that previous governments have not made efforts to increase indigenisation. Soon after the disintegration of the Soviet Union, which until then was India's most important source of defence equipment, a specially established "Self-Reliance Review Committee" conceived a "ten-year plan for self-reliance in defence systems," starting from 1995, aimed at increasing India's self-reliance index to 70 per cent by 2005. This seemingly unrealistic deadline remained a pipe dream. Since then, several studies have been conducted to examine what can be done to increase India's self-reliance capability so as to reduce dependence on imports. More recently, a Ministry of Defence committee has now suggested 2027 to be set as the revised target for achieving 70 per cent indigenisation.

**Government measures** - Since the 1990s, the Government has taken a number of steps to realise the make-in-India dream. Permitting forging of an Army-industry partnership and an Air Force-industry partnership, starting from the early 1990s; devising of a defence procurement procedure (DPP) in 1992, which has since been reviewed, revised and updated eight times (in 2002, 2003, 2005, 2006, 2008, 2011 and 2013), with the latest DPP expected to be notified in two months. Other measure taken are: opening Indian private sector participation in developing defence equipment to up to 100 per cent; an offset clause in all foreign defence purchases worth Rs 300 crore (it is now being revised to a minimum Rs 2,000 crore); and permitting foreign direct investment from an initial 26 per cent to currently 49 per cent to even 100 per cent in identified areas of critical technologies subject to cabinet approval. The DPP-2016 even proposes 90 per cent funding to private companies to develop defence equipment to give private participation a boost. The question is whether these measures are enough. The answer is probably not. India has made little headway in achieving self-reliance, despite a large state-owned infrastructure comprising a Defence Research and Development Organisation or DRDO (established almost 60 years ago in 1958), eight defence public sector units, 40 ordnance factories and 50 government-owned research and development laboratories. There are serious doubts whether India even possesses competence and know how to develop core or high-end technologies.

Continue

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## Reality bites make-in-India defence dream

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**Limited success** - The DRDO, which has a history of time and cost overruns, has been unable to develop a reliable rifle for the Army let alone an engine for the main battle tank (Arjun). Attempts at developing the Kaveri engine for the Tejas light combat aircraft have resulted in failure as have attempts at developing an airborne early warning and control system (AWACS) radar, to be mounted on an aircraft. The list of such failures is long. The DRDO's limited success lies only in developing a few variants of the Prithvi and Agni surface-to-surface missile and some sub-systems for ships and aircraft, to name a few. So does the Government expect the private industry to achieve what the state-owned industrial complex has been unable to? It cannot be an "either-or" solution. Both have a role to play as has been the case in the United States, Israel and other western countries. The DRDO, whose functioning has been described as "disappointing" and been accused of "poor conceptualisation and over ambition in trying to make world class products" by a report on its functioning prepared by a Parliamentary Standing Committee on defence, needs major restructuring. It needs to focus on fewer but high-end technologies of strategic significance. After all, the Indian Space Research Organisation (ISRO) has developed into a world-class space agency and could be a model that needs studying.

**Nobel advice** - Perhaps the Government needs to give serious thought to some advice proffered by the Nobel laureates who attended the recent Science Congress held in Mysuru earlier this month. A "Make-in-India" programme, they observed, will not benefit the country in the long term unless it is backed by sustained investments in basic science and the fostering of the spirit of curiosity. Suggesting that Make in India be replaced with the slogan "Discover, Invent and Make in India", American Nobel laureate in Physics (2004), David Gross, observed that: "New inventions, technologies, products that can compete on the world stage are in the end based on new discoveries, new understanding of the workings of nature - what we call basic science, which eventually



The Maareech Advanced Torpedo Defence System developed by the DRDO on display during the 67th R-Day parade at Rajpath in New Delhi. The DRDO was set up in 1958.

## ET EXCLUSIVE Q&A - Private Sector Getting Into Warship Building Projects, Says Navy Chief

*Navy chief Admiral RK Dhowan says private shipyards, tasked till now with constructing support vessels, will be considered for building frontline warships. He feels that it would lead to increase in the pace of work and competitive prices. In an exclusive interview with Manu Pubby and Deepshikha Hooda, Dhowan says the nation is moving from a builder's navy to a designer's navy and would achieve 90% indigenisation on INS Kadmat, under construction in Kolkata. Excerpts:*

**Our efforts at enhancing indigenisation, self-reliance and self-sufficiency are aligned to 'Make in India' strategy through the 15-yr Naval Indigenisation Plan**

**What are the new steps the Navy has taken under the 'Make in India' initiative?**

We have increased the indigenous content onboard our platforms. Our latest ship, INS Kadmat, constructed at Garden Reach, Kolkata is about 90% indigenous. All 46 platforms currently on order, ranging from submarines to aircraft carrier, are being built by Indian shipyards, public and private. Our efforts at enhancing indigenisation, self-reliance and self-sufficiency are aligned to the government's 'Make in India' strategy through the 15-year Indian Naval Indigenisation Plan. This plan enumerates major technologies and capabilities that our public and private sector industry may focus on to meet the Indian Navy's requirements. It synergises our relationship with the industry and encourages all sectors to participate in indigenous development of equipment for the Navy.

**How does the Navy plan to involve the private sector in large manufacturing projects?**

Some of the 46 platforms under construction today are being built in private shipyards. The contribution of private sector yards in making the Indian Navy a 'Builder's Navy' and now a 'Designer's Navy' is growing. Private yards have so far been on the fore front in delivering various types of support craft. They have now also stepped into warship building projects, and have received orders to build Naval Offshore Patrol Vessels, cadet training ships and floating docks.

**So, private sector will make warships?**

The Directorate of Naval Design today has to its credit 19 different design types ranging from small craft to an aircraft carrier. We have over 85 warships built on indigenous designs. The private shipyards in India also play a vital role in the design and construction of auxiliary vessels. Private shipyards, which were till now tasked with less weapon intensive ships, could be considered for construction of frontline warships, based on the expertise and experience gained. This will support the efforts of PSU shipyards, enhance the capacity of private yards, make us price competitive.

**What are the Navy's modernisation plans for the surface, sub-surface and air fleet?**

The Navy is focused on maintaining a balanced force comprising aircraft carriers, multi-role destroyers and frigates, fleet tankers, amphibious ships, patrol vessels, and other smaller craft, and a number of aviation and underwater platforms, catering for both blue water operations and coastal and offshore security.

**There is talk about the government involving the Navy in creating a 'blue economy', can you elaborate how?**

It requires a multi-agency approach as it involves diverse aspects like exploitation of marine resources both living and nonliving, preservation of marine ecology, environmental issues to mitigate climate change effects, and disaster management. Most coastal nations in our neighborhood have taken various steps to initiate actions to both harvest and safeguard the wealth that oceans have to offer. India with its long coastline, numerous islands, and large exclusive economic zone and continental shelf, should also take benefits of a 'blue economy'.

The Indian Navy will engage maritime forces of friendly nations at multiple levels, in training, in technical areas and hydrography, conduct maritime security operations, both independently, and in coordination with other maritime forces in the region.

**What does India plan to showcase at the upcoming International Fleet Review?**

The only International Fleet Review prior this was hosted by the Indian Navy in 2001 at Mumbai. An international fleet review, as the term indicates, is attended by ships and delegations from friendly nations and is hence a major event. An international fleet review is also an opportunity for the host nation to build trust and confidence with maritime neighbours and other like-minded nations. That ships and delegations from 54 nations will be in attendance is clearly an indication of the global trust and confidence placed on India and its Navy. We will also have exhibitions on 'Make in India', 'Digital and Green India'.

## IAF to procure 8 aerostat radars

By Vijay Mohan

The Indian Air Force has drawn up plans to procure up to eight aerostat radar platforms to bolster low-level air and sea surveillance. The procurement process, which has been hanging fire for the past few years, comes in the backdrop of loopholes in land and maritime border management as have been revealed in terrorist strikes in Mumbai and Punjab. An aerostat is an unpowered helium-filled balloon tethered at a certain height above the ground. It is equipped with surveillance and communication equipment. It can remain deployed for a number of days at a stretch, scan a wide swath of area and is particularly effective for detecting low-flying or surface objects, making it a cost effective alternative to aircraft in peace time. A request for information issued by the Ministry of Defence a few days ago seeks a batch of four, six or eight aerostat systems, which can be deployed at an altitude of 15,000 feet and above, have network-centric compatibility so that they can be integrated into the IAF's Air Command and Control System along with other assets and possess electronic warfare capabilities. Procurement of Aerostats was part of a series of recommendations to streamline border management and enhance surveillance capabilities in the aftermath of the 1999 Kargil conflict. However, little has been achieved in this direction. The IAF procured two Aerostats from Israeli firm Rafael at a cost of Rs 338 crore and inducted them into service in 2007 and 2008. A report by the Comptroller and Auditor General (CAG) revealed that one of the aerostats was damaged in 2009 as standard operating procedures were not followed while bringing it down, rendering it non-operational.

