

SCIENTIST

A unique 'species' and the backbone of a nation's economic
and intellectual prosperity

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Dedicated to

*All the predecessors and contemporary scientists
who upheld the best tradition of quality science
through all the thick and thin, and led their
research to fruition for an everlasting benefit to the
human being and his environment so that there
would be a better world to live in.*

FOREWORD

This book on '*Scientist*' highlights the role of scientists in evolving science as a major source of knowledge. The basic question arises as to who is a scientist, as not all men of science are scientists. Creating a scientific temper is an essential component of science, with determination, dedication and commitment being the basic ingredients of excellence. The power of anticipation and ability to visualize the future to foresee what could happen are equally important. It is not an overstatement to say that scientists form a nation's most prestigious heritage, reflecting perseverance, commitment, patience and consistency as principal virtues. The urge to enthuse youngsters is among the principal aims of a good scientist. Needless to say that scientists reflect the will to achieve through years of focused industry, perseverance and commitment.

This book undoubtedly aims to enthuse youngsters through the lives of scientists from diverse disciplines, who undoubtedly form a major component in the development of a nation. The intensity of opportunities is the measure of popularity of a scientist, as scientists create opportunities not only for themselves, but also for others. This painstaking effort is bound to enthuse many a youngster aspiring to be a good scientist. The author needs to be congratulated on a thought-provoking exercise which will provoke young minds to the realities of science.



26th December, 2008

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PREFACE

Of how many books can it be said that their publication directly affected the personal wellbeing of every person under the sun? No doubt, many books have been written which have changed the outlook of millions, altered social institutions, and even deflected the course of history, but of very few can it be said that their contents concerned the very central core of the construction of that rare amongst rarest of human morphs – the scientist – whom the entire humanity owes virtually everything, from good living conditions including clothes, drinking water, food, hygiene and health to chaste environment. They are integral to the creation of a great and attainable vision for the country's growth in intellectuality, economy, agriculture, health and so on. By sheer virtue of their utterly devoted life and integrity to their profession and the nation, scientists are inevitably indispensable to the future planning and development of a country. On the eve of the 22nd July, 2008, while seeking 'vote of confidence' on the IAEA (International Atomic Energy Agency) deal with the USA, the Prime Minister of India, Dr. Manmohan Singh, put forward his vision of India, *"....as a self-confident and united nation moving forward to gain its rightful place in the comity of nations, making full use of the opportunities offered by a globalized world, operating on the frontiers of modern science and technology and using modern science and technology as important instruments of national, economic and social development"* (The Times of India, New Delhi, July 23, 2008; p. 11), **clearly highlighting the nuclear role of science and/or scientists in overall national evolution.**

Scientists make a rare 'species', not exactly in a biological sense but in the measure of magnitude, direction and intensity of their focused thinking, dedicated perseverance, and resolute application! There is something uniquely and exclusively

associated with the lives of scientists that puts them well above the rest of forms of our species – *Homo sapiens*. The fact behind this reasoning is, in a way, clearly discernible since a nation primarily owes much of its development to the labour of its scientists. Thus, everything that we use in any aspect of our life, during peace or war, is largely a product of the painstakingly innovative and productive industry of our scientists! Truly scientists make the backbone of a nation, of the whole humanity, toiling selflessly throughout their life with focussed attention, fuelled by unflinching obsession and perseverance, unnoticed elsewhere in the annals of any branch of knowledge of human life. Yet, with all the forces of dedication and devotion employed to make a nation's economy boom, scientists quietly busy themselves unconcerned of the laurels bestowed on them; their major reward spring up from their hard work and in achieving objectives! So, when a journalist once asked the world famous Indian scientist and Nobel Laureate Dr. C.V. Raman, "What do you feel about the long and eventful period of your scientific work and achievements?" Raman replied promptly, "I have no time to think of the past and I am not inclined to do so. I spend my life as a scientist. My work gives me satisfaction." But the billion dollar question is: Whether a scientist is inborn, self-made or made per force? The answer to this question is not easily available and the subject may be debated endlessly without possibly finding a conclusive answer. It is certainly no easy task to define a scientist but for one thing that he is extremely hardworking and maddeningly obsessed to achieve his goals, come what may! The famous adage "Wise haveth their eyes, in the head; Fools waketh through forest, and see no firewood!" appropriately distinguishes a scientist from an ordinary mortal. William Wordsworth's following lines, said in a different context though, truly reflect the famed character of a scientist:

*"Who comprehends his trust, and to the same
Keeps faithful with a singleness of aim;
And therefore does not stoop, nor lie in wait
For wealth, or honour, or for worldly state;*

*Whom they must follow, on whose head must fall,
Like showers of manna, if they come at all."*

Logically a scientist in man is as old as his own origin and evolution. The unquenchable desire to live with better means and material, the genius in man guided him to persevere untiringly and achieve his targets – *hook, line and sinker!* The time-tested maxim "*Necessity is the mother of all inventions*" lead him cultivate in himself the indomitable and irreversible habit of steering through all thick and thin to reach his goal. A scientist possesses the capability of devoting the whole power of his mind to the practical and experimental investigation of a subject in all its bearings; and such a mind will rarely fail, by dint of mere industry and patient thinking, in producing results of the highest order. He has an energy and elasticity in his mind, which enables him to seize on and analyse all questions, pushing them to their legitimate consequences. Every subject in his mind has the principle of vitality, and living thoughts spring up like turf under his feet. He is the master of order, precision and regularity. Thus, as a personal conclusion, keeping in mind these arguments and facts, it seems most probable that a scientist is a self-made man. When a young and budding scientist approached a seasoned explorer, the latter advised by telling that "*... not all the men who work at science are scientists. To be a scientist is like being a Goethe: it is born in you. If you do, work twice as hard as you can.*" Yet, fully knowing that being a scientist needs nothing short of maddening obsession, and trusting nothing but realization of the facts – the truth, the preceptor went on to further advise the protégé to always call the prayer, to keep honest in his investigations;

"God give me unclouded eyes and freedom from haste.

*God give me a quiet and relentless anger against all
pretense and all pretentious work and all work left
slack and unfinished.*

*God give me a restlessness whereby I may neither
sleep nor accept praise till my observed results equal*

my calculated results or in pious glee I discover and assault my error.

God give me strength not to trust to God!

Thinking of the scientist one spontaneously creates in his mind an image of a person with tousled hair, unkempt beard, frayed cuffs and a sardonic look from a pair of dead-pan eyes seeping through a near prism of spectacles – a regular run of the mill scientist! Not only this, if you ask an ad agency to depict a scientist, they will project an image of a grey-haired, spectacled man perhaps with a beard and, of course, with lab coat. This caricature contains several other features that we have come to associate with a scientist: that it is man, he is loner, thinking up recondite ideas in isolation, that "eureka" moments dawn on him from time to time, and that he is absent-minded and naïve about ordinary chores of life. The story of the British scientist who boiled his pocket watch in the pot as he kept time with the egg in his hand while preparing breakfast reinforces this portrayal very much. All this, albeit an array of quaint feelings, however, pronounces very strongly as to how this man, the scientist, existing in whatever morph today, is generally lost with *a singleness of aim* in his mind, and concerns nothing else around him! To him his experiment is everything.

The image of scientists is inseparably linked with the transmutations of science itself, of which the scientist is at the same time product and agent. Needs for increased national security of human food, health and habitat resources have always pressured scientists to keep going stronger than ever before! Ironically, the recruitment and involvement of scientists in national efforts, particularly during wars, change both the nature of scientist, who is generally isolated, by drawing into the mainstream, and utilization of his inventions and discoveries. These were reflections of the response to the role of science and technology in the social context.

Over the years science and scientists have both taken an amazingly giant leap forward. This is electrifyingly true in case of India which is fast moving forward to become the world's one

of the strongest economies in near future. As one sees, there is no dearth of expertise in India. The country has high quality scientists and technologists many of which rank among the best in the world. What we need is the sense of belonging and oneness to achieve wonders. Be it technology innovation in the automobile industry or the drugs and pharmaceuticals sector, we need to feel great to be an Indian and great to be in India. The need of the hour is to keep the spirit of India soaring high by innovating newer technologies, making them available at an affordable cost, especially to rural masses, and at the same time remain acceptable in the global market. There is a definite paradigm shift in the long journey of change and growth witnessed in the new emerging India. To the world India is now a knowledge treasure house. For India to become globally competitive two issues that need be addressed are: (i) human capital, and (ii) science & technology innovation and advancement. India has the skills but how to bring everything together for making a final output is the question. The current era is of skill-based competition. There is obviously a need for fostering public-private partnership. Compete yet cooperate is the key. The industry and academia need to work *in tandem* so that India could lead from the front. There is a need to comprehend the importance of synergy between technology developers and the industry. India needs to focus more on pure research in addition to giving emphasis to applied research, such as in the fields of biomedicine, biotechnology, nanotechnology and information technology, if major breakthroughs are to be made in the future. Pure or basic research is where science grows; it has given rise to applications right from the cellular physiology to genomic characterization and drug and vaccine development as well as field-based disease control methodologies, particularly for the vector-borne infections.

