

समाचार पत्रों से चयित अंश Newspapers Clippings

दैनिक सामयिक अभिज्ञता सेवा
A daily Current Awareness Service

Vol. 42 No. 151 02 Aug, 2017



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This black box ejects, helps save vital data

By Ayyappan V

DRDO Floating Device Will Make Retrieval Of Debris, Info Easier

Several aircraft have gone missing in mysterious circumstances -some never to be traced again, others found only after decades, like the remains of two airplanes that an amateur investigator found on Mont Blanc in the French Alps last week, which experts believe could be those of one of the aircraft that Air India lost in two crashes in 1950 and 1966.

But military R&D agency Defence Research Development Organisation (DRDO) has now developed a self-ejectable black box for airplanes. The device ejects from aircraft when it sinks after an accident and self-activates when it comes in contact with water, with a homing signal that can help rescuers easily locate the device. Built as part of 'Make in India' initiative, the product, aimed for use on planes and submarines, has received "notice of allowance for patent" in the US and Russia.

The product can prevent situations like the 2016 AN32 crash where in spite of using deep-sea probes, authorities were not able to trace debris in the sea.

HOMEGROWN SOLUTION

DRDO has developed the floating black box as part of the 'Make in India' initiative. It will export the device after getting approvals

DRDO's device

Name | BSAT

Weight | 1.03kg

Diameter | 151 mm

Endurance | 48hours,

To be patented in Russia and the US

Other uses | Can be used for submarines, automatic underwater vehicles, torpedoes

Why floating black box

- > Most air routes are over water
- > Ejectable black box will not get damaged from the impact after hitting water
- > Easier to find since it will float
- > Conventional boxes sink, are heavier and susceptible to damage if it hits deep depths

Imaging: Shinod Akkaraparambi

HOW IT WORKS

- 1**

Black box ejects when aircraft hits water. Floats on the water and emits signals
- 2**

Powers itself on contact with water. Box can be tethered to parts the aircraft to locate debris
- 3**

Satellites, search planes can pick it up and home in on the crash site in the sea

AFTER A PLANE CRASHES INTO SEA, CURRENTS TAKE THE DEBRIS MILES AWAY

BSAT Ejectable Black Box Recorder with Satellite Transmitter -has been developed and tested by Naval Science and Technology Laboratory of DRDO in Visakhapatnam. It attracted attention from experts at an exhibition “Science for Soldiers & Society“ organised in Chennai at the CVRDE in Avadi.

Officials said the black box was developed based on the tracking technology currently used to detect torpedoes. DRDO decided to develop it further and has perfected it for an aircraft. It aims to export the product after receiving approvals.

“In most of the air crashes in the sea, the conventional black boxes fail probably because they sink to the bottom of the ocean which could be thousands of metres deep and also get affected by the currents or damaged in the impact of the crash,” an official said. “BSAT is designed to overcome all these hassles. It will eject the moment an aircraft touches the water and floats on the surface. It can also be tethered to the flight so that some portion of the debris be retrieved,” the official added.

The floating black box has a good use in defence as it can send out signals when a submarine goes below its prescribed depth and sinks, but its chief use would be in civil aviation. “The invention is good because it can find the crash site and save flight information,” said air safety expert and former pilot Captain Mohan Ranganathan.

A black box stores data including speed, altitude and other parameters of the flight of an aircraft. The information is crucial to piece together the cause of an accident. Airbus and European aviation regulator are planning to have ejectable black boxes on commercial airliners in the next two years.

Ranganathan said implementation of the new technology has to be hastened. Retrofitting of such equipment in aircraft will require permission and certification from Federal Aviation Agency.



Wed, 02 Aug, 2017

Just Rs 1.1-cr defence FDI in 3 yrs

Govt's much-hyped initiative fails to attract foreign players

By Ajay Banerjee

Not much to boast of?

- *No foreign investment received in the present fiscal till May*
- *The count stood at a mere \$1,000 in 2016-17 financial year*
- *In the 2014-15 fiscal, total foreign investment was \$78,000*
- *This is despite the Ministry of Defence okaying up to 49% stake for foreign firms in defence manufacturing sector*

In what reflects ‘lack of interest’ of foreign companies in the Indian defence manufacturing sector, there has been a mere Rs 1.13 crore foreign direct investment (FDI) in the past three years. The Ministry of Defence (MoD) had touted FDI in defence as major shift in policy and okayed upto 49 per cent stake for foreign companies to come and partner Indian companies.

