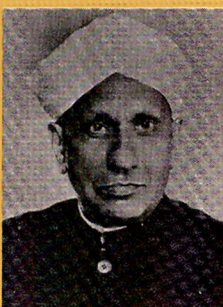
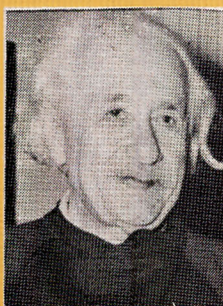
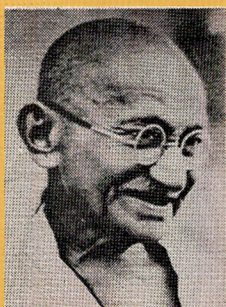




THE OTHER SIDE OF SCIENCE



Prof KAV Pandalai

Introduction by :

Dr APJ Abdul Kalam

**Scientific Adviser to Defence Minister &
Secretary, Dept. of Defence R&D**

DRDO Monograph Series

The Other Side of Science

Prof KAV Pandalai
Former Director, IIT, Madras

With an Introduction by

Dr APJ Abdul Kalam
Scientific Adviser to Defence Minister
& Secretary, Department of Defence R&D

Defence Research & Development Organisation
Ministry of Defence, Govt of India
New Delhi-110 011
1994

DRDO Monograph Series

The Other Side of Science

KAV Pandalai

ISBN 81-86514-01-5

Series Editors

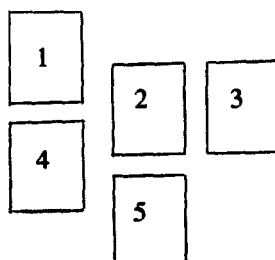
Editor-in-Chief	Editors	Asst. Editor	Production
Dr. SS Murthy	AL Moorthy, DS Bedi	DC Gupta	SB Gupta

© 1994, Defence Scientific Information & Documentation Centre
DRDO, Delhi-110 054.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of the publishers.

The views expressed in the book are those of the author only. The Editors or Publishers do not assume responsibility for the statements/opinions expressed by the author.

Cover :



1. Mahatma Gandhi
2. Albert Einstein
3. Mother Teresa
4. S. Ramanujan
5. C.V. Raman

Preface

This book is written for those who are either in or preparing for a scientific profession or who look at science with certain objective insights. The various products of science — industry, automation, electronics, computers — are very obvious and almost omnipresent today. This book throws some light on the hidden face of science — the humanist face. It also explores this side to drive home the point that science and man are inseparable, and neither of them can be analysed independently. Countless books have discussed how the nobility or devil traits of man have used and misused science. In this book an attempt is made to discuss how scientific advancements can help man to be more humanistic.

The first chapter dwells upon the genius of Einstein whom the author sees as a Maverick — walking out and ahead of the crowd and taking mankind on to a new terrain. The second chapter discusses the irrepressible beastness of man that caused a world war and how science was used as a tool of destruction. In the third chapter, the dawn of a new era in the form of Quantum Mechanics is outlined and it looks at science as an ardent progressive force. In the fourth chapter the point that science can be a collaborator of both good or evil is established in the back-drop of the World War II.

In the next six chapters the progressive thrust of science is focussed upon and science is seen as an Avenger, amplifying the return of effort; Resilient, elastic to the demand and needs; Wander, with a wide and vast terrain of possibilities; Garner, accumulator of a gigantic information wealth; Synthesiser, bringing out new possibilities from the ocean of information; and, finally, Striver, aspiring a great mass of creative humanity to aim at a better quality of life on this beautiful planet earth.

If the book can trigger a young mind to understand this aspect of science, I think this effort has been worth all the trouble. I sincerely hope that you will imbibe the true spirit of science by reading this book.

Acknowledgements

This monograph is an outcome of three years of research, thinking and writing. A lot of details had to be culled out from various sources and finally, after rewriting and modification of the text a number of times, the monograph has emerged in its present form. Much of the credit for giving this monograph the shape it has, goes to my friend Shri Arun Tiwari and his colleague Smt. Prameela Kalive to whom I am very grateful for the time they have spent on my original manuscript and for giving it the present shape. Also, it turns out that these two young scientists and the author share many common concerns and interests, particularly our strong feeling and conviction that science and technology must have a humane and moral base and should be primarily, if not exclusively, be devoted to the welfare of mankind and they should help man live in harmony with nature and himself. So, I am very happy to acknowledge all the help I received from these good professionals.

I must also acknowledge with thanks some of the ideas that owe their origin to my long association of about 40 years or more with Dr. A.P.J. Abdul Kalam who is basically a deeply pious and humane person with total dedication and commitment which are virtues that are rarely seen these days. I am thankful to him for the Introduction he has written.

To the publishers DESIDOC, my special thanks for publishing this monograph.

This book is dedicated to my wife, Shanta, my children and grand children. One can rarely achieve anything worthwhile in life without the support and help of one's family.