ਪੰਜਾਬ ਕੇਸਰੀ

03ਫਰਵਰੀ, 2016

### ਵਾਯੁਸੇਨਾ ਨੇ ਮਾਂਗੇ 1000 ਗਰੁਡ ਕਮਾਂਡੋ

ਨई दिल्ली, (वार्ता): वायुसेना ने अपने 950 प्रतिष्ठानों की सुरक्षा चाक-चौबंद करने के लिए रक्षा मंत्रालय से गरुड कमांडो के दस स्क्वाड्रन यानी लगभग 1000 गरुड कमांडो की मांग की है। पठानकोट वायु सैनिक अड्डे पर हुए आतंकवादी हमले के बाद वायु सेना के सभी प्रतिष्ठानों की सुरक्षा की समीक्षा की गई। वायु सेना के सूत्रों के अनुसार सुरक्षा समीक्षा में खामियां सामने आयी

हैं और अब इन्हें दूर करने का निर्णय लिया है। इनमें गरुड कमांडो की कमी मुख्य रूप से उभरकर आई है। हमले में वायु सेना का गरुड कमांडो भी शहीद हुआ था। अन्य उपायों में सभी प्रतिष्ठानों की दीवारों पर बिजली की बाड़ तथा सेंसर लगाना शामिल है। अभी कुछ वायु सैनिक अड्डों की दीवारों पर बिजली की बाड़ है लेकिन पठानकोट वायु सैनिक अड्डे पर ये बाड़ नहीं थी।

### भारत, ब्रूनेई रक्षा को लेकर तीन समझौतों पर हस्ताक्षर

बंदर श्री भगवान, (भाषा): भारत और ब्रूनेई ने संयुक्त सैन्य अभ्यास के जरिए रक्षा संबंधों को मजबूत करने का आज फैसला किया। उपराष्ट्रपति हामिद अंसारी की यहां शीर्ष नेतृत्व के साथ वार्ता के बाद दोनों देशों ने तीन समझौतों पर हस्ताक्षर किए हैं। संसाधन संपन्न ब्रूनेई के साथ राजनयिक संबंधों की स्थापना के बाद भारत से प्रथम उच्च स्तरीय यात्रा पर अंसारी यहां आए हैं जिस दौरान रक्षा के अलावा स्वास्थ्य और युवा एवं खेल मामले में समझौते पर हस्ताक्षर हुआ। रक्षा क्षेत्र में दोनों देश विभिन्न स्तरों पर यात्राओं का आदान प्रदान करने, अनुभव, सूचना, प्रशिक्षण और प्रशिक्षक का आदान

प्रदान करने तथा संयुक्त सैन्य अभ्यास, सेमिनार एवं चर्चा करने और रक्षा उद्योगों के बीच सहयोग करने को राजी हुए। भारत और ब्रूनेई के बीच रक्षा में सहयोग पहले से नौसेना जहाज यात्राओं, स्टाफ कालेजों में वरिष्ठ सैन्य अधिकारियों के प्रशिक्षण और अनुभव के आदान प्रदान के रूप में मौजूद है। यह फ्रेमवर्क समझौता इस सहयोग को संस्थागत करने के लिए है। अंसारी की यात्रा के दूसरे दिन एक समारोह में समझौते पर सहमति बनी जिसमें ब्रूनेई के संस्कृति, युवा एवं खेल मंत्री अवांग हल्बो, स्वास्थ्य मंत्री हाजी जुल्करनैन और उप रक्षा मंत्री अब्दुल अजीज भी शरीक हुए।

## Fully built HAL trainer aircraft readies to fly

By Ajai Shukla

**Its chequered history notwithstanding, the HTT-40 rolled out of the hangar with all its lights flashing and its cockpit powered on**

In an important milestone for Hindustan Aeronautics Ltd (HAL), its new basic trainer aircraft, the Hindustan Turbo Trainer - 40 (HTT-40) rolled out for the first time from the hangar where it was built and began preparations for its first flight, later this month. For years, the Indian Air Force (IAF) flatly opposed the HTT-40 project, demanding the defence ministry scrap it. In its place, the IAF wanted to import over a hundred new trainers from Swiss company, Pilatus, to supplement the 75 Pilatus PC-7 Mark II trainers it had already bought. The IAF repeatedly told the ministry the HTT-40 would be over-weight, over-priced and under-performing. But HAL doggedly continued development, committing more than Rs 350 crore of company funds. Given this history, there was jubilation amongst the HTT-40 design team as their first prototype, fully designed in India, rolled out of the hangar with all its lights flashing and its cockpit powered on. "The project has managed to steer through the initial headwinds and now is going full throttle," said T Suvarna Raju, the HAL chief. An HAL media release on Tuesday noted: "The team composition of HTT-40 is the youngest ever on any prototype program in HAL." The IAF, now convinced about the HTT-40's viability, wants to take charge of the project. However HAL, in a demonstration of confidence, insists on funding and controlling the project until the trainer takes to the skies. After that, the HTT-40 will be overseen by an "integrated project management team" (IPMT), headed by Air Marshal Rajesh Kumar, who attended the rollout. Before actually flying, the HTT-40 will undergo a series of ground tests. First, US firm Honeywell, which has supplied the TPE-331-12B engine, will verify it is properly integrated with the airframe. After that, the HTT-40 will do low-speed taxi runs, and then high-speed taxi runs. In the latter, it will speed down the runway, coming close to lift-off, but remaining on the ground. Only after all systems are proven on the ground, will inspectors allow the aircraft to actually lift off. If all goes according to plan, the HTT-40 will complete its flight test programme in two years, and be inducted into the IAF from 2018. HAL tells Business Standard that the HTT-40 production line will build two trainers in 2018, eight in 2019, and reach its capacity of 20 per year from 2020 onwards. Some 70 HTT-40 trainers will join the fleet, supplementing the 75 Pilatus PC-7 Mark II already in service; and another 38, whose purchase is currently being negotiated. HAL is looking beyond the IAF, at exporting the HTT-40 to air forces across the region. The designers say it can be developed into a capable ground attack aircraft that would be ideal for countries like Afghanistan, which need to provide air support to their ground troops, but cannot afford full-fledged fighters. "There are plans to weaponise and optimise HTT-40 aircraft", said Suvarna Raju. HAL says: "Its role includes basic flying training, aerobatics, instrument flying, navigation, night flying, close formation etc." The PC-7 Mark II and HTT-40, both propeller-driven turbo-prop aircraft, will be used for Stage-1 training of rookie IAF pilots. While Stage-2 training is currently being done on the HAL-built Kiran Mark II, it could shift to the new Sitara intermediate jet trainer, which HAL is now completing after long delays. Finally, budding fighter pilots will do their Stage-3 training on the Hawk advanced jet trainer, which HAL builds under licence from BAE Systems.



**A picture of the HTT-40 prototype (courtesy: Ministry of Defence spokesperson Twitter account)**

## India offers its retired soldiers to guard Brunei

On Tuesday, an agreement on defence cooperation was inked between Vice-President Mohammad Hamid Ansari and senior representatives of the Sultanate. With Sultanate of Brunei's territorial dispute with China showing no signs of ending, India has now offered the services of its retired soldiers to the tiny island nation to augment its armed forces. Brunei, so far, has been dependent on British military support, especially in the form of soldiers. If accepted, Indian hands could replace British forces in Brunei. On Tuesday, an agreement on defence cooperation was inked between Vice-President Mohammad Hamid Ansari and senior representatives of the Sultanate. While the agreement only talked about boosting defence ties by conducting joint military exercises and bilateral cooperation through exchange of visits, experience, information, training and cooperation between the defence industries, sources present at the meeting told The Indian Express that India offered to provide the services of retired officers and soldiers, particularly of the Gurkha Regiment, to Brunei. However, no final decision was taken Tuesday on the matter. Defence cooperation between India and Brunei already exists in the form of naval ship visits, training of senior military officers in staff colleges and exchange of experience. The framework agreement seeks to institutionalise this cooperation. Brunei is a British protectorate, with British forces stationed here at the request of the Sultan. Last year, the agreement between the UK and Brunei was renewed for another five years. Meanwhile, other MoUs signed during Ansari's visit included an agreement on health cooperation that will involve exchange of doctors, other professionals and experts, besides regulation of pharmaceuticals, medical devices and cosmetics. Ansari has also talked about setting up a fertiliser plant in Brunei.