The MoD has given figures in Parliament that are startling. In the present fiscal, no FDI had come in till May. In the 2014-15 fiscal, the total FDI was US \$78,000, with major chunk from France. In the 2016-17 fiscal, the investment was a mere US \$1,000. The ‘biggest’ FDI inflow was in 2015-16—US \$95,000. This is far less than the overall FDI inflow in the country during the 2016-17 fiscal when US \$60.08 billion (about Rs 3,86,885 crore) investment came. The cumulative FDI in the country during April-May this year was US \$10.02 billion, or about Rs 65,000 crore.

The MoD, in its reply to a question in Parliament, said “since defence projects involve long gestation period and investment inflow takes time even after the projects are approved and contracts awarded, there is always a time lag before the impact of FDI is visible”. In 2016, a revised FDI policy on defence was announced. This

okayed FDI up to 49 per cent under the automatic route and beyond 49 per cent is through government route wherever it is likely to result in access to modern technology or for other reasons to be recorded.

The government has also put in place a Security Manual for Licensed Defence Industries. The security manual prescribes guidelines on physical, information, documentation, cyber and personnel security aspects.

The FDI in defence policy has been reviewed with an aim to promote investment and technology transfer in defence manufacturing sector. This sector needs significant capital investment and infusion of technology for which foreign investment can play a critical role. The FDI in the sector could be the most trusted route to technology transfer, which would help in increasing the defence production base and providing the much-needed impetus to self reliance and indigenisation in the defence sector, the MoD has accepted in Parliament.



*Tue, 01 Aug, 2017
(Online)*

India, Russia sign three contracts on Kudankulam nuclear power plant

Three contracts were signed between Nuclear Power Corporation of India and Russia's JSC Atomstroyexport for design works and supply of the main equipment for stage III of Kudankulam NPP, said an official release from the Russian company.

India and Russia have signed contracts for priority design works and supply of main equipment for units 5 and 6 of the Kudankulam nuclear power plant in Tamil Nadu, two months after the main framework agreement for these units were signed during Prime Minister Narendra Modi visit to Russia. Three main contracts were signed on Monday between state-owned Nuclear Power Corporation of India (NPCIL) and Russia's JSC Atomstroyexport for priority design works, working design and supply of the main equipment for stage III of Kudankulam NPP, an official release from the Russian company said.

JSC Atomstroyexport is a key foreign trade engineering company of State Corporation "Rosatom" for construction of nuclear power facilities abroad.

"The project for construction of Units 5 and 6 of Kudankulam NPP is passing to the practical implementation phase. Designing begins, as well as development of procurement procedures of the main equipment of the Russian production to complete Stage III of the Indian nuclear power plant", said Andrey Lebedev, the Vice-President on projects in the Southern Asia, JSC ASE EC.

After overcoming initial hurdles, India and Russia signed the General Framework Agreement (GFA) and credit protocol for Units 5 and 6 of the Kudankulam NPP on June 1, a major outcome of the annual summit talks between Modi and Russian President Vladimir Putin in St Petersburg.

"On July 13, an approval for these three key contracts was obtained from the Rosatom State Corporation, the RF Ministry of Economic Development and the Ministry of Finance. On July 19, the NPCIL Board of Directors approved signing of the three contracts on Units 5 and 6 of Kudankulam NPP," the release added.

The Kudankulam NPP was the outcome of an inter-governmental agreement between the erstwhile Soviet Union and India in 1988. It is the single largest nuclear power station in India. The power station was envisaged to have six units with total capacity to generate 6,000 MW of electricity (1,000 MW each).

Air Force loses nine pilots, 28 aircraft in 40 months

By Sanjib Kr Baruah

Junior defence minister Subhash Bhamre furnished the numbers in a written reply in the Rajya Sabha on Tuesday.

New Delhi: Reeling under a critical shortage of about 500 fighter aircraft and 1,000 helicopters, the IAF just cannot afford to lose its flying machines. Yet in the in the past 40 months from 2014 to July 2017, it has lost nine pilots, 24 aircraft and four helicopters. Junior defence minister Subhash Bhamre furnished the numbers in a written reply in the Rajya Sabha on Tuesday. The aircraft that crashed include four of India's state-of-the-art frontline multi-role Sukhoi fighters with the last crash taking place on May 23 in the Assam-Arunachal Pradesh border. The last IAF chopper crash also took place in Arunachal Pradesh on July 4.

