CHAPTER 1

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1.1. Introduction

In our ancient Indian literature we find descriptions of the vimanas or aerial chariots which are described as being used by our ancient scholars thousands of years ago. Our great epics like Ramayana and Mahabharata, Vedas, Srimadbhaagavatam, ancient historical texts like ‘Samarangana Sutradhaara’ of Bhoja Deva and many other ancient literary works describe aerial chariots. These aerial chariots are further described as being used by the Kings, Rishi munis to travel from one place to another, one country to another and one planet to another. We can find carvings of the same in our ancient heritage places like Hampi, Mahabalipuram, Ellora and many other places across the world. This brings in a set of curious questions in our minds.

- Are these descriptions of aerial chariots real or imaginary?
- Did our ancient scholars really use such aerial chariots?
- What is the technology behind such vimanas?
- Did aviation science exist thousands of years ago?

To understand answers for each of these questions we should first know what Aviation is. Aviation is defined as “the practical aspect or the field of air transportation, being the design, construction, operation and application of aircraft, especially heavier-than-air flying machines”. (“Aviation | Define Aviation at Dictionary.com”) The term “Aviation” is derived from the verb "avier" (Latin word "avis") which was first used in 1863 by French flight pioneer Guillaume Joseph Gabriel de La Landelle (1812-1886) in “Flying ou Navigation aérienne”. (“Aviation Memorabilia & Collectibles” 2014) In a general sense, we can describe Shastra1 as education/knowledge. This word is by and large used as a suffix similar to English ‘logy’. For example Astra Shastra describes Shastra on "Handling of weapons". Hence Vymanika Shastra is

characterized as Shastra on the subject of vimanas. It is a mid-twentieth century Sanskrit work on aeronautic and aerospace technology.

1.2. Objectives

The important objective of this research is to conceptually connect the aviation science of the past with our current Aircraft Technology. This can be achieved by the study and understanding of Aviation Science of vedic and ancient era; comparative study of vimanas described in Vedas, Ramayana, Mahabharata and Srimadbhaagavatam with modern aircraft; study of the vimanas described in Samarangana Sutradhara of Bhoja Deva which uses the power source Mercury Ion engine in comparison with Mercury Vortex Engine designed by NASA; comparison between the concept of design, construction, components, materials used in the construction of aircraft described in Maharshi Bharadwaja’s Vymanika Shastra with modern aircraft. The final goal is to conceptually compare the features of aerial chariots described in ancient texts with those of modern aircraft, study the descriptions of technology of ancient aircraft in comparison with the technology used in modern aircraft and document the findings.

1.3. Scope of the Research

This research mainly focuses on the study of Aviation Science and vimanas described in the Rig Veda, Yajur Veda, Ramayana, Srimadbhaagavatam, Mahabharata, Samarangana Sutradhaara, Vymanika Shastra and articles written by various scholars on ancient vimanas and analyze the same in comparison with similar features of modern aircraft. This research also focuses on a few of the ancient flying machines, aircraft, spacecraft and rockets described in ancient Chinese and Greek texts; study of carvings of vimanas, aerial chariots and rockets in ancient heritage sites in India such as Ellora, Mahabalipuram and Hampi; Seti I temple in Egypt; gold model of Aircraft at Bogotá Gold Museum, Columbia; other rocket like carvings of Mayan civilization; wooden bird like artifact in Saqqara Egyptian tomb and other ancient paintings and carvings of rockets and spacecraft.

There are a few theoretical concepts which we commonly find in many of the ancient Indian texts. They are “Thought powered Aircraft”, “Aircraft with weapon holding abilities”, “Weapons and Aircraft which can be used for mass destruction”, “Mercury Vortex Engines” and “Multi storied aircraft”. We currently do not have the authentic proof to decide whether these descriptions are mere imaginations or aircraft with these features existed during ancient era.
Even with the sophisticated technology, we currently have a few features which are still being experimented and not practically used.