DESIDOC

## The South China Sea

### Making a splash

#### Taiwan's outgoing president further roils troubled waters

This week he visited Itu Aba, known in Chinese as Taiping, the biggest natural island in the Spratly archipelago in the South China Sea, garrisoned by Taiwan but also claimed by China, the Philippines and Vietnam. The Philippines and Vietnam were incensed, China much less so: it appreciates Mr Ma's adherence to the fiction that there is but "one China". From its point of view, Taiwan's territorial claims in the much-disputed sea are its own. Besides reasserting Taiwan's claim, Mr Ma wanted to rebut arguments made by the Philippines, in a case it has brought before the Permanent Court of Arbitration in The Hague. This argues that under the UN Convention on the Law of the Sea (UNCLOS), Itu Aba is a rock that cannot sustain human life. So it is entitled to 12 nautical miles of territorial waters, but not the 200-mile exclusive economic zone accorded to habitable islands. Mr Ma also possibly hoped to advertise his own "South China Sea Peace Initiative", which he announced last May but which was largely ignored. The risk is that the Philippines and Vietnam may retaliate in some way-perhaps even with high-profile visits to islands they occupy, though this is unlikely-and that this, in turn, provokes China. America is so alarmed that its representative in Taiwan issued an unusually forthright denunciation of Mr Ma's "extremely unhelpful" day-trip as soon as it was announced. Tensions over the sea have been rising in any case. China has been building frenetically, turning rocks and reefs in the Spratlys into islands, three of them already bigger than Itu Aba, with airstrips. It has recently landed civilian aircraft carrying "tourists" on one (see picture). And China has again moved a large oil rig into waters claimed by Vietnam-as it did in 2014 when it provoked fatal anti-Chinese riots. China derides all criticism. One Chinese official compares rival claimants' complaints to "smashing the windows of your neighbours' house and then saying, 'We are being threatened'." China believes America is stoking alarm as part of a broader strategy to contain it. It is true that its neighbours are gradually stepping up security co-operation with each other and with America. Just this week Vietnam approved an Indian satellite-tracking centre on its soil to share imagery, including pictures of the South China Sea. The worry is that China is steadily expanding its presence until its dominance of the sea becomes an incontestable fact. This also concerns America: the sea is a vital trade artery, and China threatens 70 years of American naval supremacy in the western Pacific. In a report published in January, commissioned by the Pentagon to look at America's strategic "rebalance" towards Asia, the Centre for Strategic and International Studies, a Washington think-tank, projected that by 2030, on current trends, "the South China Sea will be virtually a Chinese lake, as the Caribbean or Gulf of Mexico is for the United States today." Three approaches are being tried to moderate China's behaviour-legal, diplomatic and military. The broader aim of the Philippines' case under UNCLOS is to show that China's historic claim-a "nine-dash line" on maps encompassing most of the sea-has no legal basis. In October China suffered a setback when the court in The Hague accepted that the case fell within its jurisdiction. But even if the court rules in the Philippines' favour, China has made clear that it will ignore it. South-East Asian claimants in the sea-the Philippines, Vietnam, Brunei and Malaysia-have hoped that their regional club, ASEAN, can show a united front. But China prefers to negotiate with (and bully) ASEAN members individually. And it skilfully exploits the body's internal differences. As for military deterrence, a marked increase in defence spending across the region in recent years still leaves America as the only power capable of standing up to China. As a reminder of this, in November the American navy conducted a "freedom of navigation operation" in the South China Sea. These operations, conducted around the world, involve sending warships to challenge excessive maritime claims by sailing through the claimed waters. In the South China Sea, America says it takes no position on the sovereignty disputes but does want international law to apply. In this exercise, the USS Lassen sailed close to Subi reef, where China has built an artificial island on what was once a feature submerged at high tide. Yet the message was muddled. In January Ashton Carter, America's secretary of defence, explained that the operation had been conducted as "innocent passage", ie, under a provision of UNCLOS that allows warships to enter even territorial waters so long as they do nothing that might have a military purpose. So it is not clear quite what point America was trying to make. John Kerry, America's secretary of state, was in China this week (see article), after a trip that took in Cambodia and Laos, which holds the chairmanship of ASEAN this year. He spoke of the need to avoid a "destabilising cycle of mistrust or escalation" in the South China Sea. At a gathering on February 15th and 16th at a ranch in Sunnylands, California, Barack Obama will play host to the leaders of all ten ASEAN countries. The unprecedented summit is a symbolic demonstration of American support for ASEAN. China will probably scent another attempt to rally the region against it. But nothing suggests it will be deterred from trying to turn the sea into its own lake. -©The Economist

## China unveils five new military 'command theatres'

BEIJING: China has unveiled its five new military zones or "theatre of commands", continuing President Xi Jinping's efforts to streamline the world's largest armed force under a joint command system. Xi's latest step to reform China's armed forces, announced by the defence ministry late on Monday night, comes as he continues to root out corruption in the military, and at a time when Beijing is getting more assertive in its maritime territorial disputes. The five new zones have been designated as eastern, southern, western, northern and central command theatres. It appears the western theatre of command will now oversee India. The new zones replace the three-decade-old seven regional commands named after the cities where they were headquartered: Beijing, Shenyang, Jinan, Lanzhou, Nanjing, Chengdu and Guangzhou. Under the earlier structure, the Chengdu military area was in charge of security along India's eastern sector in the Tibet region, including Arunachal Pradesh, and the Lanzhou military command looked after the western sector, including Jammu and Kashmir.

The Pioneer

03 February 2016

## Strengthening Afghan Army capabilities

**Lesson of 2015, which was a year of setbacks for the Afghan Army, is that the military needs better leadership and enhanced weaponry if it is to provide the political leadership greater flexibility at the negotiating table.**

At the core of the two peace processes in South Asia are trouble-shooters, Pakistan Army and the Inter-Services Intelligence - the deep state. India was struck by one of their many strategic assets, the Jaish-e-Mohammed, serially at Pathankot and the Mazar-e-Sharif, Afghanistan, rendering on hold the twice cancelled India-Pakistan talks. In the second reconciliation dialogue with Afghanistan, the deep state plays an even more pivotal role: It nourishes, shapes and selects the Afghan Taliban whom Kabul calls the armed opposition which is to engage in direct talks with Kabul. The ISI is also involved in settling the factional fights within the Taliban to legitimise its chosen Emir of Taliban to replace the late Mullah Omar. The group, owing allegiance to Pakistan is led by Mullah Akhtar Mansour who is challenged by a more moderate group headed by Mullah Rasool which has distanced itself from Islamabad and wants the talks to be among Afghans without any facilitation. It is believed that the Mansour faction opened its account of violence in the new year by a series of high-profile attacks in Kabul which it believes betters it bargaining at the negotiating table. Not only will the deep state prop up the Mansour group for eventual face-to-face talks with Kabul, but will also facilitate the entry of the Haqqanis their leader Sirajuddin Haqqani is virtually deputy leader of the Taliban a US/UN banned terrorist group to the talks table. This charade of nominating a group chosen by Pakistan is blessed by the US and China, both Islamabad's well-wishers, who have placed the destiny of Afghanistan in the hands of the deep state. Great scepticism abounds in Kabul about the peace process as the National Unity Government is at the mercy of the US and Western donors. Instead of Pakistan reining in the Taliban and the Haqqanis, it has let them run riot, even as it pretends it has only influence, no control, over them. Under Pakistan's tutelage, the four-party talks Afghanistan, Pakistan, China and the US have held two meetings in Islamabad and Kabul and are due to hold the third at Islamabad on February 6, and probably one more before direct engagement between the Afghan Government and the Taliban chosen by Pakistan. How China, which has so far invested no more than \$300 million and recently committed another \$237 million over three years, has come to be a part of the four-party talks is mystifying. Beijing is a free rider in Afghanistan. These preliminary meetings are designed to chalk out the broad agenda for inter-Afghan talks including any preconditions - like acceptance of Afghan Constitution, renunciation of violence and severing links with terrorism. The three-stage dialogue is about evolving a roadmap for talks followed by inviting the Taliban and culminating with implementation of the peace plan. The US has convinced President Ashraf Ghani that the road to peace passes is through General Headquarters Rawalpindi. Both Mr Ghani and Chief Executive of Afghanistan, Abdullah