The world's fourth largest Air Force in terms of personnel and aircraft, the IAF operates in an air space spanning more than 40 million cubic km. At present, it operates a fleet of about 33 fighter squadrons.

Last year, a parliamentary panel was baffled at the consistently high rate of IAF crashes after the defence ministry's submission that during 2007-2015, a total of 83 accidents had taken place. The committee also expressed its concern over the fact that the rate of accidents had not come down even after 53 inquiry committees had submitted their reports on the air mishaps. The panel concluded that in most of the accidents, the cause was either human error or technical defect. "It is evident that there is either lacuna in training that is being imparted to our pilots and support officials or the systems installed are technically ill-equipped. In both the cases, the onus lies on the senior level management".

The IAF had taken disciplinary action against 14 personnel and administrative action at various levels against 87 personnel for the air crashes that took place in the period from 2006 to 2016.

Pak indebted for China support on Kashmir, NSG: Army chief

Pakistan is "indebted" to its all-weather ally China for its "unflinching support" to it on the Kashmir issue, the expansion of the NSG and the Shanghai Cooperation Organisation, army chief General Qamar Javed Bajwa has said. Describing China and Pakistan as "important strategic players in the region," General Bajwa, who was the chief guest at a reception in Rawalpindi on Monday hosted by the Chinese embassy, said, their bilateral ties have jointly benefitted both the countries.

"It is a relationship based on mutual trust, respect, understanding and cooperation. In fact, this friendship is flourishing with every passing day, which encompasses every aspect of our life," he said at a function to celebrate the 90th anniversary of the founding of China's PLA. Bajwa said the "professional collaboration between PLA and Pakistan army, will continue to expand to bring peace to the region in general and China Pakistan in particular." He noted that both China and Pakistan are faced with similar challenges and opportunities. Both countries have assumed shared responsibility towards stability in the region and prosperity of their people, he said.

He also pointed out China and his country has expanded their cooperation to wider areas and have launched strategic initiatives like the China-Pakistan Economic Corridor, defence collaboration in projects and united diplomatic front, internationally. "Pakistan is indebted to China for its unflinching support to our perspective at all international forums, may it be expansion of Nuclear Suppliers Group, Kashmir Issue, or Pakistan's full membership of the Shanghai Cooperation Organisation," he said.

Wed, 02 Aug, 2017

Will defeat all invasions, never allow anyone to split China: Xi

By Saibal Dasgupta

President Xi Jinping warned that China would never swallow the “bitter fruit“ that is harmful to its sovereignty and defeat “all invasions“ in his address to top military and Communist party officials on the 90th anniversary of the People's Liberation Army at the great hall of the people here on Tuesday . Covering a range of challenges facing China, Xi said, “We will never allow any people, organisation or political party to split any part of Chinese territory at any time, in any form.“

The statement comes in midst of a border standoff with India and analysts said it showed that the recent parleys between National Security Advisor Ajit Doval and Chinese officials on the border standoff in Sikkim had not yielded results. India favours simultaneous withdrawal by both sides but China is not ready to compromise on its road building programme in the border area, Chinese sources said.

Xi's comment on “organization or political party“ was seen as a referece to the ruling party in Taiwan and rebels in Hong Kong struggling for democratic rights in the face of controls imposed from Beijing. Xi, 64, said, “The Chinese people love peace. We will never seek aggression or expansion, but we have the confidence to defeat all invasions.... No one should expect us to swallow the bitter fruit that is harmful to our sovereignty , security or development interests.“ Xi's statement came two ys after he addressed tro days after he addressed troops after a military parade saying on July 30, saying, “I firmly believe that our gallant military has both confidence and ability to defeat all invading enemies.“

In another development, China opened a 635-km expressway on the permafrost of Qinghai-Tibet Plateau, the world's highest plateau.Nearly 36% of the road is built on an average altitude of 4,000 metres. The \$4 billion road runs over permafrost that could become unstable due to temperature changes caused by vehicles. It could prove to be a strategic asset for military transportation as in the case of Tibet Qinghai railway line.

Amid Doklam standoff, Bhutanese envoy attends PLA function in Delhi

A mid the military standoff at Doklam near the India-China-Bhutan tri-junction, Bhutanese ambassador to India Vetsop Namgyel attended an event organised by the Chinese embassy meant to mark the 90th anniversary of the founding day of PLA. Pakistan high commissioner Abdul Basit also attended the event. The event was also attended by senior officers of the Indian Army. Bhutan doesn't have diplomatic ties with China and, according to some diplomatic sources, Namgyel's presence is “interesting“ because armed forces day is not the same as national day. Indian officials said though that there was no need to read too much into the presence of Namgyel at the event.

