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LCA-NAVY MAKES MILESTONE ARRESTED LANDING ONBOARD INS VIKRAMADITYA

Light Combat Aircraft (LCA) achieved another milestone when after completing extensive trials on the Shore Based Test Facility (SBTF), its Naval version did a successful arrested landing on 11 January 2020 onboard INS Vikramaditya. LCA Navy has been developed by the Aeronautical Development Agency under DRDO.

History was created when an indigenous military aircraft made arrested landing onboard an aircraft carrier.

Secretary, Department of Defence R&D and Chairman DRDO, Dr G Satheesh Reddy congratulated ADA, Indian Navy, Hindustan Aeronautics Limited (HAL), Council of Scientific and Industrial Research (CSIR) and Directorate General of Aeronautical Quality Assurance (DGAQA) teams for the stupendous success.





125 MM FSAPDS PRACTICE AMMUNITION READY FOR INDUCTION INTO SERVICE

Fin Stabilized Armour Piercing Discarding Sabot (FSAPDS) kinetic energy ammunition is used as primary ammunition by the large fleet of T-72 and T-90 tanks of the Indian Army due to its superior lethality. The highly lethal FSAPDS ammunition is capable of destroying all known tank armour up to a direct shooting range of 2500 m. The tungsten penetrator utilised in this ammunition leads to high cost of the round, hence it is not feasible to use such service round for training of crew.

To provide tank regiments with low cost practice ammunition so as to conserve service ammunition for operations, Armament Research and Development Establishment (ARDE) Pune, has designed and developed 125 mm FSAPDS practice



ammunition in association with sister DRDO labs High Energy Materials Research Laboratory (HEMRL), Pune and Proof and Experimental Establishment (PXE), Chandipur. All the developmental trials, DGQA trials and user trials of the ammunition have been completed satisfactorily establishing parameters such as

low Equivalent Full Charges (EFC), low ricochet range and desired consistency. The last phase of user trials were successfully completed at KK Range, Ahmadnagar during 23-24 December 2019. The practice ammunition is now ready for induction in the Indian Army and will save a lot of exchequer.

EVENTS

DRDO GETS MOST INTERACTIVE PAVILION AWARD IN PRIDE OF INDIA-SCIENCE EXPO AT 107TH ISC

DRDO participated in the Pride of India-Science Expo-2020 held from 3-7 January 2020 at the 107th Indian Science Congress (ISC) at University of Agricultural Sciences, Bengaluru. The five-day mega science expo was organized as part of ISC-2020 inaugurated by the Prime Minister Shri Narendra Modi.

The DRDO pavilion was inaugurated today by the Union

Minister of Science and Technology Dr Harsh Vardhan. He visited various DRDO stalls and took a keen interest in the products and technologies displayed there. Thirty-one DRDO laboratories with more than 150 exhibits and models participated in the expo showcasing many cutting-edge indigenous defence technologies, which narrate the saga of self-reliance and national pride with the “Make

in India” spirit and was bestowed Most Interactive Pavilion Award. Star attractions of outdoor exhibits at DRDO Pavilion included Long Range Surface-to-Air Missile, Quick Reaction Surface-to -Air Missile system, Beyond Visual Range Air-to-Air Missile Astra, Radars including Battle Field Surveillance Radar (BFSR), Aslesha and Bharani, Mini UGV Autonomous Surveillance Robot,

Sentry Autonomous Surveillance Robot etc.

Indoor exhibits included models of Airborne Early Warning and Control (AEW&C) System, UAV Rustom-I and Tapas, Nirbhay Missile, Akash Missile System, Prithvi missile, Nag missile, HELINA, Maareech-Advanced Torpedo Defence System, Bukhari heating system, Ready-to-Eat Packaged Foods, Juices, etc. DRDO pavilion was major attraction amongst visitors and students. The visitors also get a chance to interact with DRDO scientists who are working on these technologies.



ANTI SATELLITE MISSILE STEALS THE SHOW IN REPUBLIC DAY PARADE

Anti Satellite Missile was the cynosure of the public in this year's Republic Day parade as part of the DRDO contingents.

The DRDO developed products like Surface-to-Air-Missile 'Akash',

Mobile Bridging System Sarvatra, Beyond Visual Range Air-to-Air Missile Astra, Light Combat Aircraft Tejas, Air Defence Tactical Control Radar (ADTCR) were displayed as part of different tableaux of DRDO

and the Armed Forces. In a first, a defence scientist, Dr Y Sreenivasa Rao, the Chief Architect and Project Director of the Mission Shakti, led the DRDO contingent.



PM DEDICATES FIVE DRDO YOUNG SCIENTISTS' LABORATORIES TO THE NATION



Hon'ble Prime Minister Narendra Modi dedicated five DRDO Young Scientist Laboratories to the nation on 2 January 2020 at Aeronautical Development Establishment (ADE), Bengaluru. These laboratories are located in Bengaluru, Mumbai, Chennai, Kolkata and Hyderabad. PM Modi has suggested DRDO to set up five young scientists' laboratory in 2014.

In his inaugural speech PM Modi said, "This decade is entirely of young dreams and our young innovators, especially the ones who were either born in the 21st century or attained adolescence in the 21st century. When I urged DRDO to rethink and reshape itself, the idea behind it was that one must work with new energy to meet the challenges of the 21st century. I am glad that the suggestion of setting up five labs in the field of advanced technologies was seriously worked out and I believe that

these Young Scientists' Labs will give new wings to the thoughts and ideas of young scientists. These labs will help in shaping the nature of research and development in the field of emerging technologies in the country.

Addressing the young scientist, the PM said, "I would like to tell my young friends that these labs will not test only technology. It is also going to test your temperament and patience. You must always keep in mind that it is only with your efforts that India will lead the way to success. You always have to keep this in mind that the responsibilities of making the lives of 130 crore Indians safe and easy are on your shoulders."

Earlier while welcoming Hon'ble PM, Secretary DDR&D and Chairman DRDO said, These five Young Scientists Laboratories have been established in very advanced areas as per the directives of the PM and will be manned by the scientists who are below 35 years of age.

The Directors of these laboratories have the powers like any other Directors of the DRDO.

The establishment of the five DRDO Young Scientist Labs lays down the foundation for research and development of futuristic technologies. Each lab will work in the area of niche technologies, viz., Artificial Intelligence, Quantum Technologies, Cognitive Technologies, Asymmetric Technologies and Smart Materials. Research in the area of rapidly evolving Artificial Intelligence will be carried out at Bengaluru; in Quantum Technology will be carried out at IIT Mumbai, in Cognitive Technologies at IIT Chennai; in new and futuristic area of Asymmetric Technologies at the campus of Jadavpur University, Kolkata and in hot and critical area of Smart Materials and their applications at Hyderabad.

DRDO DAY CELEBRATIONS-2020

NPOL, KOCHI

Naval Physical and Oceanographic Laboratory (NPOL), Kochi celebrated DRDO Day on 1 January 2020. The programme started with the webcast of the New Year message of Dr G Satheesh Reddy, Secretary, Department of Defence R&D & Chairman, DRDO. This was followed by the launch of the newly redesigned TIRC portal by Shri S Vijayan Pillai, OS and Director, NPOL. Director also released the current issue of 'Sea State'—the NPOL Newsletter.

In his address to NPOL fraternity, Shri Pillai highlighted the significant achievements and progress in the year 2019 and elucidated future plans and commitments for 2020. In continuation of the DRDO Day celebrations, Directors and Associate Directors of Projects and Groups, and Corporate Group Directors delivered presentations about the technologies and products developed.

