

NOTES TO MYSELF

Notes to MYSELF
A. P. J. ABDUL KALAM

Edited by
ARUN TIWARI

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Foreword

There is nothing new to be said about Dr. A. P. J. Abdul Kalam, just as there is nothing new to be said about the Indian civilization. The brilliance of the human mind, the profundity of our value system and our great family system-based community life need no more words of recommendation. India never ceases to amaze and mesmerize mankind elsewhere in our world, and continues to inspire dreams and visions from time immemorial and the same is with Dr. Kalam, who even in his demise, continues to inspire millions of Indian youth.

I am very happy that Vijnana Bharati is publishing Notes to Myself, a first person memoir of Dr. Kalam compiled by his long time associate and co-author of five of his books, Prof. Arun Tiwari. This book is indeed like a pure crystal form of Dr. Kalam's mind and is timeless in its relevance and unequalled in its value. I followed Dr Kalam keenly and read his writings particularly those that are aimed at inspiring the youth. As a medical doctor, I can't agree more with Dr. Kalam's idea of nation building by character building.

What is needed to build a successful nation is not very different from what is needed to build a successful individual. India is on the threshold of an economic upsurge. Things we never dreamt of as possible for a large segment of people could be possible if we handle things right. A billion healthy and focused people are indeed a miracle. But a billion unhealthy and uninspired people could be a disaster. The question of the hour is: Are we going to turn this population into a possibility or a disaster?

The book very convincingly presents Dr. Kalam's message that a pious body, a disciplined mind, and concerted effort without losing hope will activate inner energies in a way that will enable a billion people to function at their optimal capacity. India needs scientists who are not mere aggregators of facts and processors of information, but who understand the problems of their people and provide apt solutions using their scientific knowledge and technical skills. I see this book as a Master Key that will open the young minds to new possibilities and inspire them to make India a nation of health, happiness and prosperity.

DR. HARSH VARDHAN
Union Minister
Science & Technology and Earth Sciences
Government of India

Introduction

Dr A.P.J. Abdul Kalam was India's most respected Head of State of recent generations. A principled, charismatic man, Dr Kalam was loved by millions of his own people, just as he was admired and celebrated abroad. It is of little wonder, then, that his life story and career have attracted a great deal of interest. Much has been written of his many contributions to Indian society as a rocket scientist, writer, scholar, teacher, visionary and leader. His rise from a humble background in a small town, too, is legendary.

Far less is known of this great man's private thoughts and motivations, however. Countless portraits of Dr Kalam are displayed throughout the nation, and his kind, reassuring expression is familiar to any Indian. A character portrait is another matter entirely.

It is not that India's most popular president was uncommunicative or reticent, or that he had a veiled life; the difficulty in fully understanding Dr A.P.J. Abdul Kalam is simply that there are a good many aspects to this Indian icon. Indeed, even after working with Dr Kalam for more than three decades, I still find myself learning from him and about him.

Dr Kalam's generosity and expansiveness, too, was capable of embodying apparent contradictions. He was a man of peace, just as he was a firm advocate of Indian national defence. He was a staunch patriot who could just as easily reach out to people of other countries as his own. And while he was a leading scientific mind of the nation, he was unashamed in speaking frankly in public of his belief in God.

It scarce needs mentioning that any young student can benefit from studying Dr Kalam's life. The story of his career alone is enough to ignite a young mind. His involvement in the fledgling Indian space programme, from building tiny sounding rockets to the creation of India's first Satellite Launch Vehicle, SLV-3, is fascinating. His masterminding the Integrated Guided Missile Programme and guiding the country's nuclear development also makes for interesting reading. But far more powerful than accounts of his illustrious career are the lessons of his personal journey.

In *Notes to Myself*, I have sought to reveal Dr Kalam's wisdom and vision, while charting his ascent from a southern pilgrimage town to Rashtrapati Bhavan. What emerges is a man many decades before his time, who never lost the capacity to amaze and inspire; indeed, he was inspiring young students till his very last moments with us.

Just as with other great figures of history, it would be impossible to note every part of

Dr Kalam's amazing life or all his achievements. It would be just as pointless to attempt to capture all his thoughts, opinions and philosophies in a book. There would simply be too much material.

Notes to Myself summarizes the well-lived life of an ideal man. Dr Kalam set his intentions upon pursuing higher studies at the age of fifteen. Following that, he established himself in society by the time he was thirty and freed himself from worldly distractions by the age of forty. In his middle age, his energies were firmly aligned, and throughout the last decade or so of his life, he followed a higher mandate of making this planet more liveable. Before he left this world at the age of eighty-three, he issued a clarion call to make our planet more liveable. His life message is that the process of building a better world never ends, because it is as much an inner quest as an earthly duty.

I hope that I have managed to distil the essence of the People's President in these pages. I trust that the reader will gain much from his insights for life, personal development, leadership and a purposeful existence. The wisdom Dr A.P.J. Abdul Kalam imparted over the years in our conversations and writing is as impressive as his example of an enlightened life. Both can inspire the youth of our nation. May we open ourselves to the possibilities in Dr Kalam's ideas that lead us to more meaningful, fulfilling lives.

Arun Tiwari
Hyderabad
September 2016.

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About the Editor

Arun Tiwari did his Masters in Mechanical Engineering from GB Pant University and joined Defence Research & Development Laboratory (DRDL at Hyderabad as missile scientist in 1982 and reported to Dr APJ Abdul Kalam.

In 1992, on becoming Chief of DRDO, Dr Kalam decided to develop civilian spin-offs of defence technology to provide benefit of investment in defence technology to common people and appointed Prof Tiwari as the Programme Director. In 1996, Prof Tiwari developed India's first Coronary Stent with Cardiologist Dr B Soma Raju known as Kalam-Raju Stent. This led to creation of Care Foundation and later the Care Hospitals.

As a member of President Kalam's team, Arun Tiwari set up the first link of Pan-Africa e-Network of Telecommunications Consultants India Ltd (TCIL). The Network now connects Universities and Hospitals across the African continents with their Indian counterparts.

In 1999 Arun Tiwari wrote *Wings of Fire*, the autobiography of Dr APJ Abdul Kalam. The book became a modern classic going in to 30 reprints and selling more than 1.5 million copies. It is translated in to 18 Indian and foreign languages. He has written twelve books since then. His latest book 'Transcendence' with Dr Kalam and 'APJ Abdul Kalam: A Life' published after DR Kalam departed are the current bestsellers.

Arun Tiwari is currently evolving blue print for an Afro-Indian project of benefitting African smallholder farmers in growing more for Indian consumers. The multi-governmental initiative aimed at alleviating poverty, creating jobs and developing a middle economy in sub-Sahara Africa using Indian technology and financial inclusion policies. He teaches at School of Management Sciences in Hyderabad University as Adjunct Professor.

1

COCONUT GROVE

“Take care of every day—let the calendar take care of the years.”¹

Our lives are organized around the calendar. We calculate time, to know how many days remain until a certain event takes place or how long it has been since something important has happened. The earliest calendars seem to have been strongly influenced by the geographical location of the people who made them. In countries with colder climates, the concept of the year was determined by the seasons, particularly by the end of winter. In warmer countries, where the seasons are less pronounced, the moon often became the basic unit for measuring time. The Hijri calendar or Islamic calendar, originating near the edge of the tropics in what is now Saudi Arabia, still marks time with the lunar cycles.

I arrived in this world on the second day of the sixth month of the year 1350 of the Hijri calendar, corresponding to Thursday, the fifteenth day of October, 1931. I was Jainulabdeen and his wife Aishamma’s third child and second son. My father was a pious man, and a passionate believer in the nation that would become India. He named me Abdul Kalam after the great Indian scholar and eminent political leader of the Indian Independence movement, Abul Kalam Azad. My parents felt that I was a lucky child, as my father became Imam of the local mosque soon after my birth.

As was the usual practice of those times, I was born in my ancestral home. It was a modest traditional house in the holy town of Rameswaram, with a tiled verandah facing the street, just a short distance from the famous Ramanathaswamy Temple.

My home town is located more or less at the centre of Pamban Island, a 30-kilometre-long land mass lying two kilometres from the mainland in the Palk Bay, between peninsular India and Sri Lanka. Pamban and Rameswaram are the island’s two main settlements. In a sense, they represent two essential parts of life: work, and spiritual observance. Pamban is a fishing village and a harbour on the western tip of the island. It is the main point of entry to Rameswaram, the larger of the two settlements, which overlooks Palk Bay on the island’s east.

1 Ed Wynn (1886–1966) was an American actor and comedian. Dr Kalam enjoyed his 1961 film *The Absent-Minded Professor*

Pamban Island had another town, Dhanushkodi, when I was young. Dhanushkodi is near the southernmost tip of the island, where the land tapers to a point toward Sri Lanka. Though the town was left uninhabitable by the 1964 Rameswaram cyclone, the Kothandaramaswamy Temple of Lord Rama there remains. It was the only historic building in Dhanushkodi to survive the storm surge: the 7.6-metre waves that swamped the town on 23 December 1964.

Pamban Island is a significant place for Hindus. Rameswaram is the southernmost of the Char Dham or four abodes, which makes it a pilgrimage destination for thousands of Hindus every year. Rameswara means ‘Lord of Rama’ in Sanskrit, an epithet of Shiva, the presiding deity of the Ramanathaswamy Temple. Rama, the seventh avatar of the god Vishnu, prayed to Shiva here to absolve any sins that he might have committed during his war against the demon-king Ravana in Sri Lanka, about fifty kilometres away.

As with the rest of India, Pamban Island has been remarkably open to new religious ideas. Islam arrived on the island with Malik Kafur, a eunuch slave who rose to become a general in the army of Alauddin Khilji, ruler of the Delhi Sultanate. Malik Kafur reached Rameswaram during one of his three military campaigns in southern India between 1294 and 1316, which set the stage for the short-lived Madurai Sultanate. The Sultanate fell little more than half a century after it was established; but Islam remained.

In 1795, Rameswaram came under the direct control of the British East India Company and was annexed to the Madras Presidency. By the time of British rule, Christianity had found a place on the island. Its devoted band of followers joined the equally devoted Muslims and Hindus on this small but sacred piece of land in Palk Bay.

‘Every child is born, with some inherited characteristics, into a specific socio-economic and emotional environment, and is trained in certain ways by figures of authority.’²

I was fortunate to grow in an environment where three of the world’s great religions coexisted happily. My three close friends in Rameswaram—Ramanadha Sastry, Arvindan and Sivaprakash—were from orthodox Hindu Brahmin families, but would play with me as if we were children from one family. I would happily sit in the Ramanathaswamy Temple, admiring its glorious stonework and listening to the chanting of prayers. Sometimes, too, I would listen to the sermons at mass in the Catholic church nearby.

Religious beliefs of each faith were respected by all at Rameswaram, and religious festivals of each community on the island were shared events. During the annual Sri Sita Rama Kalyanam ceremony, my father and my brother Maracayer, fourteen years my senior, would arrange boats with a special platform for carrying idols to the middle of the pond called Rama Tirtha.

Here were my father and brother, Muslim men of the open sea, taking boats onto a small pond

2 APJ Abdul Kalam with Arun Tiwari, *Wings of Fire*, University Press, 1999, p. 8.

to help their Hindu brothers pray. Jainulabdeen and Maracayer understood simple realities: The sea, rivers, ponds, lakes and streams have different names and shapes. But they all contain water, and our crafts float on their surfaces in just the same manner. Similarly, religions have various forms, but they each contain truths and sustain the spiritual lives of their people.

Although it was a happy place with year-round warm weather and friendly people, Pamban Island wasn't perfect. Living in groups always poses challenges of one kind or another. The early years of my life, in pre-Independence India, were especially hard economically, as well. The Great Depression of the 1930s, heavy taxes of the colonial regime and the protectionist policies of the British government bore heavily on the Indian people. The people of Pamban Island faced these economic challenges along with the rest of the nation. But while the island's people suffered a shortage of material goods, there was no lack of interfaith communication to help them deal with their everyday issues.

► I witnessed interreligious dialogue from a very young age. Memories of a regular gathering in my family home's courtyard are etched in my mind. The chief priest of Ramanathaswamy Temple, Pakshi Lakshmana Shastrigal, Rev. Father Bodal, the leader of the Christian community and my father Jainulabdeen would meet in my home every few months to discuss the issues facing the island's people. For some reason, I took particular note of these meetings, as if I knew their sitting together, sharing glasses of buttermilk or cups of tea and chatting amiably was somehow significant. However, for them getting together to solve our small society's problems was perfectly natural for them—it was just a routine happening.

Those meetings held a lesson that stayed with me. Interfaith dialogue has never been more relevant than in the early years of the twenty-first century. Divides between religions have become rifts in some places, and differences within them often lead to violence. What is missing there is not tolerance—it is respect. Pakshi Lakshmana Shastrigal, Rev. Father Bodal and my father simply respected each others' beliefs. If people respect others' faith and beliefs and their right to hold them, there is no need for tolerance. And with this respect, conflict can find no place.

Faith sustained Pamban Island economically as much as spiritually. In most parts of India, agriculture is the primary source of people's income. This has never been the case at Pamban Island. The sandy soil of the island is unsuitable for cultivation, and very little can be harvested from the land there apart from coconuts and figs. The economy of the island depended on marine products—fish and shells—and on providing basic services and provisions to pilgrims.

'You can't cross the sea merely by standing and staring at the water.'³

Still, agriculture was some support for my family. My father owned a small coconut grove,

3 Rabindranath Tagore (1861-1941) is regarded as the outstanding creative artist of the modern Indian subcontinent. He was the first non-European to win the Nobel Prize in Literature in 1913. Dr Kalam kept his poem 'Where the Mind is without fear and head is held high' on his presidential table.

six kilometres from our home. This was, for a time, the family's main source of income. Later, my father would turn his hand to business. For most of my early years, though, scarcity was an everyday reality. And while my mother and father gave me a comfortable childhood, they toiled to make ends meet.

Jainulabdeen and Aishamma seemed quite untroubled by the hard work that supporting their family demanded, however. I would get up early in the morning and watch them begin work immediately after their Fajr (daybreak) prayers. Even before the sun emerged from the sea, Jainulabdeen would head toward the coconut grove. I would mimic my father, stepping out of the house at dawn. I would play in the fresh morning air, listening to the chorus of the seabirds. My father used to tell me that true success in life is the freedom to do for a living that which brings you happiness.

With time, Jainulabdeen found his calling, and with it, success. When I was about six years old, he embarked on the project of building a wooden sailboat to ferry pilgrims to and from Rameswaram and Dhanushkodi. He worked at building the boat on the seashore with a relative, Ahmed Jallaluddin. Ahmed would later marry my elder sister, Zohara. The two men built the boat using the traditional carvel planking method, where planks are affixed edge-to-edge onto a sturdy underlying framework. This method makes a hull which can bear heavy cargo.

I sat and watched intently as my father and Ahmed seasoned the bulkheads with heat from wood fires, and formed the frame on the beach. It looked like a boat's skeleton to my young eyes. Then, as wooden planks were fitted, it quickly became a boat, ready to venture out to sea. I saw that with knowledge and concentrated effort, common materials can be used to make something very useful. The transformation from pieces of wood into a boat was truly amazing. I also learned that a boat builder needs to be aware of the properties of the materials. My father explained that the abrasion resistance of wood varies according to its hardness and density. Also, the wood may deteriorate if fresh water or marine organisms are allowed to penetrate it.

The boat business was a great success. There were days when I joined my father on the boat to collect fares in coins from the pilgrims, as a conductor would do on a bus. I heard during these trips the story of how Sri Rama built the bridge from here to Sri Lanka with the help of his army of monkeys; how Sri Rama brought back Sri Sita and stopped at Rameswaram again and performed penance for having killed Ravana; how Sri Hanumana was sent north to bring a large Shiva Lingam but when it took longer than expected, Sri Sita made a lingam with her own hands so as not to delay the worship.

These stories and many others floated around me in different tongues and forms, as people from all over India converged at the boat service. Very early in life I understood that my country is indeed vast. I also noticed that although Indian people from one region may look quite dissimilar from those from another and speak very different language, there is some essential quality that binds them all. It may be hard to define, but I clearly felt there was a distinct Indian character which

all the peoples of our land possess. Indians, too, I could see, have a particularly deep connection to their rich cultural heritage, which gives them a sense of place and purpose. Traditions, thousands of years old, have been kept alive in India. A people without the knowledge of their past history, origin and culture is like a tree without roots.

‘The teacher awakes joy in creative expression and knowledge in children.’⁴

When I was studying in the fifth grade, a lesson from my teacher Siva Subramania Iyer made a lasting impression on me. Our teacher took us to the beach to demonstrate how birds fly. It may just be that observing seagulls that day, with their aerial acrobatics over the waves, inspired me to take up a career in aeronautics.

Iyer drew a diagram of a bird on the blackboard, showing the wings, tail, body and head, to teach about birds’ flight. He explained at length how birds create a lifting force by agitating the air with their wings. He also described to the class how they change direction while flying by tilting their wings to different angles.

When he asked the class whether we had understood how birds fly, I stood up and confessed frankly that I did not. My classmates said they did not understand, either. Our teacher wasn’t upset. He just took the class to the seashore to show birds in flight. That day, I realized that a bird is powered by its own life force and the motivation to fly—its will. Siva Subramania Iyer’s lesson did not merely impart an understanding of how a bird flies. I now had some sense of the very being of the bird reaching into the sky. I was captivated and from those moments, I developed a fascination for flying.

► In October 1942, a powerful cyclone formed over the Bay of Bengal. It unleashed torrential rain and winds gusting at more than 160 kilometres per hour onto Pamban Island. The trees of my father’s coconut grove were uprooted, and his boat was wrecked. We all cried, but my father kept his poise. He merely said ‘Inna lillahi wa inna ilayhi raji’u (We are from God and to God we shall return).’ When I asked him the meaning of this phrase he replied,

‘It often happens in this world that man loses something, or suffers some calamity. On such an occasion, we must willingly resign ourselves to our misfortune, taking this to be God’s decree. God has made this world for the purpose of putting mankind to the Test. Here, receiving and losing are both designed as trials for man. Therefore, when man receives something, he should prove himself to be a thankful servant of God. And when he loses something he should adopt the attitude of patience. Only one who can do so will pass God’s Test.’

Undeterred by the loss, my father bought teak logs to rebuild his boat. I learned, as I watched him at work, that the main reason for teak wood’s durability is that it is not eaten away by white

4 Albert Einstein (1879–1955) was a German-born theoretical physicist best known for his mass–energy equivalence formula $E = mc^2$. He received the 1921 Nobel Prize in Physics. Dr Kalam visited his former home on 28 May 2005 during his state visit to Switzerland.

ants. Wood normally serves as food for white ants and once they have made inroads into the wood, it quickly degenerates. But the bitter taste of teak is not to the liking of the white ant. To preserve teak, nature simply endowed the teak tree with such a property as would keep its insect attackers at bay. Taking a leaf out of nature's book, I decided that I would strive to develop qualities that would keep my enemies away from me.

Inspired by my father's hard work in rebuilding his boat, I ventured into my first line of work: selling tamarind seeds. The pressures of World War II on the textile, paper and jute industries created a sudden demand in the market of tamarind seeds. A paste made of the seeds was used as a chemical for processing raw materials. I started going door to door, collecting seeds and selling them to the trading shop. A day's work would fetch me the princely sum of one anna, which was enough for a hearty meal at the time. I would proudly take the coin to my mother and give it to her for safekeeping. My father was pleased with my small enterprise. I overheard him praising me to my mother. He said that hard work, saving money and self-control are not important because they create wealth, but because they create character.

‘The characteristics in human nature which we love best grow in a soil with a strong mixture of troubles.’⁵

My next line of work was newspaper delivery; a common first job for youngsters throughout the world. India was forced to join the Allied Forces and troops were deployed in the Pamban area to counter any Japanese invasion by sea. The train halt at Rameswaram Railway Station was suspended and the train would now pass by it on the way to the Dhanushkodi terminus. My cousin Samsuddin entrusted me with the duties of collecting bundles of newspapers thrown by the guard from the moving train, and delivering the papers at people's doorsteps.

As I went about my deliveries, I noticed pictures of several national leaders printed on the pages of the papers. I was enthralled. The idea of an independent Indian nation was fast turning into a reality.

At the end of World War II, it was clear that India would soon be free from British rule. Gandhiji declared, ‘Indians will build their own India.’ An unprecedented sense of hope filled the air, and my family were keen to participate in the making of the new nation. When the first panchayat board elections took place at Rameswaram, my father was voted president of the Panchayat Board.

An incident that taught me much came from my father. One afternoon I was reading my lessons loudly in my home when a visitor came and asked for my father. I told him that my father had gone for Namaz. The man said, ‘I have brought something for him, can I keep it here?’ I called out to my mother for her consent, but she was also praying and did not respond. I asked the man to leave the bundle of clothes on the cot, and I continued my study.

5 Harry Emerson Fosdick (1878–1969) was an American pastor regarded by Martin Luther King Jr. as ‘the greatest preacher of this century’. Dr Kalam would recite these lines from Fosdick's hymn ‘God of Grace and God of Glory’: ‘Grant us wisdom, grant us courage, lest we miss your kingdom's goal.’

When my father returned and saw the bundle, he asked me, ‘What is this? Who has left this here?’ I told him, ‘Somebody came and left this for you.’ He became angry, and he reprimanded me severely. I was frightened and started crying. My mother embraced and consoled me. When my father’s anger subsided, he touched my shoulder lovingly and advised me never to receive any untoward gift from anyone—ever. He told me that such a gift is always accompanied with hidden motives and so is dangerous. It is, he said, like being handed a snake, which will only poison you with its bite.

India gained independence on 15 August 1947. True independence and freedom can only exist in doing what is right. A strange inner voice told me that it was time to leave the comfort of my small, idyllic town and move on. If you carry your childhood with you, you can never reach your potential. I took permission from my father to study in the high school at the district headquarters, Ramnad. My mother was hesitant, but she finally consented. She was like an immense tree for me, whose shade had protected me from all my problems. My mother brought all the coins I had earned selling tamarind seeds and distributing newspapers, and said these would help pay for my school fees. When I resisted, she said, ‘Mothers only give.’

I left my mother and father at our home in Rameswaram, and travelled with my elder cousin Samsuddin and brother-in-law Ahmed Jallaluddin to Schwartz High School at Ramnad. I was enrolled in my new school as A.P.J. Abdul Kalam. The letters A, P and J indicated my lineage—my great grandfather Avul, grandfather Pakir and father Jainulabdeen.

2

SNAKES AND LADDERS

“The roots of education are bitter, but the fruit is sweet.”⁶

At first, I found nothing much interesting in the Schwartz Higher Secondary School. The large grounds, the big trees and the tall ceilings and columns appeared as if transported from some faraway land. The desks and benches had been battered by the years, and the atmosphere at Schwartz was cold and impersonal after Rameswaram’s small town familiarity.

The school was named after Christian Frederick Schwartz, a German Lutheran Protestant missionary who had come early in 1750 to India. I was told that the aim of every missionary is to bring the saving Gospel of Jesus Christ to people who have never heard the Good News. When the Holy Spirit begins to gather people into Christian fellowship, missionaries assist these new Christians in forming their own, indigenous church leaders.

I was amazed to learn that Christians have different denominations. Lutheran Christians are the followers of Martin Luther, a sixteenth-century German monk, who established a system of living under vows of poverty, chastity and obedience in service to society, rather than through isolated austerity and devotion. Lutherans did not take the Pope as their leader as Catholics did. They followed the doctrine of justification by grace alone, which means that simply by one’s faith in Him, one removes the guilt of one’s sins. I missed the simplicity of Father Bodal’s mass in the sermons here, for which attendance was compulsory, and yearned to visit Rameswaram as frequently as I could.

Mindful of my frequent visits home, my father sat down with me and my mother one day and said that I must move my heart away from my home town and my family. Only then, he said, would the waves of destiny carry me to the ocean of knowledge. ‘Free yourself from worldly cares as much as you can. Never look back or feel sad about things—your home is wherever you are,’ he told me. I braced myself against the pangs of homesickness, of which I now felt quite ashamed. To save my father from the pain in his heart, which he surely felt by telling me this, I let go of the pain in mine.

⁶ Aristotle (384–322 BCE). Dr Kalam was deeply inspired by the ‘Big Three’ in ancient Greek philosophy: Socrates, Plato and Aristotle. He would call Socrates a street-corner philosopher, Plato the philosopher who would be king, and referred to Aristotle as the best student of Plato who taught Alexander the Great.