The great discoveries of those scientists who came earlier have always inspired the younger generation of researchers. A scientist, in fact, runs before the time. My association with the scientific research is by now for over three decades, and full of all kinds of upheavals both in my scientific pursuits and professional evolution, and yet very enchanting and endearing.

During this span I came in touch with some of the greatest biologists, through correspondence or in person, in the country and abroad, and had the rare opportunity of learning the best of science in its true meaning and application.

In this book I have tried to bring my personal experiences, along with those of others that preceded me both in time and space, in the form of anecdotes and biographic accounts, gained through long and subtle liaison with various scientists who reached the pinnacle of “scientific success” by braving their way through unfavourable conditions, and arrived their “destination” come what may!

We all acknowledge the fact that we live today happily because of the grand contributions to good living by our scientists. Fables of grandness of many of these extraordinary men and women have been told to us in different modes, and yet it is inevitably indispensable to continue to tell their heroic tasks in the realms of science again and again since this inculcates inspiration and motivation to better our lives. Therefore, when a scientist father of a young boy who had just passed out his college degree took him along to a seasoned scientist genius in his late seventies, the boy reluctantly questioned if there was any usefulness of listening to the same old story again and again. The father had but simply remarked, “Yes, it is necessary lest we forget”, meaning the experienced advices and guidelines are treasures no one else in the whole world can transcend! Thus, life stories of scientists need to be told ceaselessly, though the *modus operandi* of making the treatment to the anecdotes may change from one treatment to another.

This ‘book’ is my way of seeing the scientist I have known in my endless journey through science-learning, with likely a pinch of personal biases, selections, omissions, exaggerations with respect to the quotations and references of scientists as examples, all there to give an honest and well researched bibliographic account to tread on fearlessly. And yet, though every humanbeing may carry with him, in his head and heart, an entirely personalized picture of ‘a scientist’, it is my firm

conviction that all that about the ‘*Scientist*’ I have endeavoured to portray here on the pages of this book *does exist*, though quite uncommonly!! At times I have portrayed at length the scientific distinctions earned by a scientist, principally done so with a view to highlight his/her international recognition, which may appear to a reader rather undigestable. But, by my own reasoning, it has been done deliberately to set, particularly before the young researchers, the high goals in life as exhibited by the lives of great scientists of India, and elsewhere in the world! Additionally, but not to overburden the worthy readers with the long and and rather technically diverse bibliographies, simple and updated inventories of the scientific titles of a few selected scientists I have known have also been appended, with a feeling to rouse keen interest in manuscripting originally and show the right path to a budding researcher on to their future scientific journeys.

Thus, I hope that this book, unique in its approach and treatment to the subject, will be able to ignite hope and belief especially in the young minds, since they are the ones who have a longer innings to play in life and surely construct anew the future of a healthy and prosperous India – standing tall and firmly on the inexorable principles of hard work and application. This is the objective of this book, ‘*SCIENTIST*’, a unique experiment and essence of my life for spreading the message of the best scientific tenets.

1st November, 2008

Dr. B.K. Tyagi

ACKNOWLEDGEMENT

This book, *Scientist*, is an essence of my lifelong achievements in a sense of best scientific tradition. It is my firm belief that scientists make a very important and integral part of our life – to sustain with adequacy of basic dignified needs like food, health and economy. In the process of writing this book, therefore, I have imbibed into me messages and thoughts of a large number of scientists, extant or not, through diverse media of print, discourses and communication and to all of them I remain extremely thankful for their constant help and cooperation. In particular, however, I feel indebted to very dear friend for more than four decades, Dr. Vijay veer, for his critical comments on the first manuscript and constant encouragement.

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