ITR, CHANDIPUR

Dr BK Das, Director, Integrated Test Range (ITR), briefed about the notable achievements of the Range during the year 2019 including successful test firing of a number of missiles comprising first night launch of some of these. He appreciated the social activities taken up by ITR like Swachhata Hi Seva Campaign, Blood Donation Camp, AIIMS Health Camps in collaboration with AIIMS, Bhubaneswar, and drive for Green ITR.

He further emphasised on the contributions of every individual along with the support of their families towards achieving this goal. He inspired employees to have a shared vision of



DRDO Day celebration at NPOL

world class test range with state-of-the-art instrumentation and infrastructure.

The Third Edition of in-house Hindi Patrika 'Arohi-Utkrushtata Ki Or' and 'Goal Document of ITR 2020' were released during the occasion.

ITR Annual Day celebration prizes of various competitions, i.e., Sports and cultural events, Quiz, Antakshari, Classical and Folk Dance, Classical and Light Vocal Songs, Ladies events, etc., were distributed to the winners.



Release of In-house Hindi Patrika of ITR

WORLD QUALITY DAY-2019

Directorate of QRS, Naval Science and Technological Laboratory (NSTL), Visakhapatnam, on the occasion of World Quality Day with the theme “Enhancing Organizational Effectiveness through Quality.” Shri PVS Ganesh Kumar, Sc ‘H’, Officiating Director, NSTL and Shri Ch Sankara Rao, Sc ‘G’, TD (QRS) addressed the gathering and promoted the awareness about the role of quality in the success of an organization and in the development of individual prosperity and exhorted the gathering to imbibe quality as culture in day-to-day work.

Posters related to quality, reliability and safety were displayed in major work centers at NSTL. In addition to this, experts were invited to deliver lectures on techniques for ensuring

compliances to quality & reliability. Dr Rajiv Nandan Rai, Assistant Professor, Subir Chowdhary School of Quality and Reliability, IIT Kharagpur delivered a talk on Ensuring Quality and Reliability through Advanced Tools

and Techniques. Shri Mukesh Kumar, Sc ‘E’, R&QA, ASL, Hyderabad, delivered a lecture on ‘Significance of Robust R&QA Structure in the Laboratories for Building Customer Confidence in DRDO Systems/Products’.



DRDO ORATION SERIES

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, as a part of its Golden Jubilee Celebrations organised DRDO Oration by Prof. Balram Bhargava, Secretary, Department of Health Research, Ministry of Health and Family Welfare, Government of India and Director General, Indian Council of Medical Research (ICMR) on “Value Conscious Innovations” on 31 December 2019 at Metcalfe House, Delhi. Dr Chitra Rajgopal, DS & DG, R&M, DRDO, Dr Alka Suri, Director, DESIDOC, Dr Rajeev Vij, Sc ‘G’, convener of the oration, were present on the occasion.

Prof. Bhargava enriched the audience with her vast experiences, ideas and thoughts. He talked about how he brought out valuable medical products for benefit of society through a motivated team of engineers and doctors. He also gave tips for a healthy



Dr Chitra Rajgopal felicitating Prof. Balram Bhargava

heart. Dr Chitra Rajgopal appreciated relentless services of Prof. Bhargava and his invention of cheap medical products for use in the country. Over

600 personnel including Directors of DRDO HQ and DRDO labs/estts of Delhi, officers and staff from various Delhi-based labs attended the oration.

SAMVIDHAN DIWAS CELEBRATION

CAIR, BENGALURU

Samvidhan Diwas (Constitution Day of India) was celebrated in Centre for Artificial Intelligence & Robotics (CAIR) on 26 November 2019. Dr G Athithan, DRDO Chair & former DG (MCC) was the Chief Guest of the function. Dr Subrata Rakshit, OS & officiating Director, CAIR administered pledge based on preamble to the constitution and fundamental duties to all the Officers/Staff of CAIR. This was followed by screening of short video on constitution & fundamental duties. Dr G Athithan in his address emphasized on the importance of our constitution, fundamental duties & responsibilities.



NSTL, VISAKHAPATNAM

Naval Science & Technological Laboratory (NSTL) organised an informative lecture on Constitution by Dr Y Satyanarayana, Director, GITAM School of Law, GITAM University, Visakhapatnam. Dr Satyanarayana elucidated the evolution of constitution and its intricacies. He described constitution just not a simple document, but 'a live institution' and how it provides basic rights to the citizen. All the officers and staff of NSTL took pledge, based on Preamble and Fundamental Duties.



OBSERVANCE OF COMMUNAL HARMONY WEEK

Communal Harmony Campaign Week-2019 was observed at ITR, Chandipur during 19-25 November 2019. Banners promoting Communal Harmony were displayed inside and outside of the office premises. Dr BK Das, OS and Director, ITR, administered the pledge on National Integration to all employees of ITR and encouraged all to upkeep honesty, integrity and harmony and made a call to donate voluntarily for fund raising of National Foundation for Communal Harmony.



CELEBRATION OF KARNATAKA RAJYOTSAVA

Defence Avionics Research Establishment (DARE), Bengaluru celebrated Karnataka rajyotsava as 'Rani Chennamma Vedike' on 29 November 2019. Shri Ra Nam Chandrashekara, a renowned Kannada Writer, Poet and Orator was the Chief Guest of the day. Cultural events were organised to mark the occasion. Prizes were distributed to the winners. The programme concluded with felicitation of the Chief Guest by Director, Associate Director and the Rajyotsava committee.



SWACHHTA PAKHWADA

ANURAG, HYDERABAD

A fortnight programme on "Swachhta Pakhwada-Plastic Se Raksha Swachhta Hi Suraksha" was organized in Advanced Numerical Research & Analysis Group (ANURAG) from 1 December 2019 to 15 December 2019. Director, ANURAG emphasized the need to bring cleanliness practices in daily activity. Cleanliness activities like internal cleaning of all Groups/ Divisions/Wings of ANURAG, external cleaning of ANURAG campus, identification of un-used/waste, plastic items and non-inventory items for disposal were organized. All employees enthusiastically took part in the Pakhwada. The prizes for best three clean areas and best three slogans were distributed by the Director.



DARE, BENGALURU

Defence Avionics Research Establishment (DARE) organised Plogging (picking litter while jogging) on 7 December 2019 as per the directives of MoD in association with Department of Drinking Water and Sanitation to create greater awareness in society against plastic waste. Director and DARE officers and staff participated in the event.



INMAS, DELHI

Institute of Nuclear Medicine & Allied Sciences (INMAS) organized a Cleanliness campaign from 1 December to 15 December 2019. Dr Tarun Sekhri, OS & Director INMAS urged the employees not to use plastic and explained its side effects. A cleanliness drive was taken out in the premises

of the Institute and all kinds of waste materials were collected. The personnel of the institute volunteered their contribution to keep the premises and departments clean. A talk on 'No use of Plastic' was delivered by Dr Rashmi Agrawal, Sc 'E'. A drawing competition and Swachhhta Rally were organized to bring awareness about no-plastic use among all employees and school students.



ITR, CHANDIPUR

Swachhata Pakhwada, during 1-15 December 2019, was carried out in Integrated Test Range (ITR), Chandipur where cleanliness drive and awareness programmes were undertaken inside and outside ITR premises. During the fortnight long campaign, ITR Team with a motto of clean and green

India undertook cleanliness drive at various places, e.g., Chandipur Beach Area, Chandipur DRDO Station area, Jhampura Street, RASMI area, ROMI area, Balasore Town and awareness programmes conducted at Chandipur School, Range School. A huge amount of plastic garbage collected and disbursed properly.

