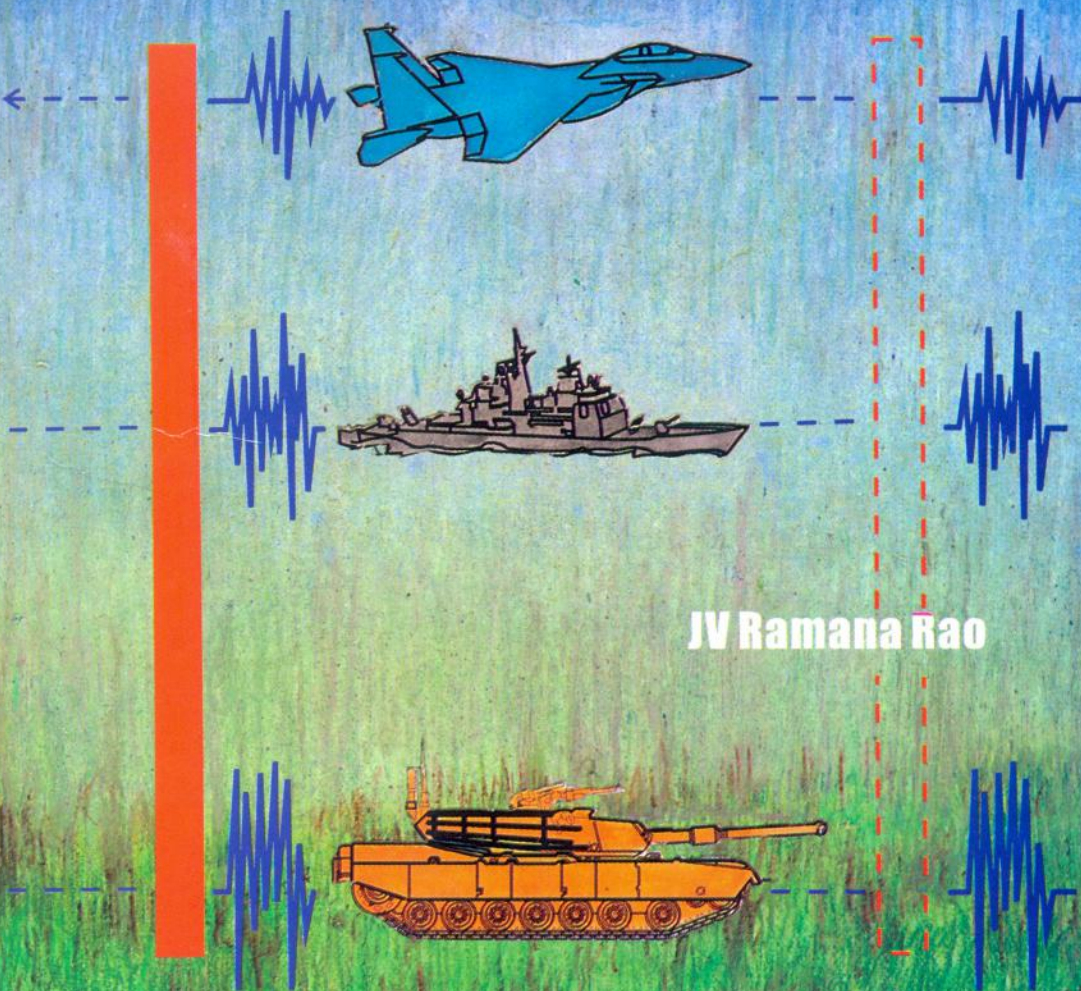




# INTRODUCTION TO CAMOUFLAGE AND DECEPTION



JV Ramana Rao

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CAMOUFLAGE AND  
DECEPTION**

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1999**

## **INTRODUCTION TO CAMOUFLAGE AND DECEPTION**

**JV Ramana Rao**

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ISBN: 81-86514-02-7

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## **PREFACE**

This introductory book on camouflage and deception is primarily intended for dissemination of knowledge and information in the field. The subject is a military science that has no counterpart in the civil sector, and as such, no university teaches and gives degrees in the field.

Camouflage and deception is an integral part of nature. For self-preservation, which is the central problem of biological evolution, all animals, small and big, both in offence and defence, adopt strategies and counterstrategies. These very principles significantly form the basis of camouflage in war. The means adopted by animals in nature have bewildering diversity and complexity all of which do not seem to have counterparts or could be duplicated even in the modern war of today. One typical example is that of the chameleon which almost instantaneously changes its colours in order to blend with its background. As yet, there does not seem to be any means in the present day war by which a military vehicle can change its colour automatically in order to blend with the background, as it moves from one background to another.

The field of camouflage and deception was existing more as a military art than science, until and during World War II. Since then, it has developed into a science. The field is inter-disciplinary and draws knowledge from several branches of science and engineering. The stealth technology, of the modern war of today, which greatly enhances the combat survivability of a fighter aircraft or bomber in the enemy's territory is a complex synthesis of several technologies. The rapid advancements that have been taking place in military sensor technologies, in turn, demand more and more sophisticated countermeasures. This is a war between the strategies and counterstrategies.