“The Chinese army has developed into a modern army of multi-military synthesis, unswervingly safeguarding national sovereignty and territorial integrity, and has the confidence and ability to cope with various security threats and challenges,“ military attache Zhou Jian was quoted as having said. TNN

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Wed, 02 Aug, 2017

How to counter China’s expansionist plans in Asia

By Anna Mirza

Beijing pumping money into Sri Lanka’s Hambantota port and neighbouring countries has raised India’s hackles

China and Sri Lanka recently signed the Hambantota port deal which is being called a “win-win situation” for both. But what is really behind China’s purchase of a port in Sri Lanka?

Critics have been vocal about the fact that Sri Lanka has fallen prey to the economic diplomatic moves that are seen as China's "give loan and in return grab land" policy. Can Sri Lanka bear the debt burden and repay the \$5 billion loan which was given in order to get a 99-year lease on the port given its internal compulsions?

Giving China majority control of the port raises concerns about Sri Lanka's national security and relations with neighbours like India. It is well known that China is adept at manufacturing low cost products and tends to lend to commodity-exporting countries with highly competitive manufacturing sectors. This is what has happened in Sri Lanka.

China pumping money into South Asian countries like Bangladesh, Pakistan, Nepal and Sri Lanka has raised India's hackles. But the question is why can't India give soft loans to Sri Lanka to pay off China loan and get the Hambantota port released? Will Pakistan be able to repay the CPEC loans?

What makes China's grand plans click is that there is no other prominent economic power in the region which has such an expansionist focus. With the US-led Trans-Pacific Partnership (TPP) in choppy waters, there are fears that the US is no longer a reliable ally in the region. This ironically applies to the Southeast Asian nations as well; looking at the case of the Philippines. With doubts over US credibility in the region, what China offers is a new sort of economic mentoring.

By making use of its huge economic clout, China is able to get what it wants in many parts of the world. India has long been obsessed with China's military might. We are seeing that in Doklam. But of far greater danger is its economic hegemony which is now established in several areas, including in our neighbourhood. India needs to come up with a proactive response to this.

Financial might can be used as a tool to depict the confidence and purpose of a global superpower. Economic power is what fuels China's assertive foreign policy. The dragon is ready to take risks and go where the West has been reluctant to venture. However, China's replacement of western influence brings with it Beijing's territorial ambitions and aggression. The only way to counter this is if nations in a particular region act in concert. But in South Asia, that seems hardly likely at the moment.



Wed, 02 Aug, 2017

Trump will be tougher on Pakistan

By Larry Pressler

Lisa Curtis' appointment to the National Security Council augurs a more punitive approach

From my perch a few blocks from the State Department and the White House, and just across the river from the Pentagon, I am starting to see the signs that a policy shift is afoot in the US position vis-à-vis its unreliable ally, Pakistan. The Trump Administration appears to be ready to take a much harder line against this rogue nation. The appointment of Lisa Curtis as the senior director for South and Central Asia at the National Security Council augurs a more punitive approach to Pakistan than the Obama Administration, which gave more military and economic aid to Pakistan than any previous administration in an effort to bribe the country into action against the terrorists hiding out in plain sight within its borders. On the contrary, Curtis has recommended that any future aid to Pakistan be calibrated against Pakistan's ending its support to the Afghan Taliban and the Haqqani Network.

In a Hudson Institute report that she co-authored earlier this year with Husain Haqqani, a former Pakistan ambassador to the United States, the two policy experts recommended that Pakistan be punished swiftly if these milestones are not met: Stripping Pakistan of its major non-Nato ally (MNNA) status and designating it a state sponsor of terrorism. Ambassador Haqqani reiterated these recommendations in a July 6 New York Times editorial. In other words, more sticks and fewer carrots. Now that Curtis is in charge of the US' policy towards South Asia and ostensibly has the ear of the nation's national security adviser and President Trump, she is in a position to initiate and implement these recommendations.