Instead of visiting Rameswaram, I now spent my free time exploring the Ramnad town. One day, I went to see the Sethupathi Raja Palace. I learned from my new friends in the school that the Raja of Sivagangai and the Sethupathi of Ramanathapuram were great kings who were defeated by the Nawab of Arcot in the eighteenth century. The throne of Arcot had two rivals: Chanda Sahib and Muhammad Ali Khan Wallajah. The British supported Muhammad Ali Khan Wallajah, while the French supported Chanda Sahib. This paved the way for a series of military conflicts amongst numerous nominally independent rulers and their vassals. These were struggles for succession and territory, fuelled by the struggle between the French East India Company and the British East India Company.

As a result of these military contests, the British East India Company established its dominance among the European trading companies within India. The French company was swept aside and largely confined to the enclaves of Pondicherry. In 1910, the British carved out a new district, Ramnad, from portions of Madurai and Tirunelveli, in an effort to govern this area more tightly.

I learned quite early in life that ‘divide and rule’ is the politician’s cry, just as ‘unite’ and ‘lead’ are the watchwords of the wise. It was not our differences which divided us. It was our inability to recognize, accept and celebrate those differences that allowed our great nation to be dominated by a much smaller, less prosperous one. Divisions kept us aground in the backwaters in the last centuries, missing any chance to set sail on the coming tides of fortune.

‘A nation is great, not because a few people are great, but because everyone in the nation is great.’⁷

In my second year in Ramnad, I became acquainted with S.T.R. Manickam, a revolutionary nationalist who housed a large library of books. Manickam would encourage people to read his books for free. The first time I went to the library, it was out of curiosity. When I asked Manickam Sir to suggest a good book for me to read, he said, ‘Any book that helps a child to form a habit of reading, to make reading one of his deep and continuing needs, is good for him.’

I found great solace in the company of books in Manickam Sir’s library, and I became a regular visitor there. After about a year, by which time I had finished reading about ten books, Manickam Sir told me, ‘Keep reading books, but remember that a book is only a book, and you should learn to think for yourself.’ Manickam Sir had become one of my early mentors, and he instilled a love of books in me that would last a lifetime.

Iyadurai Solomon, my teacher at Schwartz, was first to notice that the spark in my young mind had been kindled by the books from Manickam Sir’s library. I also felt a strong rapport with him. Iyadurai Solomon made me feel comfortable in class, with his warm and open-minded attitude. He would encourage me by saying that a good student could learn more from an ordinary teacher than a poor student could even from the greatest teacher.

7 APJ Abdul Kalam, Arun Tiwari, *You are Born to Blossom*, Ocean Books, 2008. p.33.

My high-school years coincided with perhaps the most tumultuous period of our nation's history. On 14 August 1947 Pakistan was declared a separate nation, and just after midnight, on 15 August 1947, India attained nationhood as well. Violent clashes between Hindus, Sikhs and Muslims followed. Some fourteen million people were displaced during Partition, the largest mass migration in human history.

Immediately after independence, armed tribal gangs from Pakistan invaded Kashmir. When India went to the United Nations complaining about this blatant act of aggression on its territory which had become part of India through an act of accession, the Western nations turned the whole issue on its head and declared Kashmir as a disputed territory.

The upheaval after independence raged into the following year. At 5.17p.m. on 30 January 1948, Mahatma Gandhi fell to an assassin's bullets at Birla House in New Delhi. He was about to attend a prayer meeting. I felt deeply saddened at the death of the father of our nation; shocked that anyone could kill him. I took some time away from school, and stayed at Rameswaram with my parents. There, I would hardly speak with anyone, and I often went to the mosque and sat there for hours, alone in contemplation.

One day my father sat by my side and asked the reason for my sorrow. I said, 'Father, our world is marred by injustice and dishonesty. There are all kinds of atrocities at both the individual and communal level. Why do people feel free to do as they please, without any moral consideration?'

My father said,

'God has not created people to be crazy. He has not created them to amuse himself. He has not created them just to eat, drink, sleep and have sexual relations. The freedom which people abuse is not a gift, but an obligation. Our world is a testing place, and on the Day of Judgement all without exception will be called to account for how they have used this freedom. If they have ignored and denied the truth in this world, they shall be obliged to accept it, anyway. Their options will run out; trickery and pleas for mercy will be of no use. Finally, it will be too late either to beg for forgiveness or to attempt to make amends.'

My father then told me gently,

'Son, do not ever wait to be forced to be good. Be good of your free will—here and now. And do not worry beyond a point about what is not in your control. Man is constantly under trial in this world. To pass all tests, you must learn your limitations along with your intellectual immeasurability. By doing so, you will be saving yourself from all misapprehensions, and exercising your free will to the pleasure of God. Your heart has to take one step toward God, and His love will take several steps toward you.

“There is no knowledge without a teacher”.⁸

After my talk with my father, I felt comforted, and ready to return to school. Back at Schwartz, I felt quite at ease now, too. Its fusty buildings from a bygone era had become familiar, and though it lacked the warmth of my home town, I had found my place in learning. I had also forged lasting bonds with my teachers.

I became especially close to my mathematics teacher, Ramakrishna Iyer. Ramakrishna Sir had a special fondness for me, and inspired my love for mathematics. The power of mathematics, Ramakrishna Sir taught, is that it may change one thing into another—it can transform geometry into language. So it is with education: It transforms our animal instincts into rationality.

Ramakrishna Iyer held a spiritual view of education. He believed that true education is not a process of pouring information into a student, but of calling forth what is already within. He saw it not as a process of memorization, but of nurturing, of allowing, of evoking. Education is, he told me, a process of bringing forth the person one is meant to be. For Ramakrishna Iyer, education was, above all, in manifesting the inner divine potential of man.

He once told me,

‘Book-based education cannot make a true man. Physical health, mental purity, intellectual acuteness, moral power and a spiritual outlook of life—with the correct effort supporting all of these—must combine for perfection to be achieved. Students should be thoroughgoing Brahmachari (observing chastity), adherents to satya (truth) and dharma (righteousness), to fulfil their potential.’

Ramana Maharshi, the ancient sage of the modern era, died on 14 April 1950. There was a condolence meeting for him in the school. Students were told that Ramana Maharishi was noted for his belief in the power of silence and his relatively sparse use of speech. He also showed a complete lack of concern, it was said, for fame or criticism, and had an unusual love of creatures and plants. Ramakrishna Iyer told me that evening, ‘Sat-chit-ananda (existence, consciousness and bliss) is a description of the subjective experience of God. This sublimely blissful experience of the boundless, pure consciousness is a glimpse of ultimate reality.’

Not understanding much of this, I at least gathered that if your inner world is peaceful and without conflict, your outer world will also be so. It was a valuable lesson to complete my high school education with.

After high school, I decided to pursue a career in science, and I secured admission at St. Joseph’s College, Tiruchirappalli. Until then, I had never travelled beyond Ramnad; this would be my first exposure to a large town. At the geographical centre of Tamil Nadu, Tiruchirappalli was the capital of the early Cholas in the third century BCE. With the passage of time, power changed hands

8 Swami Vivekananda (1863 –1902). Dr Kalam declared on 1 October 2004 at Swamiji’s ancestral house in central Kolkata that these words of Swami Vivekananda had been his guide: ‘Teach yourself, teach everyone his real nature. Call upon the sleeping soul and see how it awakes. Power will come, glory will come, goodness will come, purity will come, and everything that is excellent will come, when this sleeping soul is roused to self-conscious activity.’

between the Pallavas, medieval Cholas, Pandyas, Delhi Sultanate, Madurai Nayaks and finally rested with Chanda Sahib, Nawab of the Carnatic, before British rule.

As with most of our glorious land, Tiruchirappalli's rich heritage may still be seen in the monuments our forefathers have left for us. The Nayaks made Tiruchirappalli their capital in the seventeenth century and added to the existing Rock Fort Temple. The temple remains at the centre of the town, perched 83 metres high on a massive outcrop, surveying the landscape with majesty.

The buildings of the college were, I felt, just as magnificent. They had beautiful cloisters and spires like those of a centuries-old European institution. St. Joseph's College was established in 1844 by the Society of Jesus (the Jesuits)—a male order of the Catholic Church—and had been affiliated to Madras University since 1869.

I was lodged in a three-storey hostel building on campus, sharing a room with two other lads: an orthodox Iyengar Brahmin from Srirangam and a Syrian Christian from Kerala. For the first time, I was living with people whose upbringing was completely different from mine. I learned from this experience that harmony with others around you has little to do with their sharing a background or a faith. It is much more a matter of the harmony within yourself. It helped, too, that we maintained house rules and our hygiene, which are indispensable when you live in close quarters with others.

My roommates became close friends of mine, and we were a regular trio in and out of college. The three of us would walk through the town together in our free time. Together, we once even climbed the 400-odd steps to the top of the Rock Fort Temple, without stopping.

I was not a bright student at college in terms of examination grades, but I was studying hard and developing my mind. I knew by now that to succeed, I needed to develop a close and nurturing relationship with at least one teacher within the school. Our hostel warden and English lecturer Rev. Fr. Sequeira was one such teacher. He saw each student as an individual with hopes, dreams, strengths and vulnerabilities. Rev. Fr. Sequeira worked to create a classroom atmosphere in which every student could see every other student in this light; an atmosphere in which every student felt safe enough to share his thoughts and feelings. 'Life is a moving, breathing thing. We have to be willing to constantly evolve. Perfection is constant transformation,' he would say.

I was fortunate to have other, equally enlightened lecturers. They motivated me to pursue higher education as much as they urged me to develop myself as a person. My mathematics tutor, Professor Thothathri Iyengar was particularly inspiring. He and my other lecturers during these years helped me reach a higher state of being, of understanding. I would later come to know that no life can be purposeful without such a transformation. It is subtle, because it is in the inner world; but its effects on the totality of one's life are profound. As we go, so goes the world, for the world is us. The revolution that will save the world is ultimately a personal one.

One of my lecturers was particularly generous with his wisdom. In my third year at St. Joseph's,

I was appointed secretary of the vegetarian mess. One Sunday, we invited the rector, Rev. Father Kalathil to lunch. He told me, 'Kalam, don't waste your heart on this world, when God has already finished allotting you your shares in it, and has decreed their appointed times, known only to Him. Every day, He supplies you once again with fresh sustenance, whether you are looking for it or not.' This marked the beginning of my year-long spiritual fellowship with a great Jesuit teacher.

Rev. Father Kalathil wondered how ignorant are those who forget the power and the plan of the Originator and entangle themselves in the dynamics of secondary causes. Clinging to the latter and abandoning the former, people forget the everlasting and indulge in that which must pass.

Thanks to my teachers, I knew well as a youth that knowledge and devotion are the ladders to perfection. Conversely, the snakes of ignorance and hedonism will trap you in the lower levels of life's game. Or worse, they will consume you.

3

AUDACITY OF HOPE

‘Nature is never in a hurry. It operates in terms of millions of years. A human life spanning 80 or 100 years is nothing but a tiny fraction of nature’s work. A human lifetime is just wasted if it is spent in an unawakened state or slumber.’⁹

When I was in my fourth and final year at St. Joseph’s, I went one Thursday evening to the *dargah* of Nathar Vali, a Sufi saint who arrived in Tiruchirappalli in the eleventh century. Nathar Vali was among the first Sufis to bring Islam to South India and Sri Lanka. I sat for some hours at the *dargah*, quietly reflecting. After some time, a fakir appeared, as if from nowhere and sat down by my side.

‘What are you seeking, young man?’ he asked.

‘I am trying to see my real self,’ I said.

‘So what is the problem?’ the Fakir asked.

‘I am unable to see it,’ I said.

‘Scrub the *nafs*,’ said the fakir.

‘What is that?’ I asked.

‘*Nafs* is a term for the baser, lower, egotistical and passionate facets of human nature which comprises the vegetative and animal aspects of human life that shroud one’s real self. The central aim of a good human life is get rid of the *nafs* to achieve a state of purity and submission to the will of God,’ said the fakir.

‘What are these various psycho-spiritual stages? Please explain, I am really ignorant,’ I said.

‘There are psycho-spiritual phenomena that go through a human life through the situations and circumstances God creates with a great purpose. There is *qalb*. It stands for the heart which is the cradle of thoughts and emotions. It is indeed the battleground of two warring armies: those of *nafs* or passion, and *ruh* or spirit. Cleaning of the *qalb* is a necessary element in spiritual discipline for travellers on the right path. Then there is *sirr*, our egos. By emptying the *sirr*, we mean diverting one’s attention from the mundane aspects of said life and fixing it on the spiritual realm.’

⁹ APJ Abdul Kalam, Arun Tiwari, *Guiding Souls*, Ocean Books, 2005. p. 37.

‘You have used two different verbs—cleansing of *qalb*, and emptying of *sirr*. Why?’ I inquired.

‘The cleaning involves removal of the bias of what one likes and dislikes so that what is good is taken and what is bad is rejected. The emptying signifies negation and obliteration of ego-centred human tendencies. It is indeed hard work. Constant prayer and vigil are needed to achieve the illumination of the spirit. This is the essential spiritual journey,’ said the fakir with a tone of finality, and he rose to leave.

‘It is not in the stars to hold your destiny but in you.’¹⁰

Peace entered my heart. I did not get up to see the fakir off. I stayed sitting for another hour or so. That night, I enjoyed a sound and restful sleep and when I awoke the next morning, I immediately decided to cease my study of physics. I would pursue engineering instead. I knew I must do this to realize my dream of flying. Flying had captivated me from the moments when I saw seagulls aloft on the skies over Rameswaram’s waters, when Siva Subramania Iyer was teaching our class how birds fly. I could easily have made a choice to study engineering two years earlier but fortunately, even now there was a suitable course at the Madras Institute of Technology (MIT). I promptly applied for the three-year postgraduate diploma there in aeronautical engineering. My application was successful.

Admission to this prestigious institution was costly, however. My sister Zohara came to my aid, pawning her gold bangles and chain to provide for my admission fees. I was hesitant about taking her help, but I had no other option. Zohara indeed taught me all about real sacrifice. That it should be done from love. That it should be done from necessity, not without exhausting all other options. That it should be done for people who need your strength because they don’t have enough of their own. I tried to emulate my sister’s generosity throughout my life by sharing what I had and giving freely to worthwhile charities.

I quickly found my place at MIT. I was at ease with the study of engineering subjects, and I discovered my natural talent for technical drawing. I could easily look at things on different planes and from different perspectives; the plans, elevations and sections came to me with little struggle. The course was fascinating, too. I studied aviation and control techniques and defence systems that are used in airplanes and spacecraft. I felt a sense of purpose and satisfaction in acquiring skills to design, construct, develop, test and maintain any type of aircraft. I knew I had found my vocation.

The department’s learning atmosphere was intense, and the faculty comprised highly regarded international experts. Ours was a small class of about eight or nine students, which allowed me to interact closely with my lecturers, along with my classmates.

I felt a special affinity with Prof. Sponder, my teacher for technical aerodynamics. He was an Austrian scientist who had been captured by the Nazis during World War II and imprisoned in

¹⁰ William Shakespeare. Dr Kalam did not read Shakespeare extensively but used this quote from Shakespeare’s play *Julius Caesar* whenever he found anyone cribbing about destiny.

a concentration camp. Incidentally Prof. Walter Repenthin, a German, headed the aeronautical engineering department. We had another German lecturer, the legendary Prof. Kurt Tank. Prof. Tank had designed the Fockle-Wulf FW 190 single-seat fighter plane, an outstanding combat aircraft of World War II. The tension between the German professors and Prof. Sponder was clearly apparent.

‘When the student is ready the teacher will appear. When the student is truly ready ... The teacher will disappear.’¹¹

I admired Prof. Sponder’s individuality and high professional standards. He was always calm, energetic and in total control of himself. Prof. Sponder kept abreast of latest technologies and expected his students to do likewise. I would spend much time talking with him, and we took regular late evening strolls through the sprawling MIT campus.

Prof. Sponder told me that he indeed envied the great Indian civilization and the enduring identity of the Indian people. He explained that Austria has faced numerous problems throughout its history. Within Austria there are large regional variations, and parts of Austria have at various times wished to become part of adjacent countries. Prof. Sponder said that while Indians didn’t invade other countries, their great civilization has ‘digested’ the religions and customs of its invaders. Most invaders would never return to their lands; they would become over time, Indian themselves.

Another lecturer who made a strong impression on me was Prof. K.V.A. Pandalai, who taught me aero-structure design and analysis. Prof. Pandalai was a cheerful, friendly and enthusiastic teacher who would bring a fresh approach to the course every year. I gained a greater understanding of intellectual integrity from Prof. Pandalai. I had learned early in my life the need to be true to one’s own thinking. This was simple enough. Prof. Pandalai taught me a higher principle: To hold myself to the same rigorous standards of evidence and proof to which I held others. From that time, I adopted this principle, and it kept me firmly grounded throughout my career.

Intellectual integrity is related to intellectual humility, which Prof. Pandalai also stressed. Prof. Pandalai taught me how to be conscious of the boundaries of my knowledge and that I should never succumb to bias, prejudice and limitations of my viewpoint. This is not just a moral issue: staying conscious of the limits of your knowledge permits you to learn new things—and keeps you from making unnecessary mistakes.

I was truly fortunate. My lecturers were enlightened people, and they taught much beyond the curriculum. Prof. Narasingha Rao, a mathematician, not only taught me theoretical aerodynamics but also helped me appreciate more abstract thinking. I learned from him that no matter what your field of study, you can learn more from studying God’s contribution to that field than the contributions of all the world’s experts.

¹¹ Lao Tzu, ancient Chinese philosopher. Dr Kalam considered this quote as the truest interpretation of a teacher–student relationship. ‘Each one of us is here to learn from others and teach others around us,’ he would say.

Prof. Rao would say that God is infinite, because God has no beginning or end. He has always existed and always will. On the other hand, we humans are ‘semi-infinite’ because we have beginnings in our births, but our souls will exist forever. Knowing this, I came to the conclusion that from an eternal perspective, the length of time between birth and bodily death is not very important.

‘It is in your moments of decision that your destiny is shaped.’¹²

Although this length of time may not be so important, my experience was showing me that what you do with it is crucial. In my final year, I was assigned a project to design a low-level attack aircraft with four other colleagues. I assumed the responsibility of overall design and preparing the drawings. My teammates distributed amongst themselves the tasks of designing the propulsion, structure, control and instrumentation of the aircraft.

We worked at our assignment for some time. When Prof. K. Srinivasan, the guide and the Director of MIT reviewed our work, he bluntly expressed his disappointment, saying our progress was dismal. I asked for another month’s time to complete our assignment, but Prof. Srinivasan was not at all sympathetic. He told me, ‘Look, young man, today is Friday afternoon. I will give you three days’ time. By Monday morning, if I don’t get the configuration design, your scholarship will be stopped.’

I was deeply shocked by Prof. Srinivasan’s ultimatum, as the scholarship was my lifeline. If it were to be stopped, I would not be able to continue with my studies. There was no option but to finish the task within the three days our director had set, which seemed impossible.

I spoke with my team members. We quickly agreed we had to work together around the clock, and none of us slept that night. The professor’s deadline demanded this. Each of us worked at the drawing board and skipped dinner. On Saturday, I took only one hour’s break. On Sunday morning, I was close to completing my designs when I felt someone’s presence in the laboratory. It was Prof. Srinivasan, checking on our work. After looking at my drawings, he patted me and hugged me affectionately. ‘I knew I was putting you under stress and asking you to meet a difficult deadline. No stress, no progress!’

I learned an inescapable truth from this experience. I realized that we are all playing the ultimate game of life, regardless of whether we want to or not. Those who play the game well win in life, while those who play it poorly suffer. And those who do not know they are playing the game are subject to the cruellest of fates. Our destiny is to win at the ultimate game of life, for our destination is to sit with God. The fates of life only step in when we play the game poorly or refuse to play it at all.

¹² Dr Kalam liked Tony Robbins’s books *Unlimited Power*, *Unleash the Power Within* and *Awaken the Giant Within* and watched a few of Robbins’s lectures on YouTube.

“There is a divine purpose behind everything, a divine presence in everything.”¹³

When I graduated from MIT, I was twenty-six years old and ready to play the game of life. I was selected as a graduate trainee at Hindustan Aeronautics Limited (HAL) in Bangalore. My first placement was in the engine division at HAL, which dealt with the overhauling of both piston and turbine aircraft engines. Exactitude in this work is crucial; the result of tardiness can be catastrophic. This was surely good training for my later career in rocketry.

After some time, two other employment opportunities presented themselves. The Indian Air Force offered positions through short service commission, and the Directorate of Technical Development and Production (DTD&P) (Air), under the Department of Defence Production, Ministry of Defence, advertised positions for engineers. I applied for both and was called for interviews in January 1958 by the Indian Air Force at Dehradun and DTD&P (Air) at New Delhi. I had until this time never travelled beyond the southern regions of the subcontinent. Now, I would have to venture into the vast expanses of my country. I boarded the Grand Trunk (GT) Express at Madras Central Station and managed to secure a window seat.

The journey of two nights and a day changed my view of our land and its history. I could understand why the rich and fertile plains of the Ganga River and its numerous tributaries invited invasion from the people of hostile desert and mountainous lands. I saw, too, how the part of India south of the Tropic of Cancer remained largely untouched and safe behind the shield of the Vindhya and the Satpura mountain ranges. The Narmada, Tapti, Mahanadi, Godavari and Krishna Rivers had also woven a net of protection for the tapering Indian peninsula. Only the most determined of invaders could reach the far south of India.

After appearing for the interview at DTD&P (Air), I took a train to reach Dehradun. It passed through the historic city of Meerut, where India’s First War of Independence began on 10 May 1857. I stopped at Roorkee and visited the *dargah* Piran Kaliyar, which had been sanctified by the thirteenth-century Sufi saint of the Chishti Order, Alauddin Ali Ahmed Sabir Kalyari. I felt calm; infused with spiritual energy by the time I reported at the Air Force Selection Board (IAFSB) located in Clement Town at Dehradun.

I easily cleared the Stage-I tests, which consisted of an intelligence test (IQ Test) and several other examinations conducted on the first day. Twenty-five candidates were selected for the Stage-II testing, which consisted of a psychological test and group tests spread over five days. I passed all of them. Finally, I was interviewed on the last day, along with my fellow hopefuls. I finished ninth in the batch of twenty-five examined through Stage-II, to select eight officers. I was deeply disappointed; shocked, even. It took me some time to comprehend that the opportunity to join the Air Force had just slipped away from me.

13 Neale Donald Walsch (b. 1943) is an American author of the nine-book series *Conversations with God*. Dr Kalam read the entire series and discussed with me at length his 2014 book *God’s Message to the World: You’ve Got Me All Wrong*.

Feeling despondent and lost for purpose, I decided to spend some time in Rishikesh before I travelled to Delhi. I bathed in the Ganga and walked into the Sivananda Ashram situated a little way up the hill. There I met Swami Sivananda. My Muslim name aroused no reaction in Swamiji, who inquired about the source of my sorrow, even before I uttered a word. I narrated to him my unsuccessful attempt to join the Indian Air Force and my long-cherished desire to fly. My dreams, I told Swamiji, had just been shattered.

Swamiji told me to take life in his stride as it unfolds:

‘Accept your destiny and go ahead with your life. You are not destined to become an air force pilot. What you are destined to become is not clear to you now but it will be at the right time. Forget this failure for it has its own purpose to lead you to your destined path. Become one with yourself, that is all you have to do, the rest is done to you.

Have faith in God and live your life without fear and with hope in God’s good will. A faithful person constantly devotes the greater part of his days and nights in the hope of a better future for everyone around him. He goes beyond the ordinary customs of people, so the customary order of things will be certainly rearranged for his benefit. You will receive provision from sources you could never imagine, which you will be offered and ordered to accept.’

Swamiji’s words stayed with me after I left the ashram, as if they had been recorded in my mind. I was ready to leave the foothills of the Himalayas, the holy country of rishis and sages, and make my way back to a more mundane world. On the train making its way back to Delhi, I felt ready, too, to walk my destined path—even if this was not the way I had planned.