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## **Strengthening Afghan Army capabilities**

Abdullah are on the same page scripted by the Americans that Kabul's salvation lies in the accommodation of the armed opposition. Besides, the challenge of the reconciliation process, two other issues have to be confronted: First, the ratification of the arbitrary post of CEO which is an artificial arrangement crafted by the US to legitimise through compromise a fraudulent presidential election. Both Parliament and the Loya Jirga will need to regularise the CEO in the Constitution by September. Second, is holding the postponed parliamentary election in October. That 18 months after the formation of the NUG Defence Minister Masoom Stanekzai is still acting, reflects the squabbling for posts between North and South. The Afghan National Security Forces has had a busy year battling the combined might of the Taliban and the Haqqanis estimated to be 40-60,00 fighters. ANSF has suffered nearly 30 per cent more casualties in 2015 than in the previous year when they fought independently (without the US and the North Atlantic Treaty Organisation) for the first time. Suffering 16,000 casualties including 7,000 killed is intense attrition given the Taliban occupy more territory in 2016 than at any time since 2001. According to one estimate, roughly five per cent to 10 per cent of the 360 districts keep changing hands. The lesson of 2015 which the Afghans call the year of setbacks is that ANSF requires better leadership, greater motivation, enhanced weaponry and swifter mobility if they are to provide the political leadership greater flexibility at the negotiating table. The Taliban is expected to be fighting while negotiating, a strategic posture enabling moral ascendancy. A ceasefire which Kabul wants will come with costs. ANSF should exploit the divisions within the Taliban as rival groups battle for space and fight with the Islamic State. Similarly, Pakistan Taliban relocated in Afghanistan be used as a bargaining chip in road map for two-way talks. Till last month, the usual things were being said about India in Afghanistan: On its own it does not shape outcomes: It is a peripheral player (not part of four-party talks); enjoys goodwill with highest popularity ratings but no political influence; is guided by the US and conscious of Pakistan's sensitivities; it is in wait and watch mode - sitting on the fence; the two billion dollar committed to Afghanistan could have yielded better political gains elsewhere, and so on. All this appears to be changing. In a first by any Government official, External Affairs Minister Sushma Swaraj in response to repeated requests from Kabul for operationalising the strategic partnership agreement announced in December last year at the most unlikely capital, Islamabad, the equally unlikely declaration: India is ready to work with Afghanistan to strengthen its defence capability. The Mazar-e-Sharif attack was apparently messaging from the ISI to lay off weaponising ANSF. Already the first of four Mi25 helicopters has been delivered while tanks, guns and howitzers could be in the pipeline. New Delhi can no longer sit on the fence. Military equipment, trainers and a field hospital should be deployed to bolster the defence capability of ANSF. This will enable Kabul to negotiate with the Taliban from a position of relative strength. When the stalled India-Pakistan dialogue is resumed, Afghanistan should figure prominently for the threats emanating from there, especially from the IS. This requires to be tackled jointly. Prime Minister Narendra Modi recently told the Afghan Parliament: "India is here, not to light the flame of conflict or compete in Afghanistan. We support Kabul without timelines and want Pakistan to be a bridge between South Asia and Afghanistan." Strengthening the ANSF diminishes Pakistan's leverage over the reconciliation process.

## **Eye in the sky: Eagles trained to hunt drones**

### **Dutch Police Begin Drill To Tackle Menace Of Unlicensed UAVs Flying Over Airports, Public Spaces**

Dutch police puzzled over how to remove drones that pose a public safety threat are testing a way to get the job done in one fell swoop -with trained eagles. "It's a low-tech solution to a high-tech problem," spokesman Dennis Janus of the country's national police said. The idea arose because amateur use of drones has boomed and police have begun to worry about unlicensed drones flying into off-limit spaces around airports or above public events involving politicians. Possible solutions the Dutch police have studied include shooting nets at the offending drones, remotely hacking them to seize their controls, or taking them out with birds of prey. "People sometimes think it's a hoax, but it's proving very effective so far," Janus said. Showing off the technique in a video released by police, a four-propeller drone hovers in the middle of a warehouse, colored lights flashing. Released by her keeper, a white-tailed eagle glides straight toward the drone, clutches it easily in her talons and then drags it to the ground. Sjoerd Hoogendoorn of 'Guard from Above', the company working with the police to develop the concept, said the birds must be trained to recognise the drones as prey. They are rewarded with a piece of meat after each successful foray. Their scaly talons are strong and tough enough to seize most consumer-grade drones without injury from the blades, he said. "These birds are used to meeting resistance from animals they hunt in the wild, and they don't seem to have much trouble with the drones," he said. The potential impact on the animals' welfare is subject of testing by an external scientific research institute. "The real problem we have is that they destroy a lot of drones," Hoogendoorn said. "It's a major cost of testing," he added. Another unknown factor is how the birds will fare in a crowd situation, he said. A decision by police on whether to move ahead with using the eagles is expected by the end of the year.

## **Password-stealing virus prowling in Indian cyberspace**

New Delhi, pti: Cyber security sleuths have alerted Indian Internet users against the malicious activity of an online virus called "dorkbot" which perpetrates itself through social networking sites and steals sensitive personal data and passwords of a user. The malware, a variant of online virus and worm, has been specifically seen affecting operating systems running on Windows in the recent past. "It has been observed that the variants of malware named as "dorkbot" targeting windows operating systems, are spreading. "The malware belongs to the family of worms having backdoor functionality and spreads through various vectors including drive-by-download attacks, social networking sites and compromised websites with browser exploits via removable drives in the form of auto-run exploits or by means of malicious links in instant messaging chats or internet relay chats," a latest advisory issued by the Computer Emergency Response Team of India (CERT-In) said. The CERT-In is the nodal agency to combat hacking, phishing and to fortify security-related defences of the Indian Internet domain. The deadly virus, with almost a dozen aliases, is capable of stealing sensitive information from infected machine including stored passwords, browser data, cookies and has a smart and lethal potential to take complete control of the affected system, it said. The cyber security agency said the malware can hide itself by over-writing, can collect system information such as OS (operating system) information, user privileges and apps installed on the system and can act to aid remote access of the infected machine to an attacker.

## **Biological brain twister solved**

Paris, AFP: The deep folds that give the adult human brain its wrinkled walnut appearance were Nature's solution to fitting a large, powerful processor into a small skull. Like a piece of flat, square paper crumpled together to fit into a small, round hole, folding allows more neurons to be packed closer together, with shorter, faster connections between them. While scientists have long understood why there are folds in the brain's outer layer, called the cerebral cortex or grey matter, the how has remained a mystery. Do the creases develop as a result of genetic, biological or chemical signals? Or are they caused by physical forces? On Monday, a team of researchers from the United States and Europe said the folds can be explained by physics -- a discovery that may have important implications for understanding certain brain disorders. Folds in the cortex develop through buckling in weak spots which develop as the foetal brain grows, they said. The brains of human foetuses are smooth for about the first 20 weeks, when folding begins and continues until the child is about 18 months old. The surface area covered by the folded cortex is almost three times that of a smooth brain the size of our head, study co-author Lakshminarayanan Mahadevan from Harvard University in Massachusetts told AFP. "The number, size, shape and position of neuronal cells during brain growth all lead to the expansion of the grey matter, known as the cortex, relative to the underlying white matter," he said by email. "This puts the cortex under compression, leading to a mechanical instability that causes it to crease locally. "This simple evolutionary innovation... allows for the thin but expansive cortex to be packed into a small volume, and is the dominant cause behind brain folding." Mahadevan and a team used MRI scans of smooth foetus brains to build a three-dimensional gel model. They coated the surface with a thin layer of elastomer gel to represent the cortex. To mimic brain growth, they immersed the gel brain in a solvent that was absorbed by the outer layer, causing it to swell relative to the deeper region. Within minutes, folds started to appear that were remarkably similar in size and shape to the real thing, showing that the same process happened even though the model did not contain any living tissue. "It looks like a real brain," said Mahadevan's colleague and fellow author Jun Young Chung. A few other animals also have brain folds -- including chimpanzees, dolphins, elephants and pigs -- but the human brain is the wrinkliest of them all. The physical explanation for brain folds was first proposed by Harvard scientists 40 years ago. Now proven by Mahadevan's team, it was considered a controversial challenge at the time to the conventional wisdom that brain folds were created by purely biological, not physical, processes. Commenting on the study, Ellen Kuhl of Stanford University's department of bioengineering, said the findings could be an important breakthrough in diagnosing, treating and preventing a range of neurological disorders. Severe under- or over-folding, she said, can lead to seizures, motor dysfunction, mental handicap and developmental delay. Knowing whether to target mechanical or biological causes should go a long way to developing better treatments.