These policy changes are long overdue. As I state emphatically in my newly released book, *Neighbours in Arms: An American Senator's Quest for Disarmament in a Nuclear Subcontinent*, Pakistan should be treated like North Korea — like a rogue state. The only reason Pakistan is not a totally failed State is that countries like China and the United States continue to prop it up with massive amounts of foreign aid. Unless Pakistan changes its ways with respect to terrorism, it should be declared a terrorist state.

Indeed, the first Bush administration seriously considered doing so in 1992. Pakistan's leaders have essentially blackmailed us into providing aid for the war on terror with threats to cease assistance in rooting out terrorists in Afghanistan. Meanwhile, we know fully well that Pakistan harbours terrorists, and many military leaders believe terrorists have infiltrated Pakistan's ranks. We let Pakistan use US taxpayer money to build their nuclear weapons programme. Why do we now let them use US taxpayer money to harbour terrorists? Without our money and military supplies, Pakistan would be powerless. Why do we continue to call Pakistan an ally? Why do we continue to be blackmailed?

The Pressler Amendment is also wrongly blamed for political instability in Pakistan during its enforcement period. That is just nonsense — there was just as much instability in Pakistan before the Pressler Amendment. Critics will say that, during that time, Iran and Saudi Arabia started fuelling sectarianism in Pakistan. The truth of the matter is that the Pressler amendment did slow down Pakistan's nuclear ambitions, and I think the public attention forced Pakistan to be much more careful and transparent. The underlying policy objectives at the heart of the Pressler Amendment clearly have had a long-lasting impact, even if inconsistently enforced.

The US Congress is tired of Pakistan's lies and games. It cut off \$300 million in aid and blocked government funding for the transfer of F-16 aircraft last year. Congress knows squeezing them financially is the only leverage that really works. Curtis and Ambassador Haqqani understand this as well. They are old enough to remember the Pressler Amendment and its impact on Pakistan's nuclear weapons programme. Named after me, it was enforced under President George HW Bush in 1990 when he could not certify that Pakistan did not have a nuclear weapon. As a result, all aid to Pakistan was immediately cut off. It was the ultimate diplomatic "stick."

Unfortunately, the generals in the Pentagon continued to find ways to fund the generals in Islamabad and the Pressler Amendment's effectiveness and enforcement withered. Today, another type of Pressler Amendment is needed to force Pakistan to reject the terrorists in its midst. Hopefully, the new regime at the White House and in Congress will make it happen. Oddly enough, the election of Donald Trump as president might be the best thing for the relationship between the world's two largest democracies.



Wed, 02 Aug, 2017

All options on table for North Korea: White House

North on Friday carried out test of an intercontinental ballistic missile that could reach America

US President Donald Trump has kept all 'options on the table' for North Korea, which is flaunting international norms by provocative intercontinental ballistic missile tests (ICBM) and its nuclear weaponization program, the White House has said. It, however, said that the president will not make his options public.

"The President is not going to broadcast any decision, but all options are on the table," White House Press Secretary Sarah Sanders told reporters yesterday at her daily news conference. North Korea carried out an intercontinental ballistic missile test on Friday which the weapons experts said could even bring New York into range, posing a major challenge to US' security. The US strategic bombers retaliated on Saturday by flying over the Korean peninsula, and on Sunday American forces successfully tested a missile interception system the US hopes will be installed on the Korean peninsula.

Over the weekend Trump had expressed his frustration over Chinese inability to do anything against North Korea. Earlier in the day, Trump exuded confidence that he would be able to handle the North Korean situation

well, which he did not elaborate. According to the Pentagon, the Department of Defence is well prepared to protect the US and its allies from any provocative behaviour from North Korea.

Within hours of the North Korean ICBM launch, American and South Korean army personnel conducted a combined live fire exercise, the Pentagon said. "This exercise utilised the Army tactical missile system, also called ATACMS, and the [South Korean] Hyunmoo Missile-2, which fired two missiles each into territorial waters of South Korea along the east coast," the Pentagon Director of Press Operations Navy Captain Jeff Davis told reporters during an off-camera news conference. Also the US Air Force B-1 bombers along with the South Korean and Japanese air forces carried out flight over the Korean Peninsula. "The B-1s then flew over the Korean Peninsula where they were joined by four [South Korean] Air Force F-15 [Eagle] fighter jets. The B-1s then performed a low pass over Osan Air Base, South Korea, before leaving South Korean airspace and returning to Guam," Davis said. The entire operation lasted for about 10 hours.