4

MEANDERING ACROSS THE MUNDANE

“There is always a danger that a person with my kind of background—rural or small town, middle-class, whose parents had limited education—will retreat into a corner and remain there struggling for bare existence, unless some great turn of circumstances propels him into a more favourable environment. I knew I had to create my own opportunities.”¹⁴

I returned to Delhi and joined the Directorate of Technical Development and Production (Air) as part of the Technical Centre (Civil Aviation). This organization carried out field inspections of military aircraft, airborne systems and other aeronautical equipment. As a Senior Scientific Assistant (SSA), I would inspect and certify aircraft for airworthiness, for which I would earn a basic salary of Rs. 250 per month. Airworthiness is the measure of an aircraft’s suitability for safe flight. For a young man with a dream of becoming a pilot, it was a huge disappointment. I decided, however, that I would not dwell too much on my setback at Dehradun. If I was not flying aeroplanes, at least I would be helping to keep them fit to fly.

After some time, I treated my failure to join the Air Force as a looking glass. It was time for me, I felt, to recognize what I actually amounted to and be modest about myself. Do we humans not begin as a nasty-looking liquid and end up as a corpse to be burned or buried? Sobered and grounded in my reality, I attended to my work with the discipline of a soldier and the equanimity of a saint. Nevertheless, I would at times feel pangs of creative energy, and wonder if this was the correct line of work for me.

I was kept busy enough not to have too much time to think, though. After a few months, I was sent to the Aircraft and Armament Testing Unit (A&ATU) at Kanpur. There, I was to participate in the tropical evaluation of the British Folland Gnat. This was a single-seat lightweight ground-attack and interceptor fighter aircraft which was to be inducted into the Indian Air Force.

Even in those days, Kanpur was a crowded, bustling city, and far from comfortable. My stay there too brought my first experience of a north Indian winter. For a young man accustomed to the year-round warmth of the deep tropics, its chill was a rude shock. Used to eating rice as I was then, I was also particularly troubled by seeing potato dishes on the table at every meal.

14 APJ Abdul Kalam, Arun Tiwari, *Wings of Fire*, University Press, 1999, p. 28.

I felt drawn into the mood of loneliness that hung over Kanpur, despite the presence of so many people there. It is a mood which one can often feel in big cities. The people on the streets had all come from their villages in search of jobs in Kanpur's factories. They had left behind the scent of their soil and the protection of their families—everything that grounded them and gave them purpose. How could these people—harassed, living on pittance and meandering across the mundane—be the creatures of a magnificent and caring God? I wondered.

► With few people to talk to in Kanpur, I developed the habit of reading newspapers, particularly the editorial pages. I became aware of the simmering trouble between India and China. Persecuted by the Chinese military, the Dalai Lama, ruler of Tibet, reached the Indian border on 30 March 1959. Indian guards escorted him to the town of Bomdila in present day Arunachal Pradesh. The Indian government had already agreed to provide asylum to the Dalai Lama and his followers in India. Soon, the Tibetan Government in Exile was established at Dharamsala in Himachal Pradesh.

The Dalai Lama's troubles led me to reflect on the state of the world. Why must people of peace and worship suffer brute military force? Had evolution made humans naturally peaceful, or was mankind more naturally prone to violence?

‘You must not lose faith in humanity. Humanity is an ocean; if a few drops of the ocean are dirty, the ocean does not become dirty.’¹⁵

Mankind, I saw, was not only committing acts of aggression against its own kind, it was also ruining the planet's ecology. On 13 February 1960, France conducted its first nuclear test, code-named Gerboise Bleue (Blue Desert Rat) in the Sahara Desert of Algeria. With an explosive yield of 70 kilotons, it was around four times as powerful as the ‘Little Boy’ nuclear bomb the US dropped on Hiroshima on 6 August 1945. Nuclear testing in Algeria resulted in massive environmental degradation, such as the movement of sand dunes in areas already affected by wind erosion. Radiation from the blast led to a decline in livestock and biodiversity, including the disappearance of a number of migratory and endemic reptiles and birds. How could man wreak such havoc on his own species and his own planet?

I spent many lonely nights pondering such matters. I was not grown enough to know the answers, but questions still nagged at my mind. I could see that violence, reconciliation, and cooperation are all part of human nature. I understood too, that evolution didn't just shape man to be violent or peaceful: it shaped man to respond flexibly to different circumstances—and to risk violence only when it made adaptive sense to do so. I was saddened that instead of competing for food, which had become relatively easy to obtain in most parts of the world, mankind was now competing for material resources like oil and minerals.

My stay in Kanpur had broadened my horizons, but work would take me back to the familiar world of the south before long. A large number of aeronautical projects were undertaken in the

15 Mahatma Gandhi

1950s and 1960s at HAL. The Aeronautical Development Establishment (ADE) was created in 1959 in Bangalore to provide research and development support to HAL. Aeronautical engineers working in various organizations supporting military aviation were pooled to form the core team of the new organization, and I was among them. We were tasked with sourcing equipment for the Indian Air Force.

As I was entering the ADE, Air India International was entering the jet age. On 21 February 1960, Air India International acquired a Boeing 707–420 aircraft, becoming the first Asian airline to induct a jet aircraft in its fleet. Jet services to New York International Airport, Anderson Field (later J.F.K. International Airport) via London were inaugurated that same year, on 14 May. On 8 June 1962, the airline's name was officially shortened to Air India. On 11 June 1962, Air India became the world's first all-jet airline.

India was also beginning to find its feet as a scientific nation in the early 1960s. The five Indian Institutes of Technology (IITs) were in place by this time, in Kharagpur (established in the year 1950), Bombay (in 1958), Madras and Kanpur (in 1959) and Delhi (in 1961). In order to make these institutes truly world class, the academic bureaucracy sought help from abroad. Soviet Russia assisted in setting up the IIT in Mumbai. The US helped setting up IIT, Kanpur. Germany had amassed trade surpluses, and the German government was persuaded to support an IIT in the south. The German government had initially proposed Bangalore as the location for the institute. C. Subramaniam, the education minister lured the German government representatives to Madras though, handing over the governor's estate for the new campus. The government of the United Kingdom and the Federation of British Industries assisted in setting up IIT, Delhi.

I found Bangalore, the 'Garden City of India', a great place to live. It was a contrast to the crowded and polluted Kanpur, and highborn, arrogant Delhi. I had, by now, internalized the pluralism in the great Indian society. India had an uncanny way of bringing out extremes in her people. It was, I guessed, because Indians had both suffered and benefitted from centuries of migration. As a survival strategy, the Indian people had developed an extraordinary ability to be compassionate and cruel, sensitive and callous, deep and fickle—all at the same time. Caste-mindedness and loyalty to different rulers, too, had weakened the will of Indian people for a single alliance. The making of a modern, unified nation still remained a work in progress. And it was painfully slow. Our divisions had left us weak— this, the nation would soon see.

'Peace is not absence of conflict; it is the ability to handle conflict by peaceful means.'¹⁶

On 21 September 1962, a border dispute between China and India erupted into full-scale war. It started with a major Chinese offensive in Ladakh and across the McMahon Line. The McMahon Line was a line on the map that had been agreed by the British and Tibetan governments in 1914 as the territorial border. With the annexation of Tibet by China, the McMahon Line was the effective

16 Ronald Reagan, the 40th President of the United States, was in office from 1981 to 1989. Dr Kalam's determination for India to possess nuclear weapons was so nuclear weapons would never be used against India.

border between India and China. The Sino-Indian War was a national humiliation for India, with China quickly advancing from the McMahon Line into Indian territory. The Soviet Union, the United States and Great Britain pledged military aid to India. China then withdrew its forces, and the war ended on 19 November 1962.

The war was a textbook case of the prepared overwhelming the unprepared. India's defeat was less due to its troops, who were outnumbered by the Chinese force perhaps eight to one, than divisions between its argumentative politicians and bickering generals. The Chinese leadership, in contrast, was organized and decisive.

The Sino-Indian War made a strong impression on me, not the least for how India must be prepared to defend its territory. The nation's land borders extend 15,107 kilometres and are shared with seven countries, some of which have competing interests—and may at times even harbour terrorists. This demands armed forces which are properly equipped and ready for combat. Diplomacy and moral conduct are essential, for without these, a nation suffers just as a person does in their absence. But we must never forget, too, a fundamental law of nature: Strength respects strength.

‘There is no substitute for patience and acceptance.’¹⁷

Against a backdrop of widespread concern for our nation's safety, I began my reach for the heavens. A new organization, the Indian National Committee for Space Research (INCOSPAR) was set up in 1962 under the Department of Atomic Energy. Dr Vikram Sarabhai, director of the Physical Research Laboratory (PRL) in Ahmedabad, was at its helm. The organization was given the task of formulating the Indian Space Programme.

Dr Sarabhai played several roles in his efforts to nurture the fledgling space programme. He was a roving diplomat, teacher, strategist, friend, counsellor, leader and system builder. Within India, the unusual combination of his scientific reputation, aristocratic background and disarming simplicity created a loyalty—often amounting to devotion—among those who knew him.

INCOSPAR commenced its work as part of the Tata Institute of Fundamental Research, led by Prof. M.G.K. Menon. Its first task was to attract good people and groom them with necessary skills and competencies. It was this that brought Prof. Menon to ADE, Bangalore, where he spoke with me and asked me to join the organization.

INCOSPAR's first objective was quite straightforward: To establish a modest sounding rocket¹⁸ launching installation at Thumba in Kerala. From there, it would provide facilities to the international scientific community to gather data. Although there was initially no mention of

17 Cesar Chavez (1927–1993) was an American labour leader and civil rights activist. Dr Kalam took his slogan ‘I can do it’ from his Spanish ‘Sí, se puede’, which means ‘Yes, one can’ or ‘Yes, it can be done’.

18 Sounding rockets are launched with scientific instruments to probe the upper atmosphere and space.

developing satellites and satellite launch vehicles¹⁹, Dr Sarabhai must have had it in mind. Among the locations closest to the equator in India, and situated on the coast, Thumba was ideally situated for launching geostationary satellites²⁰.

‘Human progress is neither automatic nor inevitable. ... Every step forward requires sacrifice, the tireless exertions and passionate concern of dedicated individuals.’²¹

Thumba was a small village known only for its fishing. A site extending a distance of about two and a half kilometres and covering about 250 hectares was identified by the INCOSPAR team. Within this area stood an ancient church of St. Mary Magdalene at Pallithura and the bishop’s residence. Prof. Vikram Sarabhai met several politicians and bureaucrats for help in obtaining the land, but his efforts were wasted. Determined to succeed and convinced of the purity of his mission, Prof. Sarabhai decided to meet the bishop and plead his case personally. At that time, Rev. Father Peter Bernard Pereira was the bishop. Prof. Sarabhai met him on a Saturday. The bishop heard him patiently and asked him to come to the Sunday morning mass, where he would present the matter before the community.

At the mass the following morning, the Bishop said,

‘My children, I have a famous scientist with me who wants our church and the place I live for the work of space science research. It is true that science enriches human life. What he is doing and what I am doing are the same. Within six months, our abode and church will be newly built and given to us. Children, can we give them God’s abode, my abode and your abode for a scientific mission?’

There was a pin-drop silence for a few moments, then a loud ‘Amen’ from the congregation filled the church.

The bishop and his congregation’s warm gesture for the greater good would pay dividends for the nation over the following decades.

Our team quickly set to work on the site, making use of whatever we could there for our purposes. TERLS (Thumba Equatorial Rocket Launching Station) was soon up and running. Our pioneering space programme was not the least bit fancy, though. The church building served as the main office for the scientists. The bishop’s house was converted into a workshop. Even a cattle shed became a makeshift laboratory for the sounding rockets.

Our work of establishing TERLS was an enormous task. Facilities needed to be built, and we

19 A satellite launch vehicle is a rocket used to carry a satellite from the Earth’s surface into outer space.

20 A geostationary satellite is a satellite placed in a geostationary orbit. This is a circular orbit 35,786 kilometres (22,236 mi) above the Earth’s equator. It follows the direction of the Earth’s rotation, such that the satellite appears motionless, staying in a fixed position in the sky to ground observers.

21 Martin Luther King Jr. (1929 –1968) was leader in the African-American Civil Rights Movement. Dr Kalam saw King as his alter ego and was deeply pained he was assassinated on 4 April 1968. Decades later, Dr Kalam based his ‘Dream, dream, dream ...’ slogan on the famous ‘I Have a Dream’ speech of Martin Luther King Jr.

had to bring ourselves up to speed on unfamiliar technology. While it was a classic bootstrapping effort, our passion for the work fuelled our efforts. There were no strict working hours, and it was common practice for scientists at Thumba to work as much in a day as they could, only stopping in time to catch the last bus of the evening. Before long, the management arranged for a Jeep to take the scientists home after late-night shifts.

While the facility was being built, it was decided to send seven rocket engineers for training with NASA in the United States. I was among the seven chosen.

5

FROM A COCOON, THE BUTTERFLY

‘America was built on courage, on imagination and an unbeatable determination to do the job at hand.’²²

A group of four of us, all engineers, travelled to the Langley Research Center (LaRC) in Hampton, Virginia, in March 1963. The centre conducted basic research in a variety of fields for aeronautical and space flight. It also had management responsibility for the Lunar Orbiter and Viking projects and the Scout launch vehicles. We lived in the hostel attached to the centre and would eat at the self-service cafeteria, trying to pick vegetarian fare from among the many meat dishes. Mashed potatoes, boiled beans or peas, bread and lots of milk soon became my staple diet.

After completing our training at LaRC, we went to Goddard Space Flight Centre (GSFC) at Greenbelt, Maryland. GSFC was named after Dr Robert H. Goddard, a rocket theorist and practical inventor who first launched a liquid-propellant rocket in March 1926. Goddard Space Flight Centre was responsible for unmanned spacecraft and sounding rocket experiments. It also operated the worldwide Space Tracking and Data Acquisition Network (STADAN), which later became Spaceflight Tracking and Data Network (STDN); and it managed the development and launch of the Thor-Delta launch vehicle.

In the third and final phase of our training we were posted at the Wallops Flight Centre (WFC) at Wallops Island in Virginia. WFC was the only rocket flight-test range owned and operated by NASA. Wallops launched Scout boosters and sounding rocket experiments, with instrumentation developed by scientists and engineers throughout the United States and the world.

Our visit to America was not all work. On weekends we would go to Washington D.C. on an old Dakota plane, which NASA used to fly free of charge for its employees. Hotels at Washington offered discounted room charges for NASA personnel then, but it was still about \$6 per night, and too costly for us. We would save what money we had and stay awake overnight, roaming all over the US capital before catching the early-morning shuttle flight back to Wallops.

²² Harry S. Truman, the 33rd president of the United States (1945–1953). He made the decision to drop the atomic bomb on Hiroshima and Nagasaki. Dr Kalam always referred to Truman as ‘the bomb fellow’.

‘God has no intention of setting a limit to the efforts of man to conquer space.’²³

Immediately upon my return to Thumba, the Nike Apache rocket was successfully launched with the Vapour Cloud payload, on 21 November 1963. This marked the beginning of the Indian space programme. It was followed by launches of Russian M-100 and French Centaure sounding rockets. While the M-100 could carry a payload of 70 kilograms to an altitude of 85 kilometres, the Centaure was capable of reaching 150 kilometres with a payload of approximately 30 kilograms.

Facilities were still very basic at the Thumba site. The launch pads were still being built; and since the only vehicle there was always busy, we had to either walk or use a bicycle to move within the range. Not being a cyclist, I would often hitch a ride on the back of a bicycle with a colleague. We would even tie rocket parts and payloads to the bicycle frame to take them from place to place in the complex.

Once we had become used to launching foreign-made rockets, our task was to build the first modern Indian-designed rocket. In a sense, there was a historical symmetry to this. Rockets had first made their impression on the world in south India, under Hyder Ali and Tipu Sultan late in the eighteenth century. These Mysorean rulers had successfully deployed thousands of Mysorean rockets against British East India Company forces, who had been awed by their glare and terrifying destruction.

The rocket we planned to build, of course, would have quite a different purpose. Its payload was to be research instruments, which it would carry into the sub-orbital region in the upper atmosphere to collect scientific data. Our first sounding rocket was named RH-75: ‘RH’ was for ‘Rohini’, the name of the rocket series, and ‘75’ was its diameter of 75 millimetres. It was a 1.5 metre-long rocket, so small and thin it looked like a pencil from a distance. The RH-75 made its maiden flight on 20 November 1967. This was the fifty-second launch of a sounding rocket from TERLS. It was flown twice again in 1967 and another twelve times in 1968, making a total of fifteen RH-75 flights. Our groundbreaking indigenous rocket was a success.

There were other exciting challenges before us. NASA was planning a series of Applications Technology Satellite (ATS) launches. The Applications Technology Satellites were to be placed into a geostationary orbit, where they would perform functions in communication, meteorology and navigation. NASA made mention of its need to field-test an ATS project, which involved direct television broadcast for receivers, from a satellite. The three countries that were large enough and close enough to the equator for testing a direct-broadcast geostationary satellite at that time were Brazil, China, and India.

23 Dr Kalam regularly quoted Pope Pius XII (1939–1958), who headed the Roman Catholic Church at the dawn of the space age, during his numerous speeches to medical professionals and researchers. Dr Kalam emphasized the rights and dignity of patients and medical responsibilities. He also underlined the moral implications of psychological illnesses and the uses of psychopharmaceuticals—and the rights of family members to make decisions against expert medical advice.

Brazil proved uninterested; its population was mostly concentrated in a few cities, and conventional television broadcast technology was clearly a better solution. The People's Republic of China was out of the picture for political reasons. India was therefore the only feasible option for an ATS field test. It was densely populated, yet only Delhi had a television transmitter—a small one, left behind by a Dutch electronics company after a trade show.

‘Come, my friends,
It is not too late to seek a newer world ...’²⁴

Dr Sarabhai cleverly seized this opportunity. He requested NASA to provide INCOSPAR an ATS satellite for a year to conduct a satellite instructional television experiment in India's villages. He saw a great opportunity to convince India of the need to invest heavily in space technology. It was a unique chance, he well knew, for INCOSPAR to learn the ground segment of a satellite system from the Americans. It was a priceless opportunity too for a whole generation of Indian scientists and engineers to be initiated in this technology. The organization would also receive a systems management lesson for later building our own satellite.

On the strength of Dr Sarabhai's persuasion, the Indian Department of Atomic Energy and NASA signed an agreement for the Satellite Instructional Television Experiment (SITE) in 1966.

With these developments, the Indian government soon recognized the role of space communications in nation building. An Experimental Satellite Communication Earth Station (ESCES) was established in 1967 at Ahmedabad. On 15 August 1969, INCOSPAR, under the Department of Atomic Energy, was made independent as the Indian Space Research Organization, and the Department of Space was created by Prime Minister Indira Gandhi.

‘Understanding paradoxes is essential. Most of the time, you are not able to live by the golden mean, but you must live without rest in tension between mutually exclusive demands.’²⁵

Freedom comes from strength and self-determination. These were goals of decades and generations when the nation was starting its space programme from scratch. Dr Vikram Sarabhai could see that for India to become a spacefaring nation, it would have to forge a series of partnerships with nations at the forefront in space technology. India, in turn, would have to offer its cooperation to these nations. Coupled with hard work, this could allow, over time, the country to build a thriving technological sector. It is impossible to get something for nothing.

Vikram Sarabhai's practical approach to developing indigenous technology was inspiring for me. In one sense, it seemed the very opposite of the swadeshi philosophy. It was likely, though, the most effective and sensible means of achieving swadeshi aims in those times. Some would have

24 Alfred Lord Tennyson in ‘Ulysses’. Dr Kalam would quote Tennyson's famous line from his poem ‘Sir Galahad’: ‘My strength is as the strength of ten; Because my heart is pure.’

25 APJ Abdul Kalam, Arun Tiwari, *Guiding Souls*, Ocean Books, 2005, p. 108.

had us shut our doors to the world to become more self sufficient in those years. Dr Sarabhai demonstrated that by opening doors and inviting discussion and cooperation from abroad, far more can be accomplished.

His approach was as much about cooperation within the nation's technology community as it was about international associations. In January 1968, Dr Sarabhai called me to Delhi, and showed me a Russian rocket-assisted take-off (RATO) system at Tipat range. He entrusted me and an Air Force Group Captain, Narayanan, with the duty of making the rocket in India. The RATO system would be used for helping military aircraft into the air on short Himalayan runways. The development work was to be carried out at the Space Science and Technology Centre where I was working with the Defence Research and Development Organization (DRDO), HAL, DTD&P (Air) and Air Headquarters.

Here I was, an Indian rocket engineer and Air Force Group Captain, liaising with numerous bodies within our nation's defence establishment. Our task was to build a rocket of a design that had been given freely by the Russian government. It was truly a case of myriad partnerships; collaboration across international borders and between Indian institutions.

I always believed in the value of institutions. India's ancient civilization has survived because of its institutions—and I mean this in the broader sense of the word. Our nation and culture have survived successive invasions over thousands of years, and more recently colonial rule and other setbacks. This is because our people have lived as members of institutions—of families and communities—rather than as individuals.

The strength of our institutions is just as relevant for the individual as it is for the nation. Indian people always found meaning in their lives not by their individual strength, but from living in harmonious social relationships. And to be successful, you most surely need to find a place for yourself in your family, schools, colleges and the many worldly institutions that you encounter in your professional life. It is your duty to yourself as much as to those around you.

Group Captain Narayanan and I, two very different men but both products of intensive training in institutions, had quite a challenge ahead of us. The Russian RATO Dr Sarabhai had shown us was impressive. This 220 kilogram unit was capable of generating a 3000 kgf thrust with a total impulse of 24,500 kilogram seconds. Our duty was to fit an Indian version of the rocket on the HF-24 Marut jet fighter bomber, an aircraft designed by my former professor at MIT, Kurt Tank. Narayanan and I seemed an odd pair to head this project. He was a perfectly groomed, forceful military officer; organized and impatient. I was a scientist and engineer, comparatively casual in manner and dress. With a select team, we had to achieve our goal within only eighteen months.

By this time, I knew that technology is only useful if it is relevant to people; it must be meaningful for them, and they must see that it is for their benefit. I understood too that any promising early-stage technologies developed in laboratories required 'maturation'. This means additional development, testing, prototyping; and only then are the technologies ready for use in their intended application.

This project was to require all these steps. With the RATO, I had opted for a composite structure for the motor, using filament fibreglass and epoxy. I also used composite propellant with event-based ignition and a real-time jettisoning system. These were fairly new technologies, and needed much development.

The first static test of the RATO motor was conducted in February 1969. Another sixty-four tests followed in the next four months. All this was accomplished with only twenty engineers working on the project. The RATO project was a success; and it was achieved by partnerships between defence institutions and with the help of private organizations.

I learned the secret of managing technology intensive projects through the RATO project. The proper combination of technology and human skills is full of promise but hard to realize. Failure here most often lies in the mishandling of the technology: Lack of knowledge and inadequate skills lead to this mishandling. Knowledge and skills must be properly developed for success—knowledge comes from learning; skills come by doing. And there are no shortcuts here. It is much the same for every field or profession.

‘If your actions inspire others to dream more, learn more, do more and become more, you are a leader.’²⁶

Another factor which allowed Group Captain Narayanan and me to successfully oversee the RATO project was Dr Sarabhai’s approach. He supported our project wholeheartedly. But more than that, he placed trust in us, and allowed us the freedom to work efficiently whenever we requested it. He agreed to my request for us to use air freight and travel by air rather than train to save time, which was most unusual in those days. He also granted his permission for private companies to assist us where we felt it was necessary. Trust, I would come to understand, is the basis of all productive business.

I would draw other conclusions from the RATO project. We often hear of ‘born leaders’, which tends to discourage the less forceful among us from taking on leadership roles. Leadership, I now knew, was something that could be learned and developed over time. Leadership comprises specific mental and interpersonal skills that are accessible to everyone, not only a select few. In order to master these skills, individuals must view them as behaviours that require careful reflection, evaluation and practice.

The learning of leadership is as much an inner process as it is in learning to deal with others. It is useless to develop externally oriented abilities without working on internally oriented ones. The internal work includes gaining self-awareness, asking powerful questions, communicating with a purpose and developing an entrepreneurial mindset.

²⁶ John Quincy Adams was the 6th president of the United States (1825 -1829). Dr Kalam would talk of the fundamentals of American foreign policy laid down by Adams—self-determination, independence, non-colonization, non-intervention, non-entanglement in European politics, freedom of the seas and freedom of commerce—and how the US under later presidents abandoned all of these.

Dr Sarabhai, a brilliant leader himself, understood that becoming a leader was also about taking the best advantage of the circumstances around you. ‘How else would you climb the ladder of success,’ he would ask us, ‘without stepping on the rungs of opportunity?’