## UK scientists find new cancer-killing technique

London, PTI: Scientists in the UK have found a new way to combat cancer by getting tumour cells addicted to drugs that will kill them in minutes. Scientists at the Beatson Institute in Glasgow, which is run by Cancer Research UK and closely linked to Glasgow University, developed the "significant" technique as a research tool while trying to understand how cancer cells die. The technique called "mito-priming" was published today in 'Nature Communications' as the latest method to be developed by researchers in the fight against cancer. It means mito-priming can be applied to identify new anti-cancer drugs to screen their effectiveness. According to the paper, BH3-mimetics are a promising new class of cancer drugs developed to specifically kill tumour cells. They target a family of proteins called BCL-2 proteins, which function to keep cancer cells alive. While not yet in use in clinical practice, BH3-mimetic anti-cancer drugs are showing promise in late-stage clinical trials, particularly in the treatment of chronic lymphocytic leukaemia (CLL). Researchers are hopeful the pioneering mito-priming method can be applied to screen for new drugs to target BCL-2 proteins and help find new ways to kill cancer cells. Stephen Tait, the lead author of the paper 'Mito-priming as a method to engineer Bcl-2 Addiction', writes: "We have developed a new way to make any cell type sensitive to BH3-mimetic treatment. We term this method mito-priming". "Mito-priming can be used to rapidly screen for new BH3-mimetics and other anti-cancer drugs, and should improve ways to kill cancer cells. It can also be used to rapidly define the potency and specificity of BH3-mimetics," he wrote.

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Deccan Herald

03 February 2016

## Promise and peril: A primer on gene editing

**Paris, AFP: Britain's granting of a licence Monday for scientists to alter the genes of embryos for infertility research has thrown the controversial technique under a white-hot spotlight.**

**But what is it?**

Gene editing is the direct, surgical modification at the molecular level of a genome, which is the genetic blueprint for every individual animal or plant. It is far more precise than conventional selective breeding or an earlier generation of genetic engineering techniques. Gene editing is already widely used to add desirable traits to food crops or livestock, and in lab animals for research on disease. Chinese researchers announced last year they manipulated the genomes of non-viable human embryos looking for a way to correct a rare and fatal blood disorder. There are several forms of gene editing, all of them involving the removal or addition of gene snippets. The human genome consists of long strings of DNA made up of about three billion "base pairs" of the chemical "letters" A, T, G and C (adenine, thymine, guanine and cytosine) in a particular order. These comprise about 20,000 to 25,000 genes. Gene editing makes it possible to remove or insert snippets of DNA at precise locations using molecular "scissors", like altering a film sequence or using the "find & replace" function in a word-processing software. This allows researchers to "knock out" genes that cause disease (certain forms of cancer or Tay-Sachs, a very rare condition which destroys nerve cells, for example), or repair a naturally-occurring mutation. The editing methods in use today are divided into two broad groups. In the first, the engineered changes persist only for the life of the organism, in the second it is passed on to the next generation. The newest technique - known by its acronym CRISPR/Cas9 - has rapidly dominated the field because it is cheaper and much simpler to use. It is also the one best suited for editing the genome of still-developing embryos. But such so-called "germline modification" means that DNA changes, if the embryo were allowed to live and become an adult, would be passed on to its offspring, effectively tinkering with the process of evolution.

## China names asteroid after nobel laureate

Chinese authorities have named an asteroid after scientist Tu Youyou who won the 2015 Nobel Prize for Physiology or Medicine for her work with artemisinin, which is now widely used to fight malaria.

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## Don't go to Zika-hit nations: Centre to pregnant women

By Susmi Dey

### Makes NCDC Key Cell To Probe Such Cases

Aday after the World Health Organisation (WHO) declared the spread of Zika virus a public health emergency of international concern, the health ministry on Tuesday issued guidelines to tackle any outbreak. The health ministry issued a detailed advisory, including a travel advisory, asking pregnant women to either defer or cancel their travel to affected areas. It has also designated the National Centre for Disease Control (NCDC) as the nodal agency for investigation in case of an outbreak. Zika is an emerging viral disease transmitted through the bite of an infected Aedes mosquito, which is also known to transmit infections like dengue and chikungunya. In May 2015, Brazil reported its first case of Zika virus disease. Since then, the disease has spread within Brazil and to 24 other countries in the region. In India, Zika virus is of concern because the Aedes mosquito, responsible for its spread, is present in the region and there is no evidence of immunity to the virus. The health ministry said all international airports and ports will display signage with information on the disease. Travellers will be asked to report to the customs if they are returning from affected countries and suffering from febrile illness. A joint monitoring group has also been set up under the director general of health services to monitor the overall situation. The Indian Council of Medical Research (ICMR) has also been roped in to identify research priorities and take appropriate action. The ministry has also asked states to activate rapid response teams comprising of an epidemiologist or public health specialist, a microbiologist and a medical specialist to tackle any outbreak of the disease. Following a review meeting on Monday, WHO experts agreed "a causal relationship between Zika infection during pregnancy and microcephaly is strongly suspected, though not yet scientifically proven". The UN agency has raised an urgent need to coordinate international efforts to investigate and understand this relationship better. Though Zika virus does not cause mortality, there are concerns following suspected possible associations found between the virus and neurological problems like microcephaly, a condition of abnormally small head in babies. The last such public health emergency was declared for the 2014 Ebola outbreak in West Africa, which killed over 11,000 people.

