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Through the window of the compartment, I watched the countryside slip past. From a distance, the men in the fields in their white dhotis and turbans, and the womenfolk in bright splashes of colour against the green background of paddy fields, seemed to inhabit some beautiful painting. I sat glued to the window. Almost everywhere, people were engaged in some activity which had a rhythm and tranquillity about it—men driving cattle, women fetching water from streams. Occasionally, a child would appear and wave at the train.

It is astonishing how the landscape changes as one moves northwards. The rich and fertile plains of the river Ganga and its numerous tributaries have invited invasion, turmoil, and change. Around 1500 BC, fair-skinned Aryans swept in through the mountain passes from the far north-west. The tenth century brought Muslims, who later mingled with the local people and became an integral part of this country. One empire gave way to another. Religious conquests continued. All this time, the part of India south of the Tropic of Cancer remained largely untouched, safe behind the shield of the Vindhya and Satpura mountain ranges. The Narmada, Tapti, Mahanadi, Godavari, and Krishna rivers had woven a net of almost unassailable protection for the tapering Indian peninsula. To bring me to Delhi, my train had crossed all these geographical impediments through the power of scientific advancement.

I halted for a week in Delhi, the city of the great Sufi Saint Hazrat Nizamuddin, and appeared for the interview at DTD&P(Air). I did well at the interview. The questions were of a routine nature, and did not

challenge my knowledge of the subject. Then I proceeded to Dehra Dun for my interview at the Air Force Selection Board. At the Selection Board, the emphasis was more on "personality" than on intelligence. Perhaps they were looking for physical fitness and an articulate manner. I was excited but nervous, determined but anxious, confident but tense. I could only finish ninth in the batch of 25 examined to select eight officers for commissioning in the Air Force. I was deeply disappointed. It took me some time to comprehend that the opportunity to join the Air Force had just slipped through my fingers. I dragged myself out of the Selection Board and stood at the edge of a cliff. There was a lake far below. I knew that the days ahead would be difficult. There were questions to be answered and a plan of action to be prepared. I trekked down to Rishikesh.

I bathed in the Ganga and revelled in the purity of its water. Then, I walked to the Sivananda Ashram situated a little way up the hill. I could feel intense vibrations when I entered. I saw a large number of sadhus seated all around in a state of trance. I had read that sadhus were psychic people—people who know things intuitively and, in my dejected mood, I sought answers to the doubts that troubled me.

I met Swami Sivananda—a man who looked like a Buddha, wearing a snow-white dhoti and wooden slippers. He had an olive complexion and black, piercing eyes. I was struck by his irresistible, almost child-like smile and gracious manner. I introduced myself to the Swamiji. My Muslim name aroused no reaction in him. Before I could speak any further, he inquired about the source of my sorrow. He offered no explanation of how he knew that I was sad and I did not ask.

I told him about my unsuccessful attempt to join the Indian Air Force and my long-cherished desire to fly. He smiled, washing away all my anxiety almost instantly. Then he said in a feeble, but very deep voice,

Desire, when it stems from the heart and spirit, when it is pure and intense, possesses awesome electromagnetic energy. This energy is released into the ether each night, as the mind falls into the sleep state. Each morning it returns to the conscious state reinforced with the cosmic currents. That which has been imaged will surely and certainly be manifested. You can rely, young man, upon this ageless promise as surely as you can rely upon the eternally unbroken promise of sunrise... and of Spring.

When the student is ready, the teacher will appear—How true! Here was the teacher to show the way to a student who had nearly gone astray! "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 revealed now but it is predetermined. Forget this failure, as it was essential to lead you to your destined path. Search, instead, for the true purpose of your existence. Become one with yourself, my son! Surrender yourself to the wish of God," Swamiji said.

I returned to Delhi and enquired at the DTD&P(Air) about the outcome of my interview. In response, I was handed my appointment letter. I joined the next day as Senior Scientific Assistant on a basic salary of Rs 250/- per month. If this was to be my destiny, I thought, let it be so. Finally, I was filled with mental peace. No more did I feel any bitterness or resentment at my failure to enter the Air Force. All this was in 1958.