NPOL, KOCHI

Naval Physical & Oceanographic Laboratory (NPOL) organized the second part of 'Swachhata Hi Seva' campaign activities in accordance with the nationwide sanitation movement from 2 December 2019. All groups, projects, residential campus and Bhavan's Varuna Vidyalaya (DRDO sponsored School) were sensitized about the importance of Clean, Green and Healthy Campus. Various events were organised to mark the campaign. More than 200 officers and staff participated in Plogging (picking up plastic litter while jogging) event enthusiastically. Shri Vijayan Pillai, OS and Director, NPOL, spoke about the need of the cleanliness and exhorted NPOL fraternity to become a model to the outside community. A Shramdaan-cum-Awareness campaign was also organised outside technical campus to sensitize the public. For this, a walk was conducted, led by Director NPOL, starting from NPOL gate to the nearby places and waste materials were collected. A total of 60 employees participated and about 10 truckloads of wastes were disposed during 10-13 Dec 2019.

NSTL, VISAKHAPATNAM

Naval Science & Technological Laboratory (NSTL) organised "Swatchh Bharat Abhiyan" at NSTL campus with large participation of employees. Dr OR Nandagopan, OS & Director NSTL, and the employees of the O/o DG (NS&M), AO (R&D), MES, Ramanath Secondary School and MKM along with their family member participated with great enthusiasm to make this Abhiyan



Garbage collected at Chandipur Beach by ITR employees during Swachhta Pakhwada



Cleanliness Campaign at NPOL



Swachhta Campaign at NSTL

a grand success. Dr OR Nandagopan thanked all for their hearty support and for their participation and interest for

this noble cause and hoped to inculcate this practice and continue to achieve Clean and Green NSTL.

RAISING DAY CELEBRATIONS

DARE, BENGALURU

Defence Avionics Research Establishment (DARE) celebrated its 33rd Annual Day on 20 December 2019. DS & Director Dr K Maheswara Reddy in his address touched upon various technical, managerial and administration milestones achieved in the year 2019. He emphasized the necessity of initiatives to be taken at individual level, team level & lab level to transform DRDO to meet expectations of the nation.

Director conferred the Laboratory-level DRDO Awards to meritorious personnel for their excellence in the service. He also presented mementoes to the employees who completed 25 years of service. Shri AP Regu Kumar, Sc 'G', Associate Director, distributed awards to the employees for their excellence in sports activities conducted to commemorate the occasion.

DRDE, GWALIOR

Defence Research & Development Establishment (DRDE) celebrated its Raising Day with gaiety and enthusiasm on 28 December 2019. Dr DK Dubey, OS & Director, DRDE, inaugurated the function. In his address, he highlighted the significant achievements of DRDE in the year 2019 and urged scientists and staff to work with complete involvement and dedication in the projects so that all commitments of DRDE to the Services can be fulfilled.

Director presented the Lab-level DRDO Awards to the meritorious scientists and staff for their significant contribution to the laboratory and also felicitated DRDE staff who have completed 25 years of service in the organization.

Dr Rahul Bhattacharya, Sc 'G', Associate Director presented prizes



Inaugural function of DARE Raising Day



Cultural function at DRDE Raising Day

to the winners of various sport events held during the event. On this occasion, Badakhana was arranged for invited guests, retired employees and staff members of DRDE, DSC and MES. A colourful cultural programme was also organized for children of DRDE employees. Mrs Dubey, first lady of DRDE was the Chief Guest on this occasion and distributed prizes to children.

DRL, TEZPUR

Defence Research Laboratory (DRL) celebrated its 58th Raising Day on 21

November 2019. Shri PK Gupta IG, SSB, Frontier HQ, Tezpur graced the function as the Chief Guest.

Dr SK Dwivedi, Director, DRL in his welcome address highlighted the achievements of the laboratory. Laboratory-level Awards and 'SN Dube Publication Award' for the best paper were presented. Director's appreciation awards were also distributed to the employees. A colourful cultural function by invited artists and members of DRL fraternity was organised to mark the occasion. Prizes were distributed to the winners of sports events and

artists. Retired employees also actively participated in the event and shared their views. The programme ended with a community dinner.

NPOL, KOCHI

Naval Physical & Oceanographic Laboratory (NPOL) celebrated its 67th Annual Day on 16 December 2019. Dr G Satheesh Reddy, Secretary, Department of Defence R&D and Chairman DRDO, graced the occasion as the Chief Guest. Shri S Vijayan Pillai, OS & Director, NPOL presented the annual report and highlighted the achievements and progress of NPOL made in the field of sonar systems.

Dr G Satheesh Reddy lauded NPOL for developing key technologies for underwater surveillance systems. He said that the growing scale of the lab's international initiatives was an unquestionable indicator of its technology domain strength in the global arena. He stressed that it is important to set high goals and work beyond the specifications set by the users.

Lab-level DRDO Awards were conferred upon the meritorious employees. Prizes were also distributed to the winners of sports competitions held during Annual Day. A cultural function and community dinner were organized during the event.



BOOK EXHIBITION

Centre for Artificial Intelligence & Robotics (CAIR), Bengaluru organised a Book Exhibition. Five well-known publishers/book vendors participated in the exhibition and showcased both technical and non technical books. The exhibition was inaugurated by Dr Upendra Kumar Singh OS & Director, CAIR. The exhibition received overwhelming response from officers and staff of CAIR.





7TH DRDO YOUNG SCIENTIST MEET

The 7th DRDO Young Scientists Meet (YSM) was held at Integrated Test Range (ITR) Chandipur. YSM is an annual meet of young scientists from all the laboratories of DRDO spread across various parts of the country to provide a platform to the young minds to interact with each other and promote innovative ideas. The meet was inaugurated by Secretary Department of Defence R&D and Chairman DRDO, Dr G Satheesh Reddy along with Director ITR, Dr BK Das and other dignitaries from DRDO. More than 250 young scientists from various DRDO laboratories across the country engaged in a number of events including team building, group discussion, extempore presentation, technical quiz, etc. Invited talks were delivered by eminent persons from academia, industry and research institutes.

This edition of YSM was unique in many ways such as launching a dedicated App for ensuring wider reach among the young scientists, conducting online



interactions through quizzes, opinion polls and discussion forums, etc. As a part of ITR's green initiative, no plastic policy was adopted. Moreover, a novel idea of a 'Young Scientists' Forest' was conceived where in all the participants, guests and senior officials planted more than 300 fruit bearing plants inside ITR technical complex.

Winners of various competitions were awarded during the valedictory function. In his valedictory address Director, ITR urged all the young scientists of DRDO to have faith and belief in their potentials and work on innovative and challenging ideas to meet futuristic requirements in the defence sector.

SPECIAL TRAINING PROGRAMME ON MATLAB

A Special training programme on MATLAB was organized at ITR during 2-6 December 2019. Dr BK Das, OS & Director, ITR inaugurated the programme and urged the participants to refresh their knowledge during the training programme.

The programme aimed to update the knowledge of the participants regarding MATLAB Suit Software. Various topics related to MATLAB Suit Software, e.g., MATLAB fundamental, Machine Learning with MATLAB, Deep learning with MATLAB, Optimization Techniques in MATLAB were covered (both in theory and practice) in the



Programme. Thirty One participants from ITR attended the course. The

programme was organised by Shri PN Panda, Sc 'F', AGD (HR) and his team.