## WHO declares global emergency over Zika virus spread

The last such public health emergency was declared for devastating 2014 Ebola outbreak in West Africa. The World Health Organization declared a global emergency over the explosive spread of the Zika virus, which has been linked to birth defects in the Americas, calling it an "extraordinary event" that poses a public health threat to other parts of the world. The UN agency took the rare step despite a lack of definitive evidence proving the mosquito-borne virus is causing a surge in babies born with brain defects and abnormally small heads in Brazil and following a 2013-14 outbreak in French Polynesia. Monday's emergency meeting of independent experts was called in response to the spike in babies born with microcephaly in Brazil since the virus was first found there last year. Officials in French Polynesia also documented a connection between Zika and neurological complications when the virus was spreading there two years ago, at the same time as dengue fever. "After a review of the evidence, the committee advised that the clusters of microcephaly and other neurological complications constitute an extraordinary event and public health threat to other parts of the world," WHO Director-General Dr. Margaret Chan said. WHO, which was widely criticized for its sluggish response to the 2014 Ebola crisis in West Africa, has been eager to show its responsiveness this time. Despite dire warnings that Ebola was out of control in mid-2014, WHO didn't declare an emergency until months later, after nearly 1,000 people had died. "If indeed, the scientific linkage between Zika and microcephaly is established, can you imagine if we do not do all this work now and wait until the scientific evidence comes out?" Chan said. "Then people will say, 'Why didn't you take action?'" WHO estimates there could be up to 4 million cases of Zika in the Americas in the next year, but no recommendations were made to restrict travel or trade. "It is important to understand, there are several measures pregnant women can take," Chan said. "If you can delay travel and it does not affect your other family commitments, it is something to consider." "If they need to travel, they can get advice from their physician and take personal protective measures, like wearing long sleeves and shirts and pants and using mosquito repellent." The US Centers for Disease Control has advised pregnant women to postpone visits to Brazil and other countries in the region with Zika outbreaks, though officials say it's unlikely the virus could cause widespread problems in the US. On Monday, health officials added four more destinations to a list that now includes 28 locations, most of them in Latin America and the Caribbean. The last time WHO declared a public health emergency was for the devastating Ebola outbreak in West Africa, which killed more than 11,000 people. Similar declarations were made for polio in 2013 and the 2009 swine flu pandemic. Such emergency declarations are meant as an international SOS signal and usually trigger increased money and efforts to halt the outbreak, as well as prompting research into possible treatments and vaccines. There are currently no licensed treatments or vaccines for Zika. WHO officials say it could be six to nine months before science proves or disproves any connection between the virus and babies born in Brazil or elsewhere with abnormally small heads. Zika was first identified in 1947 in Uganda but until last year, it wasn't believed to cause any serious effects; about 80 percent of infected people never experience symptoms. The virus has also been linked to Guillain-Barre syndrome, which causes muscle weakness and nerve problems. Michael Osterholm, an infectious diseases expert at the University of Minnesota, said it was still unclear how Zika had evolved since it first emerged in Africa, but that even minor genetic changes might have major consequences. "It could have just been some point mutation (in the virus) that has now made a big difference," Osterholm said, adding it would likely take years to curb the mosquito populations capable of spreading Zika - and before local populations gain enough immunity for the number of cases to fall. Jimmy Whitworth, an infectious diseases expert at the London School of Hygiene and Tropical Medicine, said we might soon see babies born elsewhere with malformed heads as the virus becomes entrenched in other countries. "It could be that we're getting the strongest signal in Brazil," he said. "But having these cases occurring and pinning it to Zika is tough." Whitworth said it was important for WHO to act quickly, despite the lack of definitive evidence that Zika is responsible for the surge in microcephaly cases. "For situations like this, you have to essentially have a 'no regrets' policy," he said. "Maybe this will be a false alarm when more information is available months later, but it's serious enough on the evidence we have right now that we have to act."

## Mission to Mars

The Orion capsule, NASA's spacecraft designed to land humans on Mars, was carried from the US space agency's Michoud Assembly Facility in New Orleans to Kennedy Space Centre in Florida for structural integrity tests

### The Mission

The Orion, which was carried in a Super Guppy aircraft, will carry four astronauts and will be launched from NASA's rocket-in-the-making - the Space Launch System (SLS) for the mission scheduled for 2018

### What are the Aircraft carried

NASA and Orion manufacturer Lockheed Martin will outfit the crew module with its systems and subsystems necessary for flight, including its heat-shielding thermal protection system

### The Super Guppy

The Super Guppy has a cargo area that is 25 feet tall, 25 feet wide and 111 feet long and the jumbo plane, which can carry over 26 tonnes of cargo, is often used by NASA to ferry large components around the country that would take too long (or be impossible) to ship by land or by sea. The aircraft was designed during the Apollo programme and was used in the 1960s to carry parts of the Saturn V rocket from California to Florida

In 2013, the Super Guppy was used to carry Orion's heat shield, which was the largest of its kind ever built.

Orion's launch date. Assuming there are no delays or changes in NASA's mandate, Orion's first crewed-mission will take place in 2023. NASA hopes to use Orion to send humans to Mars by the mid-2030s.

### on Twitter

"The pressure vessel of @NASA\_Orion for Exploration Mission-1 is heading to KSC today." NASA's Kennedy Space Center

## At the core of it

Scientists have collected an unprecedented sequence of rock samples from the shallow mantle of the Atlantic Ocean that bear signs of life, unique carbon cycling, and ocean crust movement

### The expedition

During a 47-day expedition to collect rock cores from the Atlantis Massif - a 4,000m tall underwater mountain along the Mid-Atlantic Ridge, researchers collected rock samples using seabed rock drills from Germany and the UK - the first time the technology has been utilised in ocean drilling

### The Aim

The aim of the expedition was to determine how mantle rocks are brought to the seafloor and react with seawater - such reactions may fuel life in the absence of sunlight, which may be how life developed early in Earth's history and on other planets.

## Balloons and white spaces: The next step in connectivity

Take a closer look at Google's Project Loon and Microsoft's White Spaces Project that aim to provide internet access to rural areas.

### Project Loon

#### What is Project Loon?

Officially announced in June 2013, Google's project comprises a network of balloons that travel approximately 20 km above the Earth's surface in the stratosphere and provide connectivity in rural and remote areas through a wireless communication called LTE (long-term evolution).

#### How does it work?

Individual balloons can provide connectivity to a ground area of around 80 km in diameter. To use LTE, Project Loon partners with telecommunications companies to share cellular spectrum so that people will be able to access the internet from their phones and other LTE-enabled devices. The balloons relay wireless traffic from smartphones and other devices back to the global Internet using high-speed links. Solar panel and wind is used to power electronic equipment in the balloon throughout the day.

#### How do the balloons travel?

In the stratosphere, winds are layered and each layer varies in speed and direction. Project Loon uses software algorithms to determine where its balloons need to go, then moves each one into a layer of wind blowing in the right direction. By moving with the wind, the balloons can be arranged to form one large communications network.

#### How big are the balloons?

The balloons measure 15 metres wide by 12 metres tall when fully inflated. The inflatable part are made from sheets of polyethylene plastic.

#### What happens if a balloon needs to be brought down?

When a balloon is ready to be taken out of service, gas is released to bring the balloon down to Earth in a controlled descent. If a balloon drops too quickly, a parachute attached to the top of the envelope (the inflated portion) is deployed.

### White Spaces Project

#### What is the White Spaces Project?

Microsoft's project aims to provide low-cost broadband connectivity using the white spaces, a technology that utilises unused television spectrum to deliver low-cost Internet.

#### What is white spaces?

Broadband spectrum is generally organised into frequency "bands" (think of the channels on TV) to eliminate "bleeding" of transmissions from one channel onto another (like the electronic "snow" you sometimes see during a TV program). These spaces or gaps between various frequency bands used by television companies for broadcast are called white spaces they ensure the signals do not interfere with one another. In India, Microsoft proposes to utilise this unused spectrum from television for internet connectivity.

#### How is it different from Wi-Fi?

As per an official in the Communications Ministry, wi-fi has a range of about 100 meters, whereas the 200-300 MHz spectrum band available in the white space can reach up to 10 km. The spectrum has an advantage over Wi-Fi and Bluetooth since it can travel over long distances and pass through walls easily.

#### What companies gain

According to industry experts, the gains to companies are multifold. Firstly, in this experimental phase, the companies don't need to build physical infrastructure such as towers.

"The height of the towers, at present, depends on the buildings they are on. In such zones, for better coverage you need towers with really high antennas. If the concept takes off, firms can save a lot on their capex as costs might come down," according to Romal Shetty, partner and head of telecommunications, KPMG. Addition-

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## Balloons and white spaces: The next step in connectivity

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ally, the firms can gain from the early-mover advantage, as there is a large portion of the population which still doesn't have access to basic internet facilities. Connecting these people to the internet will promote smartphone adoption, which in turn leads to a huge growth in user base for all technology-based companies. "A lot of content can be pushed to the untapped population. Moreover, global companies can learn a lot from these projects that will help them in emerging markets around the world such Africa and South America," said Hemant Joshi, telecom leader, Deloitte India said. Fields such as e-healthcare, online education, net banking, agricultural knowledge and smart energy can be accessed by the people through the internet, which, in turn will provide companies with a previously untapped market.

### Challenge ahead

Telecom companies have been eager to know the policy stand of the government regarding white spaces. So far, despite the nod to an experimental pilot projects, communications and information technology minister Ravi Shankar Prasad had mentioned that once the results come, the final decision on policy initiatives would be taken after carrying out all due diligence and it would be consistent with security requirements. The experimental 'go-ahead' assumes significance as in December last year, Prasad has said that the frequency used by Project Loon would interfere with cellular transmissions.