October 1994
Gul Mohur Avenue
77/2 Velachery Road
Madras-600 032

K.A.V. Panialai

Introduction

Very rarely does one get a chance to write an introduction for the book of one's teacher. Having got this chance, I am feeling proud and perplexed. Proud because an academician like Prof. Pandalai chose me for this job from the small army of scientists and engineers he created in his illustrious teaching career. Perplexed because I always thought it very difficult to see science in isolation from cultural ethos and without ideological contamination. The book helped me to focus on some of these points.

I vividly remember an incidence that occurred during my first few days at Madras Institute of Technology (MIT) where I joined for my engineering degree after doing graduation in Physics. With my strong theoretical background, I was wondering if I made a right choice to take up engineering. One morning, when my mind was filled with some similar doubts, a new teacher entered our class. There was an invisible aura of wisdom around this gentleman. He spoke nonstop for more than three hours. By the time the class was over I had fallen in love with aeronautics. The gentleman was Prof. Pandalai.

When I started reading the script of this book I found it almost irresistible. In fact it was a nonstop reading and I must say I am more than happy to introduce this book to you. The book covers milestone scientific and technological achievements made in the twentieth century and provides their historical context. Almost effortlessly Prof. Pandalai has lifted the narration of a chronology of events to the statements of a natural continuum.

The book is divided into ten unequal chapters. The first chapter starts with a retroflection and settles on Einstein who was the living form of the spirit of science and technology of that time. In the second and third chapters Prof. Pandalai has brought in the genius of Srinivasa Ramanujan and C.V. Raman and has interwoven the memories of their towering personalities with facts like world's first airmail in Allahabad and the recent controversy of

cold fusion. With these three chapters the reader is poised to see science together with the scientists.

In the fourth chapter, the genesis of the dark facet of science is explored in the backdrop of the World War II. The fifth, sixth and seventh chapters summarise the arrival of computers, artificial intelligence and space age. So far, the emphasis is on aerospace and military sciences.

In the eighth chapter Prof. Pandalai turns to biological sciences and presents a thoughtful analysis of emerging cultural ethos and value system. His pain on observing moral decay of society overtakes his natural optimism in the ninth chapter but he soon jumps out of that in the tenth and concluding chapter, aptly titled Striver, and ends the book on a very positive note.

What would have triggered Prof. Pandalai to write a book of this kind? With a grand career and towering reputation behind, he has nothing to achieve but a sort of 'I told you' satisfaction from this effort at his age. However, he has offered, in the form of this book, a great vision of hope and optimism to young readers who would surely get a tremendous boost to their scientific zeal. I have thoroughly enjoyed the book and strongly recommend it to all those who see things in a progressive perspective and do things with scientific temper.

September 1994

A.P.J. Abdul Kalam

New Delhi.

Contents

Preface	<i>iii</i>
Acknowledgements	<i>iv</i>
Introduction	<i>v</i>
1. Maverick	1
Gallopig Pace/ Max Planck's Quantum Theory/ Einstein/ Parndtl breaks D'Alembert's Paradox/ Theory of Relativity/ Grand Unification.	
2. Irrepressible	7
Airmail at Allahabad/ First World War/ Birth of Soviet Union/ Transatlantic Radio Communication/ Srinivasa Ramanujan/ Three Notebooks/ Hardy's Scale of Mathematics Geniuses.	
3. Ardent	13
Radio and Television/ Uncertainty Principal of Heisenberg/ Planes cross Atlantic and Pacific/ C.V. Raman/ Discovery while sailing over Mediterranean/ First Asian Noble Laureate in Physics/ Basic Issues of Cold Fusion.	
4. Collaborator	21
New Deal of Roosevelt/ Atom Smasher/ Transcontinental Airline Service/ Pearl Harbour/ Rebirth of Rocketry/ Technological Enterprise for War/ Beastly Madness/ Emergence of ENIAC/ Arrival of Computers.	
5. Avenger	27
The Four Generations/ Artificial Intelligence/ Liquidation of British Empire/ Unsafe World for Good and Pure.	
6. Resilient	30
Mount Everest Conquered/ Dawn of Space Age/ First Civilian Nuclear Power Station/ First Satellite enters Orbit/ New Materials/ Earth circumnavigated.	

7.	Wander	34
	Communication Satellites/ Space Walk/ Disasters/ Search for Extra-Terrestrial Intelligence/ Deep Space Network/ Space Telescope.	
8.	Garner	38
	Boost to Biological Sciences/ Molecular Biology/ Biotechnology/ Synthetic Ethos/ Chromosome Separation/ Man Playing God/ Civilisation as Product of Cerebral Cortex/ Big Place in a Small Space/ A Liberation/ Carl Sagan.	
9.	Synthesiser	44
	Mess created by Monkey Minds/ A Balance Sheet/ Vermin of the Planet/ Perversity of Homo Politicus/ Oppenheimer's Personal Tragedy/ Hopeless Existence/ Only One-Thirtieth for Eating/ Light of Asia becomes a Black Hole/ Scapegoat of God/ Holes in the Air.	
10.	Striver	51
	Post-Cold War Cooling/ Perestroika and Glasnost/ The Turning Point/ Missile Proliferation/ Small Mercies/ Global Management System.	
	For Further Reading	55

'My vast transcendence holds the cosmic whirl;
I am hid in it as in the sea a pearl.'