A new leadership challenge awaited me after the RATO project’s completion. Dr Sarabhai released a ten-year plan for space research in the country. This document made it clear that the long-term goal of the ISRO would be for national development. The ISRO, it said, must help the nation by focusing on telecommunication, remote sensing for resource surveys and meteorology. For this, we needed to design, fabricate and launch Indian satellites, including geosynchronous²⁷ ones, with Indian launch vehicles. I was handpicked by Dr Sarabhai as the project director for building the Satellite Launch Vehicle (SLV).

The SLV was to be a four-stage²⁸ rocket with all solid-propellant motors. This would be the first indigenous rocket to put a satellite in a low-earth orbit, which means at an altitude of between 160 kilometres (c. 100 miles) and 2,000 kilometres (c. 1,200 miles). There, the satellite would have an orbital period of between approximately 88 and 127 minutes. Objects below 160 kilometres of altitude would experience very rapid orbital decay and altitude loss under the gravitational pull of the earth. Our target was to put a 40 kilogram satellite load into a 400 kilometre orbit.

The active international cooperation which nursed the ISRO in its early years was now to give way to self-reliance and the development of indigenous technology. The organization was to work on spacecraft subsystems like apogee and booster motors, momentum wheels and solar panel deployment mechanisms. The plan promised technological spin-offs like gyroscopes, transducers, telemetry, special materials, adhesives and polymers. These could be developed by the ISRO and later used for general industrial applications to boost the nation’s manufacturing sector.

We would still take note of existing, successful technology from overseas. Our starting point for the SLV would be the Scout (an acronym for Solid Controlled Orbital Utility Test system). The Scout was designed in 1957 at the US Langley Research Center, where I had trained with my colleagues. It was the first, and for a long time, the only orbital launch vehicle with a four-stage, all-solid propulsion design. The standard Scout launch vehicle was approximately 23 metres (75 feet) in length with a launch weight of 21,500 kilograms (47,398 pounds). It was a long way from the tiny RH-75 with which we had begun our indigenous space programme.

By 1971, the design phase of the launcher was complete, and of the six designs the team had produced, Dr Sarabhai chose the third. The project was thus named SLV-3.

Not long after the SLV-3 project began, the Indian scientific community was deeply saddened by Dr Vikram Sarabhai’s passing away, on 30 December 1971. He was only fifty-two years old.

27 A geosynchronous satellite has an orbit around the Earth with an orbital period intentionally matching the Earth’s sidereal rotation period (the rotational period with respect to the stars). A satellite in a geosynchronous orbit is at an altitude of approximately 35,786 kilometres (22,236 miles) above mean sea level.

28 A stage in rocketry refers to an engine with its own propellant.

I was shocked by the suddenness of his death, and felt his loss keenly. Just hours before he died of a cardiac arrest, I had spoken with Dr Sarabhai on the telephone from the Delhi airport before I boarded a flight to Trivandrum. He had asked me to meet with him at the airport when I landed. Instead of meeting him when I arrived at the airport, I was met with the news of his death. For a time, I felt lost. My guru and mentor was no more.

In the coming years, I would face the deaths of my mother and father, too. These experiences, and several national tragedies where people died needlessly, led me to contemplate the matter of death deeply. It seemed to me that though death is a universal life event, almost no one wants to die. Even people who want to go to heaven don't want to die to get there. Yet death is the destination we all share. Nobody has ever escaped it. And that is as it should be, because death is very likely the single best invention of life. It is life's change agent. It clears out the old to make way for the new.

► In any case, Dr Vikram Sarabhai's brainchild, the SLV-3 project, would be guided by others after his passing. Dr Satish Dhawan eventually took over as the permanent head of the ISRO, while Dr Brahm Prakash was to be my director. TERLS was renamed Vikram Sarabhai Space Centre in Dr Sarabhai's honour. Dr Vikram Sarabhai did not live to see his dream of a spacefaring India come to pass; but we faithfully followed his vision.

The SLV-3 was a quantum leap from our earlier efforts. Building the Rohini sounding rockets themselves was no small matter, especially with our limited resources. Even with a sizeable budget and the input of many scientists, designing and building a functional satellite and a launch vehicle was a titanic undertaking.

Nonetheless, I was very comfortable working on the SLV-3 project. I would never tire of meeting people: discussing, arguing, explaining and understanding issues. It was my passion. I had no time for idle gossip and small talk. When at leisure, I preferred reading a good book or listening to Carnatic music to socializing. I was convinced that living according to reason and virtue is to be in harmony with the universe's divine order. I was gradually realizing the importance, too, of living a purposeful life. I felt free from the prison of sensory pleasures and miseries hidden behind merry-making. Now in my forties, I was well settled in a bachelor's lifestyle, which was perhaps not much different from that of a monk or a sadhu's.

I would need the patience which comes with middle age and a settled mind. The project contrasted with the RATO endeavour, whose development only involved a few aspects and progressed with a sense of urgency. The SLV-3 was plodding along many developmental paths, one of which could best be described as a blind alley. We entered into a partnership with the French space programme, where SLV-3 and the French launch vehicle Diamant BC would share a fourth stage. Our team spent two years redesigning the SLV-3 fourth stage to suit the Diamant, only to have France abandon its national launcher programme in favour of the European Ariane launcher in 1975.

I was most upset, to say the least. My director Dr Brahm Prakash helped me gain a different understanding of what I saw as a wasted two years. He told me that in international space

collaborations, there is give and take in so many forms, that it is spread over long periods of time, sometimes across generations of people. International technology exchange is like *Indrajaal*: it is a mysterious web of technical know-how intricately woven across institutions. No good work done ever goes to waste; it gets reflected and utilized somewhere else.

In these years, Dr Brahm Prakash and I became especially close. We would take evening strolls after work at times, and though he was a heavy smoker, he never lit a cigarette as we chatted and walked. He reminded me of my father, especially in how he expressed his wisdom. He once told me, ‘Humility is not the act or posture of lowering oneself in relation to others. Humility is about having a clear perspective and respect for one’s place in context.’

Dr Brahm Prakash’s harmonious leadership and intelligence kept the challenges of the SLV-3 project in perspective. Perhaps this helped us deal with the disappointment of India launching its first satellite with a Russian rocket rather than the SLV-3. On 19 April 1975, India launched the satellite Aryabhata from Kapustin Yar, Astrakhan Oblast, in Russia.

Aryabhata was named after the famed Indian astronomer and mathematician of the fifth century. It was an impressive satellite, constructed as a twenty-six-sided polyhedron with a diameter of 1.4 metres. All of its faces, except the top and bottom, were covered with solar cells. A Kosmos-3M launch vehicle was used to put the Aryabhata into a near-circular orbit of 600 kilometres altitude.

The launch of Aryabhata was a success. A combination of government support and international collaboration had brought India into the space age. The ISRO owes much for this to the work of Dr Vikram Sarabhai: a man who was a visionary and a patriot. His brilliance in his field was combined with a revolutionary desire to use technology to benefit his country; and equally, its people.

Dr Sarabhai was a natural diplomat, too, with a gift for reaching out and inspiring international cooperation. Vikram Sarabhai managed to secure the American space organization NASA’s cooperation, while laying the groundwork for Aryabhata’s launch from a Russian cosmodrome. This was at a time when the US and Russia were still facing off in the Cold War. It may very well be that space programmes played some part in maintaining peace between the world powers.

‘Success is the result of perfection, hard work, and learning from failure.’²⁹

The Aryabhata was followed by Bhaskara-I, named for the great Indian mathematician of the seventh century. Bhaskara-I was launched on 7 June 1979, again from Kapustin Yar. The 444-kilogram satellite built by the ISRO was fitted with two television cameras, one of which was infra-red. The satellite collected data related to hydrology, forestry and geology. For the Satellite Telecommunication Experiments Project (STEP) to establish satellite-based post and telegraph services during 1977-79, the ISRO used the Franco-German *Symphonie* satellite.

²⁹ Colin Powell was the 65th United States secretary of State under President George Bush (2001 -2005). I watched his 2003 speech to the United Nations on television with Dr Kalam, in which Colin Powell gave a detailed description of Iraqi weapons programmes. Dr Kalam asked, ‘Why is he lying?’ The weapons, as it turned out, did not exist, and that speech became a blot on Powell’s otherwise illustrious record.

A little more than two months after Bhaskara-I's successful launch in Russia, on 10 August 1979, we held the first experimental flight trial of SLV-3. The primary goals of the mission were to conduct a live test of the satellite launch vehicle to evaluate on-board systems like stage motors, guidance and control systems and electronic subsystems. With the test, we could also evaluate ground systems, like checkout, tracking, telemetry and real-time³⁰ data facilities in launch operations built at Sriharikota High Altitude Range (SHAR) in southern Andhra Pradesh.

The rocket took off at 0758 hours. Stage I performed perfectly, but the second stage went out of control. The flight was terminated after 317 seconds, and the rocket's shattered wreck splashed into the sea, 540 kilometres off the coast of Andhra Pradesh. A fuel leak had caused the failure; but I was not to know that until later.

To say that this incident caused me profound disappointment would be an understatement. It was among the most traumatic experiences of my life. As the project director, I was responsible for the success or failure of the test. Immediately after the flight's termination, someone asked me, 'What do you suppose could have gone wrong?' I walked away without answering. I had had a night-long countdown and little sleep throughout the week. My legs were stiff with tension. I was too tired to think. I just went to my room, collapsed on the bed and slept.

When I awoke a few hours later, I found Dr Brahm Prakash waiting outside my room. He took me for a late lunch at the canteen and we spoke. Not a word was said about the test disaster. He took me to a press conference in the evening. It was attended by a large contingent of Indian and international press; and of course, the entire ISRO top brass. I felt that I would be destroyed by the media.

Prof. Satish Dhawan took charge of the situation. First, he surprised everybody with his opening statement, congratulating the SLV-3 team for achieving a flawless launch and their successful development of the first-stage booster motor. He mentioned me by name, saying that I had shown exemplary leadership. He said that I had put in a mammoth effort involving thousands of people over seven years—and had never allowed personal likes and dislikes to come in the way of my duties. I was stunned.

When one correspondent questioned him, saying, 'Twenty crores of taxpayers' money has been drowned in the Bay of Bengal,' Prof. Dhawan kept his cool and answered,

What is being attempted in the space programme in India has far reaching consequences. You will not be able to count the amount of money that would go out of the country in the future if India does not have its own communication and remote-sensing satellites. Please understand the billions of dollars' worth of work done by low paid and frugally living employees of our government organizations.³¹

30 Real time is time calculated backwards, with the rocket firing at 0 second. It is independent of clock time.

31 Arun Tiwari, *Indian Above All—A.P.J. Abdul Kalam: A Life*, HarperCollins, 2015, p.95.

There was silence. Prof. Satish Dhawan then added that he was confident that in exactly a year's time, SLV-3 would successfully place a satellite in orbit.

Later, I offered to resign, but Prof. Dhawan would not hear of it. He told me, 'Kalam, your work has far reaching consequences. This is your destiny. Don't run away from it.'

SLV-3 was successfully launched on 18 July 1980. It placed the Rohini satellite RS-1 in orbit, thereby making India the sixth member of an exclusive club of spacefaring nations. The success of the SLV-3 project showed the way to advanced launch vehicle projects such as the Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV). On 26 January 1981, the Republic Day of India, I was awarded the Padma Bhushan, the third-highest civilian honour of the country. Anna University, Madras, conferred upon me the honorary degree of Doctor of Science. I had emerged from my cocoon.

6

INSTRUMENT OF GOD

‘The turning point in the process of growing up is when you discover the core of strength within you that survives all hurt.’³²

My Padma Bhushan triggered mixed reactions at the ISRO. While some there shared my happiness, others felt I was being unduly singled out for recognition. Some of my closest associates became envious. An inner voice told me that the time had come for renewal. As if in answer to my prayers, I had a chance meeting with Dr Raja Ramanna, pioneer of India’s nuclear programme with Dr Homi Bhabha. Dr Ramanna was the scientific adviser to the defence minister at the time.

Dr Raja Ramanna invited me to the Defence Research and Development Organization (DRDO) and smoothened my exit from the ISRO. I joined the DRDO’s missile development centre in Hyderabad, the Defence Research and Development laboratory (DRDL), as its director on 1 June 1982.

My move was upwards: it was a promotion in the scheme of things. But for me, this was unimportant. Taking up my new position was simply a matter of facing new challenges and a change of scene, which everyone needs from time to time. I had realized by then that one who attaches importance to themselves, has no real importance. I need not be concerned about my career, too, because its search for me was more important than my search for it. Authority will be conferred upon you according to how you conduct yourself and how you perform, not by how you feel about your career path. And you can never really know where your career may take you, anyway. God knows what man doesn’t!

My move to the DRDL was part of a government and Department of Defence endeavour to develop an Integrated Guided Missile Development Programme (IGMDP). Missile development had been stuck at the drawing board and static test bed stages for some time. Our nation had long lagged behind regional and world powers in military hardware, and it was time for India to take its

³² ‘Max’ Lerner (1902–1992) was an American journalist and educator. Dr Kalam had his book *The Unfinished Country* in his personal library. He read to me from the book the following description of American culture: ‘Always striving, always hungry, never satisfied ... an open universe of tragedy and conflict and choice.’

national defence seriously. Political will for the IGMDP was backed by significant resources, too. Defence Minister R. Venkataraman managed to get an unprecedented budget of Rs. 388 crores (50 million dollars in those days) sanctioned for the programme.

The five projects included in the programme were given appropriate Indian names, in the spirit of India's tryst with missile technology. The surface-to-surface missile was called Prithvi (the Earth), the tactical core vehicle for short-range air defence was named Trishul (the trident of Lord Shiva), the medium-range surface-to-air defence missile was given the title Akash (the sky) and the anti-tank missile project was called Nag (the serpent). I gave the name Agni to my dream project of an intermediate-range ballistic missile (a missile having a maximum range of between 1,000 and 3,000 km), as the payload would re-enter the atmosphere from space as a ball of fire.

'Pride relates more to our opinion of ourselves, vanity to what we would have others think of us.'³³

Despite general enthusiasm for the IGMDP in India, the programme met with significant obstacles, many of which were from outside the country. It seemed the world's nuclear powers felt only they should possess missile technology.

► In 1985, I visited the United States as part of a bureaucratic team, with a mission to buy a supercomputer from Cray Inc., in Seattle, USA. Ostensibly, the computer was needed for weather forecasting. I needed it for computational fluid dynamics analysis of the Agni re-entry payload. India did not have hypersonic wind tunnels, and the only way to design a re-entry stage was to model it and test it using a powerful computer. Only the United States and Japan had the necessary supercomputing technology. The Americans snubbed our delegation, conveying bluntly their decision not to sell the machine to India.

Indian scientists were again compelled to follow a swadeshi approach to technological development; and it would be for the nation's long-term benefit. Indian computer experts rose to the challenge of creating an indigenous supercomputer of the Cray computer's capability, then in the gigaflops range. Like any properly focused indigenous endeavour, this swadeshi computing effort was the seed of a new field of opportunity for the nation; and it would continue to be harvested well into the new century.

The Centre for Development of Advanced Computing (C-DAC) was created in Pune in 1988 as India's national initiative in supercomputing under the leadership of Dr Vijay Bhatkar. The *Wall Street Journal* took note of the development with the front-page headline: 'Angry India does IT' when the C-DAC delivered the supercomputer PARAM, three years later.

India's missile programme was to face other roadblocks. In April 1987, Canada, France,

³³ *Pride and Prejudice* by Jane Austen was perhaps the only novel in Dr Kalam's library, which was otherwise flooded with non-fiction and poetry books. Dr Kalam used to caution against pride: 'While pride harms only the proud, arrogance due to overbearing pride brings contempt for others,' he would say.

Germany, Italy, Japan, Great Britain and the United States joined hands and created The Missile Technology Control Regime (MTCR). The MTCR was formed with the purpose of curbing the spread of unmanned delivery systems for nuclear weapons. It targeted delivery systems that could carry a minimum payload of 500 kilograms for a minimum of 300 kilometres.

The MTCR was not a treaty, but a voluntary arrangement among member countries sharing a common interest in controlling missile proliferation. MTCR countries had committed to applying an export embargo to a common list of controlled items. This list included virtually all key equipment and technology needed for missile development, production and operation.

‘When the going gets tough, the tough gets going.’³⁴

It hardly seemed just that nations with missiles should prevent India from building its own. The nations imposing the MTCR bans were not facing the challenges India must. As a country located in one of the world’s most unstable regions, India can hardly afford to be dependent on imported weaponry if it wants to be taken seriously in the emerging world order. We had to find a way around the MTCR regime.

The DRDO developed clustered liquid-propellant rocket engines with programmable total impulse, with the ability to use different payload-range combinations. This was a clever design idea, where multiple rocket motors were configured in a circle and fired simultaneously. It helped to sidestep the embargoes. With the help of the ordnance factory at Khadki (near Pune), we also completely eliminated the import of propellant for Prithvi engines.

The selective embargoes that seemed intent on ruining our IGMDP may have slowed our progress, but they could not stop it. In spite of technology denial, trade curbs and arm-twisting at every international forum, the Prithvi missile was successfully flight tested on 25 February 1988 at Sriharikota High Altitude Range (SHAR). It was a significant event. The test established India’s capability to develop the basic modules for future guided missiles. Prithvi could be modified from a long-range surface to an air missile, and could also be deployed on a ship. It was accurate, too: Prithvi achieved a CEP³⁵ of less than 100 metres.

Other successful tests would follow. On 22 May 1989 at exactly 7.17 a.m., the Agni missile plumed its chariot of fire over the Interim Test Range in Chandipur, Orissa. It propelled India into an exclusive club dominated by the world’s technological and military giants. The 300-odd scientists at the control centre, watching the pencil-thin missile arch across the sky on television monitors, thumped each other on the back. I was lifted onto the shoulders of the jubilant scientists.

Agni was igniting nervous reactions in capitals stretching from Washington to Beijing, however, only five countries – the US, the Soviet Union, France, China and Israel – had developed intermediate-

34 President Venkataraman, the former defence minister, gave these encouraging words to Dr Kalam as he faced challenges with the IGMDP.

35 Circular error probable (CEP) is a measure of a missile’s precision. A CEP of 100 metres means the missile will land within a circle of 100 metres of the intended target.

range ballistic missiles (IRBMs). For India, Agni's successful flight represented a quantum leap in strategic capability. Your actions are indeed your agents.

Apart from its ability to destroy military targets deep inside enemy territory, Agni can also act as a delivery system for a nuclear warhead. With the plutonium production in India's nuclear reactors and a number of Agni missiles deployed at strategic sites, India's nuclear deterrence factor is multiplied enormously. But what Agni had proved—perhaps more than its strategic capability—was that scientists working in different departments and laboratories are capable of coordinating and working together for a common goal. Shortcomings in this had long hampered India's defence research and development effort.

On 7 February 1990, the Nag missile had its maiden flight. The feat was repeated again the next day. The missile featured a high-strength composite airframe with foldable wings and fins, an Imaging Infra-red (IIR) seeker with high immunity to countermeasures, an on-board real-time processor, a compact sensor package, an electric actuation system and a digital autopilot. Once launched, the Nag would not need to be guided, allowing the launcher to seek cover. The missile could use its autonomous onboard guidance to hit even a fast-moving tank.

The Akash missile was successfully tested on 14 August 1990, proving its ram-rocket technology, which had been developed for the first time in India. A medium-range surface-to-air missile (MR-SAM) with a range of 25 kilometres and an altitude of 18 kilometres, Akash would be completely guided by radar, and have a digital proximity fuse to detonate its warhead after coming close to a moving target. A direct hit was not necessary.

‘Before God trusts you with success, you have to prove yourself humble enough to handle the big prize.’³⁶

In July 1992, I took over as the director general of the DRDO and the scientific advisor to the raksha mantri (defence minister). I was taking over the reins of the DRDO at a crucial time for the nation. On 26 December, Boxing Day 1991, the Soviet Union (USSR) was formally dissolved, and with this, our treaties with the USSR became null and void. India was perhaps now the most vulnerable it had been since Independence. We were left with no superpower backer, and we were surrounded by enemies.

Economically weak, we were in no position, either, to build nuclear weapons and bear the burden of international sanctions that would follow. One must bear in mind that a powerful nation cannot hold its power only on the strength of its armaments. It must have a strong economy, robust systems of governance; and above all, self-reliance in materials and critical technologies.

Nonetheless, we had to make our missiles ready for deployment to ensure our nation's defence. Before leaving for Delhi to take up my new positions, I initiated a limited series production of the Prithvi and Agni missiles. Developing and field testing missiles successfully was no small

³⁶ Robert Schuller (1926-2015) was an American Christian motivational speaker and author. Dr Kalam read all his books. He called him a messenger of positive thinking and a symbol of success.

undertaking. Bringing those missiles into production was another matter entirely. This was an immense challenge, particularly for the ordnance factories.

The Indian defence industry was capable of manufacturing defence hardware; but it was conditioned to undertake licensed production of overseas designs, with carefully prepared drawings and quality control systems already in place. Ordnance factories would not find the detail they required in the fairly basic drawings drafted by the development agency. These left much to the imagination, which can be disastrous in a factory setting. Standardization, process optimization, quality assurance and reliability were tough manufacturing disciplines that needed to be put in place for the IGMDP.

Nevertheless, our indigenous defence hardware production had to start somewhere. With the correct fostering of talent and material support, the defence organizations would have to bootstrap—use whatever resources they could muster to make the production happen, and learn in the process. In a sense, this is exactly what an individual needs to do in facing any new challenge. You discover your strength when you are compelled to utilize the best of your own resources. I am reminded here of Prof. Srinivasan’s aphorism, ‘No stress, no progress!’

Bootstrapping and seizing the day are especially relevant in the twenty-first century, for the country and for the individual. We are living in an age of unprecedented technological progress, and it is essential that we grasp the opportunities it offers us. This means applying technology for the benefit of the people of the nation as much as the nation itself, on an almost unimaginable scale.

Technology may be a particularly powerful means for uplifting the poor. People from the lower levels of the social pyramid can suffer from acute misery simply for want of basic applications of technology, such that would give them good medicine, decent seeds for crops, means of controlling pests or better ways to tan leather. It seemed to me in the first stages of deregulation in the 1990s, that economic improvement could only go so far in raising the living standard of much of India’s population. Too many of our nation’s people seemed trapped in another age as we headed into the new century. I was becoming increasingly aware of the need for science to play a greater, practical role in bettering people’s lives.

My reading of history told that the most rapid advances in technology and medicine come during times of conflict. The radar’s capability saw great leaps forward during World War II, which allowed the radar’s use for more accurate weather forecasting in the post-war years. Antibiotics (penicillin and sulphanilamide), blood transfusions and anti-malarial medication were all developed during World War II to lessen battlefield casualties, and we are still benefiting from these innovations.

At the DRDO, we had just fostered our own technological revolution in response to pressing defence needs. I felt that cutting-edge military technologies the DRDL was using in the IGMDP must somehow help in improving people’s lives—especially those of the less fortunate.

► During 1992, I became acquainted with two doctors at the Hyderabad based Nizam’s Institute of Medical Sciences (NIMS): cardiologist Dr B. Soma Raju and orthopaedic surgeon Dr B.N.

Prasad. They inspired me to help develop civilian spin-offs of defence technologies, to provide poor patients with affordable treatments.

Both doctors liaised with DRDO scientists in two revolutionary, interdisciplinary projects. Dr B.N. Prasad designed an innovative Floor Reaction Orthosis (a kind of leg calliper) to help polio-affected children walk. Dr B.N. Prasad's design used an advanced composite material developed by the DRDL, which was lighter and stronger than conventional materials. Dr B. Soma Raju made a groundbreaking, affordable coronary stent with delta-ferrite-free austenitic steel wires. The surfaces of the wires were free from wire-drawing-induced micro-channels, which allowed their use in such a delicate application.

The results were satisfying. The callipers were economical and popular too for their lightness: they weighed some 300 grams, whereas conventional callipers could weigh as much as 4 kilograms. Thousands of patients were fitted with them. The stent dramatically reduced the cost of surgery for heart patients, who had earlier been forced to pay huge sums of money for a stent alone, never mind for the surgery. Our indigenous stent was equally effective as imported stents, but for a fraction of the cost. The introduction of the Kalam-Raju Stent, as it was called, caused a price crash in the market for imported stents. Even today, stents are available to Indian patients at some of the lowest rates in the world.