At the Directorate, I was posted at the Technical Centre (Civil Aviation). If I was not flying aeroplanes, I was at least helping to make them airworthy. During my first year in the Directorate, I carried out a design assignment on supersonic target aircraft with the help of the officer-in-charge, R Varadharajan, and won a word of praise from the Director, Dr Neelakantan. To gain shop-floor exposure to aircraft maintenance, I was sent to the Aircraft and Armament Testing Unit (A&ATU) at Kanpur. At that time, they were involved in a tropical evaluation of Gnat Mk I aircraft. I participated in the performance assessment of its operation systems.

Even in those days, Kanpur was a very populous city. It was my first experience of living in an industrial town. The cold weather, crowds, noise and smoke were in total contrast to what I was used to in Rameswaram. I was particularly troubled by the ubiquitous presence of potatoes on the dining table, right from breakfast to dinner. To me, it seemed that a feeling of loneliness pervaded the city. The people on the streets had all come from their villages in search of jobs in factories, leaving behind the smell of their soil and the protection of their families.

On my return to Delhi, I was informed that the design of a DART target had been taken up at the DTD&P (Air) and that I had been included in the design team. I completed this task with the other team members. Then, I undertook a preliminary design study on a Human Centrifuge. I later carried out the design and development of a Vertical Takeoff and Landing Platform. I was also associated with the development and construction of the Hot Cockpit. Three years passed. Then the Aeronautical Development Establishment (ADE) was born in Bangalore and I was posted to the new establishment.

Bangalore as a city was in direct contrast to Kanpur. In fact, I feel our country has an uncanny way of bringing out extremes in her people. I suppose, it is because Indians have been both afflicted and enriched by centuries of migrations. Loyalty to different rulers has dulled our capacity for a single allegiance. Instead, we have developed an extraordinary ability to be compassionate and cruel, sensitive and callous, deep and fickle, all at the same time. To the untrained eye, we may appear colourful and picturesque; to the critical eye, we are but shoddy imitations of our various masters. In Kanpur, I saw paan-chewing imitations of Wajid Ali Shah, and in Bangalore it was replaced by dog-walking sahibs. Here too, I longed for the depth and calmness of Rameswaram. The relationship between the heart and the head of an earthy Indian has been eroded by the divided sensibilities of our cities. I spent my evenings exploring the gardens and shopping plazas of Bangalore.

The workload at ADE during the first year of its inception was quite light. In fact, I had to generate work for myself at first, until the tempo gradually built up. Based on my preliminary studies on ground-handling equipment, a project team was formed to design and develop an indigenous hovercraft prototype as a ground equipment machine (GEM). The team was a small working group, comprising four persons at the level of Scientific Assistant. Dr OP Mediratta, Director of the ADE, asked me to lead the team. We were given three years to launch the engineering model.

The project was, by any standards, bigger than our collective capabilities. None of us had any experience in building a machine, let alone a flying machine. There were no designs or standard components available to begin with. All we knew was that we had to make a successful heavier-than-air flying machine. We tried to read as much literature as we could find on hovercrafts, but there was not much available. We tried to consult people knowledgeable in this area, but could find none. One day, I simply took the decision to proceed with the limited information and resources available.

This endeavour to produce a wingless, light, swift machine opened the windows of my mind. I was quick to see at least a metaphorical connection between a hovercraft and an aircraft. After all, the Wright Brothers made the first aeroplane after fixing bicycles for seven years! I saw in the GEM project great opportunities for ingenuity and growth. We went straight into hardware development after spending a few months on the drawing board.

There is always the 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 circumstance propels him into a more favourable environment. I knew I had to create my own opportunities.

Part by part, subsystem by subsystem, stage by stage, things started moving. Working on this project, I learned that once your mind stretches to a new level it never goes back to its original dimension.

At that time VK Krishna Menon was the Defence Minister. He was keenly interested in the progress of our small project, which he envisioned as the beginning of the indigenous development of India's defence equipment. Whenever he was in Bangalore, he always found some time to review the progress of our project. His confidence in our ability ignited our enthusiasm. I would enter the assembly shop leaving my other problems outside, just as my father used to enter the mosque for prayer, leaving his shoes outside.

