



Life Sciences Research in Service of Soldier



Brahma Singh

Defence Research & Development Organisation
Ministry of Defence, New Delhi - 110 011

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Service of Soldier**

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Prof Brahma Singh

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DEDICATION

Dr APJ Abdul Kalam



*The monograph is dedicated to
Dr APJ Abdul Kalam, Bharat Ratna
Former President of India,
Secretary Defence Research, Scientific Advisor to Raksha Mantri,
Director General, Defence Research and Development Organisation,
and
Principal Scientific Advisor to Govt of India*

GYAN & VIGYAN, PURUSH

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सत्यमेव जयते

FOREWORD

भारत सरकार
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नई दिल्ली-110 001

Government of India
NATIONAL INSTITUTION FOR TRANSFORMING INDIA
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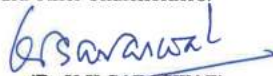
The R&D activities of the laboratories are focussed on recruitment, selection and development of appropriate human capital, development of intricate life support systems and technologies to protect against extreme and toxic/lethal environments, and promotion of health and well-being of combat personnel. The fields of research include protective equipment and clothing, physiological-psychological aspects, protection against chemical, biological and radiological and nuclear (CBRN) warfare, high altitude agro-animal technologies to meet fresh food requirement of troops by exploiting bioenergy as alternate fuel, and meeting instant food requirements for high altitude battlefield operations.

Equipping the armed forces with cutting-edge weapon systems is important for war preparedness, but equally important is the human component which has to be optimized in terms of psychological, physiological and nutritional aspects as well as protected with life support systems from all conceivable operational hazards. To achieve this objective, the cluster of life sciences laboratories in DRDO are focussing research and development projects on military nutrition, soldier health, safe combat clothing and devices to keep the morale of troops high and in a fighting fit state.

Setting selection criteria for officers and personnel for a variety of jobs in the Armed Forces, promulgating optimized ration scales with fresh and processed foods tailored to the multiple Indian dietary habits and operational needs, developing acclimatization schedules for harsh terrain, developing specialized protective clothing, biomedical devices, protective gear, life support systems in hostile and challenging environments, countering strategies to overcome chemical, biological, radiological and nuclear (CBRN) threats, in addition to their detection, protection, decontamination and medical management of eventualities, developing psycho-socio-behavioural methodologies to cope with stresses, and testing alternative systems/strategies to enhance the performance of the soldier are some of the contributions of these laboratories that have been covered in this monograph.

Chapters on the impact of research and development of this cluster not only on the defense but the civil sector are interesting, as are chapters on the potential of technologies/products/processes developed for commercial exploitation and revenue generation. Chapters on future prospect of research and development in this cluster are thought provoking and can stimulate scientists to undertake appropriate projects.

I congratulate Prof. Brahma Singh for compiling and clustering the research and development of life sciences cluster of DRDO Laboratories. Hope the monograph will aid present and future scientists of DRDO and other stakeholders.


(Dr V K SARASWAT)

New Delhi
05.08.2020



Preface

Life Sciences Research in Service of Soldier- a monograph is a compilation of research and innovations leading to development of technologies and products unique in scientific par lane being biased towards the genuine needs and requirements of man/woman in uniform under different terrain, climates and conditions of his/her operation both in peace or war and conflicts in the country. A man/woman in uniform have same food, health, living conditions requirements as that are prevalent in civil sector. But uncongenial, difficult, dangerously risky and other unexpected conditions related to war scenario, threat perceptions, inclement weather, barren terrain, poor connectivity/cutoff/isolation, etc., necessitate specialised research and development wing to cater for the working efficiency improvement and comfort of man and woman in uniform through life science research and development. Besides, arms/weapons and ammunitions other essential requirements – food, clothing and shelter (Roti, Kapada aur Makan) health, physiology, protection against modern unconventional wars- biological, nuclear, chemical and psychological in Armed Forces necessitate area and situations specific ready stores with unconventional requirements.

To meet research and development needs on above DRDO (Defence Research and Development Organisation) has life science cluster of laboratories consisting of Defence Bio-Engineering & Electro Medical Laboratory (DEBEL), Bangalore, Defence Institute of Bio-Energy Research (DIBER), Haldwani (Uttarakhand), Defence Food Research Laboratory (DFRL), Mysore (Karnataka), Defence Institute of High-Altitude Research (DIHAR), Leh (Ladakh, UT), Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi, Defence Institute of Psychological Research (DIPR), Delhi, Defence Research Laboratory (DRL), Tezpur (Assam), Institute of Nuclear Medicine & Allied Sciences (INMAS), Delhi, Defence

Research & Development Establishment (DRDE), Gwalior (MP), Defence Institute of Psychological Research (DIPR), New Delhi. In addition life science research board and society on biomedical sciences are there in the cluster.

This monograph is compilation of significant research and development by the above laboratories since the inception of DRDO. In the process a large number of scientists and staff have contributed under the able direction of several directors of these laboratories. The compiler indebtedly acknowledge their hard work leading to useful development of technologies and products. Special thanks to each one of the present directors of above laboratories. Without their cooperation and assistance, it was not possible to compile this monograph.