This biomedical and defence industry collaboration was a clear demonstration of India's capability. I saw, time and again throughout my career, the talent and ingenuity that the nation possesses in its people. All it takes is will, determination and the commitment of qualified individuals to cooperate. Every effort toward self-sufficiency in technology—and indeed, in every sphere—can only benefit our great, ancient nation.

Self-sufficiency is particularly important for our national defence, and a self-sufficient military should always be our ultimate goal. For this to happen, though, we need more than a progressive defence establishment and government investment. We must have active partnerships—between universities, the private sector and the DRDO.

As scientific advisor to the defence minister and the director general of the DRDO, I could plainly see the nation in the mid 1990s was far from ready for complete self-sufficiency in defence hardware. India's industrial, and research and development base had yet to evolve to that stage. There had to be a compromise, and this was to be an intermediate phase we referred to as self-reliance. Self-reliance meant to equip the armed forces with a whole range of equipment that might come from foreign and domestic sources, while our military industrial capability matured.

‘Nothing is at last sacred but the integrity of your own mind.’³⁷

37 Dr Kalam revered ‘Self-Reliance’, an 1841 essay written by American philosopher Ralph Waldo Emerson, almost as much as scripture. One of its most powerful passages is, ‘Trust thyself ... [be aware that] society and worldly influences must be resisted in favour of one's own individuality, and that self-worth has great importance and value.’

In the meantime, we had to be frank and realistic with our ability to address the military's requirements. In 1996, the navy expressed its urgent need for a quick-reaction air defence system to protect its warships at sea from aircraft and anti-ship missiles. The Pakistani Navy had acquired Harpoon missiles from America and Exocet sea-skimming missiles from France. These missiles could, by day or by night and regardless of weather conditions, approach our ships at near-sonic speed and inflict terrible damage. Not only must the warship fire its anti-missile missile at the earliest, the anti-missile missile had to 'see' the incoming missile through the visual disturbance of the waves.

The deployment of Trishul, the missile that had been intended for this purpose, had been delayed. Trishul had not finished its static trials from a fixed launcher, leave alone the second and far more difficult stage of mounting it and firing it from a sailing warship. The navy had no option but to commission two ships without missile armaments.

I did not deny that we couldn't meet the navy's needs, and I didn't offer excuses. I simply said, 'The services must be served.' This meant we would have to look at missile systems from overseas to fit on the new ships. The navy evaluated several systems that we suggested, and settled on the Israeli Barak missile. Not only was the Indian Navy's needs met with this choice, the Barak missile order led to a 350-million-dollar joint project with the DRDO. This would develop Barak-Extended Range surface-to-air missiles with a greater than 100-kilometre range, ten years later.

There were to be other large-scale overseas partnerships, some of which would continue well into the new century. With our collaborations in aerospace over the years, I enjoyed no small measure of goodwill in the Russian scientific establishment. This assisted greatly in establishing a joint venture between the DRDO and Russia's NPO Mashinostroyeniya, which began with the signing of an agreement on 12 February 1998 in Moscow. NPO Mashinostroyeniya was the legendary organization which developed iconic cruise missiles such as Malakhit and Granit, along with ICBMs³⁸ and spacecraft.

The joint venture would see development of a supersonic missile which would conform to MTCR rules. According to the agreement, India would hold a 50.5 per cent share in the joint venture company BrahMos Aerospace Limited, the purpose of which was the design, development, manufacture and marketing of the world's fastest supersonic cruise missile. With a common goal, we had forged an agreement that fulfilled everyone's needs.

The joint venture was faithful to a shared vision, too, and the company and missile's name itself reflected this. BrahMos was named for the Brahmaputra and Moskva Rivers, honouring the partnership of the two countries in the project. The missile BrahMos, we decided, must follow the basic rule of war: when the speed of attack increases, it automatically reduces the response time of the enemy. BrahMos should therefore be the fastest of all missiles in its class. It must be faster than the Tomahawk missile, which had attracted world fame during the 2003 US invasion of Iraq.

38 Intercontinental ballistic missiles.

The BrahMos would have two stages: the first, consisting of a solid-fuel rocket that would take the missile beyond the sound barrier (Mach 1). The second stage would see, a liquid-fuelled ramjet that would propel it to Mach 2.8. The missile could cruise as low as 10 metres above the wavetops, making it a ‘sea skimmer’. The BrahMos is still the fastest cruise missile in operation.

I had completed the task that had first been given to me at the DRDL. India was a world missile power, with a technological base that was created rather than acquired. Our systems were being built by our own people, where once they had been borrowed from others. Most importantly, India would enter the new century well placed to meet the defence challenges of its complex region. Our nation could now take its place as a global military power.

I still felt, though, that I had not completed my life’s work. In the last decade of the twentieth century, it was clear that much of the country was lagging behind the rest of the world. Key segments of the economy and the population seemed to suffer from a lack of vision. How could we revive the country’s historical greatness in the twenty-first century? How could we awaken the enormous youthful talent that remained largely untapped?

Throughout the missile programme I felt that I was the subject of God’s transformative power. I now sensed that God’s guiding hand was leading me toward new challenges, at a time in my life when many had perhaps thought that I would retire.

7

VISION OF A DEVELOPED INDIA

‘Where there is no vision, the people perish.’³⁹

At the Technology Information, Forecasting and Assessment Council (TIFAC), I oversaw an extensive study by a team of 500 experts to develop a vision of India as a developed nation by the year 2020. We reflected and analyzed what makes a country developed. We concluded that broadly speaking, a wealthy nation with a decent standard of living for its people and a high international standing is a developed nation.

There are a number of figures for measuring the wealth of a nation: its gross national product (GNP), gross domestic product (GDP), balance of payments, rate of economic growth, foreign exchange reserves, per capita income, etc. As economic indicators, these combine to give a reasonable reflection of a nation’s wealth. They are, though, only indicators; and if viewed in isolation, they may even cloak the misery of the common people in respectability.

Our work needed to take a broader view. We formulated a plan to turn India into a developed nation before 2020, and published our plan as a book, *India 2020: A Vision for the New Millennium*. The plan looks beyond dry economic issues, and addresses matters which can improve people’s lives along with the nation’s prosperity.

India 2020 identified a number of areas for progress: doubling agricultural and food processing outputs; reliable electric power infrastructure providing urban amenities to rural areas, with an emphasis on increasing solar power operations; education directed toward literacy; healthcare, social security, and overall health for the Indian population; information and communication technology for increased e-governance and to promote education in remote areas, telecommunication and telemedicine; and critical technologies and strategic industries, particularly nuclear technology, space technology and defence technology.

We now had a vision of how India could emerge as one among the world’s first four economic powers by 2020. The vision is still workable. But it requires commitment, and a strong desire for people to work together for national good and long-term wealth, rather than for quick profits. This is now the challenge for India’s youth.

39 *The Bible*, Proverbs, 29:18 (King James Version).

Paradise lies under the shade of swords.⁴⁰

While we were working on Vision 2020 in the mid-1990s, the national leadership began showing a willingness to address our nuclear status. It had long been clear to the scientific community and defence establishment that India's nuclear capabilities were trailing dangerously those of our potential enemies. India needed to become a fully nuclear-capable nation, and for this, it needed to test a nuclear bomb. With the economic crisis of 1991 far behind us and the economy quite robust, the time seemed ripe for a test.

Prime Minister P.V. Narasimha Rao quietly scheduled a nuclear test, which was to take place on 19 December 1995. By mid December, he had even gone so far as to have a bomb set in place, ready for detonation. The test would not take place, though. On 15 December, the *New York Times* reported that US spy satellites had captured images of preparations for a nuclear test in the Rajasthan desert. The prime minister was subjected to considerable diplomatic pressure, principally from the US, to cancel the test. US President Bill Clinton personally telephoned Prime Minister Rao, to extract an assurance from him that there would be no test.

In my view, other nuclear-capable nations had no business preventing India from addressing its defence needs by developing nuclear weapons—especially when hostile neighbouring countries possessed them already. I wrote to the prime minister on 14 January 1996, asking him to withdraw from the ongoing Comprehensive Nuclear-Test-Ban Treaty (CTBT) negotiations, and conduct a nuclear test as soon as possible. While he privately remained committed to our cause, he kept his plans on hold. He seemed to be biding his time.

General elections were held in India in 1996. The Indian National Congress government of Prime Minister P.V. Narasimha Rao was defeated, and a hung parliament resulted. President Shankar Dayal Sharma invited Atal Bihari Vajpayee as leader of the Bharatiya Janata Party (BJP) to form a government. Prime Minister Vajpayee could not muster support from more than 200 of the 545 members of parliament and resigned, ending his thirteen-day government with Pramod Mahajan as his defence minister.

During this brief period, however, the outgoing prime minister, Narasimha Rao, briefed the new prime minister Vajpayee about the readiness for a nuclear bomb test. Prime Minister Vajpayee gave a go-ahead order for a test, just before his government fell.

The next prime minister, H. D. Deve Gowda appointed Mulayam Singh Yadav, the former chief minister of Uttar Pradesh, as Defence Minister. I developed a strong personal bond with Mulayam Singhji. He even gave me some lessons in Hindi. Mulayam Singhji shared with me his vision for the South Asian Association for Regional Cooperation (SAARC), which had been established on 8 December 1985. He saw the potential for a Great Indian Union along the lines of the European Union, with economic connectivity and free movement of people across the Indian subcontinent.

⁴⁰ This expression is found in canonical Islamic texts, including the famous collection of Muhammad ibn Ismail al-Bukhari. Dr Kalam interpreted it as, 'Those who would have peace must be ready for war.'

Mulayam Singhji was keen, too, for the nation to develop its nuclear capability, and told me to be ready with nuclear devices for tests. Prime Minister Deve Gowda did not share his enthusiasm, though, and refused to grant permission to carry out any nuclear tests.

There was yet another change in government—the third within a year. The Gowda government collapsed in April 1997 when the Congress (I) Party withdrew its support from the coalition. Inder Kumar Gujral, the minister for external affairs in Gowda’s cabinet, who was widely regarded as a peacenik, was chosen as the new coalition leader. Prime Minister Gujral reappointed every minister from Gowda’s cabinet, including Mulayam Singhji as the defence minister.

Prime Minister Gujral was of the view that 1997 was not the right time for India to test its nuclear weapons. He believed that the Indian economy needed to be especially resilient to withstand international sanctions if it tested a nuclear bomb. He knew, too, that it would be difficult for his weak coalition government to weather the international storm of protest that would result from nuclear tests.

This is not to say that the Gujral government was soft on national defence. I was one of the key scientists associated with building India’s nuclear potential and the prime minister soon announced, in November 1997 to be precise, that I would be awarded the Bharat Ratna. This was a clear public and international statement of the importance the government gave to national security. Also, I was the second scientist after Sir C.V. Raman to receive the award. Sir C.V. Raman was conferred the Bharat Ratna in 1954 for his contributions to physics.

Although I remained convinced of the importance of India possessing a nuclear capability to at least match its potential enemies, I knew the defence establishment would have to be patient. We remained ready, however.

‘India must stand up to the world and act like the country of a billion people living together for over two millennia. Countries of a few million assembled in the last few hundred years can’t decide the destiny of a great civilization.’⁴¹

The 1998 general election was to bring a sense of purpose to the nuclear test issue. Political stability returned with an exclusive mandate for the Bharatiya Janata Party (BJP). During the election campaign, the BJP had voiced its intention to further the nation’s nuclear weapons programme if it were voted to power. The election victory indeed cleared doubt in people’s minds on the nuclear question. There was now a broad consensus that India should conduct a nuclear test and unabashedly manifest itself as a nuclear power. The nation must possess a nuclear capability to deter attacks from other nuclear-capable states, and it must be afforded its deserved status on the world stage.

Within a fortnight of securing a vote of confidence for his coalition government in parliament, Prime Minister Vajpayee called me and R. Chidambaram and authorized us to conduct nuclear

41 Arun Tiwari, *Indian Above All—APJ Abdul Kalam: A Life*, HarperCollins, 2015. p. vii.

tests. Brajesh Mishra, principal secretary to the prime minister and Vajpayee's most trusted aide, was nominated as the single authority in the bureaucracy for our liaison. 'Thirty days' time was thought reasonable notice for those responsible to carry out the tests. A full-moon-night enthusiast, I suggested Buddha Purnima day for the tests, which would be 11 May 1998. With barely any discussion, everyone agreed wholeheartedly on this auspicious date.

The whole event was to be shrouded in secrecy. The bitter experience of 1995, when the plans of testing the nuclear bomb came to be known by the United States, was still fresh in everyone's minds. Prime Minister Vajpayee therefore decided that every measure should be taken to keep the impending nuclear trials from being exposed. He did not share his plans with his cabinet colleagues. Even Defence Minister George Fernandes remained uninformed about our preparations. The team we had assembled was small too, which would also help to maintain secrecy.

The remote location of the test site was familiar to the world: it was the very place where India's first nuclear test had been conducted in 1974, at Pokhran Test Range. Just as with the 1974 test, our tests were to be conducted underground.⁴² Pokhran is a small town in a remote location in the Thar Desert, in the Jaisalmer district of Rajasthan. It is surrounded by rocks, sand and five salt pans. The name Pokhran means 'place of five mirages', an apt name for this arid, scorched wasteland. The test range is some distance from the town.

Pokhran Test Range had been under the charge of the 58 Engineer Regiment of the Indian Army's Corps of Engineers. The regiment had dug three deep shafts over the preceding several years, working during the night hours to avoid the surveillance of spy satellites. There were many dry, abandoned wells in the area. Three of them were deepened and widened into shafts 50 metres deep. The six shafts were assigned code names. All facilities at the range were kept in a state of continuous readiness for more than a year, so that a test could be carried out within as little as ten days' notice.

Days before the tests, the bombs were transported to Pokhran and put in place. A thermonuclear device was placed in the shaft code named White House (over 200 metres deep), while the fission bomb was assigned to the Taj Mahal shaft (over 150 metres deep). The first sub-kiloton shot was to be detonated in the Kumbhkarana shaft. The other three 50 metre shafts for the second test series were designated Navatala ('new well' in Hindi), abbreviated as NT 1, 2, and 3.

Little was left to chance in the lead up to the test day. Scientists were careful to travel to Pokhran alone. When scientists visited the site, we would be dressed in army fatigues, and we were assigned military identities. I was known as Major General Prithviraj at Pokhran Test Range. Every effort was made so as not to arouse suspicion that a test was imminent.

The day dawned on 11 May 1998 with heavy gusts blowing the powdery desert sands over

⁴² The Partial Test Ban Treaty (PTBT) is an international treaty which came into operation in October 1963. The treaty prohibited all nuclear detonations that were not underground, such as the French Gerboise Bleue test in Algeria in February 1960.

Pokhran. Although there was barely any likelihood that the underground explosions would vent any radioactivity, we could not take a chance. The wind could very well carry the dust created by the explosion toward the town of Pokhran. We would have to wait. Prime Minister Vajpayee cancelled all his engagements for the day and stayed at home near the secure hotline from the test site. I remembered a very beautiful sentence I had read somewhere in my youth: ‘You usually have to wait for that which is worth waiting for.’ My colleagues and I had waited years for these tests. A few hours more could not worry us.

I called the prime minister at 3 p.m. to tell him that the winds were dying down and the tests could be conducted during the next hour. At 3:43:44:2 p.m., the three larger nuclear devices were detonated simultaneously. The combined force of the blasts lifted an area about the size of a cricket ground to a few metres above the earth, billowing clouds of dust and sand into the air. In contrast to the 1974 explosion, no claims were made that these were ‘peaceful tests’. Indeed, government officials quickly emphasized the military nature of the explosions. ‘These tests have established that India has a proven capability for a weaponized nuclear programme,’ Brajesh Mishra told reporters.

Two days later, on 13 May two sub-kiloton devices were detonated underground in NT1 and NT2. The bomb in NT3 was pulled out and taken back to its vault under orders from R. Chidambaram, as he felt the team had the results they needed with five blasts. As he told the team laconically, ‘Why waste it?’

The Pokhran-II nuclear test proved the arrival of more powerful and lighter nuclear weapons, small enough to be carried by missiles. India was now a fully nuclear-capable power.

On 28 May 1998, Pakistan carried out nuclear tests at Ras Koh Hills in the Chagai District of Balochistan Province. It was followed by another test on 30 May 1998. Prime Minister Nawaz Sharif famously said, ‘If India had not exploded the bomb, Pakistan would not have done so. Once New Delhi did so, we had no choice because of public pressure.’

I laughed at the uproar in the Western media following the tests of May 1998. Why should Britain have a nuclear arsenal but not India? Why did nobody say anything when the French were conducting atmospheric nuclear tests in occupied Algiers? Are these not reasonable questions? The answers don’t lie in claiming that Britain and France have a divine right to nuclear weaponry, but in a truly ethical decision for unilateral nuclear disarmament. And neither the West, nor the Russians nor the Chinese were interested in this. India had little choice but to find its place in a nuclear-capable world, and it had done so.

‘If you want to make peace with your enemy, you have to work with your enemy. Then he becomes your partner.’⁴³

43 Nelson Mandela (1918–2013) was a South African anti-apartheid revolutionary. He served as president of South Africa from 1994 to 1999. Dr Kalam admired him greatly, and finally met him on 16 September 2004 during his state visit to South Africa as the president of India.

On 20 February 1999, Prime Ministers Atal Bihari Vajpayee and Nawaz Sharif created history by opening the gates of friendship at the Wagah border, breaching the walls of hatred that had characterized India–Pakistan relations for the preceding fifty-one years. When Prime Minister Vajpayee, accompanied by twenty-two eminent Indians, arrived at the border check-post in the Delhi-Lahore bus, Prime Minister Nawaz Sharif stood there to receive him.

As the two leaders shook hands and embraced, hundreds of people lined up on both sides of the border, celebrating the event. It was a defining moment in the history of the subcontinent. Despite the nuclear tests on both sides of the border, the leadership of the countries managed to make inroads toward a peaceful coexistence.

The 1999 Kargil War, which began months later when Pakistan infiltrated forces over the Line of Control (LOC) into Kashmir, and ended with the Pakistani forces being evicted, demonstrated just how fragile this peace was. Or more to the point, it showed that powerful forces were determined to undermine peace.

Our leaders must continue to take advantage of opportunities for peace in the subcontinent, despite the tendencies of some to provoke conflict. Perhaps the *Mahabharata's* ancient wisdom is relevant here. When Bhishma was mortally wounded, lying on his bed of arrows and waiting for death, the Pandavas approached him, and asked him for his advice. Bhishma told them, ‘Nobody is anybody’s friend. Nobody is anybody’s enemy. It is the circumstances that make enemies and friends.’ The world will change. Strategic thinking must be fluid and responsive. Just as a person must be aware of her situation and adjust her approach accordingly, so must the nation.

► In the latter half of 1999, I knew it was time for me to move from the DRDO; but the government of India was in no mood to let me retire. In November 1999, The Office of the Principal Scientific Adviser to the Government of India (PSA) was created. I was to be the first occupant of this position. The PSA would evolve policies, strategies and missions for generating innovations. The PSA would also generate science and technology tasks in critical infrastructure, economic and social sectors in partnership with government departments, institutions and industry. I must function in this position, too, as the secretariat and chairperson of the Scientific Advisory Committee to the Cabinet.

I could sense the hand of God guiding me on to a new path. Where the path would lead, though, was not yet clear. I would just have to accept God’s will, and follow it—as I had throughout my life. I recall my father telling my mother, when I was a young boy sitting on her lap,

Faith has two halves: One half is patience (*sabr*) and one half is gratitude (*shukr*). The meaning of patience is that I should not complain to anyone, should not be attached to my comforts and privileges, should not hate the bad times and should not love to have the bad times go away. He who gets broken, gets broken, and he who gets mended, gets mended.

‘Empowerment comes from within. Nobody can give it, except the Almighty.’⁴⁴

On 30 June 2001 I met Pramukh Swamiji, the Head of Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha (BAPS) in Delhi. I was immediately impressed with Pramukh Swamiji’s gentle, gracious presence, and I felt compelled to share my thoughts with him. I told Pramukh Swamiji that India had had a vision before 1857 to be an independent nation. The struggle persisted for the following ninety long years. During this time the entire Indian society—people from all walks of life, rich and poor, young and old, elite and ordinary, educated and illiterate—all came together in this aim. The goal was singular and focused, and it was well understood that India must be a free country.

I briefed Pramukh Swamiji about my work spanning forty years in three of the great scientific fields of India: atomic energy, space research and defence research. I said that I was pained to see that despite the passage of fifty years since India’s independence, there was no new vision. India was still a developing country. It was not strong economically, it was not socially cohesive; and at times, not even stable. Indeed, the nation faced serious threats to its security. Its energy deficiency was unbearable, and it suffered from a crippling dependency on imports of oil and critical technology.

Then I got to the heart of the matter. I said quite bluntly that I felt that it was not enough to secure a mandate from the government or even sufficient finances. The problem lies in finding people to carry out the mission of developing the nation. To realize this great dream of a developed India, three types of people are needed—*punya atma* (virtuous people), *punya neta* (virtuous leaders) and *punya adbhikari* (virtuous officers). How can the ranks of these people be filled?

Swamiji gave a crisp, spontaneous reply, ‘People need faith in God. They must be accustomed to compliance and to obeying God under all circumstances. When it is a matter of destiny, none of us can reject it, change it, erase it or resist it. Submit everything to God.’ Swamiji expanded on these thoughts in a discussion that lasted for more than an hour.

It was now clear to me that together with academic and scientific training, spiritual training

44 APJ Abdul Kalam, *Turning Points*, HarperCollins, 2012, p. 27.

should be imparted in schools. From the beginning, children must be taught values—only then may they become virtuous adults. ‘God does not change what is in a people, until they change what is in themselves,’ Swamiji said.

Pramukh Swamiji had inspired me, and from this first meeting, I began corresponding with him. He would become, as he was to countless others, my spiritual teacher, friend and guide.

‘Divine desperation is the beginning of spiritual awakening because it gives rise to the aspiration for the realization of God.’⁴⁵

On 30 September 2001, I was flying in a helicopter from Ranchi to Bokaro to attend a Jharkhand State Science and Technology Council meeting. There was violent turbulence, and the pilots said there was something terribly wrong with the helicopter’s rotor. Moments before landing at Bokaro at around 4.30 p.m., the helicopter engine failed. The craft plummeted to the earth from a height of about 100 metres. Miraculously, all of us on board survived. Needless to say, we were all terribly shaken.

That night, I had a vivid dream. I saw myself in a desert surrounded by miles of silvery sand shining under a full moon. Five men stood in a circle around me. They were Emperor Ashok, Caliph Umar, Albert Einstein and Mahatma Gandhi—historical figures I deeply admired. One at a time, the men stepped forward and offered me sage advice.

The next morning, I read in the newspaper that a plane carrying the young leader Madhavrao Jivajirao Scindia and a team of journalists had crashed on the outskirts of Mainpuri in Uttar Pradesh. Everyone on board had perished. I was deeply pained. And then, a shiver ran down my spine. What would have happened if the helicopter had lost power a few seconds earlier at Bokaro? Was there a link between my surviving this mishap and the divine messages in my dream?

Upon returning to Delhi, I met Prime Minister Atal Bihari Vajpayee and requested him to relieve me from government service. I said, ‘Sir, I have completed seventy orbits around the sun, may I take leave now?’ Prime Minister Vajpayee offered me a ministerial position. I politely declined his offer. After some silent moments with unspoken words hanging in the air, the prime minister said, ‘*Jaisi aapki marjee*’ (As you wish, so it be).

In November 2001, I moved to the campus of my alma mater, Anna University in Chennai, and resumed my academic pursuits as Professor, Technology and Societal Transformation. I became involved in teaching and research tasks, which was something I had always wanted to do. But my official responsibilities never allowed me to teach. It was clear to me by then that I had a divine ordinance to produce spiritually enlightened, skilful and hard-working youths. This could not be fulfilled by mere classroom teaching. It would need something far beyond this.

45 Meher Baba (1894–1969) was an Indian spiritual master. From 1925 until his death, Meher Baba observed silence. Dr Kalam liked Meher Baba’s description of the universe as imagination of the God who only really exists, and that each soul is really God passing through imagination to realize individually His own divinity.