"The US maintains flexible bomber and fighter capabilities in the Asia-Pacific theatre, retaining the ability to quickly respond to any regional threat in order to defend the US homeland and in support of our allies," Davis said in response to a question. "North Korea remains the most urgent threat to regional stability," said Air Force General Terrence O'Shaughnessy, the Pacific Air Forces commander.

"Diplomacy remains the lead; however, we have a responsibility to our allies and our nation to showcase our unwavering commitment while planning for the worstcase scenario. If called upon, we are ready to respond with rapid, lethal, and overwhelming force at a time and place of our choosing," O'Shaughnessy said. All this was in addition to the a successful missile defence test using the Terminal High Altitude Area Defence (THAAD) system. "A medium-range target ballistic missile was airlaunched by a US Air Force C-17 [Globemaster III] over the Pacific Ocean.

The THAAD weapon system located at Pacific Spaceport Complex Alaska in Kodiak, Alaska, detected, tracked and intercepted the target," said the Pentagon press secretary. This was the 15th successful intercept in 15 tests for THAAD.



Wed, 02 Aug, 2017

Russia's military drills near NATO border put US on alert

By Michael Gordon & Eric Schmitt

Russia is preparing to send as many as 1,00,000 troops to the eastern edge of Nato territory at the end of summer in one of the biggest steps yet in the military buildup undertaken by President Vladimir Putin and an exercise in intimidation that recalls the most ominous days of the Cold War.

The troops are conducting military maneuvers known as Zapad, Russian for "west," in Belarus, the Baltic Sea, western Russia and the Russian enclave of Kaliningrad. The drills will feature a reconstituted armoured force named for a storied Soviet military unit, the First Guards Tank Army. Its represents the first time since the collapse of the Soviet Union that so much offensive power has been concentrated in a single command.

The exercise, planned for many months, is not a reaction to sweeping new economic sanctions on Russia that US Congress passed last week, but is part of a larger effort by Putin to shore up Russia's military prowess. Beyond Russia's interference in the 2016 US presidential election, its military has in recent years deployed forces to Syria, seized Crimea and intervened in eastern Ukraine, rattled the Baltic States with snap exercises and buzzed Nato planes and ships.

US military officers said that the maneuvers could be used as a pretext to increase Russia's military presence in Belarus, a central European nation that borders three critical Nato allies: Poland, Lithuania and Latvia. "The great concern is they're not going to leave, and that's not paranoia," General Tony Thomas, the head of the US Special Operations Command, said in July.

For this installment of the Zapad maneuvers, a Cold War relic revived in 1999 and held again in 2009 and 2013, Russia has requisitioned enough rail cars to carry 4,000 loads of tanks and other heavy equipment to and from Belarus.

The United States has already sent 600 paratroopers to Nato's three Baltic members for the duration of the Zapad exercise and delayed the rotation of a US-led battle group in Poland. "We'll be ready; we'll be prepared," said Lt Gen Frederick Hodges, the head of US army forces in Europe. "But we're not going to be up on the parapets waiting for something to happen," Hodges said.

Americans locked out of Moscow property

The US embassy in Moscow accused Russian authorities on Monday of barring diplomatic staff from a property on the outskirts of Moscow, after having earlier agreed to grant access until Tuesday for them to retrieve belongings. A Russian foreign ministry official said the US embassy had sent in its trucks without obtaining permits which were required as the property was in a conservation area. The property is leased by the US embassy for its staff to use for recreation. An embassy spokeswoman said, "In line with the notification, the US mission to Russia was supposed to have access to our dacha until noon on August 1.



Wed, 02 Aug, 2017

Scientist, leader & institution-builder

By S N Tandon

Yash Pal, the eminent scientist and educationist served as a role model to be emulated. He was against the barriers between science and technology or between natural sciences and social sciences. For him, a full education should involve exposure to all the areas of human interest.

YASH PAL, scientist, educationalist, builder of institutions, and a great leader passed away on the morning of July 25. He was a popular public figure and a lot has been written about him. I will try to give a glimpse of his person. My association with him was of more than five decades — first as his Ph D student and later as a colleague and friend.

When I saw Yash (as he was called by his friends), first in the year 1963 in TIFR, his persona, with a pipe in mouth, generated a sense of awe in my semi-rural mind. However, when I actually met him, I was put at ease within minutes by his informal and gentle style of conversation. Soon, I started working with him and his students, on problems relating to transport, interactions, and composition of Cosmic Rays. The approach was simple but new to me. A question is raised, it is thought over by individuals with rounds of group discussions to arrive at a plausible solution, before looking for solutions provided, if any, by others. This was an effective method to encourage independent thinking about any question. He was the happiest when exploring a new idea, making simple and rough estimates to check the implications and confirm that it works. The detailed calculations could follow these essential steps. Perhaps, citing an example would not be out of place here.