In addition, I am indebted to directors DESIDOC and Life sciences cluster and their respective Director Generals since the sanction of this project till date for their encouragement and supports. Monographs Division of DESIDOC deserves special mention for their cooperation and support for giving the required design and printing assistance. I acknowledge my family members for their help in completing the assignment despite delay due to Covid-19 outbreak.



(Brahma Singh)

Padma Shri Awardee

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I am thankful to Dr G Sateesh Reddy, Chairman, DRDO and Secretary, Department of Defence Research and Development, Dr Ajay Kumar Singh, Distinguished Scientist, Director General Life Sciences, New Delhi; and Dr Alka Suri, Director DESIDOC, New Delhi to provide me an opportunity to compile and complete this monograph on Life Sciences Research in Service of Soldier.

The assistance and cooperation extended by laboratory directors of DRDO-life science laboratories cluster, namely, Dr K Ramachandran, Scientist 'H', DIPR; Dr Bhuvnesh Kumar, Scientist 'H', DIPAS; Smt Manimozhi Theodore, Scientist 'H', DEBEL; Dr DK Dubey, Scientist 'H' DRDE; Dr Tarun Sekhri, Scientist 'H', INMAS; Dr Om Prakash Chaurasia, Scientist 'G', DIHAR; Dr Madhu Bala, Scientist 'G', DIBER; Dr Sanjai K Dwivedi, Scientist 'G', DRL; Dr Anil Dutt Semwal, Scientist 'G', DFRL are thankfully acknowledged. Without their co-operation it was not possible to complete this project. I am highly indebted to each of them.

The contributions of Dr AK Singh, Director General, Life Sciences, DRDO and Dr Shashi Bala Singh, former Director General, Life Sciences and Director (DIPAS, DIHAR) are gratefully acknowledged for critical observations on the monograph and suggestions, besides going through the part of manuscript.

Grateful thanks to Dr K Rama Chandran, Director, DIPR to provide exhaustive write up on DIPR contributions and Dr SK Dwivedi, Director, DRL to critically go through the write up on technologies/products/processes developed by agro-technology laboratories of life science cluster.

The time devoted by Dr Alka Chatterjee, Scientist 'G'; Dr TM Kotresh, Scientist 'G', DEBEL; Dr Rajesh Arora, DIPAS; Dr Aseem Bhatnagar and Dr Jubilee, Dr G Guru Dutta, Scientists of INMAS, to go through certain

chapters of the monograph helped me to progress the project. I am thankful to each of them.

Assistance rendered by Dr Som Nath Singh, Scientist 'G', DIPAS; Dr Sripathy G, Project Manager, SBMT, DEBEL; Dr T Stobdon, Scientist 'E' and Dr Vijay Kumar Bharti, Scientist 'F', DIHAR; Ms Maju Lata Joshi, Scientist 'F'; Dr RP Bhatt, Scientist 'F', Secretary, LSRB and Mr Hemant Kumar, Rashtrapati Bhawan, New Delhi is acknowledged with indebtedness.

Last but not the least, I am indebted to my wife Smt Saroj Singh for her persistent encouraging words. Ms Shailaja Singh, Ms Bobby Singh, Ms Neelu Singh and Ms Rachna Singh, my daughters, were always enquiring the progress and persuading me not to give up the project in between. They assisted me in their own way without which it would have been difficult to complete the project. I am thankful to them with blessings.

Brahma Singh

CHAPTER 1

Introduction

Life sciences research in the service of soldier is the domain of India's important Research and Development (R&D) defence department known as Defence Research and Development Organisation (DRDO) with its headquarters as DRDO Bhawan, at Raja Ji Marg, New Delhi. It is a fairly large organisation meeting different and distinct requirements of the defence forces mainly through indigenisation and development of new technologies. Life science laboratories of DRDO are mainly researching upon various aspects of human (soldier) life to improve the logistics leading to not only for better quality of life and better performance but helping him/her to remain in fighting fit mode always particularly in difficult terrain, adverse environment and other adversaries on ground (Army), in water (Navy) and in air (Air Force) and allied services. The contributions of these laboratories cannot be visible and appreciated being of daily routine use of developed technologies by the troops besides being of great importance during battle, which is rare. But the battle if at all is there it is fought by destructive weapons which are rightly and accurately operated with precision by man behind them whose fitness, balance and protection dictate satisfactory performance/positive end result. The man/soldier is continuously improving his/her efficiency/performance taking advantage of R&D of life science cluster of laboratories of DRDO. Hence defence requirements of this cluster of laboratories can hardly be overemphasised. Very brief introduction of DRDO is as under.