The Statesman

03 February 2016

## Finding the weight of antimatter

Star Trek and Dan Browne's Angels and Demons have brought the word antimatter into everyday vocabulary. Stated simply, it is a kind of matter that annihilates, or disappears into a flash of energy as soon as it contacts ordinary matter. How, then, can we, who live in an ordinary world, ever learn anything about this kind of stuff? Is it for real? While all matter is made up, ultimately, of combinations of just three elementary particles, the electron, the proton and the neutron, a class of antiparticles, the positron, the antiproton and the antineutron and also antiparticles of other fundamental particles found in nuclear reactions has been both predicted in theory and detected in the lab, and in cosmic rays. The antiparticle of a particle is exactly like the mother particle, except that it has the opposite charge and also the opposite magnetic moment because of the reversal of its components. But because of the fact that antiparticles arise essentially to balance the counter particle with the help of the energy equivalent to the mass of both the particles, a particle-antiparticle pair cannot exist at the same place - they destroy each other, giving off just gamma rays, sometimes with a rearrangement of their components, if there are any. But antiparticles behave normally with other antiparticles and can form anti-atoms that have antiprotons in negatively charged nuclei and positrons in orbit, and even anti-molecules. There may exist somewhere, in fact, a whole anti-universe that is just like the one we are familiar with. But nearer home, we have real a experience with a simple atom, the antihydrogen that forms when positrons and antiprotons, which arise in radioactivity and collisions in accelerators, are brought together. A group of researchers at Liverpool, Berkeley, Lausanne, Manchester, Warrington (UK), London, Geneva Toronto, Vancouver, Aarhus, Stockholm, Calgary and Yavne, Israel, report in the journal Nature a further confirmation that atoms of antihydrogen are electrically neutral, just like ordinary hydrogen.

**Significance** - Now why is this significant and why is it important? It is significant because work of just any kind with antimatter presents problems that do not exist with ordinary matter, the main problem being that antimatter is shortlived and rarely stays around in quantity. For all this, positrons and antiprotons, which are charged antiparticles, can be confined with the help of electric and magnetic fields and studied. Their masses and charges have, thus, been estimated with very high accuracy as being equal to those of electrons and protons. And as the charge on the electron or proton is equal, to a very high degree of accuracy, the hydrogen atom is also expected to be electrically neutral, which has been confirmed to a very reliable extent in an experiment. This conclusion, however, has not been confirmed equally well for the antihydrogen atom. In the case of ordinary hydrogen, it is reasonably simple to generate a stream of atoms that can be subjected to strong electric fields before they are detected, to see if the stream is even slightly deflected. But with antihydrogen, there is, first, the problem of creating the atoms, by combination of positrons and antiprotons, and then there is the

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## Finding the weight of antimatter

difficulty of containing or creating a stream of the atoms. Positrons and antiprotons are charged particles and can be controlled by fields and kept away from contact with ordinary matter, but the antihydrogen atom is neutral (or very nearly so) and it strays, to be annihilated. Getting antihydrogen atoms and then definitely testing their electrical neutrality has, thus, been a challenge. However, as the hydrogen atom has a magnetic moment, using magnetic fields becomes a way to trap the electrically neutral antihydrogen atom. Atoms that are not moving too fast can, thus, be confined within a ring of a stronger magnetic field, like a golf ball in a depression. But the trap is not a strong one and it is only a single anti-atom that is generally trapped. And even this atom can be detected only when it gets out of the trap and annihilates. The best test of neutrality so far was of 2014, where antihydrogen atoms were created and confined within the trap in the ALPHA facility at CERN, near Geneva, and subjected to electric fields as they escaped to see if they deflected. The results, which were published in Nature Communications, were that the atoms were neutral to the eighth decimal place, which was a great advance over the previous limit of 1997. The current advance, whose result is a 20-fold improvement, uses a different method - not of deflecting emerging atoms but testing if electric fields are able to knock atoms out the weak magnetic trap. Comparatively slow-moving antihydrogen atoms were trapped in a shallow magnetic depression and then subjected to pulses of electric fields. In case the atoms had any electric charge, it was worked out they would gain energy and escape the trap. The experiment was then to apply the field for some time and then switch off the trap to see if any anti-atoms were left!

### Importance

The fact that antihydrogen is found to be neutral does not come as any surprise, as all the theory, and this is exceedingly successful theory says that this is the way it should be. In fact, finding anything else would be not just astonishing but would also upset our entire understanding of physics and the nature of things. The reason there is interest in being sure of the charge neutrality of antihydrogen is to eliminate uncertainty in experiments in another area of interest - to test the gravitational properties of antimatter. For all the success of quantum physics and the General Theory of Relativity, the fact is that there is no bridge between the two areas of study and there are still gaping holes in our understanding of the universe. On the one hand it is not clear why the universe is all ordinary matter and no antimatter. In the field of cosmology, there is no proven mechanism that leads to the expansion of the universe and also the way galaxies are seen to rotate. Unlike the solar system, where the outer planets go round slower than the inner planets, in the case of a galaxy the outermost regions go round much faster than expected. The only way to explain this seems to be by proposing some invisible matter as pervading the galaxy, to show itself only through gravity. Another difficulty is with the Big Bang Theory of the origin of the universe - the theory says there should be a difference in the level of leftover radiation as seen in different parts of the universe. But what is observed is that the radiation is uniform over distances so large that there could have been no communication from opposite ends, within the known age of the universe. How this is so can be answered only by proposing very fast expansion during the first split seconds, so that places that were once in contact have now been flung so far apart.

### Repulsive gravity

Finding devices to fix these deficiencies in the current theory calls for setting the universe free to expand, because of the presence of matter whose gravitational interaction would be repulsive, in place of being attractive. If antimatter were this kind of entity, the fact would pave the way to much progress in developing a theory of the nature and origin of the universe. The General Theory of Relativity itself would need refinement but finding candidate samples of dark matter or energy would be an advance indeed. The force of gravity, however, is so weak that only the presence of a six million billion billion-kilogram earth below us that has made it possible for us to be intuitively aware of gravity. While the measurement of gravitational forces between positrons or antiprotons, whose weight is in billionths of a billionth of the billionth of a gram, is hence hard enough, the fact that these objects are affected by electric fields makes the detection of how gravity affects them simply out of question. Hence the interest in trying our luck with the antihydrogen atom, which may at least be electrically neutral. But even with the antihydrogen atom, the force of gravity would be so weak that the slightest whisper of electrical effects would wreck the measurements. Experiments to show that the atom is electrically neutral cannot, hence, be accurate enough to push as far back as possible the presence of electric effects that could lead us astray in case we were able to measure gravitational properties of antimatter.

## **The Theia signature**

A "violent, head-on collision" created earth as we know it, according to new ground-breaking research. A planetary embryo called Theia, thought to be around the size of Mars or our planet, collided with earth 4.5 billion years ago when it was just 100 million years old. It was already known that Theia and earth collided, but the new evidence from the University of California, Los Angeles-led scientific team shows it was less of a side swipe, as previously thought, and more of a "head-on assault". The force of the impact resulted in early earth and Theia, together, to form a single planet, with a piece breaking off and entering its gravitational pull to form the moon. Researchers studied moon rocks from three Apollo missions and compared them with volcanic rocks found in Hawaii and Arizona. To their surprise, no difference was found in the oxygen isotopes and it was established that the rocks from each shared chemical signatures. Edward Young, lead author of the new study and a UCLA professor of geochemistry and cosmochemistry, said, "We don't see any difference between the earth's and the moon's oxygen isotopes; they're indistinguishable. Theia was thoroughly mixed into both the earth and the moon, and evenly dispersed between them. This explains why we don't see a different signature of Theia in the moon versus the earth." According to Professor Young, Theia was growing and would likely have become a planet, had it not been destroyed in the collision. The research, funded by the National Aeronautics and Space Administration, the Deep Carbon Observatory and a European Research Council-advanced grant (Accrete) and published in the journal Science, also raised questions about earth's origin. These include whether the collision would have removed any water contained by earth - before asteroids rich in water hit our planet tens of millions of years later.