But not everyone accepted Krishna Menon's opinion about GEM. Our experiments with the available parts and components did not exactly delight my senior colleagues. Many even called us a group of eccentric inventors in pursuit of an impossible dream. I, being the leader of the "navvies", was a particularly inviting target. I was regarded as yet another

country bumpkin who believed that riding the air was his domain. The weight of opinion against us buttressed my ever-optimistic mind. The comments of some of the senior scientists at ADE made me recall John Trowbridge's famous satirical poem on the Wright Brothers, published in 1896:

. . . . with thimble and thread
And wax and hammer, and buckles and screws,
And all such things as geniuses use; —
Two bats for patterns, curious fellows!
A charcoal-pot and a pair of bellows.

When the project was about a year old, Defence Minister Krishna Menon made one of his routine visits to ADE. I escorted him into our assembly shop. Inside, on a table lay the GEM model broken down into sub-assemblies. The model represented the culmination of one year's untiring efforts to develop a practical hovercraft for battlefield applications. The minister fired one question after another at me, determined to ensure that the prototype would go into test flight within the coming year. He told Dr Mediratta, "GEM flight is possible with the gadgets Kalam now possesses".

The hovercraft was christened Nandi, after the bull ridden by Lord Shiva. For a prototype, its form, fit and finish was beyond our expectation, given the rudimentary infrastructure we possessed. I told my colleagues, "Here is a flying machine, not constructed by a bunch of cranks but by engineers of ability. Don't look at it—it is not made to look at, but to fly with."

Defence Minister Krishna Menon flew in the Nandi, overruling the accompanying officials' concern for his safety. A Group Captain in the minister's troupe, who had logged in many thousands of flying hours, even offered to fly the machine to save the minister from the potential danger of flying with an inexperienced civilian pilot like myself and gestured to me to come out of the machine. I was sure about my competence in flying the machine I had made, and therefore shook my head in negation. Observing this wordless communication, Krishna Menon dismissed the insulting suggestion of the Group Captain with a laugh and signalled to me to start the machine. He was very happy.

"You have demonstrated that the basic problems of hovercraft development are solved. Go for a more powerful prime mover and call me for a second ride," Krishna Menon told me. The skeptical Group Captain (now Air Marshal) Golay, later became a good friend of mine.

We completed the project ahead of schedule. We had a working hovercraft with us, moving on an air cushion of about 40mm with a load of 550kg, including the tare weight. Dr Mediratta was visibly pleased with the achievement. But by this time, Krishna Menon was out of office and could not take his promised second ride. In the new order, not many people shared his dream with regard to military applications of an indigenous hovercraft. In fact, even today, we import hovercrafts. The project was mired in controversies and was finally shelved. It was a new experience for me. So far, I had believed that the sky was the limit, but now it appeared that the limits were much closer. There are boundaries that dictate life: you can only lift so much weight; you can only learn so fast; you can only work so hard; you can only go so far!

I was unwilling to face reality. I had put my heart and soul into Nandi. That it would not be used was something beyond my comprehension. I was disappointed and disillusioned. In this period of confusion and uncertainty, memories from my childhood came back to me and I discovered new meanings in them.

Pakshi Sastry used to say, "Seek the truth, and the truth shall set you free." As the Bible says, "Ask and you shall receive." It did not happen immediately, but it happened nevertheless. One day, Dr Mediratta called me. He inquired about the state of our hovercraft. When told that it was in perfect condition to be flown, he asked me to organize a demonstration for an important visitor the next day. No VIP was scheduled to visit the laboratory during the next week as far as I knew. However, I communicated Dr Mediratta's instructions to my colleagues and we felt a new surge of hope.

The next day Dr Mediratta brought a visitor to our hovercraft—a tall, handsome, bearded man. He asked me several questions about the machine. I was struck by the objectivity and clarity of his thinking. "Can you give me a ride in the machine?" he enquired. His request filled me with joy. Finally, here was someone who was interested in my work.

We took a ten-minute ride in the hovercraft, a few centimetres above the ground. We were not flying, but were definitely floating in the air. The visitor asked me a few questions about myself, thanked me for the ride and departed. But not before introducing himself—he was Prof. MGK Menon, Director of the Tata Institute of Fundamental Research (TIFR). After a week, I received a call from the Indian Committee for Space Research (INCOSPAR), to attend an interview for the post of Rocket Engineer. All I knew about INCOSPAR at that time was that it was formed out of the TIFR talent pool at Bombay (now Mumbai) to organize space research in India.