I knew I must reach out to the nation's youth; and this meant travelling across the country and speaking with them directly. I quickly saw that the sparks within India's brilliant young minds was just waiting to be ignited. On 11 April 2002 I was invited to a function at the Anandalaya High School in Anand, Gujarat. When I reached Ahmedabad in the evening of the previous day, it was under curfew. I went to Anand by road, escorted by the police. The next day at the school, during the informal interaction after my lecture, one boy asked me a question: 'Who is our enemy?' I did not have a prompt answer, so I passed the question to the other children present there. After a while, a girl answered, 'Sir, our enemy is poverty.' I was thrilled by the clarity of her answer. It was like the blazing sun cutting through dark clouds.

Deep within, however, I knew that spiritual poverty is even worse than material poverty. The ignorance of the soul is our real enemy.

I expected at this time to spend the rest of my years speaking directly to India's children. I felt it was my duty to ignite their young minds with a passion for learning and a more spiritual existence, just as my teachers had done for me. It was not to be. Back at Anna University on 10 June 2002, I received an urgent message from the vice chancellor's office. The Prime Minister's Office (PMO) was looking for me, and I was asked to come directly to the vice chancellor's telephone to speak to the prime minister.

I was perplexed, as I had had no contact with any government functionary for some time. When I arrived in the vice chancellor's office, I was connected to the prime minister's office, and after a few minutes, Prime Minister Atal Bihari Vajpayee came on line. He said, 'Kalam sahib, the nation needs you as its Rashtrapati.' I thanked the prime minister and requested an hour's time to speak with my family and reflect upon his generous offer, before I gave him an answer. Vajpayeeji said, 'Please do that. But I need only a "yes" and not a "no".'

"The nature of things is dharma."⁴⁶

I filed my nomination papers in Parliament on 18 June 2002. When I had been asked about an auspicious time to file the papers, I said that astronomy, not astrology, keeps the world going. I was about to assume the highest office of the land; but I would continue to function in the same manner that had sustained me all my working life. And I would remain a scientist.

It was perhaps inevitable, though, that my election campaign would raise questions about my religious practices. Comparisons between me and former presidents Zakir Husain and Fakhruddin Ali Ahmed were rejected—I was not seen as a Muslim in the common understanding of the word. The sudden emergence of a veena playing, Bhagavad-Gita reading, Rameswaram-born Muslim struck many as an unreal happening.

46 Acharya Mahapragya (1920–2010), the tenth head of the Svetambar Terapanth order of Jainism, told Dr Kalam *vattbu sabavo dhammo*, that the nature of things is *dharmā*. It is the law, which leads, binds, or takes back a being to its essential nature; enables it to realize the divinity inherent in itself; helps it to extricate itself from the misery of mundane existences and reach the state of supreme beatitude.

While my nomination challenged stereotypes of vote-bank-based Indian politics, perhaps it was not so surprising. India's is, after all, a diverse, pluralist society. Some commentators were swift to note that my interest in India's rich, ancient cultural and religious heritage was not at all uncommon among Muslims. One journalist wrote,

'The Indian Muslim, like any other Indian, is a creature of his village, district, state, in every possible way ... Kalam is part of a continuing tradition which exists but about which we have developed an amnesia because of the obsession of the global media—and that of our own—with painting the Muslim in a monochromatic shade. As for Kalam's familiarity with Hindu scriptures, was not Justice Ismail in Chennai the country's leading authority on the Kambar Ramayanam? And Kalam, for all his devotion to Rama, still has to catch up with Abdul Rahim Khan-e-Khana's verses in Sanskrit dedicated to Dasrath's son.'⁴⁷

'Start by doing what's necessary; then do what's possible; and suddenly you are doing the impossible.'⁴⁸

On 18 July 2002, I was elected the eleventh president of India, and the first scientist president of the republic, by a thumping majority, winning 90 per cent of the votes polled. I decided to visit Gujarat as my first presidential duty outside the national capital. Gujarat had recently been ravaged by two disasters. One was the Bhuj earthquake of 26 January 2001, where as many as 20,000 people had lost their lives, and lakhs had been injured. The second disaster that ravaged Gujrat thirteen months later was however, entirely man made.

Gujarat was stricken with communal violence. On 27 February 2002, two railway carriages had been set alight at Godhra, and firefighting efforts were deliberately hampered by an angry mob. The flames claimed the lives of fifty-nine passengers, including many women and children. A retaliatory bloodbath followed in many parts of the state. Months later, the situation remained tense, and many people were still unable to return to their homes.

The rioting in Gujarat raised awkward questions about the authenticity of our multireligious society. Does the real safety of the minorities lie in the goodwill of the majority? Had Delhi and Kashmir not seen the failure of this goodwill in 1984 and 1990?

I have always been horrified by the senseless violence of communal riots. How can ordinary people be goaded to abandon their sanity and indulge in killing innocent men, women and children? The nation must not be held hostage to deranged mindsets. Those inciting hatred and communal violence need to be dealt with firmly.

When I arrived at Sardar Vallabhbhai Patel International Airport near Ahmedabad on 10 August 2002, I was surprised to be met by Chief Minister Narendra Modi and his entire cabinet. I visited twelve areas in Gujarat—three relief camps and nine riot-hit locations where the losses of life

47 Saeed Naqvi, *The Indian Express*, 21 June 2002.

48 St. Francis of Assisi, twelfth-century Italian Roman Catholic friar and preacher.

had been high. Chief Minister Narendra Modi escorted me throughout my visit, which was particularly helpful. I was able to suggest urgent actions that were required as I received petitions and complaints from people. After visiting the relief camps and riot-hit locations, I went to BAPS Shri Swaminarayan Mandir on Shahibaug Road and met Pramukh Swamiji. Swamiji said,

Our society is going through a difficult time, and peace, as you say, has to prevail. There are thousands of victims, both Hindus and Muslims. Right measures need to be taken to alleviate their suffering. Life is sacred; peace is sacred. My *vintee* (petition) to Rashtrapati and Mukhyamantri is to work for peace and unity of minds. I have only one earnest prayer to God. That never again should such cruelly unfortunate days come in the lives of any other person, society, state or nation.⁴⁹

If all of us regard our fellow human beings with compassion and understanding, it is difficult to imagine that communal riots such as these will ever occur.

► The first few months as President were a whirlwind of public events and meetings. Two events after my trip to Gujarat stand out in my memory, at least for personal reasons.

I always avoided celebrating my birthday. Now that I was a public figure, this was going to be difficult. I found a solution in being away from the capital. I had been invited to the Buddha Mahotsava festival by the Union Tourism Ministry in Tawang, Arunachal Pradesh on 15 October 2002, and I decided to attend. I had heard much about the sacred Buddhist monastery Galden Namgyel Lhatse. It is one of the largest lamaseries of the Mahayana sect in Asia. The lamasery is situated on the spur of a hill overlooking the Tawang-chu Valley, at an altitude of over 11,000 feet. I reached there in an Indian Air Force helicopter, wearing an oxygen mask as we flew over the highest of peaks.

I offered prayers in the gloriously colourful temple, and met the Rimpoche (the local term for the head Lama). I asked the Rimpoche, ‘What advice can I take back for the people of India?’

‘Put aside the violence,’ the Rimpoche replied.

‘And how can I do that?’

‘By sublimating your ego it is possible. It’s ego that is the core of selfishness and from it stems all violence.’

‘But how can this be done? How can we control our egos?’

‘Learn to forget the “I” and “Me”.’

I was taken aback by this simple, stark and short answer. In the bright luminance of the Rimpoche’s words I could see the root of all trouble in human relations.

The holy month of Ramadan began on 5 November 2002. According to tradition in Delhi, all prominent people—the president, the prime minister, political leaders, ambassadors and

⁴⁹ A.P.J. Abdul Kalam with Arun Tiwari, *Transcendence*, HarperCollins, 2015, p. 11.

businessmen—would host *Iftar* parties. At these parties, they would serve the evening meal when Muslims end their daily Ramadan fast at sunset. People from all religions would attend these parties, many having already eaten heartily that day. Not only were the list of attendees part of news, the names of those who could not make it made news too! Over the years, *Iftar* parties became events around which political analysts constructed conspiracy theories, forecast alliances and so on and so forth. One must say, though, that food is usually delectable at these *Iftar* parties.

A grand *Iftar* party from the new president was much anticipated. I was not at all convinced, however, that I should host a party, especially when there were many going hungry in our nation. Why, I asked my secretary, P.M. Nair, should I host a party to feed people who are already well fed? I asked him to find out how much cost would be involved in holding an *Iftar* party. It was an estimated Rs. 22 lakhs. I instructed P.M. Nair to donate that amount to a few orphanages in the form of food, clothes and blankets. I asked that the selection of the orphanages be made by a team in Rashtrapati Bhavan. I would have no further role in this, except to add a little of my own money to the amount.

That night, I heard my father's voice in my head; 'Your destruction lies in putting your pleasures before your religion, your worldly interests before your interest in the hereafter, and the creatures before the Creator. Put this advice into practice and it will prove to be all you need.'

This world is indeed the farm of the hereafter, and cultivation must be done in the heart. The seed is faith in God, and it is tended by righteous deeds. If your heart is tender, compassionate and merciful, you will surely reap fine rewards, but if it is hard and unforgiving, it will yield little but suffering.

‘We are all part of one Universe and therefore equal. God touches and moves, warns and desires all equally, and He wants one quite as much as another. The inequality lies in the way in which His touch, His warnings and His gifts are received.’⁵⁰

In 2003 a group of Jain monks walked barefoot for more than 20 kilometres to Rashtrapati Bhavan and presented me the first copy of the book *Finding Your Spiritual Centre*. This is a compilation of the teachings of Acharya Mahapragya, the tenth head of the Svetambar Terapanth order of Jainism. I was amazed at their endurance and determination, which surely derived from their faith. They would only take glasses of lemon water for refreshment, too, after their long trek.

I first met Acharya Mahapragya on 4 November 1999. Acharya Mahapragya said, ‘Kalam sahib, I bless you and your team, you made a nuclear bomb to deter our enemies from attacking our country. *Abimsa paramo dharmaha, dharma himsa tatbaiva cha*. Non-violence is the greatest dharma, so too is all righteous violence. But I have a second mission for you. Discover a system by which the nuclear bomb becomes irrelevant, insignificant and ineffective.’

Acharya Mahapragya’s profound statements led me to ponder deeply about man’s capacity for violence. In terms of weapons of mass destruction, it is astounding. While India was a latecomer to nuclear armaments and has relatively few, the world superpowers have assembled massive nuclear arsenals. There is somewhere in the order of 20,500 nuclear warheads in the world today. If we assume the average power of these devices is 33,500 kilotons, there are enough to lay waste the whole of the Earth’s landmass.

This is a chilling expression of man’s inclination for violence. It is not simply an issue of weaponry: one can see expressions of this violence daily in homes, on the streets and in the media. The nuclear bomb can only become ‘irrelevant, insignificant and ineffective’, I concluded, when violence has no place inside people’s hearts.

50 A.P.J. Abdul Kalam, Arun Tiwari, *Squaring the Circle: Seven Steps to Indian Renaissance*, University Press, 2013, p. viii.

It is worth considering one of my favourite verses of Confucius, which I would often quote during my presidency:

‘Where there is righteousness in the heart, there will be beauty in the character.
Where there is beauty in the character, there will be harmony in the home.
Where there is harmony in the home, there will be order in the nations.
When there is order in the nations, there will be peace in the world.’

Surely, this is a clear guide on how nuclear bombs may become irrelevant, insignificant and ineffective. What Confucius does not say in this verse, however, is how righteousness may dwell in the heart.

Acharya Mahapragya and I believed that your moral foundation, or conscience, was set in place within the family, and your conscience is the birthplace of your ethics and righteousness. In our book the *Family and the Nation*, Acharya Mahapragya and I highlighted a process of become self-aware so that you can connect to your conscience, and act on what your conscience says.

As we worked together, Acharya Mahapragya and I developed a powerful spiritual fellowship. Perhaps this was similar to the fellowship of Jain Muni Raichandbhai Ravajibhai Mehta and Mahatma Gandhi. Acharya Mahapragya believed, as did I, that spiritual principles should find expression in everyday life—and we both wished to engage with the issues of the world.

‘The angel is free because of his knowledge, the beast because of his ignorance. Between the two remains the son of man to struggle.’⁵¹

Acharya Mahapragya and I cooperated in organizing an interreligious gathering in Surat on 15 October 2003. There, heads of all the major religious groups in India met and discussed common principles and shared ideas for interfaith cooperation. Representatives of Hinduism, Buddhism, Christianity, Jainism, Islam, Sikhism, Judaism and Zoroastrianism—and in some cases a number from different branches of these religions—came to this groundbreaking, single-platform event.

The results were encouraging. The fifteen eminent leaders who attended the gathering may have seemed diverse in appearance and beliefs, but they had much in common. All shared a commitment to universal spiritual values; they were willing to look beyond their own faith’s teachings to acknowledge the truths in other faiths. They all were willing, too, to reach out to their fellow Indians of other religious persuasions for the common good.

I felt that as President, I had my own role in promoting interfaith harmony. This was not at all difficult, given my fortunate upbringing in the multifaith society of Pamban Island. I had always visited Christian churches and Hindu temples, and enjoyed places of worship, regardless of the religion. As a Muslim president, this habit would take on a greater significance.

51 Rumi (1207–1273) was a Persian poet and Sufi mystic. Dr Kalam studied most all Rumi’s poems in translated form and quoted him extensively in his lectures.

On 20 November 2003, I arrived in Tirupati to participate in the golden jubilee celebrations of Sri Venkateswara University. In the afternoon I reached Sri Venkateswara Swamy Temple, which sits atop the seventh peak of the Tirumala Hills, Venkatadri. I was received with traditional *Isti Kapal* temple honours to the accompaniment of traditional music, amid melodious chanting of Vedic hymns by the temple priests.

Later, in the sanctum sanctorum of the temple, I stood before the deity and paid obeisance. At the Ranganayakula Mandapam, situated inside the temple complex, I was given Vedasirvachanam, a recited blessing from the temple's priests. Much to the surprise of the priests, I asked them to conduct Asirvachanam for the welfare of the nation and its people. I sat on the floor and ate the prasadam served in a bowl made of plantain leaves. I could see tears welling in the eyes of the priest who served me the prasadam.

‘Only those who will risk going too far can possibly find out how far one can go.’⁵²

Along with such uplifting spiritual occasions, as President and Supreme Commander of the armed forces, I had the honour of attending significant military events and parades. On 25 April 2004, the Indian Navy's sailing ship, the three-masted barque⁵³ *INS Tarangini*, returned to its base at the Southern Naval Command after a historic voyage around the world. I welcomed the ship and its crew at an impressive ceremony at the south jetty at Kochi Naval Base. Columbus had taken about eight months to travel 3,000 nautical miles. *INS Tarangini* covered 35,454 nautical miles (65,661 kilometres) in fifteen months, visiting thirty-seven ports in eighteen countries.

I told the accomplished seamen who had sailed the *INS Tarangini* this immense distance, ‘Columbus discovered a new continent through his mission, whereas you have travelled through all the continents and won the hearts of the people of the continents you visited. The sea was your classroom and the elements of nature your teachers.’

Mastering the sea has been a great lesson for our nation. Historically, there have been many land-based invasions of the northern parts of India by kings and warriors of central Asia. These invasions undoubtedly caused much suffering and altered the fabric of our society. But it was subsequent invasions which occurred through sea routes—beginning with trade and ending with conquest—that ultimately caused India greater humiliation.

The Portuguese entered India in 1498 from the west coast and gained a lasting foothold on the subcontinent in Goa. Later during the sixteenth century, Danish and French forces landed at Tharangambadi and Pondicherry respectively. During the seventeenth century the British came to India by the sea and formed a trading company. They eventually overpowered the Portuguese, the

52 T. S. Eliot (1888–1965), one of the twentieth century's finest poets, was awarded the Nobel Prize in Literature in 1948. Dr Kalam had Eliot's book *Four Quartets* in his library and mentioned to me the theme of man's relationship with time, the universe and the divine present in the book.

53 A barque is a sailing vessel with at least three masts, with the mainmast and the foremast square rigged and only the mizzen mast (the smaller mast at the aft or rear of the vessel) rigged fore and aft.

French and the Danish, and ruled India for more than 250 years. Neglect of seafaring power was thus a key factor in India's falling under British rule.

Our modern, well-equipped navy will ensure we never repeat history's mistake, and that we rigorously maintain our maritime security.

During my presidency, India was beginning to reclaim its ancient glory in another mode of transport. Before the arrival of the British, India was a world leader with its roads and trade network, and the subcontinent received somewhere in the order of one quarter of the world's income owing to that. In the third century BCE, the Mauryan rulers connected Takshashila (Taxila) and Pataliputra (present-day Patna) with a road some 2,600 kilometres long. This road was constructed in eight stages. By the first century of the Common Era, India enjoyed nearly a third of the world's income, and it relied heavily on a well-constructed road network.

During his short rule from 1540 to 1545, the Mughal ruler Sher Shah Suri renovated the Mauryan road along the Gangetic Plain and extended it to Kabul in the west and Chittagong in the east. This road was further improved by the British and named the Grand Trunk (GT) Road.

During British rule, India witnessed a massive expansion of transport infrastructure. By 1920, India's rail network was the fourth largest in the world, and macadamized⁵⁴ roads penetrated to the village level. These modern roads and rail lines were constructed for the benefit of British trade, and the expense was unfairly borne by the Indian taxpayer. But it cannot be denied that the rail network and roads actually helped in shaping modern India.

At the time of independence, India had been battered by two-and-a-half centuries of colonial exploitation. Its share of the world's income was less than a paltry 4 per cent. The nation's leaders embraced socialist policies which favoured central planning and state-owned enterprises, and trade and road networks were neglected. Indeed, for the first fifty years after Independence, less than 500 kilometres of four-lane highways were built.

Prime Minister Vajpayee changed this situation drastically. One of his first major announcements when he assumed the prime minister's office in October 1999 was about the 6,000 kilometre highway project called the 'Golden Quadrilateral'. This project involved connecting most of the major industrial, agricultural and cultural centres of India, and the nation's four metropolitan cities—Mumbai, Delhi, Kolkata and Chennai—with large, modern highways. Over the following five years, almost 25,000 kilometres of national highways were built, which was a great boost to the nation's prosperity. I consider this perhaps the first honest attempt in modern times to integrate the economy of our vast country.

'A leader is best when people barely know he exists, when his work is done, his aim

54 Macadam refers to a type of road construction popularized by Scottish engineer John Loudon McAdam in the first half of the nineteenth century. His methods are still used today, along with sealing the road with tar.

fulfilled, they will say: we did it ourselves.⁵⁵

Leaders come and go; only the nation and its people endure. On 22 May 2004, I administered the oath of office and secrecy to Dr Manmohan Singh as the prime minister of India, in the Ashok Hall of Rashtrapati Bhavan. No prime minister in the history of modern India had the credentials that Dr Manmohan Singh had. As a politician, he had experience as leader of the opposition in the Rajya Sabha and in the 1990s, as Finance Minister. As a technocrat, there was barely an important post in the government that Manmohan Singh had not held. He had been the chairman of the University Grants Commission, the adviser to the prime minister, the governor of the Reserve Bank of India, the deputy chairman of the Planning Commission and the chief economic adviser. I developed a harmonious relationship with Prime Minister Singh in the best tradition of the Indian system of government.

India was reaching out and forging strong international links in the new century. A few months after the election of Prime Minister Manmohan Singh's UPA government, on 16 September 2004, I attended the inaugural session of the Pan-African Parliament. There, I declared India's support to connect all the fifty-three nations of the African Union by a satellite and fibre-optic network that would provide effective communication for tele-education, tele-medicine, the Internet and videoconferencing (notably diplomatic communications (VVIP) and VoIP (Voice over Internet Protocol) services). The network would also support e-governance, e-commerce, infotainment, resource mapping and meteorological services. India offered to fund the project with an estimated budget of 150 million dollars, and took up responsibility for capacity building through education of doctors and nurses.

In a sense, this was very much the kind of mentoring that spacefaring nations had fostered with India in the early 1960s. India was now taking its place as a technological power and bringing advancement to other nations—just as other countries had done for India decades earlier.

While I was in Africa, I took the opportunity to meet one of my heroes and the great African statesmen of the twentieth century, Nelson Mandela. I found Mr Mandela a most cheerful and engaging man when I visited him at his Johannesburg home. I was thrilled to be in the presence of this frail but towering figure, who had won freedom for South Africa from the tyranny of apartheid. Nelson Mandela, it seems, had his own hero; and this was our very own Gandhi. Mahatma Gandhi's non-violence had heavily influenced Mandela. It underpinned his campaign, in the early 1990s, for a peaceful transition from apartheid to an inclusive democratic system.

When I was leaving his house at the end of my time with him, Mr Mandela came to the portico to give me a send-off. As he walked, he discarded his walking stick and I became his support. When I held his hand, I asked this great man to tell me about the pioneers of the anti-apartheid movement in South Africa. 'Of course,' he responded. 'One of the great pioneers of South Africa's freedom movement was M.K. Gandhi. India sent us a righteous barrister M.K. Gandhi. We returned him to you as Mahatma Gandhi.'

55 Lao Tzu. See reference 19.

After my visit with Nelson Mandela, I went to Durban, and from there, travelled 105 kilometres to Pietermaritzburg. It was there, in this rural South African town, that the Mahatma was born. The young lawyer Mohandas Karamchand Gandhi shivered through the cold winter night of 7 June 1893 at Pietermaritzburg Railway Station. He had been unceremoniously shoved out of the train and his baggage tossed onto the platform, simply for refusing to leave the first-class cabin. ‘Coolies’ and ‘non-whites’ were not allowed in the first-class cabin, he was told by railway officers—even though he had a first-class ticket. This indignity ignited the heart of perhaps the greatest freedom fighter in history.

Gandhi deeply reflected on his situation and the plight of his countrymen in those bleak hours at Pietermaritzburg. The blatant injustice of this event was a turning point in Gandhi’s life. He resolved then and there to stay in South Africa and fight for the rights of downtrodden Indian immigrants. When he returned to India on 9 January 1915, he was a seasoned freedom fighter, ready to lead the nation toward independence as the Mahatma.

As I rode the nineteenth-century steam train from Pentrich Station to Pietermaritzburg to re-enact Gandhi’s journey, it occurred to me that everybody’s life has such a turning point. There will be an event in your life, just as there was for Gandhi, where you will be inspired to strive, or even driven by adversity, toward greater achievements and ideals. The event will likely feel unpleasant at the time, just as shivering in the cold at Pietermaritzburg and smarting at his humiliation was for Gandhi. But in retrospect, it will be a blessing, just as was my failure to qualify as an air force pilot in Dehradun.

Those who persevere are often rewarded, and may even see a complete reversal of their fortunes. Gandhi eventually received international recognition for his peaceful campaign for India’s independence. He was even posthumously granted the Freedom of the City award in Pietermaritzburg in April 1997, and a statue of the Mahatma now stands in the town.

For my part, I found an opportunity to rekindle ambitions that had been quelled nearly half a century earlier. On 8 June 2006, I flew a Sukhoi-30-Mk1 fighter plane at the Lohegaon Air Force Base in Pune. I co-piloted the plane with Wing Commander Ajay Rathore, commanding officer of the Lightning Squadron based at Lohegaon. We flew the jet to an altitude of some 25,000 feet (7.5 kilometres), and reached speeds of around 1.25 Mach (one-and-a-quarter times the speed of sound). I had finally fulfilled my childhood dream.

Never give up your dreams. I would often tell the youth I met,
 Dream, dream, dream
 Dreams transform into thoughts
 And thoughts result in action⁵⁶

56 A.P.J. Abdul Kalam, *Ignited Minds*, Penguin, 2002, p.1.

‘Controversy is only dreaded by the advocates of error.’⁵⁷

My presidency held many such memorable occasions as my meeting Nelson Mandela, retracing Gandhi’s steps, and flying a fighter aircraft; but it also had its share of controversy. And the controversies, I would find, imparted their own personal lessons.

The proclamation I made under Article 356 of the Constitution was a fiasco. It sent political tremors across the nation; and it raised serious questions about the exercise of this Article by the union government. Issued from Moscow late in the evening on 23 May 2005, the proclamation dissolved the Bihar Assembly. I signed it only after receiving the advice of the governor of Bihar, Buta Singh, and after his advice had been endorsed by the Union cabinet. Prime Minister Manmohan Singh had spoken with me at length on the subject, too.