DRDO E-LIBRARY WORKSHOP

A two-day national workshop on “Managing Information and Technologies for Research Analysis (MITRA)” was organised by Defence Scientific Information and Documentation Centre (DESIDOC), Delhi during 4-5 December 2019. The aim of the workshop was to increase awareness and train DRDO librarians to use Koha software for developing DRDO E-Library. Dr Rajeev Vij, Associate Director, DESIDOC, welcomed the participants and elucidated the importance of such need-based courses. He stressed on the need for increasing cooperation amongst all DRDO libraries. Smt Vinod Kumari Sharma, Sc ‘G’, DESIDOC, gave an overview of the workshop.

Dr Alka Suri, Director, DESIDOC, delivered a scintillating talk on “DESIDOC Making New Strides in Information Dissemination: A Paradigm Shift.” Dr RK Sharma, Librarian, United Nations Information Centre for India and Bhutan, was the Guest of Honour at the inaugural function. He shared his 32



years of experiences. The inauguration event was Chaired by Dr Neeta Verma, Director General, National Informatics Centre. She stressed on the need for active participation of sister DRDO libraries for successful completion of this task.

Main thrust areas of discussions included Library & Information Services: Analysis of Content for the Present and Future, Digital Information

Services, DRDO Website: Way Ahead, DRDO Journals, DRDO Newsletter and Technology Focus: Issues and Challenges, etc. A panel discussion on Future of Libraries: DRDO’s Perspective was also held.

Dr Biman Basu, Retired Senior Scientist, NISCAIR delivered an invited talk on: Effective Strategies for Enhancing the Publications Quality and Readership.

TRAINING ON FIRE SAFETY

Defence Avionics Research Establishment (DARE), Bengaluru, organised Fire Safety Training on 6 December 2019. The training was arranged to motivate and to educate DARE personnel regarding the importance and inevitability of understanding and practicing concepts related to fire safety.

A talk by Capt. Bhopanna, a renowned Fire Safety Trainer, followed by practical session on how to use the fire extinguishers during exigency was also organised on the occasion.





COURSE ON PRODUCTIONISATION & TOT OF WEAPON SYSTEM

Defence Research and Development Laboratory (DRDL), Hyderabad organized a three-day CEP course on “Productionisation and Transfer of Technology of Weapon System” during 11-13 December 2019. Shri B Shivadaya Rao, Sc ‘G’, Group Director, Engineering welcomed the dignitaries, invitees and the participants. Dr ND Pandey, Sc ‘G’, Course Director, presented the course details.

Dr MRM Babu, DS & Director, ASL and Programme Director, Agni, inaugurated the course and emphasized on quality plans, production documentation and involvement of production partner from the beginning

of weapon system project for successful Transfer of Technology (ToT). Dr Dasharath Ram, DS & Director, DRDL, addressed the audience on the importance of technology transfer documentation for various weapon systems under productionisation and urged the participants to utilize the course to the fullest. Shri GN Rao, OS & Director, SPIC delivered inaugural lecture on “Productionisation and Transfer of Technology of Weapon System.”

The course elicited overwhelming response and 37 participants from 12 DRDO labs, GAETEC and BrahMos attended the course. The course focused on sensitizing the participants

about need aspect, pre-requisites, process, challenges, quality assurance and follow-up works related to productionisation and ToT of weapon system. Distinguished speakers from DRDO, MSQAA, RCMA and BDL delivered the lectures with case studies covering various topics on bridging gap between development and Production, Challenges of Productionisation and Technology Transfer, Safeguarding DRDO Interests/IPR, Techno-Commercial Issues, Alternate Manufacturing Process Development, etc. Shri Patrick D’Silva, OS & PD, Astra presided over the valedictory function. Shri B Hari Prasad, Sc ‘G’, Technology Director, DPTT delivered vote of thanks.



CEP ON STIMULATING, SUPPORTING & SUSTAINING CREATIVITY & INNOVATION IN R&D ORGANISATION

A three-day CEP course titled “Role of HRD in Stimulating, Supporting and Sustaining Creativity and Innovation in R&D Organisation” was organized by Institute of Nuclear Medicine & Allied

Sciences (INMAS), Delhi during 11-13 December 2019. The course was aimed at imparting knowledge on innovation as performance driver in R&D organization, enhancing institutional innovative strategies

through HRD interventions (HR Tools/Methodologies) and promoting and nurturing creativity for sustained innovations. A total of 14 lectures were organized as per objectives of CEP along with practical sessions during

the course. Twenty-seven scientists and technical staff from the HR wings of 17 DRDO labs participated in the course.

The course was inaugurated by Dr AK Singh, DS and DG (LS), DRDO. In his inaugural address, DG (LS) emphasized the importance of such courses for making HR a strategic function in DRDO. He shared with the

gathering 10 points on the basis of which HR management could bring about a change in creativity and innovation in R&D organisations. He also discussed about factors that limit the innovative ideas of researchers and suggested the possible ways to overcome them.

Lectures were delivered from Guest Faculty from various reputed institutes

like MDI, Gurgaon, FITT, IIT Delhi, Innovation Cell, MHRD, TIFAC, CII, Gurgaon, DHRD DRDO HQ, Delhi, etc. in an interactive way.

Dr Rashi Mathur, Sc 'E', Head HRD was the Course Director and Shri Navin Kumar Soni, Sc D, Oic HRD & TIRC was the Deputy Course Director.



COURSE ON ADVANCE SUPPLY CHAIN MANAGEMENT & FOOD TECHNOLOGY

Advance Supply Chain Management & Food Technology (ASMAFT-11) course was conducted during 11-14 December 2019 at Defence Food Research Laboratory (DFRL), Mysuru. Twenty senior Army ASC officers along with Chief Instructor from ASC Centre & College, Bengaluru attended the course. Dr AD Semwal, Director, DFRL inaugurated the course.

Principles of food processing and preservation, quality control, food standards and food supply chain management, ration technology and management, food packaging in supply chain management, storage of cereals, modern warehousing, food safety, post harvest quality of fruits and vegetables, technology of oil blending, packaging requirements and quality assurance for dairy products, functional foods were



discussed during the course. The course also included state-of-the-art and novel technologies to render comprehensive knowledge to the senior Army officers in food processing, frozen and chilled meat/chicken, quality control and management.

A visit to Central Food Technological Research Institute (CFTRI) and ITC Foods, Nanjangud was also arranged as part of the course to understand the different technological aspects of Food processing. Dr R Kumar, Sc 'F,' was the Course Director.

NATIONAL S&T SEMINAR-2019

Snow and Avalanche Study Establishment (SASE), Chandigarh, in association with other Chandigarh-based laboratories of DRDO, viz., Terminal Ballistics Research Laboratory (TBRL), Defence Institute of High Altitude Research (DIHAR) and Regional Centre for Military Airworthiness (RCMA) organized the National Scientific and Technical Seminar-2019 during 12-13 December 2019 to promote the use of official language in R&D activities. The two-day annual event was third edition since its inception in 2017 and was a proud occasion to celebrate S&T achievements in Rajbhasha

Hindi. The event was inaugurated by Shri Anurag Agrawal, IAS, Chief Electoral Officer, Haryana. The Chief Guest in his inaugural address emphasized on the importance of the use of Hindi in administrative and technical work.