During the 1960s, he was interested in experimental investigation of possible presence of anti-matter in the astronomical bodies by looking for anti-nuclei (similar to nuclei of atoms we are made of, but with an electrical charge which is opposite or negative) in Cosmic Rays. This investigation called for measuring the sense of bending of the particles in a magnetic field by an instrument flown in a balloon from Hyderabad. The challenge in this experiment was to measure bending of few tens of micrometres over some tens of centimetres. After a thorough discussion within the group, it was realised that the experiment required very thin and very flat glass plates and a measuring machine which could measure distances to a few micrometres over twenty centimetres — big demands which were not readily available in those days. Once configuration of the experiment and the basic requirements were understood, with great confidence he announced the decision to go ahead with the experiment and that solutions for the details would be found in due course. With his

optimism and guidance, a successful experiment was conducted to place upper limits on the fraction of anti-nuclei, and hence fraction of anti-matter in the astronomical bodies producing Cosmic Rays.

In 1972, he took up the responsibility for setting up the Space Applications Centre of ISRO at Ahmedabad. It was a big change from being an established Professor at TIFR working on fundamental research to creating a large facility to exploit space technology for national benefit. SITE, the very first project at this centre very dear to his heart, was aimed at enabling mass education in isolated villages. It required setting up all the systems for transmission to the satellite, and reception of weak signals from the satellite in large number of villages. The success of this project in a short three-year period required all of Yash's leadership qualities: tenacity, optimism, an open mind and confidence to solve any problem, guiding and encouraging young persons to take up difficult tasks, and interdisciplinary vision. He developed a strong group of young engineers full of enthusiasm and confidence. This tradition set by him continues at the Space Applications Centre. It continues to develop systems for remote sensing and communication, which are state of the art or better, for our country.

After leaving ISRO, he was the Chief Consultant with the Planning Commission in 1983, Secretary of Department of Science and Technology for three years, and Chairman of the UGC during 1986 to 1991. During his term at UGC he oversaw establishment of inter-university centres to provide centralised facilities for research to teachers in universities. His vision of these centres was not centralisation but optimal use of expensive resources which could not be made available to individual universities. In addition, Information and Library Network (INFLIBNET) was set up to provide ready access to current literature to universities through information technology.

He was very concerned with the state of education at all levels which did not encourage the spirit of observation and enquiry. He deeply felt that through its excessive burden, our education did not allow time for free thinking and took away the joy of learning. He chaired several committees for improvements of primary-secondary as well as higher education. The reports from these committees always emphasised the need to encourage the students to observe and enquire about the nature and their surroundings, and the need to relate the material of the books to the local surroundings and culture.

While the reports by his committees made recommendations about drastic changes to educational methods, the realist in him sensed the difficulties in implanting basic changes.

His attitude toward learning by observation and questioning was probably best seen through the television show "Turning Point". To him, the questions asked of him were no less than learning by the curiosity of children. In the show, he discussed the questions and explain the basic concepts involved in answering these. I remember a few occasions when he discussed some of these questions with me with great enthusiasm — questions relating to phenomena which most of us see in everyday life but do not observe — such as how a simple taraju works or what all happens when a container with water is heated on a gas stove or why one layer of a puri is thicker than the other.

For a man with so many achievements, he appeared surprisingly easy going. With his humanism, egalitarianism, broad and tolerant outlook, and generosity he was able to connect easily with people of all ages from different backgrounds and occupations. On several occasions, we were fortunate to host Yash and Nirmal (his wife) at our home. In informal conversations during these visits, Nirmal did not hesitate to make fun of him, which he always accepted with a smile or laughter. Yash is gone but his values and wisdom will guide us.

Learning should be a joy, not a burden

The report on “Learning Without Burden”, by Yash Pal in its recommendations states: There is a deeper malaise in our society, which impacts our young children. If we continue to value a few elite qualifications far more than real competence for doing useful things in life, and if the economic distance, between those who can manage to cross some academic hurdles and those who can't, continues to widen, we will probably continue to spend our effort in designing hurdles instead of opportunities for children to learn with joy.