Sri Aurobindo Ghosh
in 'The Indwelling Universal'

Chapter 1

Maverick

To us who have got used to man-made satellites orbiting the earth once in about 90 minutes at speeds of the order of 3000 km/h, satellite communication that enables us to see 'live' programmes and events taking place in any part of the globe, computers and supercomputers that can carry out millions of operations each second, international and intercontinental travel by jet planes including the supersonic Concorde, rapid transit systems and so on that have helped to shrink space and time, it may be difficult to think of a time when even travel by automobile/bus was not at all that common. And that was the situation in 1900, at the dawn of this century when long-distance travel and communication were very, very slow. Quite naturally, the pace of life then was comparatively very slow and as a result, the pressure on man's nervous system was not great. Perhaps, at that time, neurotics and psychiatric cases as a percentage of the population were comparatively small. All that has been changed in the last 94 years, thanks to the developments in science and technology during this century in which the galloping pace of such developments is so evident as we shall see in what follows.

Today man's motto is Faster the Better. Of course, gasoline-powered automobiles and diesel engines came into existence at the end of the last century. So also wireless telegraph and steam turbine. Electron was discovered in the last century. But our scientific world-view was still dominated by the laws of Newtonian mechanics, one of the greatest discoveries of all times. All natural phenomena were thought to be continuous processes. But in 1900, the Quantum Theory by Max Planck was outlined. The simple or over-simplified world of continuous processes

was initially unwilling to accept the concept of 'quanta' and discrete or discontinuous processes. That the emission or absorption of energy by an electron in an atom occurs only when a certain 'quanta' has been reached and not continuously was fundamental to Planck's Quantum Theory. This discrete behaviour pattern is familiar to those who study the natural frequencies of free undamped vibration of dynamic systems like a vibrating string/beam/plate/shell. These natural frequencies form a discrete set. Anyway, when Max Planck's Quantum Theory was proposed, it startled the world of science.

In another five years (i.e., in 1905) Einstein shook the world of science with his theory of Special Relativity. The decade 1905-1915 is reckoned as Einstein's decade. It was in 1915 that Einstein came out with his theory of General Relativity. But in the first two years of this century, many other developments took place. These include the invention of escalator, glider, gas welding, transatlantic radio telegram by Marconi, cure for yellow fever, radio telephone and transmission of photos by wire. Then on 17 December 1903 two bicycle mechanics, the Wright brothers, who earlier had successfully designed and developed the glider, ushered in the era of powered flight when they successfully flew their gas engine-propelled aircraft at Kitty Hawk, North Carolina. It is worth mentioning here that flight by man was an obsession of Leonardo da Vinci who lived in the 15th century. He had made several sketches of flying machines. The Wright brothers gave wings to the world. This is undoubtedly one of the greatest technological developments of all times. As we shall see later, the invention of the flying machine not only helped shrink the world but it also had its misuse, abuse and misapplication which is a reflection of the monkey mind of man and his tribal propensities.

In the first decade of the century, there were other notable inventions. They include gyrocompass, radio vacuum tube, crystal radio detector, the mass production industry ushered in by Ford's model 'T' automobile assembly line, demountable tyres and the phenolic resin plastic (Bakelite). In 1909, Bleriot flew over the English Channel and Admiral Peary discovered the North Pole. Also the typhus vaccine was discovered. Another important scientific development of 1909 was the announcement by Sigmund Freud of his Theory of Psychoanalysis and the important role of psyche in the life of the mind. In spite of the war between Tzarist Russia and Japan, which started in 1904 and which Russia lost, there are reasons to feel happy about



About the Author

Born in 1928 at Jamshedpur, Prof. K.A.V. Pandalai obtained his Masters in Aeronautical Engineering (1950) and Doctors in Aero Engineering (1955) from Polytechnic Institute of Brooklyn, New York, USA.

During his tenure at Indian Institute of Technology (IIT), Madras, Prof. Pandalai held many positions, including that of Director of the Institute. He has over 44 years of research and teaching experience in aircraft structure mechanics, composites, classical aerodynamics and so on. He has taught at many educational institutions in India and abroad which include Polytechnic Institute of Brooklyn, Stanford University, California and George Washington University at Washington, USA. He has guided many MTech/MS and PhD students and has about 100 research papers to his credit.

Prof. Pandalai was awarded the CSIR Silver Jubilee Award (1971) of Rs. 6.25 lakh for use as seed money to set up FRP Research Centre at IIT, Madras, of which he functioned as first Director. He is also the recipient of Senior Grade Foreign Fellowship of the National Science Foundation of the USA and NRDC of India awards. He is a Fellow of the Indian Academy of Sciences and the Aeronautical Society of India. He was a Fellow of the Royal Aeronautical Society and the Acoustical Society of America.

Even after his retirement in 1988, Prof. Pandalai is actively involved in the field of aeronautics and composites and on various issues of science and technology and their impact on society.