The purpose of this research is to:

- Appreciate the contributions of our ancient scholars to the field of Aviation Science.
- Study the description of ancient vimanas in comparison with modern aircraft.
- Conceptually study the available technical details of ancient vimanas in comparison with a few concepts of aircraft technology prevalent today.
- Study the carvings of a few of the aerial chariots, rockets and spacecraft in India and across the world.
- Document the findings from this research so that our current generation can get the insights of the contributions of our ancient scholars and understand the relevancy of ancient works in current era.
- Finally study if these descriptions of vimanas in ancient texts can provide ideas for designing better aircraft in future.

The comparative study carried out as a part of this research is limited to conceptual comparisons mainly because there are no literary evidences which describe the actual technology behind a few of the ancient Vimanas. Practical experiments and scientific research to prove the technical information available in the ancient literary works of the Vedic and ancient era is out of scope of this research.

1.4. **Hypothesis**

Based on the available literary evidences and literature review done the following hypothesis statements can be derived.

**There are conceptual similarities between vimanas described in Vedic and other ancient texts when compared with modern aircraft.**
• “Thought powered aircraft” or “Kaamagam Yaanam” described in Ramayana and Mahabharata can be conceptually compared with “Thought powered aircraft” being researched by researchers from the University of Minnesota, USA.

• Destruction caused by Saubha Vimana described in Srimadbhaagavatam and Hiranyapura described in Mahabharata can be conceptually compared with that of the most powerful bomber aircraft used in wars.

• There are visual similarities between carvings of Vimanas, rockets or spacecraft in ancient heritage places when compared with modern aircraft.

• The concept of using Mercury as a propellant described in Samarangana Sutradhara of Bhojadeva can be conceptually compared with the similar concept mentioned in some of the Kritaka Vimanas described in Vymanika Shastra. This in turn can be compared with Mercury Vortex Engine designed by NASA.

1.5. Classical Perspective of Vimanas and Vymanika Shastra

The concept of travelling by air was most common during the ancient era. It is accepted that our ancient scholars had excellent knowledge of aeronautics. The Rig Veda, the most veteran record of humankind includes references to flying chariots of various Vedic deities like Pushan, Vayu, Agni, Asvins and Vishvedevas. It is said that Maharishi Bharadwaja has written a book called “Yantra Sarvasva”. In that book, Chapter 40 titled “Vymanika Shastra or Science of Aeronautics” describes the design, construction and applications of various aircrafts (Josyer 1973). This book gives the clear classification of vimanas and explains in detail about the design and the materials used in the construction of vimanas. In the year 1952, G.R.Josyer discovered the ancient manuscript of this text written by Pandit Subbaraya Shastry. In the year 1959 Hindi translation of the text was first published, only after this, people started knowing that such an amazing technology existed during our ancient era. (“Vaimānika Shāstra” 2014) Since it was in Hindi, it could reach only limited readers within India. Thanks to G.R.Josyer who has given a great contribution by translating this work to English and publishing the Sanskrit text along with English translation in the year 1973. It is only because of him, this text could reach the enthusiastic researchers across the world. It has eight chapters containing 3000 shlokas. Pandit Subbaraya Shastry has claimed that it was orally delivered to him by ancient sage Bharadwaja.
Around forty scientific texts related to aviation, metallurgy etc. are quoted in this text. These show that even before this text was written our ancient scholars knew about aviation science, metallurgy, meteorology, physics, electrical engineering, mechanical engineering, botany, chemistry etc. (Josyer 1973)

It is believed that India’s first unmanned aircraft called “Marutsakha” was built and tested by the Indian scientist Shivkar Bapuji Talpade (1864–1916) with the help of the Pandit Subbaraya Shastry in the year 1895, i.e. eight years before the invention of Wright brother’s ‘Wright Flyer’. The name “Marutsakha” is derived from 96th hymn, 2nd sukta in seventh mandala of Rigveda while addressing goddess Saraswati.