Countermeasures, signature suppression/signature management, stealth, low observables: these are the modern terms being employed in place of the classical terminology – camouflage, concealment and deception. The author, however, has entitled this book in the classical terminology.

This book has been written in eleven chapters based on the information available in open literature. Chapter 1, starting with the origin of camouflage, provides an introduction to the field. Chapter 2

provides glimpses of modern military technology and its future trends. This has been introduced in order to have a better appreciation of the importance of countermeasures in war. Chapter 3 deals with camouflage in nature. This provides the basic concepts of camouflage. Chapter 4 covers camouflage in the visible region. Camouflage in war started with ways and means to defy detection by the human eye. Before dealing with the different techniques of visual camouflage, the various sensors that are used in the visible region of the electromagnetic spectrum are briefly described. Chapter 5 starts with the basics of infrared radiation, then discusses the infrared sources—natural and man-made, infrared sensors and imaging systems, and infrared signatures of major military targets. Then the various infrared countermeasures are dealt with. Chapter 6 deals with basics of microwaves—generation, properties, microwave sensors, different types of radars, radar cross-section and its prediction and measurement, RCS of major military objects – aircraft, ships and tank, radar absorbing materials and paints, and RCS reduction methods. Chapter 7 briefly touches upon the role of deception in war in general and deception equipment in particular. Chapter 8 deals with camouflage materials for suppression of signatures in visible, infrared and microwave regions, including signatures of non-electromagnetic nature such as acoustic. Chapter 9 briefly touches upon stealth technology – its history, and its application to major military platforms. Chapter 10 gives a brief account of some aspects of research and development activities in the field carried out in DRDO laboratories. Chapter 11 summarises the various facets of the field and future trends.

The technologies associated with target acquisition are rapidly advancing. New tools, such as artificial intelligence, neural networks, pattern recognition and automatic target recognition, may further enhance sensor capabilities. These might lead to counterstealth technologies demanding counter-counterstealth measures.

The entire approach towards the field must be viewed from the scenario mentioned above. The field has to counter more challenges in future.

Hyderabad  
February 1999

JV RAMANA RAO

## **ACKNOWLEDGEMENTS**

At the outset I would like to express my deep sense of gratitude to Dr APJ Abdul Kalam, SA to the Minister of Defence and Director General DRDO, Government of India, who has been the driving force behind this task and who has given me this assignment. I would also like to express my grateful thanks to Shri A Nagaratnam, former Director, Defence Laboratory, Jodhpur (DLJ), for going through the manuscript of the book and providing several valuable suggestions.

I have been greatly helped by Defence Research and Development Laboratory (DRDL), Research Centre Imarat (RCI), Defence Metallurgical Research Laboratory (DMRL), Hyderabad; Aeronautical Development Establishment (ADE), Electronics and Radar Development Establishment (LRDE), Aeronautical Development Agency (ADA), and Centre for Artificial Intelligence and Robotics (CAIR), Bangalore; Research and Development Establishment (Engineers) (R&DE Engineers), Armaments Research and Development Establishment (ARDE), Institute of Armament Technology (IAT), High Energy Materials Research Laboratory (HEMRL), and College of Military Engineering (CME), Pune; Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur; Instrument Research and Development Establishment (IRDE), Defence Electronics Applications Laboratory (DEAL), Dehradun; Defence Science Centre (DSC), Solidstate Physics Laboratory (SPL), and Defence Scientific Information and Documentation Centre (DESIDOC), Delhi; and Combat Vehicles Research and Development Establishment (CVRDE), Chennai, in extending library facilities, through xerox copies of articles and papers published in open literature. I express my sincere thanks to the Directors of all these laboratories.

I take this opportunity to thank Prof J Srihari Rao, Regional Engineering College, Warangal, for his support in the preparation of material pertaining to generation of microwaves and radars; Prof Raghavendra Gadagkar, Indian Institute of Science (IISc), Bangalore; Prof J Sobhanadri and Prof VRK Murthy, Indian Institute of Technology (IIT), Chennai for their valuable suggestions and discussions.

I gratefully acknowledge the support provided by Dr AR Reddy, former Director, DLJ for extending every type of facility that I have asked for and to Dr SS Murthy, Director, DESIDOC and Dr Ramesh Kumar, Director of Materials, and their colleagues for their support and valuable suggestions.

It is a great pleasure to acknowledge the excellent support provided by Dr N Kumar, and Dr SR Vadera, DLJ, in writing the chapter on Materials for Camouflage Applications. But for their support, it would have been difficult for me to do justice to this chapter. I would also like to express my sincere thanks to Shri Anil Das, DLJ, for his assistance in writing the chapter on Deception.