Still, the Supreme Court judgment against the proclamation on 24 January 2006 came as a blow. It heavily criticized the Bihar governor for recommending the dissolution of the state assembly the previous year, and held that my proclamation was unconstitutional.

After going through the Republic Day ceremonies two days later with some aplomb, I became withdrawn and reflective. While I had not been directly criticized by the court, as I had acted only on the advice of the cabinet, I felt compromised. I considered resigning as president, and I discussed this at length with all my friends and senior officials at Rashtrapati Bhavan. After questioning my actions and mulling over them, I came to the conclusion that I had done the right thing under the circumstances. I was duty bound to follow the advice of the cabinet according to the Constitution. Anything else would have undermined the authority of the government. I had followed my moral compass—regardless of the outcome.

Perhaps my ego was hurt by this episode. It is indeed ego that focuses on one’s own survival and pleasure, and hurts when one is proved wrong. Ego is selfishly ambitious to the extent of excluding others, too. The ego, however, may be elevated by conscience to encompass the greater good. Conscience sees life in terms of service and contribution. Conscience has patience and wisdom guiding it. It is capable of adaptation. I had, early in life, chosen to be guided by my conscience, and my conscience would continue to lead me when I was President and also well after that.

‘I am a firm believer in the people. If given the truth, they can be depended upon to meet any national crisis. The great point is to bring them the real facts.’⁵⁸

I was invited to the eighty-eighth convocation of Banaras Hindu University (BHU). There is a beautiful spiritual connection between Kashi and my hometown Rameswaram. After a pilgrimage to Kashi, most devotees will make their way to Rameswaram; a means of completing the spiritual

57 Benjamin Rush (1746–1813) was a Founding Father of the United States. He pioneered the therapeutic approach to addiction. Dr Kalam often gave his example for what a true leader can do for the good of ordinary people.

58 Abraham Lincoln was the 16th President of the United States (1861–1865). He led the United States through its Civil War to preserve the Union, abolished slavery, strengthened the federal government and modernized the economy. Dr Kalam declared Lincoln as his guiding soul.

journey. I recalled my earlier visit to Kashi in 1991 to deliver the convocation address at the Indian Institute of Technology (IIT) at BHU. In that convocation Kashi Naresh Shri Vibhuthi Narayan Singh, the Maharaja of Kashi and Chancellor of the University introduced me to the audience, stating that I had come to the land of the Ganges at Kashi from Rameswaram Agnitereeram. I used this occasion to articulate my idea of enlightened citizens.

Inquiry, creativity, technology, an entrepreneurial mindset and moral leadership are the five attributes to be cultivated throughout the education process. If we develop these five attributes in our students, we will produce 'autonomous learners'. These are people who are self-directed, self controlled, lifelong learners, who have the capacity to respect authority, yet are capable of questioning authority in an appropriate manner.

Young autonomous learners almost inevitably become young, enlightened citizens. With some encouragement and organization, these are the kind of people we need to help the nation develop. I was becoming increasingly convinced, as my presidency progressed, that India was in dire need of a renaissance. I was just as sure that this could only occur with the support of the nation's youth.

‘Kurkshetra is within you. The battle is raging within. Ignorance is Dhritrashtra; the individual soul is Arjuna; the in-dweller of your heart is Krishna, the charioteer; the body is the chariot; the senses are the five horses; egoism, cravings, likes and dislikes, lust jealousy, greed pride and hypocrisy and the host of other mental defilements are the hundred Kaurvas.’⁵⁹

In my last Republic Day Eve Address to the nation in January 2007, I invoked a powerful question: ‘What can I give?’ It was similar to a question posed by another president, US President John F. Kennedy, forty-six years earlier at his inaugural address to his nation. Kennedy had urged his people then to ‘ask not what your country can do for you, ask what you can do for your country’.

These and similar questions are just as relevant now as they were in earlier decades. Almost everyone appears driven by what he can take from the system, snatch away from the others around him and further individual interests—mindless of the cost. I had identified the root of all social illness in the madness of ‘What can I take?’ The cure for this illness is surely in a personal introspection of ‘What can I give?’

As my presidency was drawing to a close, I felt that I must highlight the vast, virtually untapped power of the Indian people. Developing India is a mission of a billion people, in which everyone has a role to play. It will only become reality if everyone gives through individual and collective participation in a nationwide movement. My interactions with our citizens, particularly our youth, showed me they possess almost limitless positive energy. Indians are eager to give all they can to make India developed. Their energy must be encouraged, facilitated and properly utilized by the government. It is essential for our citizens to actively participate in the nation’s development.

‘If instead of a gem, or even a flower, we should cast the gift of a loving thought into the heart of a friend, that would be giving as the angels give.’⁶⁰

59 APJ Abdul Kalam, Arun Tiwari, *Guiding Souls*, Ocean Books, 2005. p. 32.

60 George MacDonald (1824 –1905) was a Scottish author-poet and Christian minister. Dr Kalam would quote MacDonald’s conviction that God does not punish except to amend, and that the sole end of His greatest anger is the amelioration of the guilty.

A few months after my last Republic Day Eve Address, I would speak before the most prominent international audience of my term. It was to be the first time a president of India would address the European Parliament. On 24 April 2007 I arrived in Strasbourg, France. The main parliament building is a very modern-looking, curved structure dominated by glass. The sun was shining that day, and the building was beautifully reflected in the waters of the River Ill.

The European Parliament Hall, which is a good deal larger than the Central Hall of the India Parliament, was packed. After a short introduction by European President Hans-Gert Pottering, I began with a Tamil quote from the Sangam period that states the world is one big family. I went on to say that the European civilization has a unique place in human history. Europe's people had valiantly engaged in the adventure of exploring the Earth, resulting in the discovery of many ideas and systems.

I did not gloss over the darker aspects of European history, though. At the end of my forty-five-minute speech, I recited my poem, 'A Message from Mother India', about the European Union. The poem paid homage to the blessed lands of Europe and the adventurous, creative and methodical spirit of the people who lived here. Then it spoke of the wretched past of Europe: of crusades, persecution of Jews, colonial wars unleashed upon nations across continents and seas and the two World Wars, all of which brought unimaginable bloodshed and misery to her nations. After establishing the two polarities—the best of minds and the worst of deeds—I positioned the European Union as the golden mean of human possibilities.

When I concluded my speech, saying *namaskar* with palms pressed together, the 700-odd parliamentarians present gave me a standing ovation. European Parliament President Hans-Gert Pottering described my address to the European Parliament as extraordinary, the likes of which they had not heard before.

‘Those who desire to rise as high as our human condition allows, must renounce intellectual pride.’⁶¹

We may sometimes forget how close our association has been with Europe, throughout history. I arrived in Greece on 25 April 2007. The Greek President, Karolos Papoulias surprised me by showing me a coin depicting the figure of King Milinda, which is testimony to the powerful connection between the ancient civilizations of India and Greece.

Every child in India knows of the battle between the Indian king Porus and the Macedonian-Greek ruler Alexander the Great in 326 BCE. Alexander overran the Persian Empire and reached the river Jhelum, the western boundary of Porus's kingdom that stretched as far as the Ganga in the east. The valour of King Porus's army in battle blunted the courage of Alexander's men, and they refused to march further into Indian lands.

61 Alexis Carrel (1873–1944) was a French surgeon and biologist. He was awarded the Nobel Prize in Physiology or Medicine in 1912. Dr Kalam declared his book *Man the Unknown* as one of his four favourite books, the other three being the *Thirukkural*, *Light from Many Lamps* by Lillian Watson and the *Holy Quran*.

Alexander turned back leaving behind Greek forces, which established themselves in the city of Takshashila. More than thirty Greek kings ruled and perished there, often in conflict with each other, before Chandragupta Maurya defeated King Seleucus and signed a treaty of peace. Chandragupta Maurya married Seleucus's daughter, and marriages between Indian and Greek families thereafter became a practice in the Indian ruling class. Greek troops even assisted Chandragupta Maurya in toppling the Nanda dynasty.

Several Indo-Greek kingdoms ruled over the region from the Hindu Kush Mountains in the west to the Ganga–Yamuna plains in the east and the Vindhya Mountains in the south. Most of these kingdoms followed Buddhism. In time, the Greek population assimilated into India's vast, rich society, and became Indian themselves—a benign fate that would await many invaders throughout the centuries.

Dynasties rise and fall, kings rule then perish; and presidents enjoy terms of five years and retire. It is a grave mistake indeed to become attached to the trappings of office or power: They are more fleeting than life itself. In this knowledge, I was grounded throughout my presidential term. And just as Dr Brahm Prakash had taught me decades earlier, I remained aware of my place in context. A few months before my term was to come to an end, I had a revelation of my place in the scheme of things. It came to me as I walked with a friend in the glorious Mughal Gardens of Rashtrapati Bhavan.

As we strolled along the stone paths in the gardens, my friend and I discussed my options after my term. The flowers were a kaleidoscope of colours, and the greenery itself exuded the fragrance of the brief Delhi spring. As we walked, a well-fed white cat walked across our path, barely acknowledging our presence. It moved slowly and purposefully, as if it owned the garden. I laughed. I now saw my place at Rashtrapati Bhavan from quite a different perspective. 'That cat will still be here after July, unlike the likes of me, who come and go after five years,' I said to my friend. 'These animals—cats, dogs, deer and peacocks—they are the real permanent residents at Rashtrapati Bhavan!'

► As goes the tradition, the government of the day fields the person of its choice in the Presidential election and I was not that choice but there were some valiant attempts by regional parties to keep me in Rashtrapati Bhavan. An assortment of parties—the All India Anna Dravida Munnetra Kazhagam (AIADMK) led by J. Jayalalithaa, the Samajwadi Party led by Mulayam Singh Yadav, the Telugu Desam Party (TDP) led by Chandrababu Naidu and the Indian National Lok Dal (INLD) led by Om Prakash Chautala—came together as the United National Progressive Alliance (UNPA). A delegation from the UNPA met me on 20 June 2007 and requested that I stand for presidential election.

I had received literally thousands of emails asking me to seek a second term as President; and I was aware, too, of the overwhelming public sentiment for me to stay at Rashtrapati Bhavan. I felt, though, that Rashtrapati Bhavan, which had become a people's Bhavan during my tenure, could be cheapened by electioneering.

I knew that it was time for me to leave politics, anyway. I had already phoned Pramukh Swamiji, my spiritual mentor and guide, to discuss the matter with him. He was in the US at that time. He said, 'Kalam Saheb, do not stand for re-election. Let go! Go and serve the people. By serving selflessly, a person transcends any office, however high it may be.' Pramukh Swamiji's advice resonated with me, and on 22 June 2007, I made public my decision to not seek a second presidential term.

The members of Parliament hosted a farewell for me in the Central Hall of Parliament on 23 July 2007. I thanked Prime Minister Manmohan Singh and his predecessor Atal Bihari Vajpayeeji, with whom I had worked during my five years of presidency. I also acknowledged the support of Vice-President Bhairon Singh Shekhawat. I then used the occasion to raise some very important points.

First, I said, that there is a general feeling and appreciation that the environment internal and external to India's system of governance has gone through rapid and apparently irreversible change. The challenges posed to national sovereignty, integrity and economic growth posed by these changes need to be addressed coherently and rapidly. Our social organizations tend to deteriorate and become crisis prone. As a social entity, India's system of governance appeared to have entered a stage of crisis, and this was a clarion call for self-renewal and change.

Second, I said, globalizing has strengthened India's economy. The nation is richer, but great vigilance is needed to enhance the power of Parliament. International treaties now increasingly govern much economic decision-making, and the Indian Parliament is one of the few parliaments in the world that does not have a system of effective treaty oversight in place. Treaties are by and large a fait accompli by the time they come to Parliament. Hence the power to oversee and legislate on treaties and agreements with foreign nations is urgently required for Parliament.

I added that the future political leadership the world over has to rise to the challenge of sustainability of growth, development, environment and resources. The national leadership has to inspire confidence in our people that 'we can do it'. Urging the MPs to debate my suggestions, I said that they should draw up a 'Parliamentary Vision for the Nation', similar to the framing of our country's Constitution. This twenty-first century parliamentary vision for India needs to have a global and long-term perspective. It also needs to be underpinned with implementation strategies, integrated structures and action plans for transforming India into a developed country. For this, there should be two benchmarks: a national prosperity index and the attainment of energy independence before 2030.

After the swearing-in ceremony in the Central Hall of Parliament on 25 July 2007, the new president and the former returned to Rashtrapati Bhavan in a horse-drawn carriage as per the tradition. It was a repetition of the events of 25 July 2003, when former President K.R. Narayanan brought me to Rashtrapati Bhavan from Parliament. The drama remains, actors change. That day, I was bringing the new president, Smt. Pratibha Patil, to her home for the next five years.

There were two suitcases I brought in 2002, and I took the same two with me when I checked

myself out of Rashtrapati Bhavan. I flew to Chennai in the evening, to stay at Anna University. I was now back where I had been, five years earlier; and my mission was still to inspire our nation's youth.

'Science and spirituality ... are not antithesis but they are two wheels of the same cart or they are two faces of the same coin.'⁶²

A few months after I left Rashtrapati Bhavan, I was invited to speak at an international conference in celebration of the fiftieth anniversary of space exploration—Fifty Years in Space. This was to be held at the California Institute of Technology (Caltech) on 20 September 2007. Attending the conference would give me opportunity to meet scientists at The California Institute of Technology, Graduate Aeronautical Laboratories (GALCIT), Northrop Grumman Space Technology and NASA's Jet Propulsion Laboratory. I had been interacting with the scientists for some time but had been unable to meet them, as no presidential visit was scheduled to the US during my term.

I particularly enjoyed my discussions with scientists involved in space exploration. The various disciplines in this field tend to make scientists philosophical, at the very least. At some stage in his work, a space scientist is forced to confront his place in infinity; and this is always for the better. If you see yourself in relation to the world and its people as just an individual among billions, it can be humbling. Considering yourself as a person in an infinitely vast universe can be mind-numbing as well as humbling. It will likely also give you a broader, more spiritual perspective of human existence.

'Who are we? Living on an insignificant planet of a humdrum star lost in a galaxy of a universe in which there are far more galaxies than people.'⁶³

Before you attempt any contemplation of the grand design, you should appreciate the vastness of the Universe. What we see around us is but a small part of the colossal reality: Our place in the Universe is like a speck of sand in the Thar Desert. Light would take less than one tenth of a second to travel around the earth. The approximate diameter of the Universe is at least ninety-three billion light years, which means that for light to travel across the Universe's immensity, it would take some ninety-three billion years!

The Sun is a relatively small star; yet around 1.3 million earths could fit within it. Betelgeuse, a red giant star about 640 light years from Earth, can accommodate around 1,000 suns along its diameter. If we consider the Sun as the size of an orange, on that scale, the earth is a grain of sand circling in orbit around it at a distance of about 10 metres. Again on the same scale, the nearest star to the Sun, a star called Alpha Centauri, is some 2000 kilometres away.

62 M. S. Dadage, 'Science and Spirituality', Bombay Sarvodaya Mandal and Gandhi Research Foundation, <http://www.mkgandhi.org/articles/sci.%20and%20spirituality.htm>, Accessed 27 August 2016.

63 Carl Sagan (1934 –1996) was an American astronomer, cosmologist and author. Dr Kalam called Carl Sagan 'an 'idea person' and 'a role model' for liaising between sciences.

A galaxy can be visualized as a cluster of oranges (in reality, approximately 30 million kilometres in diameter) where an average distance of 3000 kilometres separates each orange. With innumerable solar systems in the universe, there is a high probability that life exists in at least some of them. There is also a significant probability that a fraction of it must constitute intelligent life.

Pondering all this can only alter our awareness—and make our regional mindsets and national squabbles seem very petty indeed.

“The lack of money is the root of all evil.”⁶⁴

Before the conference at Caltech, I took the opportunity to visit the headquarters of CISCO, the American multinational IT corporation, in San Jose. The CEO of CISCO, John Chambers was standing in the lobby to receive me. I knew John Chambers as much for his annual salary of 20 million dollars as anything else, and was pleasantly surprised at his simple manner. He showed a complete absence of any airs and graces that are so common in the Indian business world.

I asked John Chambers how he had taken CISCO from a 70 million dollar company to a 38 billion dollar corporation. His answer was simple and straightforward:

‘After selling computers for about seven years, I moved to Wang Laboratories. Nothing clicked there and Wang had gone from a 2 billion dollar profit in 1989 to a 700 million dollar loss in 1990. And then I came here. It is all about vision and hard work, Sir. Vision without hard work is useless. Many of our friends in Europe are suffering that. Hard work without vision is what billions of poor are doing around the world. No big secrets. Wang suffered from lack of vision, CISCO succeeded because we saw the future before others could even guess it.’

Chambers then queried, ‘What is your vision, Sir, if I may ask?’

I said, ‘Look John, India’s destiny is to show the world how to promote economic growth in a way that enhances social equity, this is what I am trying to do. There are three billion poor people in the world. The transformation that we do as one-sixth of the world’s population will benefit all the other nations.’

Our conversation confirmed to me that having a vision is essential for success. It is just as important for companies making computers and building market share for profit, as it is for any nation aspiring for development. Likewise, any person who wishes to prosper must have a vision, whether it be for education, business, personal development or career. You simply cannot live happily without some kind of workable vision.

⁶⁴ Mark Twain, the pen name of Samuel Langhorne Clemens (1835–1910). Twain was an American writer, publisher, entrepreneur and lecturer. Dr Kalam would quote Mark Twain’s famous quip: ‘In religion, all other countries are paupers; India is the only millionaire’. Twain travelled through India in 1896.

'I have always been a religious person in the sense that I maintain a working partnership with God. I was aware that the best work required more ability than I would ever possess and therefore I needed help that only God could give me. So I must make a true estimate of my own ability, then raise it by 50 per cent by putting myself in God's hand and then get down to work with no doubts and fears in my mind.'⁶⁵

On 28 April 2009 I was awarded the Hoover Medal, an American prize named for Herbert Hoover, the 31st President of the United States and the first recipient of the medal, at the Columbia University in New York. I was told that I was the first Asian to receive this honour, which has been given annually since 1930 by the American Society of Mechanical Engineers. I used my acceptance speech to voice my concerns for the world's precarious situation.

Indeed, my reflection on the state of the world was deepening in the years after my presidency. I felt that we are in a transitional period. People are disoriented and suffering. We need to be aware of this, and our approach to living itself must change. It is not that we must compete more with each other. Instead of competing, we must together develop the most harmonious strategies for life. We need communities to share the complexities of our own evolution.

Part of this evolution involves acknowledging and living constructively with our primitive tendencies. Advances in genetics have demonstrated a great similarity in the genomes of man and animals. Research has shown, too, that the limbic system of the brain is likely a major cause of conflicts. It is now clear there is a biological dimension to man's tendency to make war.

Balancing this tendency, of course, is the mind. Exercising reason is humanity's hope for peace. The mind is capable of understanding the price that humanity has paid for its conflicts. It may also comprehend that if our attention to conflict were diverted to development, human civilization may take a very different shape, and humankind may enjoy peaceful coexistence.

The mind must also identify material factors which have led to war throughout history, and determine how we may avoid future conflicts. Lack of resources, inequitable growth within

65 A.P.J. Abdul Kalam with Arun Tiwari, *Wings of Fire*, University Press, 1999, p. 49.

countries and different parts of the world, deprivation, natural calamities and ego are among the reasons for conflicts. Hatred remaining from perceived historical wrongs is often a factor, too.

Having identified the material factors which provoke war, it is essential that we remain alert to potential sources of conflicts in the twenty-first century. That way, we can avoid armed confrontation, at least as far as is possible. Technological advances in weaponry have made warfare a danger to humanity's very existence. In these times, man is already fighting wars on all fronts—environmental degradation and diseases on one side and terrorism on the other side. He can scarce afford needless fighting, anyway.

A guiding, practical principle for maintaining peace would be ensuring a decent quality of life for all in the world. This immediately removes much of the motivation for war; and it is in the best interests of humanity, in any case. This, however, is no small matter. It requires the exercise of much intellect and learning, along with technology.

Consider the breadth and depth of the issues involved: energy and environment; understanding the atmosphere; exploration of outer space; increasing the outreach of science; equitable distribution of wealth; dealing with deadly diseases; weaning people off drugs, and improving family ties. Knowing this, we can appreciate that the critical task of improving all of humanity's quality of life requires the best minds, from every part of the world.

In short, mankind's salvation lies in the victory of consciousness over blind and ignorant forces—in nature, in society and in man himself. The principles which can guide a vision of developing our country apply equally to making this planet more liveable, and human society prosperous and harmonious. The inspiration that drives individuals to transcend worldly limitations and become captivated by a greater purpose must be experienced collectively. This alone will be humankind's saving grace.

‘Arise, awake, and stop not till the goal is reached.’⁶⁶

On 11 September 2012, I spoke at the 150th birth anniversary celebrations of Swami Vivekananda, at Ramakrishna Mission in New Delhi. I began my speech with the words spoken by India's patriotic saint on this date in 1882 in Chicago: ‘Help and not fight’, ‘assimilation and not destruction’, ‘harmony and peace and not dissension’. Swami Vivekananda's enlightened words resonate as much now as they did when he first uttered them.

The world, I stressed, is still faced with conflicting civilizations. Conflict has arisen mostly from differences of language, religion and culture, and is fuelled by poverty, which affects around half of the world's population. Now, environmental challenges too threaten a common understanding across national and cultural divides. The planet's ecology is reeling under the effects of climate

⁶⁶ The *Katha Upanishad* (1.3.14). The god of death Yama is advising the child protagonist Nachiketa. ‘Arise! Awake! Approach the great and learn. Like the sharp edge of a razor is that path. The wise say it is hard to tread and difficult to cross.’ Swami Vivekananda popularized this shloka.

change due to the indiscriminate use of fossil fuels. There will be a shortage of water, which will impact around 50 per cent of the people of the world, and large sectors of the world's population are likely to suffer from new diseases.

In the coming years, it will surely be as difficult as ever for the world's nations to apply the principles Swami Vivekananda championed in his famous Chicago speech. We need to ask ourselves confronting questions: Can we collectively resolve to live in an ecologically sustainable way? Can we have prosperity without poverty and peace without fear of war? Can we ensure that all citizens of the world have decent places where they may live?

'Besides the noble art of getting things done, there is the noble art of leaving things undone. The wisdom of life consists in the elimination of non-essentials.'⁶⁷

It was clear to me that the most serious issues facing people of this century went far beyond national borders. I thus felt that worthwhile opportunities to raise awareness and offer perspectives on these abroad were not to be missed. When an invitation arrived to give the keynote address at the Beijing Forum 2012, I was particularly happy.

Since the publication of my two books in China, *Wings of Fire* in 2002 and *Guiding Souls* in 2007, I had wanted to travel there. Due to my work, however, it could not happen. The Beijing Forum 2012 was a suitable event to discuss matters of worldwide concern, and in attending, I would fulfil my long-held aspiration to visit this great nation of the Far East.

China had always fascinated me. The Chinese culture is one of the world's most enduring, having lasted thousands of years. I was not just impressed with the longevity of the Chinese civilization: I was intrigued at China's rise as a world power in the preceding thirty years. Meetings scheduled after my speech would give me the opportunity to understand more about this amazing land, from some of its most learned citizens.

I gave my keynote address on 2 November 2012 in the presence of UN Secretary General Ban Ki-moon and the former Prime Minister of the Republic of Korea, Ro Jai-bong, among other distinguished speakers. In the address, I shared my vision of a liveable planet earth. I reminded delegates that nations unite when they share a common urge, and that the time for this is upon us what with climate change and pressing environmental issues. We need to consider a comprehensive plan for a liveable planet earth. Only an international plan could address problems of management, water, energy, healthcare and education for all the world's seven billion people.

On the day following my address, I met members of the Chinese People's Institute of Foreign Affairs (CPIFA) at a luncheon. There, we shared a discussion on the factors that had allowed the two great ancient civilizations of India and China to endure, despite invasions and periods of foreign rule over the centuries. Two important points emerged from our discussion.

⁶⁷ Lin Yutang (1895–1976) was a Chinese writer. His informal but polished style in both Chinese and English made him one of the most influential writers of his generation. Dr Kalam wanted to write an Indian version of Lin Yutang's masterpiece *My Country My People*.