Director SASE, Shri Naresh Kumar welcomed all the delegates and informed about wide range of S&T topics related with defence technologies, cryosphere, natural calamities, energy and food security, general science, medicine, etc., to be discussed during the seminar. Participants from various DRDO labs and other research institutes across Bengaluru, Dehradun, Hyderabad,

Jodhpur, New Delhi and Pune presented their research work in Hindi during eight technical sessions. Participants from Archaeological Survey of India, Bharat Electronics Limited, Central Scientific Instruments Organization, National Small Industries, Post Graduate Institute of Medical Education & Research and Post Office Department also attended the event. Total 87 articles and research papers were presented.

The event was attended by Guest of Honours Dr Manjeet Singh, Director TBRL, Dr OP Chaurasia, Director DIHAR and Shri Vivek Kumar, Chief Engineer, RCMA.



TRAINING PROGRAMME ON MOUNTAIN WARFARE

Institute for Systems Studies & Analyses (ISSA), Delhi in collaboration with Centre for Land Warfare Studies (CLAWS), New

Delhi organized a three-day training programme on Mountain Warfare during 18-20 December 2019 at CLAWS, New Delhi.

Twenty participants from ISSA attended the training programme.

INTERNATIONAL HIGH ENERGY MATERIALS CONFERENCE AND EXHIBITS – 2019

The 12th International High Energy Materials Conference and Exhibits HEMCE-2019 was inaugurated by His Excellency Shri Banwarilal Purohit, Hon'ble Governor of Tamilnadu on 16 December 2019 at Student Amenity Centre, IIT (M), Chennai. Shri MSR Prasad, Director General Missiles & Strategic Systems (MSS), Prof. Bhaskar Ramamurthy, Director IIT (M) and Shri A Rajarajan, Director SDSC, Shri KPS Murthy, OS, Director HEMRL & President HEMSI graced the occasion. Chairman Organising committee, Shri Ranganathan, Deputy Director, SDSC and Convener Prof. PA Ramakrishna IIT (M) were also present during the occasion. The conference was organised by SHAR Chennai Chapter with central theme of conference “Exploring the Innate Inclusive Potentials of High Energy Materials.”

Delivering the inaugural address, Shri Purohit highlighted the importance of the HEMCE meet to foster research and innovations in the area of high energy materials development for space and defence applications. Addressing the Conference, Guest of Honour Shri MSR Prasad, highlighted the achievements of DRDO in the area of high energy materials and stated that ongoing developmental work on smoke-less propellants, high energy propellants and fuel rich propellants for ramjet technology, is going to be a game-changer for air launch systems.

Prof. Ramamurthy and Shri A Rajarajan, Director SDSC and Shri Murthy, President HEMSI also addressed the gathering on this occasion. Shri Murthy announced that this year a special award, Solar Shakti award has been instituted by M/s Solar industries Nagpur for individual

or group of scientists who have contributed significantly in creating or improving the National Defence System to commemorate the “Mission Shakti”. During function, abstract proceedings, souvenir and proceedings of full papers were released. Various HEM awards were also distributed at the hands of Shri Purohit.

The conference was attended by more than 550 delegates from DRDO, ISRO, OFB, CSIR, DAE, MOP, Academic Institutions and Industries. More than 20 scientists from US, UK, Germany, Russia, Israel and Malaysia participated in the conference. During HEMCE-2019, a HEMSI Students Symposium (HS2) was also organised in which the students were provided with a platform to present their creative thoughts and proposals on themes related to space/defence systems.





R&D SUBGROUP MEETING OF IRIGC M&MTC

The mid-term meeting of the R&D Sub-Group of the India-Russia Inter-Governmental Commission on Military and Military Technical Cooperation (IRIGC M&MTC) was held at Naval Physical and Oceanographic Laboratory (NPOL), Kochi, during 16 to 18 December 2019. The meeting was attended by around 120 delegates from Russia and India.

The meeting was Co-Chaired by Dr Sudhir Kumar Mishra, DS & DG BrahMos from the Indian side and General-Lieutenant Igor Makushev,

Chairman of MTC of Armed Forces of Russian Federation from the Russian side. Dr Samir V Kamat, DS & DG NS&M also attended the meeting. Shri Vijayan Pillai, OS & Director, NPOL welcomed the delegates. After the opening remarks by both the Co-Chairs, Shri Atul D Rane, OS & Director, DIC, DRDO HQ, briefed the agenda for the meeting. Mr Vladimir Zhurov, Secretary, R&D Sub-Group and Head of R&D Directorate, Defense Technologies & Space Department, JSC Rosoboronexport gave a brief on the cooperation in progress. Mr Alexander

Mikasev, the First Secretary and Maj. Anatoly Trunov, the Military Attaché from the Russian Embassy at New Delhi also attended the event.

Dr G Satheesh Reddy, Secretary DDR&D & Chairman DRDO addressed the delegates and stressed upon the need to collaborate and work together.

Deliberations on the ongoing projects were held between the sides. Several new proposals were also discussed for possible consideration. Russian delegation visited various technical facilities at NPOL.



WORKSHOP ON INFORMATION SECURITY AWARENESS

Laser Science & Technology Centre (LASTEC), Delhi organized a two-day workshop on “Information Security Awareness” during 17-18 December 2019. The workshop focused on reviewing the information security trends and applications in the field of cyber security.

During the workshop lectures were

arranged from expert faculties in the field of information security from DRDO like: Directorate of IT&CS DRDO HQrs, ANURAG, Directorate Systems and Technology Analysis, ARDE, MHSU (I), SAG, R&DE (Engineers) and CAIR, etc. All important information security tools/topics were covered for strengthening lab security, viz. Overview

of Information Security, DRONA Services, Mails, ISG Firewalls and Social Media Policies, ANURAG Hardened Linux (AHL)/ANURAG Hardened Windows (AHW), DRDO Standards for Software Development (DSSD), Integrated Material Management Software V2.0 (IMMS), contemporary security aspects as relevant to labs

inside Metcalfe House complex, USB Security Tools, Information Technology Hardware's Security, CIAG, Controlled One Way Gateway, data transfer from CIAG Internet to DRONA, Internet e-mails, Firewalls, Mayurpankh E-Office Automation Software, IT Audit Policies, Secure Desktop Processing System (SDPS)/Secure Internet Access System (SIAS) and Secure Software Development Framework, etc.

The workshop enhanced information security awareness in the laboratory. Topics covered in the workshop will be helpful in implementing of information security guidelines and polices in DRDO labs.



WORKSHOP AND TRAINING ON RECORDS MANAGEMENT

Records are integral part of any organization. They are the wheels of efficient administration. Proper record management ensures that no unwanted record is retained for too long and no important document gets destroyed prematurely. In order to create awareness and sensitize the officers and staff of DRDO, Directorate of Rajbhasha and O&M (DROM) organized a two-day training programme for the Records Officers who have not attended any workshop and training either from NAI or DRDO HQ on 19 and 20 December 2019.

The programme was inaugurated by Shri KS Varaprasad, DS & DG (HR), and Shri RB Singh, Ex-Chairman, CEPTAM, was the Chief Guest of event. Dr Ravindra Singh, Director, DROM, delivered the theme address of the training programme. In his address Shri RB Singh mentioned about the importance of organization and methods



in general and records management in particular. He praised DRDO for taking up record management seriously. Expert faculty from NAI delivered the lectures. Dr Alka Suri, Director, DESIDOC and Shri RB Singh also delivered talk on

Digitalization and O&M, respectively.

Fifty participants from various DRDO labs/estt/units attended the training. The programme concluded with vote of thanks by Smt Asha Tripathi, Sc 'G' and the Course Coordinator.