I take this opportunity to thank Shri P Rama Seshu, Dr Krishna Kumar, Shri SN Puspak, Shri Ramesh Chandra Saxena, Shri BL Soni and Shri N Bohra, my ex-colleagues in DLJ, for the services rendered by them.

I gratefully acknowledge the support provided by Dr Kartikeya V Sarabhai, Director, Centre for Environment Education (CEE), Ahmedabad. I would also like to place on record my sincere thanks and appreciation to Smt Meena Raghunathan, Programme Coordinator; Shri Mukesh Barad, Artist; and Shri DM Thumber, Artist of CEE for their excellent work in the preparation of some of the illustrations of the Chapter – Camouflage in Nature.

I would like to place on record my sincere thanks and appreciation to Shri MS Verma, Shri RP Sharma, Shri Virendra Vikram and Shri Mangi Lal for preparing drawings of figures; to Shri Madho Singh and Rajender Vimal for preparing colour transparencies; and to Shri ML Choudhary, Shri BT Mathai, Shri M R Patel and Shri Ajay Singh, of DLJ, for the excellent assistance provided by them in word processing.

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# CHAPTER 1

## INTRODUCTION

The word 'camouflage' has its origin in the French word *camoufler* which means 'to disguise'<sup>1</sup>. When the word entered the English dictionary initially, it had a limited meaning, implying concealment or disguise of military objects in order to prevent detection by the enemy. The only sensor available in the early days was the human eye. The means to camouflage a military object were foliage and other locally available material.

The concept of camouflage is as old as nature, and it has been an integral part of it. All animals, small and big, are found to employ several methods of concealment and disguise for self-preservation, both in defence and offence. Practically no animal is safe, since for every animal there is a predator. Both the predator and the prey have to adopt strategies for their survival. Thus there is an evolutionary arms race between different species and also within the same species. In the progress of biological evolution, both the predators and the prey have to constantly and equally improve their strategies and then pass them from generation to generation<sup>2,3</sup>. In the arms race in nature there exists a bewildering diversity in the strategies and counterstrategies adopted by different animals. All these techniques may be termed as camouflage and deception in nature<sup>2,3</sup>. Although there may not be a counterpart in the present day arms race to each and every strategy adopted by animals in nature, these very principles, by and large, form the basis of camouflage in war. Whether it is concealment or disguise, deception is inherent in all the methods.

Human civilization, beginning with primitive man, has been using camouflage, concealment and deception in various forms for different purposes, particularly in wars. The basic philosophy remaining one and the same, the changes that have come are in the methodology of application and the levels of sophistication.

Several examples can be cited from ancient wars in which camouflage was extensively utilised with great advantage. The

German legend<sup>4</sup> “The Nibelungenlied” describes the camouflaging cap, the ‘Tarnkappe’. Siegfried wins the cap from the dwarf king Alberich. The cap makes him invisible. It makes him defeat Brunhilde, the Queen of Iceland, in battle. The Greeks<sup>1,4</sup> could not conquer Troy for ten years, not until they employed a ruse—the wooden Trojan horse. The Greeks hid themselves in its belly. The horse was pulled inside the city by the Trojans which led to the conquer of Troy. The use of twigs and leaves on the caps and moving under natural cover by Genghis Khan’s mounted mongols, and leaving of camp fires burning by George Washington after departing from the camp, are but a few examples where last minute decisions on camouflage measures had changed failures to successes.

Camouflage was employed by the French army during World War I in order to prevent detection of guns and vehicles from the enemy’s observation<sup>5</sup>. Camouflage which was existing more as a military art became a science during World War II. At that time a wide range of military objects, such as individual soldiers, guns, vehicles, tanks, airfields and shipyards, needed protection against aerial observation through naked eye and aerial photographs<sup>6</sup>. This provided the impetus to develop the field of camouflage and deception on scientific lines. Even during World War II, the field was essentially confined to the ways and means to disguise military objects against human observation, i.e. camouflaging of military objects against sensors which were available in the visible region. Technological advances in the field of remote sensing covering a wide range of the electromagnetic spectrum have in turn demanded equivalent countermeasures.

Prior to World War II, camouflaging of military objects against sensors employed in the infrared region of the electromagnetic spectrum did not seem to have been employed, as no such sensors were available. In the subsequent wars, such as in the Vietnam War, new detectors beyond the visible region of the electromagnetic spectrum came into use. The need for camouflaging military objects beyond the red end of the visible region had arisen with the development of infrared false colour photographic film during World War II which provided an impetus for research and development in the field of infrared radiation. Since then, the field has seen rapid growth, in particular in the area of military reconnaissance, surveillance and target acquisition. This in turn has put great stress on countermeasures to defy detection by infrared systems. Thus progress in the field of infrared engineering became synonymous with the development of military infrared<sup>7</sup>. Much of the work done in the field was classified and not available in open literature. The field of infrared camouflage known under different names – infrared

ISBN: 81-86514-02-7

Defence Scientific Information & Documentation Centre  
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