1.1 DEFENCE RESEARCH AND DEVELOPMENT ORGANISATION (DRDO)

Defence Research and Development Organisation (DRDO) with its headquarters in New Delhi works under Department of Defence Research

and Development of Ministry of Defence. Secretary to Department of Defence Research and Development of Ministry of Defence is now the chief and chairman of this organisation. Earlier, before the implementation of Dr Rama Rao Committee recommendations, scientific advisor to Raksha Mantri, Director General, DRDO and Secretary to the department of research and development used to be the chief of it. DRDO dedicatedly working towards enhancing self-reliance in Defence systems and undertakes design and development leading to production of world class weapon systems and equipment in accordance with the expressed needs and the qualitative requirements laid down by the Indian three Services, Army, Air Force and Navy mainly for futuristic requirements.

DRDO was formed in 1958 from the amalgamation of the then already functioning Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development and Production (DTDP) with the Defence Science Organisation (DSO). DRDO was then a small organisation with 10 establishments or laboratories. Over the years, it has grown multi-directionally in terms of the variety of subject disciplines, number of laboratories, achievements and stature. A separate Department of Defence Research and Development was formed in 1980 which later on administered DRDO and its 50 or so laboratories/ establishments.

In 2010, the then Defence Minister Shri AK Antony ordered the restructuring of the DRDO to give a major boost to defence research in the country and to ensure effective participation of the private sector in defence technology development. The key measures to make DRDO effective in its functioning include the establishment of a Defence Technology Commission with the Defence Minister as its Chairman. The programmes which were largely managed by DRDO have seen considerable success with many of the systems seeing rapid deployment as well as yielding significant technological benefits. DRDO has achieved many successes since its establishment in developing other major systems and critical technologies such as aircraft avionics, Unmanned Aerial Vehicles (UAVs), small arms, artillery systems, Electronic Warfare (EW) systems, tanks and armoured vehicles, sonar systems, command and control systems, integrated missile systems and many more.

The vision, mission and core competence of DRDO are as under:



Figure 1.1. View of DRDO Bhawan, New Delhi: Mr Narendra Damodar Modi, Prime Minister of India, unveiling bust of Dr APJ Abdul Kalam, Former President of India and Scientific Advisor to Raksha Mantri and DG, DRDO, New Delhi.

(a) Vision

Make India prosperous by establishing world-class science and technology base and provide our Defence Services decisive edge by equipping them with internationally competitive systems and solutions.

(b) Mission

- Design, develop and lead to production state-of-the-art sensors, weapon systems, platforms and allied equipment for our Defence Services.

DRDO MONOGRAPHS/SPECIAL PUBLICATIONS SERIES

About the Monograph

DRDO Monograph, Life Sciences Research in Service of Soldier, has been compiled by Prof Brahma Singh, Padma Shri Awardee, Former Director & Emeritus Scientist, Life Sciences, DRDO HQrs. Life science cluster of laboratories of DRDO is mainly researching upon various aspects of human (soldier) life to improve the logistics leading to not only for better quality of life and better fighting performance but helping him/her to remain in fighting fit mode always particularly in difficult terrain, adverse environment and other adversaries on ground (army), in water (navy) and in air (air force) and allied services (at borders).

The significant research and development of DRDO life science cluster of laboratories, namely, Defence Bio-Engineering & Electro Medical Laboratory (DEBEL), Bangalore; Defence Institute of Bio-Energy Research (DIBER), Haldwani (Uttarakhand); Defence Food Research Laboratory (DFRL), Mysore (Karnataka); Defence Institute of High-Altitude Research (DIHAR), Leh (Ladakh, UT); Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi; Defence Institute of Psychological Research (DIPR), Delhi; Defence Research Laboratory (DRL), Tezpur (Assam); Institute of Nuclear Medicine & Allied Sciences (INMAS), Delhi; Defence Research & Development Establishment (DRDE), Gwalior (MP); Defence Institute of Psychological Research (DIPR), New Delhi; since the inception of these laboratories/DRDO till date, have been explained briefly but beautifully in this monograph in a language understandable by the readers.

About the Author



Dr Brahma Singh, Padma Shri Awardee, Chairman, Prof Brahma Singh Horticultural Foundation (BSHF), New Delhi is horticulture scientist of repute. The Government of India honored Dr Brahma Singh, in 2014, by awarding him Padma Shri, the fourth highest civilian award, for his contributions to the fields of science and technology.

He is known for his expertise on greenhouse cultivation and developing agro-animal technologies for greening Leh valley, Ladakh, UT. He is acknowledged for identifying and popularising the health crop of seabuckthorn in India. He is member of Ladakh Development Board, besides being fellow of several scientific academies and societies and life time achievement awardee by several organisations.

Since 1974 to 2001, Dr Singh served DRDO. He held position of Director, Defence Research Laboratory (DRL), Tezpur; FRL (now DIHAR), Leh; and Director, Life Science Cluster of laboratories, DRDO HQrs during his service. He has 80 scientific publications and 8 books to his credit.

In 2004, Dr Singh joined the Rashtrapati Bhavan, as the Officer on Special Duty (Horticulture) at the President's Secretariat where he worked till 2007. Dr Singh wrote two coffee table books, Trees of Rashtrapati Bhavan and Roses of Rashtrapati Bhavan besides adding herbal, tactile and other gardens there under the guidance of the then President of India, Dr APJ Abdul Kalam.

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