TRAINING OF ARMY PERSONNEL IN SIACHEN AND LEH SECTOR

As per the requirement of Armed Forces in Ladakh region, a winter period Capacity Building Training Programme was organized by Defence Institute of High Altitude Research (DIHAR) on 7 December 2019 at DIHAR HQ Leh for the troops of Leh Garrison. The programme was earlier organised on 21 and 22 November 2019 at DIHAR Dett Partapur for Sicaheh Sector. These training programmes covered various aspects of protective vegetable cultivation, animal

husbandry, micro-farming techniques, poultry rearing practices, and fruit and tree plantation practices. In total 86 were given training, which included ground demonstration of the agro-animal technologies. The participants were also handed over various types of saplings and seeds for plant propagation at their Unit locations.



TRAINING ON MUSHROOM CULTIVATION UNDER DRDO PROGRAMME ARUNODAYA

A one-day training on mushroom cultivation under DRDO Programme Arunodaya was conducted by Defence Research Laboratory (DRL), Tezpur, at Hari Gaon, Tezpur, on 29 November 2019. A total of 25 local farmers attended the training programme. They were informed about the nutritional benefits of mushrooms and their importance as alternative source of income, especially for rural woman self-help groups. The participants prepared 52 mushroom bags under the supervision of DRL team as a part of practical demonstration and hands on training. Farmers were satisfied with comprehensive knowledge imparted by the team DRL regarding different facets of oyster mushroom cultivation.

Technology booklet and mushroom technology calendar were distributed among the participants for their reference.



COURSE ON STATE-OF-THE-ART & EMERGING TECHNOLOGIES IN SOLID ROCKET IGNITERS

A CEP course on “State-of-the-Art & Emerging Technologies in Solid Rocket Igniters” was conducted during 25-29 November 2019 at High Energy Materials Research Laboratory (HEMRL), Pune. The course was inaugurated by Dr CB Kartha, eminent scientist and expert in the field, who delivered a talk on ‘Solid Rocket Igniters: State-of-the-Art & Emerging Technologies’.

The course focused on delivering a comprehensive knowledge about the pyrotechnic ignition systems for solid rocket propellant motors besides giving a brief knowledge about Pyrogen ignition systems and initiation systems. It covered various design aspects from concept to product realization, advances in state-of-the-art technology, special applications, latest developed and demonstrated theoretical approaches, Computational Fluid Dynamics: simulations and analysis. A total of 26 scientists, executives and



works managers from different DRDO, Brahmos Aerospace Private Limited and Ordnance Factories participated. The participants were also given hands-on training and were taken to a visit to the Hi-tech Processing Facility for Igniting Compositions. The course

provided deep insight into major design considerations, realization, testing and applications of Solid Rocket Igniters.

Shri Sanjay Gupta, General Manager, OF, Dehu Road, Pune was the Chief Guest for the valedictory programme.

WORKSHOP ON WILD EDIBLES OF NORTH-EAST INDIA

DRL organised a workshop on “Wild Edibles of North-East India: Prospects & Challenges” on 26 November 2019. The workshop focussed on edible wild plants of the North-East, their identification, nutritional potential, traditional knowledge, scope and challenges for future needs.

Dr SK Dwivedi, Director, DRL, in his welcome address highlighted the importance of conservation of wild edibles for futuristic applications. Eminent speakers from academia and research institutes discussed and shared their vast knowledge and experiences on the huge potential of wild edible



plants. Seven lectures, delivered in three technical sessions, covered wide array of topics like role of wild edibles in food and nutritional security in NE India, challenges and opportunities in health

care and economic growth, methods & approaches in Ethnobotany, etc., and probability of herbal industry in Assam. Fifty-one participants attended the workshop.



TRAINING PROGRAMME ON AIR OPERATIONAL & TACTICAL DOMAIN FOR SYSTEM ANALYSIS, MODELLING & SIMULATION

Institute for Systems Studies & Analyses (ISSA), Delhi in collaboration with Centre for Air Power Studies (CAPS), New Delhi organized a three-day training programme during 18-20 November 2019 on Air Operational and Tactical Domain for System Analysis, Modelling & Simulation at CAPS, New Delhi. Twenty participants from ISSA and DRDO sister labs attended the training programme.



SYMPOSIUM ON MILITARY ERGONOMICS

A Symposium on “Military Ergonomics” was organized by from Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, on 10 November 2019. This event was part of 17th International Conference of Indian Society of Ergonomics (ISE) on “Humanizing Work and Work Environment (HWWE

2019)” organized by Dr BR Ambedkar National Institute of Technology, Jalandhar, Punjab during 8-10 November 2019.

Talks were delivered on visual performance with varying illumination and viewing distances in Indian soldiers while using night sighting devices; ergonomics in military 3d

anthropometric scan of Indian males, lower extremity for design of potential assistive devices; mental and physical workload of two military running events; and how carbogen, a mixture of oxygen and CO₂, could be used for protection against noise induced hearing loss.

Dr Madhusudan Pal, Sc ‘F’, DIPAS, was the convener of the symposium.



INTERNATIONAL SYMPOSIUM ON BALLISTICS

Scientists from Terminal Ballistics Research Laboratory (TBRL), Chandigarh presented 15 technical papers in the 31st International Symposium on Ballistics (ISB) held in Hyderabad from 4 to 8 November 2019, organized by International Ballistics Society and Aeronautical Society of India for the first time in India. The Symposium was Co-chaired and inaugurated by Dr VK Saraswat,

Member, NITI Ayog, Government of India and Dr G Satheesh Reddy, Secretary, Department of Defence R&D, Chairman DRDO and Chairman AeSI. The Symposium was convened by Dr Y Sreenivas Rao.

The symposium had presentations in six key areas of ballistics consisting of internal ballistics, external ballistics, terminal ballistics, launch dynamics, explosion mechanics, vulnerability

and survivability. It was attended by 274 participants with 114 from India and 163 participants from 30 different countries. Bir Bahadur Sherpa, SRF of TBRL received student award for his technical paper. TBRL also became Silver Life Member of International Ballistics Society and received Life Membership Certificate.

INFRA DEVELOPMENT

INAUGURATION OF NON-CONTACT MEASUREMENT CENTRE

Dr Tessy Thomas, DS & DG, Aeronautical Systems, inaugurated the Non-Contact Measurement Centre (NCMC) in presence of Director GTRE and senior scientists of GTRE on 21 November 2019 at QA-Vanes & Blade section of GTRE.

Non-contact measurement is a non-destructive technology that digitally captures the shape of physical objects using a line of structured blue light creating "point clouds" of data from the surface of an object.

NCMC in GTRE is equipped with Comet L3D blue light scanner with Polyworks software. The scanner system works on principle of Triangulation, Gray code and Phase-shift by projecting the line shadows from a 2D lens to a 3D surface and uses advanced algorithms to generate point clouds. The system has a 5 Megapixel camera with a field of view up to 250 mm synchronized with



a rotary table of 400 mm diameter. The key features of the system are 3D Digital data acquisition, dimensional extraction of air-foils and geometrical dimensions and tolerances parameters of aero engine components with programming capability for repetitive

measurements and its portability.

The addition of the NCMC to the inspection arena enabled inspection of dimensional, profile and GD&T parameters of vanes and blades simultaneously with one skilled manpower.