I went to Bombay to attend the interview. I was unsure about the type of questions I would have to face at the interview. There was hardly any time to read up or talk to any experienced person. Lakshmana Sastry's voice quoting from the Bhagawad Gita echoed in my ears:

> *All beings are born to delusion . . . overcome by the dualities which arise from wish and hate . . . . But those men of virtuous deeds in whom sin has come to an end, freed from the delusion of dualities, worship Me steadfast in their vows.*

I reminded myself that the best way to win was to not need to win. The best performances are accomplished when you are relaxed and free of doubt. I decided to take things as they came. Since neither Prof. MGK Menon's visit nor the call for an interview had been of my making, I decided this was the best attitude to take.

I was interviewed by Dr Vikram Sarabhai along with Prof. MGK Menon and Mr Saraf, then the Deputy Secretary of the Atomic Energy Commission. As I entered the room, I sensed their warmth and friendliness. I was almost immediately struck by Dr Sarabhai's warmth. There was none of the arrogance or the patronising attitudes which interviewers usually display when talking to a young and vulnerable candidate. Dr Sarabhai's questions did not probe my existing knowledge or skills; rather they were an exploration of the possibilities I was filled with. He was looking at me as if in reference to a larger whole. The entire encounter seemed to me a total moment of truth, in which my dream was enveloped by the larger dream of a bigger person.

I was advised to stay back for a couple of days. However, the next evening I was told about my selection. I was to be absorbed as a rocket engineer at INCOSPAR. This was a breakthrough a young man like myself dreamed of.

My work at INCOSPAR commenced with a familiarization course at the TIFR Computer Centre. The atmosphere here was remarkably different from that at DTD&P (AIR). Labels mattered very little. There was no need for anyone to justify his position or to be at the receiving end of the others' hostility.

Some time in the latter half of 1962, INCOSPAR took the decision to set up the Equatorial Rocket Launching Station at Thumba, a sleepy fishing village near Trivandrum (now Thiruvananthapuram) in Kerala. Dr Chitnis of the Physical Research Laboratory, Ahmedabad had spotted it as a suitable location as it was very close to the earth's magnetic equator. This was the quiet beginning of modern rocket-based research in India. The site selected at Thumba lay between the railway line and the sea coast, covering a distance of about two and a half km and measuring about 600 acres. Within this area, stood a large church, whose site had to be acquired. Land acquisition from private parties is always a difficult and time-consuming process, especially in densely populated places like Kerala. In addition, there was the delicate matter of acquiring a site of religious significance. The Collector of Trivandrum then, K Madhavan Nair, executed this task in a most tactful, peaceful and expeditious manner, with the blessings and cooperation of Right Rev. Dr Dereira, who was the Bishop of Trivandrum in 1962. Soon RD John, the executive engineer of the Central Public Works Department (CPWD), had transformed the entire area. The St. Mary Magdalene church housed the first office of the Thumba Space Centre. The prayer room was my first laboratory, the Bishop's room was my design and drawing office. To this day, the church is maintained in its full glory and, at present, houses the Indian Space Museum.

Very soon after this, I was asked to proceed to America for a six-month training programme on sounding rocket launching techniques, at the National Aeronautics and Space Administration (NASA) work centres. I took some time off before going abroad and went to

Rameswaram. My father was very pleased to learn about the opportunity that had come my way. He took me to the mosque and organized a special namaz in thanksgiving. I could feel the power of God flowing in a circuit through my father to me and back to God; we were all under the spell of the prayer.

One of the important functions of prayer, I believe, is to act as a stimulus to creative ideas. Within the mind are all the resources required for successful living. Ideas are present in the consciousness, which when released and given scope to grow and take shape, can lead to successful events. God, our Creator, has stored within our minds and personalities, great potential strength and ability. Prayer helps us to tap and develop these powers.

Ahmed Jallaluddin and Samsuddin came to see me off at Bombay airport. It was their first exposure to a big city like Bombay, just as I myself was about to have my first exposure to a mega city like New York. Jallaluddin and Samsuddin were self-reliant, positive, optimistic men who undertook their work with the assurance of success. It is from these two persons that I drew the core creative power of my mind. My sentiments could not be contained, and I could feel the mist of tears in my eyes. Then, Jallaluddin said, “Azad, we have always loved you, and we believe in you. We shall always be proud of you”. The intensity and purity of their faith in my capabilities broke my last defences, and tears welled up in my eyes.

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