The first of these was the issue of the peoples' traits. If we list the characteristics of Indian and Chinese people, we would likely find common characteristics—simplicity, love of nature, patience, indifference to international affairs, a 'this would not work, I know' attitude, land fertility and agriculture, industry, frugality, love of family life, pacifism, contentment, humour, conservatism and sensuality. The order and intensity of these traits would vary between regions, but these were some vital common traits. They made Indian and Chinese people different from the Mongols and Europeans who, at least for some time, governed their affairs.

The second important point of this discussion was the quality of these two ancient cultures that had convinced many invaders to settle in these countries, rather than return to their lands. How was it possible for the Indian and Chinese civilizations to survive periodic political disasters? How did they remain, where other ancient civilizations, such as Rome, were all but destroyed by their invaders? What made the two great lands so culturally stable?

Our group concluded that the factor which had allowed the Indian and Chinese cultures to endure was the prominence of the family system. The family system was so well defined and organized in both India and China as to make it impossible for a man to forget his lineage. This form of social immortality—which the Indians and Chinese prized above all earthly possessions—had something of the character of a religion. It was enhanced by the ritual of ancestor worship, and the consciousness of it was deep in the collective soul of both the Indian and the Chinese people.

The invaders of India and China were all too anxious to join the local families to claim part of this immortality. Either consciously or unconsciously, they craved the feeling that when one dies, one does not simply cease to exist: one's self lives on in the great stream of family life.

'Youth is not a time of life—it is a state of mind, it is a temper of the will, a quality of the imagination.'⁶⁸

A few months after my trip to China, Chief Minister of Gujarat, Narendra Modiji invited me to address a conclave to discuss 'How government and business can change to provide Indian youth with the opportunities they deserve'. The conclave was held by the Citizens for Accountable Governance at Ahmedabad on 29 June 2013. I had developed a strong connection with Narendra Modi over the years. Chief Minister Narendra Modiji was a self-confident leader, and his commitment to renewable energy and development in his state was laudable.

At the conclave, I spoke about the seven steps I had outlined in my book *Squaring the Circle*, for making India a developed nation:

1. Gain understanding of the irrefutable law of cause and effect in all matters. Voting for the wrong leader brings not only misery and gloom but will also alter the destiny of a democratic nation.

⁶⁸ Samuel Ullman (1840–1924) was an American businessman and poet. His poem 'Youth' was one of Dr Kalam's favourites. 'You are as young as your faith, as old as your doubt; as young as your self-confidence, as old as your fear.'

2. Face the truth of socio-economic inequality and the history of Partition, and undertake reconciliation by developing the minorities, the marginalized and the poor with a generous mindset and by special efforts.
3. Correct our misplaced worldviews by revamping the education system for the development of a creative mind, a well-integrated self and the ability to be a useful part of society.
4. Encourage and foster social enterprise to tackle social problems, improve communities and the environment by convergence of technologies at the bottom of the community pyramid.
5. Achieve energy independence by 2030 through nuclear, solar, wind and renewable energy routes. Provide lifeline energy to all our citizens, irrespective of their ability to pay.
6. Indigenize our telecommunication, IT and electronics manufacturing and proactive security for the nation's interests against cyber and terrorist attacks.
7. Integrate with the world economy, following the path of social democracy, and assume leadership of the world in making our planet more liveable.

Despite my hectic schedule, the years were passing for me. Many of my friends and colleagues had died or were suffering from illnesses, or were just experiencing the effects of old age. My close friend and colleague since 1982, Gen. R. Swaminathan, died on 15 February 2013. Swaminathan had been my right-hand man in the Defence Research and Development Laboratory when I was the director there, and the DRDO headquarters when I took over as the director general. He had been sick for some time, and his death did not come as a surprise. Nevertheless, and despite my philosophical view of death, I felt his loss deeply.

Perhaps Swaminathan's passing added urgency to my concern when I heard that my close friend and spiritual mentor Pramukh Swamiji was seriously ill, little more than a year later. Pramukh Swamiji was bedridden and had stopped eating. He was living merely on the fluids that were being administered to him by his worried followers. I promptly decided to visit him.

On 11 March 2014, I travelled to Sarangpur near Rajkot in Gujarat. In spite of his condition, Pramukh Swamiji was happy and radiant. He exuded peace and enlightenment. There was not even a flicker of pain or sense of any complaint in him. He did not speak, but looked into my eyes and held my hand for more than ten minutes. He gave me a rosary before I departed and smiled, much to the delight of all the sadhus present.

After I returned to Delhi, I sat in deep contemplation for some time. Every meeting I had had with Pramukh Swamiji had brought its insights and revelations. And in his presence, I had become much more aware of my real self. Pramukh Swamiji had been a mentor and guide to millions of others throughout the world, too. His life was itself an example of giving and of the creation of excellence.

In the months that followed, Pramukh Swamiji's health rallied, and he became well enough to give darshan again. I felt I should write a book that paid tribute to Pramukh Swamiji while he was

among us. As he was a true embodiment of transcendence, I thought it only appropriate to entitle the book, *Transcendence: My Spiritual Experiences with Pramukh Swamiji*. *Transcendence* was to become my most important project that year.

Work on the book took on a sense of urgency, given the state of Pramukh Swamiji's health, for I was determined to hand the book to him. Once the manuscript was submitted to the publisher in mid-April 2015, I monitored its progress almost daily. The hardcover book came to me in almost record time, on 15 June 2015, and I immediately called to organize a meeting with Pramukh Swamiji.

Presenting the book to Swamiji was something of a pilgrimage. I arrived in Ahmedabad on 19 June 2015. While I was too old to walk to Sarangpur from there to see him in the tradition of a true pilgrimage, I decided not to travel by helicopter, despite the rough roads. I would travel by car instead. That night, at almost 1.30 a.m., I sat with the first copy of the book, and pondered how I might sign it. After some deliberation, I wrote on the title page, 'Maha Pramukh Swamiji, Revered Spiritual Teacher. My respects.'

In an event in Sarangpur on 20 June 2015, I presented the book to Swamiji. As I handed him the book, I said, 'You are a great teacher, a great spiritual teacher. I've learnt a great lesson from you: how to remove "I" and "Me" (I-ness and My-ness).'

Afterwards, I was welcomed in an assembly of Swaminarayan sadhus and 3000 youths. I asked them,

'What would you like to do to make this planet Earth liveable? You have to evolve yourself and shape your life. You should write it on a page. That page may be a very important page in the book of human history. And you will be remembered for creating that one page in the history of the nation—whether that page is the page of invention, the page of innovation or the page of discovery or the page of creating societal change or a page of removing poverty or the page of fighting injustice or planning and executing a mission of networking of rivers or the page of evolving a clean environment with solar energy for generating a liveable planet earth.'

On the way back to Delhi, I felt calm. It had been a journey of completion and achievement of purpose: I had written all I needed to write, and my work had been handed to my teacher. I did not know when Pramukh Swamiji and I would meet again; but we had established a divine bond, which is everlasting. Pramukh Swamiji's mentoring defined the ultimate stage of my spiritual life. He had put me in a God-synchronous orbit, and no manoeuvres were required anymore. I was placed in my final position in eternity. I was at peace.

“The struggle between happiness and unhappiness that had so far been the story of human existence—and the struggle between peace and war that had been the history of the human race—must change. The power that would lead us to eternal victory amid these struggles is the power of good within us.”⁶⁹

Aeronautical engineer, rocket scientist, missile man, President, visionary, teacher and the most inspiring head of state in living memory—Avul Pakir Jainulabdeen Abdul Kalam was all these and more. Unquestionably the most popular Indian president and the most respected Indian leader since Mahatma Gandhi, he transcended all the usual boundaries in his remarkable life; and did so with charm and humility.

There is much that one can learn from this great man, not the least of which is faith. Dr Kalam himself spoke a good deal about the power of faith. He never took credit for his success, but would often say that placing himself in God’s hands multiplied his efforts and gave him strength. He would often recount how his father had told him, “See yourself always as a zero, and God as the one. Now if the zero is placed on the left of the one, it remains as one. This is the original position of man—a zero. But if God wants to bestow upon a person any grant, He moves this zero to the right of the one, and you become ten; you now have value!”

Apart from the power of faith, perhaps the greatest lesson you could learn from the life of Dr A.P.J. Abdul Kalam is the potential of your imagination. A young man from a lower middle-class family living in a small town, the young Kalam had no family influence or wealth to rely on. He was no natural genius, either. But through the sheer force of his imagination, he became one of the most accomplished Indians of his generation. Nothing limited his learning or his achievements; everything seemed possible for him through his vision. His career path was thus as awe-inspiring as the trajectory of the missiles he created.

Dr Kalam remained convinced of the power of imagination, throughout his life. He would often say that the most important duty of parents and teachers is to ensure that children use their imagination. He talked of dreams, visions and aspiration to adults almost as much as to children, too, for he firmly believed these were the key to a successful life.

69 A.P.J. Abdul Kalam, Arun Tiwari, *Transcendence*, HarperCollins, 2015, p. xii-xiii.

Of course, imagination can do little without work. While the young Kalam may not have always been a ‘class topper’, his astonishing capacity for hard work brought him academic success. Later, in his working life, he followed his visions unrelentingly. It mattered little whether it was building a hovercraft, placing a satellite into orbit or writing a book. He would calmly and firmly apply himself to his mission—over hours, days, months and years—until it was accomplished. He was stoic when faced with obstacles, and modest when his goals were achieved.

Once, I asked Dr Kalam how he viewed his life. He was as realistic as he was frank in his reply: ‘As a young person I always obeyed the orders I received from my conscience. My heart was always attached to my parents, to my sister Zohara and my brother Maracayer and other people in the family, to my teachers and those who helped me when I needed them. I considered all people who crossed my path, for good or bad, with equal respect, for it was God’s will that they were nice or harsh to me. I was afraid of any intoxication and temptations. I gave away most of my earnings to charity and never allowed it to be known to anyone. I was equitable when leadership positions were given to me. As a policy, I loved to be alone while remembering God in situations when tears must wash my soul of anguish and torment.’

Most apparent in these words is Dr Kalam’s ethical approach to life. Dr Kalam was the very embodiment of integrity, which he regarded as the state of being whole, just as with the related word ‘integer’. Perhaps Dr Kalam’s ethical behaviour makes his accomplishments especially admirable. Indeed, they would have held far less value had they involved corrupt or dishonest practices, just as a student’s distinction is meaningless if he has cheated in his examination. Dr Kalam was more rigorous on himself too in maintaining his integrity, than he could possibly have been with others. This was his way.

Dr Abdul Kalam set himself standards that could only inspire others; he was an example to his colleagues, those who worked for him and the nation. It may well be that this is the greatest lesson to be learned from the life of Dr A.P.J. Abdul Kalam. In following his example as much as heeding his words, you can only lead a better, more satisfying life. You will come to live with principle as he lived, act with faith as he acted, and you must pursue your dreams to their fulfilment.

I have not gone anywhere
 Like a well I remain in this great land
 Looking at millions of its children
 To draw from me
 The inexhaustible divinity
 And spread God’s grace everywhere
 As does the water drawn from a well.⁷⁰

70 A.P.J. Abdul Kalam with Arun Tiwari, *Wings of Fire*, University Press, 1999.

Timeline

- 1931: Born on October 15, in Rameswaram, Tamil Nadu.
- 1946-50: Schooling at Schwartz Higher Secondary School in Ramanathapuram, Tamil Nadu.
- 1954: Graduated in Physics from St. Joseph's College, Tiruchirappalli, Tamil Nadu.
- 1958: Completed Aeronautical Engineering from Madras Institute of Technology and joined Directorate of Technical Development and Production, DTD&P (Air).
- 1959: Joined the Aeronautical Development Establishment (ADE), created by DRDO to provide research and development support to HAL, as the first batch of recruits.
- 1962: Joined The Indian National Committee for Space Research (INCOSPAR) was set up by the Indian Government to formulate the Indian Space Programme.
- 1963: Trained by NASA at Langley Research Center (LaRC), Goddard Space Flight Center (GSFC) and Wallops Flight Center (WFC), in the United States of America.
- 1980: India enters the space club by putting the Rohini satellite in the near earth (400 km) orbit with SLV-3 on 18 July with Dr kalam as the Project Director.
- 1981: Awarded the Padma Bhushan, the third-highest civilian honour of India. Anna University, Madras, conferred the honorary degree of Doctor of Science, the first of the 48 honorary doctorates that he would receive later.
- 1982: Returned to DRDO and took over as the Director of Defence Research & Development Laboratory (DRDL), Hyderabad, the nodal agency for development of missiles technology in India.
- 1988: Surface-to-Surface missile system Prithvi successfully test fired on 25 February. Research Centre Imarat (RCI), a world-class missile integration facility inaugurated at Hyderabad.
- 1989: Intermediate Range Ballistic Missile system Agni successfully test fired on 22 May.
- 1990: Awarded the Padma Vibhushan, the second highest civil award of India.
- 1992: Appointed Scientific Advisor to the Raksha Mantri (Defence Minister) and Director General Defence Research & Development Organization (DRDO).

1997: Conferred upon the highest civilian award in India Bharat Ratna and became the second scientist after Sir C.V. Raman to receive the award.

1998: India conducts the Pokhran II nuclear tests in May with Dr Kalam as the chief project coordinator.

1999: Appointed as the Principal Scientific Advisor to the Government of India with a cabinet minister rank.

2001: Returned to Anna University as Professor of Technology & Societal Transformation

2002-2007: President of India

2009: Conferred upon the International von Kármán Wings Award and Hoover Medal.

2015: Departed at Indian Institute of Management (IIM), Shillong, 27 July.

Major Projects of Dr Kalam

Diamant Rocket Stage-Iv

Dr Kalam modified the SLV-3 fourth-stage design to suit the Diamant (French for Diamond) airframe. Diamant was the first satellite launcher and the only one at that point of time not built by either the USA or USSR. The 400 mm diameter was changed to 650 mm and the propellant mass went up from 250 kg to 600 kg. It took the team two years to develop the new design that would be the Diamant rocket's third and upper stage. France abruptly abandoned its national launcher programme in favour of the European Ariane launcher but not before successfully testing Stage-IV in a flight trial in September 1975. This effort marked the arrival of composite material technology in India and the first ever filament machine was installed at Thumba Equatorial Rocket Launching Station (TERLS), Trivandrum.

Satellite Launch Vehicle

Satellite Launch Vehicle(SLV-3) was India's first experimental satellite launch vehicle, which was an all-solid, four-stage vehicle weighing 17 tonnes with a height of 22m and capable of placing 40 kg class payloads in Low Earth Orbit (LEO). It was called SLV-3 as it was option 3 out of three configurations discussed. There was no SLV 1 or 2 ever made.

SLV-3 was successfully launched on July 18, 1980 from Sriharikota Range (SHAR), when Rohini satellite, RS-1, was placed in orbit, thereby making India the sixth member of an exclusive club of space-faring nations. SLV-3 employed an open loop guidance (with stored pitch programme) to steer the vehicle in flight along a pre-determined trajectory. The first experimental flight of SLV-3, in August 1979, was only partially successful. Apart from the July 1980 launch, there were two more launches held in May 1981 and April 1983, orbiting Rohini satellites carrying remote sensing sensors.

The successful culmination of the SLV-3 project showed the way to advanced launch vehicle projects such as the Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous satellite Launch Vehicle (GSLV).

Rohini Satellite

Rohini is the name given to a series of satellites launched by the Indian Space Research Organisation (ISRO). RS-1 was a 35 kg experimental spin stabilized satellite designed with a power handling capability of 16 W. It was successfully launched by SLV-3 into an orbit of 305 x 919 km with an inclination of 44.7°. All the fourth stage parameters of SLV-3 were successfully telemetered to the ground stations by RS-1 during the launch phase. The satellite had an orbital life of 9 months. The satellite carried Digital sun sensor, Magnetometer and temperature sensors. The structure was made of Aluminium Alloy. The satellite had a mission life of 1.2 years and an orbital life of 20 months.

Research Centre Imarat (RCI)

The DRDO had acquired approximately 2,100 acres of land in the 1970s for the purpose of developing a range for anti-tank missile testing. Mindful of the fact that his primary challenge in the Integrated Guided Missile Development Program was the development of requisite basic technologies, Dr Kalam decided to establish a model high-technology research centre here to carry out front-line research in areas such as special materials, embedded electronics and software. These would comprise the bedrock upon which an ambitious missile programme could be successfully constructed. Facilities for testing and evaluating missile systems were added. Prime Minister Rajiv Gandhi laid the foundation stone for the new facility in August 1985 and President R. Venkataraman inaugurated it on 27 August 1988. It was indeed the vision to develop technologies and systems rather than particular missiles that had made the organization's accomplishments possible.

Prithvi Missile

Prithvi was the first missile to be developed under the Integrated Guided Missile Development Program, initiated in 1983 to achieve self-sufficiency in the development and production of wide range missile systems.

The Prithvi was successfully flight-tested on 25 February 1988 at SHAR. It was a watershed event in India's military development, as this test established India's capability to develop the basic modules for future guided missiles. The Prithvi had the provision for modification from a long-range surface missile to an air missile; it could also be deployed from a ship. A CEP of less than 100 metres was achieved.

The successful launch sent political shock waves across the region, particularly in unfriendly neighbouring countries. Variants make use of either liquid or both liquid and solid fuels. Developed as a battlefield missile, it could carry a nuclear warhead in its role as a tactical nuclear weapon.

Agni Missile

Agni Missiles are long range, nuclear weapons capable surface-to-surface ballistic missile. The first

missile of the series, Agni-I was successfully tested in 1989. It had a solid-fuel first stage and liquid-fuel second stage and could carry a conventional payload of 1,000 kg or a nuclear warhead at a speed of 2.5 km/s to a range of 700-1250 km. Agni-I was developed at a meagre budget of three million dollars; and it had established India in the league of ballistic missile nations.

Despite the triumph of the Agni launch, the defence establishment was well aware of rival nations' progress in missile capability. While the Agni missile was under development, Pakistan too had made advances. It had tested two surface-to-surface missiles, Hatf-1 and Hatf-2, built with the help of China. Pakistan claimed that Hatf-1 had a range of 80 km and its successor, a range of 300 km. This immediately spurred India into the full-scale development of Agni and its four smaller sisters.

This original technology demonstrator was evolved into the all-solid-fuel Agni-II, III, IV and V missiles. Agni-II has a range of 2,000–2,500 km; Agni-III has a range of 3,500 km, and can take a warhead of 1.5 tonnes. The range was expanded to 4,000 km with Agni-IV and with Agni-V India had its own intercontinental ballistic missile (ICBM) capable of striking targets more than 5,500 km away.

Wheeler Island

After the rigmarole and unpleasantness of having to relocate people every time a launch was planned at the Interim Test Range in Chandipur, Orissa, and to avoid the media attention it attracted, Dr Kalam proposed to move the launch site to Wheeler Island, a landmass of about 2 sq. km in area, approximately 20 km of Chandipur coast.

Dr Kalam personally got involved in getting the paperwork done with the district authorities, including forest and environment officers for the land transfer and met the chief minister of Orissa, Biju Patnaik for final approval. Biju Patnaik gave Dr Kalam a warm hug. He said, 'Kalam, you are a good person. I have been following your work since Sarabhai's days. Whatever you ask, I will give. Your mission – the missile programme – is very important to the country. Anything needed from Orissa will be yours ... give me a promise (that you will make an ICBM). The day India makes its own ICBM, I shall be stronger as an Indian.'

Wheeler Island later became the missile test facility for most Indian missiles, but Biju Patnaik's promise could not be fulfilled before his death on 17 April 1997. Now all Agni launches take place from this facility. In a fitting tribute to Dr Kalam, the Odisha government on renamed the Wheeler Island as Abdul Kalam Island in September 2015.

India 2020 Vision

Kalam's vision of a developed India by the year 2020 emerged out of his insights into how larger forces that run the world must be handled in the national interest. In 1993, Dr Kalam took over as chairman, Technology Information, Forecasting and Assessment Council (TIFAC). He launched

an extensive study by a team of 500 experts to develop a vision of India as a developed nation by the year 2020.

India 2020 identified five areas of progress: agriculture and food processing aimed at doubling the present production; infrastructure with reliable electric power providing urban amenities to rural areas and increasing solar power operations; education and health care directed towards illiteracy, social security and overall health for the population; information and communication technology for increased e-governance to promote education in remote areas, telecommunication and telemedicine; and critical technologies and strategic industries, particularly the growth of nuclear technology, space technology and defence technology.

Union Finance Minister Arun Jaitley said on 31 July 2016 that there was a need for credible politics to ensure there can be credible policies that deliver the GDP growth rates that will make India a developed country at least by 2030, ten years later than the goal given by the former President A.P.J. Abdul Kalam.¹

BrahMos Missile

Not content with merely building a missile of the type of the IGMDP, Dr Kalam wanted a futuristic weapon. Harnessing the tremendous goodwill he enjoyed in the Russian scientific establishment, Dr Kalam established a joint venture in 1998, creating an equal partnership between DRDO and Russia's NPO Mashinostroyeniya to manufacture and market the supersonic cruise missile BrahMos, named after the Rivers Brahmaputra and Moscow.

BrahMos has two stages: the first, consisting of a solid-fuel rocket, would take the missile to break the sound barrier (Mach 1). The second stage, a liquid-fuelled ramjet, would propel it to Mach 2.8 and has a maximum range of 290 km. The ship-launched and land-based missiles can carry a 200 kg warhead, whereas the aircraft-launched variant (BrahMos A) can carry a 300 kg warhead. The missile would cruise as low as 10 metres above the wave tops, making it a 'sea-skimmer'. True to Dr Kalam's vision, the Brah Mos is the fastest cruise missile in operation today.

Coronary Stent

India's Missile Man would not merely be content with aerospace technology. Ever versatile, and with a mind that inquired far beyond the bounds of his own field, Dr Kalam was instrumental in pioneering various technologies for the less fortunate in society. He led the development of a coronary stent by developing delta-ferrite-free austenitic steel wires with a surface free from wire-drawing-induced micro-channels at the Defence Metallurgical Research Laboratory, Hyderabad.

With the medical inputs from Cardiologist Dr B. Soma Raju to DRDO scientists interdisciplinary biomedical collaboration emerged that was unprecedented in India. The introduction of the Kalam-Raju Stent caused a price crash in the market for imported stents, and even today stents are available

¹ <http://www.thehindu.com/business/Economy/we-have-missed-the-2020-bus-says-jaitley/article8922275.ece>

to Indian patients at the lowest rates in the world. Technology Institutions (TI) programme of the newly founded ICICI Bank provided one million dollars' funding to set up a Cardiovascular Technology Institute at Hyderabad. This led to the creation of the Care Hospital by Dr B. Soma Raju, which is a 500 million dollar enterprise as in 2016.

Pokhran II Nuclear Tests

Pokhran, a small town in a remote location in the Thar Desert of the Jaisalmer district in Rajasthan. The first underground nuclear test was performed here in 1974. Pokhran had seen the beginnings of nuclear India. The 58 Engineer Regiment of the Indian Army's Corps of Engineers had dug three shafts over the preceding several years, working during the night hours to avoid detection of their activities by spy satellites and kept in a state of continuous readiness for more than a year so that a test could be done within as little as ten days of a decision.

As part of the strict protocol to maintain secrecy, Dr Kalam and Dr Chidambaram donned army greens whenever they visited Pokhran, and their real identities were never revealed even to the people working there. Dr Kalam was known as Major General Prithviraj, and Dr Chidambaram was called Major General Natraj. Dr Anil Kakodar, director, Bhabha Atomic Research Centre (BARC), and the 100-odd scientists and technologists from the BARC and DRDO who descended on Pokhran to conduct the tests, were also given army fatigues and false military identities.

On 11 May 1998, the Buddha Purnima day, At 3:43:44.2 p.m. IST, three devices were detonated simultaneously. The combined force of the three blasts lifted an area about the size of a cricket ground to a few metres above the earth, sending billowing clouds of dust and sand into the air. Two days later, on 13 May 1998 the two sub-kiloton devices were detonated underground. The Pokhran-II nuclear test had now proved the arrival in India of more powerful and lighter nuclear weapons, small enough to be carried by missiles.

On 28 May 1998, Pakistan carried out nuclear tests at Ras Koh Hills in the Chagai district of Balochistan province. It was followed by another test on 30 May 1998. This had exposed the presence of nuclear bombs in our neighbourhood and the sinister designs of attack on India by our inveterate enemies. Pokhran-II indeed exposed the subterfuge, deceit, and involvement of Pakistan's generous friends to keep India in check. It changed the power dynamics of South-East Asia forever in India's favour.