AWARDS

Mechanical Engineering Design Award-2019

Dr N Kishore Nath, Sc 'G' and Project Director, Advanced Systems Laboratory (ASL), Hyderabad, has been conferred National Design Award in Mechanical Engineering-2019 for his outstanding contribution in the field of Engineering Design by NDRF of The Institution of Engineers (India). Award was presented by Dr Tamilisai Soundararajan, Hon'ble Governor of Telangana at the Prize Distribution Ceremony of 34th Indian Engineering Congress held on 27 December 2019 at Hyderabad.



HIGHER QUALIFICATION ACQUIRED



Ms Pramila Patil obtained her PhD in Chemistry from Bharathiar University, Coimbatore, for the thesis entitled "Studies on Nano Gold Doped Ceria-Lanthana Solid Solution for Catalytic Applications."



Shri Dhruv Kumar Nishad, Sc 'D', INMAS, Delhi has been awarded PhD in Life Sciences by Bharathiar University Coimbatore for the thesis entitled "Development of a Few Novel Biomedical Approaches for Radionuclide Decorporation."



Shri V Bharatwaja Srinivasan Ayyangar, Sc 'F' has been conferred PhD by IIT-Madras for the thesis entitled "Hydrodynamic Characterization and Stability and Manoeuvring Analysis of a Flatfish Autonomous Underwater Vehicle."



Shri Himalaya Nirjhar Das, Sc 'G' has been conferred PhD by IIT-Delhi for the thesis entitled "Improvement of Hydrodynamic Efficiency of Full-Scale Composite Marine Propellers in Off-Design Conditions Using Smart Material Actuation."



Shri Tejasvi K, Sc 'E', Advanced Systems Laboratory, Hyderabad, has been awarded PhD by NIT, Warangal for the thesis entitled "Agglomeration Processes in Metallized Solid Rocket Propellants."



Mrs SH Sonawane, Sc 'E', has been awarded PhD (Applied Chemistry) by DIAT, Pune, for the thesis entitled "Studies on Isocyanate-Free Curators for Solid Rocket Propellant: Synthesis, Characterization and Curing Studies."

SPORTS ROUND-UP

DESIDOC GOLDEN JUBILEE VOLLEYBALL TOURNAMENT

As a part of its Golden Jubilee Year, DESIDOC organized the Maitri Cup Volleyball Tournament at Metcalfe House from 18 November 2019 to 21 November 2019. Dr JP Singh, Director, DMS & President, DRDO Sports Board inaugurated the tournament in the presence of Dr Alka Suri, Director DESIDOC and Dr Seema Vinayak, Director, SSPL. Eight teams from Delhi-based DRDO labs participated in the tournament. Director ISSA Shri SB Taneja was the Chief Guest of the finale. In a nail-biting final Team DIPR won the tournament. SSPL was the Runner Up.



DRDO NEWSLETTER



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DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 47th in the Series of extracts of the monograph, "Defence Research & Development Organisation: 1958-1982", by Shri RP Shenoy, former Director of Electronics and Radar Development Establishment (LRDE).

LIFE SCIENCES & HEALTHCARE

Hyperthyroidism which is the result of excess activity of the thyroid gland was also the subject of clinical investigation by the Institute. The scientists of INMAS pioneered the methodology of employing smaller fractionated doses of radio iodine, a few times at suitable time intervals instead of the more common method of large doses of the radioisotope to deliberately destroy the functioning of the thyroid gland partially and restore it to its normal status. In this manner, they brought down the incidence of late on set of hyperthyroidism to about 3 per cent.

Radiation Biology and Health Physics –The study of radiation burns had attracted the attention of INMAS scientists right from the 1960s. It is one of the four centres in the country working actively on radioprotectors. The goal of these investigations was to discover substances which offer efficient radioprotection with least toxicity. Early investigations led to the use of an ointment, from an indigenous plant aloe vera for accelerated healing of radiation burns. Subsequently, several chemicals were screened and two non-toxic long acting effective radioprotectors have been developed to prevent radiation-induced injuries. At the same time, studies were also conducted on the basic mechanism of regulation of DNA repair processes in radiation-induced and chemically-induced lesions. Based on theoretical considerations and a variety of animal model systems, the scientists have discovered that 2-deoxy-D-glucose (2DG) acted both as a radioprotector

of normal healthy tissue and as a radio sensitizer (radiation damage enhancer) for tumour cells under exposure to radiation. Confirmatory trials combining 2DG and radiation were being planned at Delhi and Bangalore in the first quarter of the 1980s.

In the area of health physics, the concern about exposure to radiation led to the setting up of a compact and competent group of scientists who carried out research on internal dosimetry and critical review of the recommendations of the International Commission on Radiological Protection (ICRP). Significant contributions were made in the area of whole body counting for radiation protection and clinical application to establish physiological norms for total body potassium and iron plus vitamin B-12 absorption in the Indian population. Over a period of time, several types of whole body counting systems and calibration techniques were designed and a new whole body counting geometry (Buddha Posture) was evolved to suit Indian conditions.

Since the Reference Man used by ICRP for establishing radiation exposure safety limits was based on the Caucasian living in temperate conditions in North America or Europe, straightforward application of these limits to Indians would not be accurate and correct. Therefore, work on providing input to the development of Reference Indian with well defined anatomical and physiological characteristics applicable to our population was initiated and preliminary recommendations were made for the parameters of the Reference Indian.

Radiopharmaceuticals –Radio pharmaceuticals are the substances used to give radiation doses to patients and are therefore essential for the practice of nuclear medicine. The radionuclide of choice was the short half-life (6hr) ^{99m}Tc which gave minimum dose to the patient and could be conveniently tagged on to a variety of pharmaceuticals. The emphasis of INMAS scientists was on indigenous modifications to several widely used ^{99m}Tc -labelled pharmaceuticals, development of newer radio-pharmaceuticals and evolving simplified quality control procedures. Several new ^{99m}Tc tagged pharmaceuticals such as Cu-mannitol for renal dynamic function, Cu-GHA for spleen, DMSA for soft tissue tumours and metastases, etc., were developed. In addition, many ^{99m}Tc -labelled Mix and Use kits were designed to instantly produce radiopharmaceuticals of high quality.

Defence Institute of Physiology & Allied Sciences

DIPAS is primarily engaged in research for increasing the operational efficiency (physical as well as mental) of Armed Forces personnel in relation to the diverse micro-and macro-environments. DIPAS owes its origin to the small physiology group of scientists at the Defence Science Laboratory, who initiated studies in 1952 on the physiological factors that would lead to increase in fighting efficiency, safety and comfort of the Armed Forces personnel under varying operational conditions. For the Army, problems associated with hot environmental conditions under which the jawan had



to live and work, for the Navy it was the habitability conditions in the ships, which had been designed to operate in cold and temperate climates and for the Air Force, it was the effects of the hot environment on the air crew, that were to be attended to and resolved by the scientists. To cope with the workload, the small group had expanded into two large divisions in 1960 and the Parliamentary Committee which was visiting the Physiology Division in 1960-61, recommended the establishment of a separate institute to look into the problems of physiology related to Defence Services. Consequently, the Defence Institute of Physiology and Allied Sciences came into being in September 1962 at Chennai. Meanwhile, the aftermath of the Chinese incursions at our borders shifted the focus of physiological studies to high altitude and cold environment. In view of the difficulties experienced for efficient functioning from the south of the country, the Institute was shifted back to Delhi on the recommendations of a committee appointed by the Ministry of Defence. In 1970, the Government of India decided that DRDO should take over the Physiology Research Wing of the Himalayan Mountaineering Institute, which was re-designated as Physiology Research Cell, DRDO at Darjeeling.