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## **The laws of thermodynamics**

**By Tapan Kumar Maitra**

All living systems require an ongoing supply of energy. Usually, energy is defined as the capacity to do work, but that turns out to be a somewhat circular explanation because work is frequently defined in terms of energy changes. A more useful definition is that energy is the ability to cause specific changes. Since life is characterised first and foremost by change, this definition underscores the total dependence of all forms of life on the continuous availability of energy. The high level of order that exists in cells is possible only because of the availability of energy from the environment. Cells require energy to carry out various kinds of change, including synthesis, movement, concentration, charge separation, the generation of heat and bioluminescence. The energy needed for these processes comes either from the sun or from the bonds of oxidisable organic molecules such as carbohydrates, fats and proteins. Since chemotrophs feed directly or indirectly on phototrophs, there is a unidirectional flow of energy through the biosphere, with the sun as the ultimate source and entropy and heat losses as the eventual fate of all the energy that moves through living systems. The flow of energy through cells is governed by the laws of thermodynamics. The first law specifies that energy can change form but must always be conserved. The second provides a measure of thermodynamic spontaneity, although this means only that a reaction can occur and says nothing about whether it will actually happen or at what rate. Spontaneous processes are always accompanied by an increase in the entropy of the universe and by a decrease in the free energy of the system. The latter is a far more practical indicator of spontaneity because it can be calculated readily from the equilibrium constant, the prevailing concentrations of reactants and products, and the temperature. Cells obtain the energy they need to carry out their activities by maintaining the many reactants and products of the various reaction sequences at steady-state concentrations far from equilibrium, thereby allowing the reactions to move exergonically toward equilibrium without ever actually reaching it. A negative  $\Delta G'$  is a necessary prerequisite for a reaction to proceed, but it does not guarantee that the reaction will actually occur at a reasonable rate. To assess that, we must know more about the reaction than just its thermodynamic status. We need to know whether an appropriate catalyst is on hand and at what rate the reaction can occur in the presence of the catalyst.

## Tiny marine organisms may have abig role in environment

HOW DO you find your food? Most animal species, whether they rummage through a refrigerator or stalk prey in the wild, obtain nutrients by consuming living organisms. Plants, for the most part, adopt a different feeding, or "trophic," strategy, making their own food through photosynthesis. There are, however, certain enterprising species that can do both: photosynthesise and consume prey. These organisms, found mostly in certain ocean plankton communities, live a flexible, "mixotrophic" lifestyle.

Now researchers at MIT and Bristol University in the United Kingdom have found that these microscopic, mixotrophic organisms may have a large impact on the ocean's food web and the global carbon cycle. The scientists developed a mixotrophic model of the global ocean food web, at the scale of marine plankton, in which they gave each plankton class the ability to both photosynthesise and con-

sume prey. They found that, compared with traditional models that do not take mixotrophs into account, their model produced larger, heavier plankton throughout the ocean. As these more substantial microbes die, the researchers found they increase the flux of sinking organic carbon particles by as much as 35 per cent.

The results, says Mick Follows, associate professor in MIT's Department of Earth, Atmospheric and Planetary Sciences, suggest that mixotrophic organisms may make the ocean more efficient in storing carbon, which in turn enhances the efficiency with which the oceans sequester carbon dioxide.

"If (mixotrophs) weren't in the oceans, we're suggesting atmospheric carbon dioxide might be higher, because there would be less of the large, carbon-rich particles formed which efficiently transfer carbon to depth," Follows says. "It's a hypothesis, but it has been ignored in carbon cycle

models until now, and we suggest it must be represented because it's potentially very important."

Today's ocean models typically take an "either/or" approach, grouping plankton as either photosynthesisers or consumers of prey. This approach, Follows says, oversimplifies the processes taking place in the ocean that may ultimately contribute to how carbon moves through the oceans and atmosphere. He says mixotrophs are often overlooked, because our terrestrial experience makes them seem rare.

"To us on land, we tend to think of (mixotrophs), like Venus fly traps, as exotic — they are a curiosity to us," Follows says. "Our traditional perspective is biased by the land, where organisms fall into one or the other category, rather strictly. But in the oceans, the more people have looked at plankton, the more mixotrophy seems to be common."

ADAPTED FROM MIT NEWS

## MIT wins design competition for Musk's Hyperloop

MIT student engineers won a competition to transform SpaceX and Tesla Motors co-founder Elon Musk's idea into a design for a Hyperloop to move pods of people at high speed. Massachusetts Institute of Technology, based in Cambridge, Massachusetts, was named the winner Saturday after a competition among more than 1,000 college students at Texas A&M University in College Station. The Hyperloop is a high-speed ground transport concept proposed by Musk to transport "pods" of 20 to 30 people through a 12-foot diameter tube at speeds of roughly 700mph. More than 100 university teams presented design concepts to a panel of judges in an event that began Friday. Over the weekend, a thousand high school and college students congregated at Texas A&M University to pitch prototype design ideas for Elon Musk's Hyperloop. The winning team from MIT will build a vehicle to be tested by Musk & Co. The winning team said the philosophy behind their design "is to demonstrate high-speed, low-drag levitation technology. We aim to build a light pod to allow us to achieve the highest cruise speed." The design relies on a magnetic levitation system that keeps the pod 15 millimeters above the Hyperloop tube's surface. The pod's shell will be constructed of woven carbon fiber and polycarbonate sheets. In case of emergency, the pod design includes a braking system that will automatically activate if any system in the pod fails, and, if necessary, the pod would be able to drive itself forward or backward using physical wheels. On the team's website, it explains that its prototype has one major goal: "to demonstrate high speed, low drag levitation technology." To that end, the 550-pound pod is designed to accelerate at 2.4G to a maximum speed of 250mph. The construction of the prototype pod is said to begin this month, with testing taking place from April. Elsewhere, Delft University of Technology from The Netherlands came second, the University of Wisconsin third, Virginia Tech fourth and the University of California, Irvine, fifth. It's expected those teams will also build and test pods for Hyperloop, too. "We don't have any specific plans to back Hyperloop companies," Musk said.

## EUROPEAN SPACE AGENCY LAUNCHES TELECOM HUB



**T**he European Space Agency says a new laser terminal has been launched into orbit as part of wider efforts to develop Europe's first optical communications network, a system able to monitor natural disasters and other catastrophes.

The European Data Relay System terminal, launched Friday from Kazakhstan, was released from its host satellite Saturday morning.

The stationary hub will collect information from surveillance satellites and relay it using an ultra-fast laser data connection to the ground.

The agency and its partner, Airbus Defense and Space, say they will begin testing the system in the next few days and start delivering services to customers in the summer. A second data relay node is scheduled for launch next year, a third in 2020.— Reuters

### Beating a Go champion with machine learning

IN 1996 IBM challenged Garry Kasparov to a game of chess against one of its computers, Deep Blue. Mr Kasparov, regarded as one of the best-ever players, won—but Deep Blue won the rematch. Two decades on, computers are much better than humans at chess but remain amateurs when it comes to the much tougher, ancient game of Go. Or at least, they did. Now a computer has managed to thrash a top-drawer human player. The computer used a program, called AlphaGo, developed by DeepMind, a London-based artificial intelligence (AI) company bought by Google in 2014 for \$400m. It took on Fan Hui, European Go champion, beating him 5-0, according to a report in Nature. Beating a champion at Go has long been considered a "grand challenge" in AI research, for the game is far harder for computers than chess. Go players alternately place black or white stones on a grid of 19x19 squares with the aim of occupying the most territory. The size of the board, and the number and complexity of potential moves, make the game impossible to play via brute-force calculation. Demis Hassabis, DeepMind's founder and one of the paper's authors, reckons that a typical Go turn offers around 200 legal moves, compared with just 20 or so in chess. Whereas a chess-playing computer like Deep Blue was programmed directly by humans, AlphaGo used AI to teach itself about how to play Go and then make its own decisions. This was done with a technique called machine learning, which allows computers to figure out for themselves how to do things, such as to recognise faces, respond to speech and even translate between languages. AlphaGo works in two parts. When it is the computer's turn, the program first suggests moves based on the sorts of general tactics that human players have used in the past—much as Deep Blue would. Then the second part of the system sifts those moves for those that look like they might lead to a win, again based on patterns it has picked up through memorising zillions of previous games. The ultimate test of AlphaGo's capabilities, though, will come in March. DeepMind has persuaded Lee Sedol, a Korean player widely regarded—like Mr Kasparov in his day—as one of the best-ever players, to take on their machine in a series of games in Seoul. If AlphaGo wins—and given its performance against Mr Hui, that seems like a distinct possibility—then human brains, and their possessors, will have to cede another defeat to the machines. —©The Economist