Early Investigations and Findings— One of the earliest assignments was the study of energy expenditure by a soldier carrying a load in different terrains and environments. Studies and experiments by DIPAS scientists showed that a load upto 50 per cent of the weight of the soldier as against the conventionally accepted norm of 30 per cent, could be carried without any disproportionate increase in energy expenditure. Marching speeds for soldier with different loads and for different terrain conditions were worked out and the influence of load distribution along the body length was also determined. Efficiency of a soldier was found to improve with lighter foot wear. Similarly, hand carriage of such

loads as school bags was shown to require thrice the energy than if it was carried on the back in a rucksack.

The aversion of Indian troops to drink water laced with salt during summer months was taken up for investigation to check whether it posed health hazards. DIPAS scientists found that Indians unlike the Europeans, were more accustomed to heat and since salt in their sweat was not high, the heat casualties among Indian troops were more due to water depletion or heat hyperpyrexia. This was easily remedied by replacing water losses in sweat on an hourly basis. Thus, the issue of extra salt to troops in summer months was dropped.

The cause of death of some divers during ascent from shallow dives was referred to DIPAS by the Navy. DIPAS scientists were able to point out the limitations of the accepted theory that it was due to release of excess nitrogen in to the blood vessels during decompression caused by the ascent, and postulated that the cause was actually rupture of lung alveoli and capillaries during ascent, due to expansion according to Boyle's law. These research findings were published in the Proceedings of the Royal Society and are referred to in textbooks on submarine medicine.

High Altitude and Cold Environment Studies – The physiological problems of high altitude include acute mountain sickness (AMS), high altitude pulmonary oedema (HAPO), high altitude cerebral oedema (HCO), high altitude hypertension (HAPH), high altitude retinopathy (HAR), snow blindness, chilblains and frostbite. Investigations were conducted among three types of personnel namely, fresh inductees, acclimatized lowlanders and high altitude natives. Their findings are outlined in the succeeding paragraphs.

Acute mountain sickness, which occurred among nearly 50 per cent of the mountain trekkers, produced only minor symptoms for 2-3 days, and required no treatment in vast majority of cases. In a small minority of cases, where it could turn into as eve

reform, rapid ascent was found to be the cause and exercise on arrival at high altitude (HA) might be a predisposing factor. A common complaint of troops arriving at HA was disturbances in the sleep pattern, particularly above 3500 m. Investigation by DIPAS revealed that reduction in slow-wave sleep and frequent arousals were adaptive response so that prevented accentuated levels of hypoxaemia due to sleep hyper ventilation.

The more serious disease was the HAPO which occurred in more than 2000 cases among our troops during the Chinese incursion in 1962. The incidence was found to be about 0.6 per cent amongst troops with in 45 minutes of their being inducted by air from the plains to altitudes of 3500 m and above. The symptoms were cough, chest pain and breathlessness which occurred within 3-4 days of arrival. If it was not taken care of, the patient would become dangerously ill very quickly and some even died by literally drowning in their own secretions. Those troops who after HA exposure came down to the plains for 3-4 weeks and again returned to HA were more prone to HAPO than the fresh inductees. DIPAS drew an acclimatization schedule to be strictly followed by the Army personnel going on tenure at altitudes of 4500 m and above. Since there was a noticeable drop in efficiency at 3500 m altitude and a significant loss at 5000 m altitude and above, optimal work capacity, load carriage, marching speeds and maximum period of tenure were also prescribed for different altitudes. As a result of the investigation on the thermogenic needs at HA, DIPAS recommended a uniform scale of 4800 calories for all high altitudes. The investigations of the Institute also indicated that systematic physical training for 8 weeks at moderate altitudes as well as yoga exercises resulted in improvement in maximum oxygen uptake and lesser margin of increase in cardiac and respiratory frequency on induction to high altitudes.

To be continued...

VISITORS TO DRDO LABS/ESTTS

CAIR, BENGALURU

Dr S Guruprasad, DS & DG (PC & SI) and Air Marshal SBP Sinha (Retd) visited Centre for Artificial Intelligence & Robotics (CAIR) on 5 November 2019. Dr UK Singh, OS & Director CAIR, briefed him about the activities of the Centre, which was followed by discussion on CAIR developed technologies in the area of secure systems, command & control systems and intelligent systems and robotics.



* Lt Gen Raj Shuka, YSM, SM, DG PP visited CAIR on 30 November 2019. There was a briefing by Dr Subrata Rakshit, OS & Officiating Director CAIR, followed by discussion and demonstration of technologies developed by CAIR in the area of secure systems and GIS technologies.



DIHAR, LEH

Shri RK Mathur, Hon'ble Lt Governor Ladakh UT, visited Defence Institute of High Altitude Research (DIHAR) on 9 December 2019. The VIP was briefed in details by Dr OP Chaurasia, Director, DIHAR, about the various R&D activities being undertaken by DIHAR for the benefit of defence personnel and civil population of Ladakh.



DIPAS, DELHI

Lt Gen Anup Banerji, SM, PHS, Sr Col Commandant & DGAFMS visited Defence Institute of Physiology & Allied Sciences (DIPAS) on 23 December 2019 along with Surg Vice Admiral Joy Chatterjee, VSM, DGHS (AF). Director DIPAS gave a brief presentation about the overall activities of DIPAS and the XIII Five Year Plan projects to be taken up.



HEMRL, PUNE

Air Vice Marshal Sanjay Bhatnagar, VM, VSM, ACAS, OPS (OFF), New Delhi along with Wg. Cdr. AS Viridi, Wg. Cdr. Wpns. (T-2) visited High Energy Materials Research Laboratory (HEMRL) on 3 December 2019. During the visit, Dr Manoj Gupta, OS & Offg. Director HEMRL briefed him on the activities of HEMRL. Presentation on the projects related to high explosives and igniters was given by the senior scientist.



* Rear Admiral Sanjay Misra, VSM, DG, NAI, New Delhi, visited HEMRL on 6 January 2020. Dr (Mrs) SD Kakade, Sc 'G' & Offg. Director, HEMRL, briefed him about the activities of the lab. Presentation on the projects related to Life Extension of Missiles, Igniters and Air Force Projects was given to the visitor.



NSTL, VISHAKAPATNAM

Former Chairman ISRO AS Kiran Kumar, visited Naval Science and Technological Laboratory (NSTL) on 5 November 2019. In his scintillating address to NSTL employees, he briefed about his journey in ISRO, from the launch of Sounding Rockets at Thumba and Mangalyaan to Gaganyaan Programme.



Former Chairman ISRO AS Kiran Kumar being felicitated at NSTL

RCI, HYDERABAD

Vice Admiral G Ashok Kumar, AVSM, VSC, Vice Chief of Naval Staff, visited Research Centre Imarat (RCI) on 8 January 2020. He visited various missile facilities at RCI.



Vice Admiral G Ashok Kumar at RCI

VRDE, AHMEDNAGAR

Air Marshal NJS Dhillon, AVSM, C-in-C SFC, & Maj Gen Jha, MGGS (LV) visited Vehicle Research and Development Establishment (VRDE), on 8 November 2019. Shri Sangam Sinha, OS & Director VRDE, briefed the visitors about the activities of VRDE. They were also briefed about proposed future projects.

A technical presentation on SF&D projects was presented by Shri Sanjay Choudhuri, Sc 'G'. Vehicles/systems developed by VRDE displayed, specifically of SF&D programme, Wheeled Armament Platform, Autonomous Un-manned Ground Vehicle.



Air Marshal NJS Dhillon at VRDE 