Rigveda Mandala 7 2017: 58

‘Marut’ means ‘stream of air’ and ‘Sakha’ means ‘friend’. Mr. D. K. Kanjilal in “Vimana in Ancient India: Airplane or Flying Machines in Ancient India”, and news articles contemporary to Thalpade published in Marathi-dialect daily paper Kesari, describes that Marutsakha is designed based on descriptions of vimanas in Hindu Mythology. (“Shivkar Bapuji Talpade”) Pt. S. D. Satawlekar who was Talpade’s student has written that Marutsakha sustained flight for a couple of minutes. He has described that Mahadeva Govinda Ranade who is the famous Indian Judge and Nationalist along with HH Sayaji Rao Gaekwad III, the king of Baroda during that time have witnessed the flight of first unmanned aircraft “Marutsakthi” which flew to a height of 1500 feet before falling down to earth. (Baidya 2015). This is mentioned in the records of “Annals of the Bhandarkar Oriental Research Institute”. (“Shivkar Bapuji Talpade”)

The “Samarangana Sutradhara” of Bhojadeva describe that Vimanas were made of light material with solid body made of iron copper and lead. Ivan. T. Sanderson in the introductory chapter of the text “VIMANA Aircraft of Ancient India and Atlantis” authored by “David

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Hatcher Childress” quotes “Desmond Leslie”, who has described Vimanas in Samaranga Sutradhara. Leslie describes that the body of Vimana should be strong and durable, made of light weight material similar to a flying bird. He describes that Mercury Engine should be placed with Iron heating apparatus underneath it. People in the vimana can travel long distances using the power latent in the mercury. (Childress 1991, VIMANA Aircraft of Ancient India & Atlantis: 10)

Thirty first chapter of Samarangana Sutradhara deals with Named Yantravidhanam. i.e. the chapter dealing with the preparation of Mechanical Contrivances. (Sharma 2012:363-404) This chapter devotes 223 stanzas on these machines or vimanas.

In addition to the Vymanika Shastra, the Samarangana Sutradhara and the Yuktikalpataru of Bhoja, there are many verses in the Rig Veda and Yajurveda, a lot of literary passages belonging to the Ramayana, the Mahabharata, the Puranas and the Srimadbhaagavatam which describes these vimanas.

Descriptions of vimanas in our epics create a pictorial representation of vimanas in our mind.

In Sarga 8, Sundara Kanda of Ramayana, Lord Hanuman provides amazing and glorious description of Pushpaka Vimana.

स तत्स्य मध्ये भवनस्य संस्थितम्।
महद्विमानम् मणिवज्ञचिन्तितम्।
प्रत्यत्जाम्बूनदजालकृत्रिमम्।
ददर्श वीरः पवनाल्मजः कपि:। ५-८-१(Valmiki, “Ramayana - Sundara Kanda, Sarga 8”)

This Pushpaka Vimana which is studded with diamonds and gems and decorated with a series of refined gold will be lying in the middle of the tall building. Courageous Hanuman will be surprised at the sight of the beauty of this huge vimana.

न तत्र किंचिन्त्र कृतम् प्रयजलतो।
न तत्र किंचिंत्र महारत्यलवल।
Hanuman describes that in the Pushpaka Vimana there is not even a small thing which is not made with great effort, not even a small part which is not studded with best diamonds and it has characteristics which are definitely not in Deva vimanas also, and there is nothing which is not of great significance.

In Sarga 121, Yuddha Kanda of Ramayana, when Rama decides to return back to Ayodhya after killing Ravana, Vibhishana decides to send Rama, Lakshmana and Seetha in Pushpaka Vimana. It is described as follows:

Vibhishana describes that the wonderful and excellent thought powered aerial chariot shining like the sun, named Pushpaka Vimana, was made by Vishwakarma for Brahma, later Brahma gifted it to Kubera, the God of riches, which was later stolen by Ravana along with Lanka.

In Mahabharatha, we find the description of the Indra’s aerial chariot driven by Matali through which Arjuna travels to Amaravati, we find the description of the airport terminal and vimanas at Amaravati, the Metallic flying city called ‘Hiranyapura’, the legend of Saubha Vimana and so on. In one particular legend in Srimadbhaagavatam, lord Krishna searches for Salva, when the Saubha Vimana of Salva is made imperceptible Krishna promptly shoots a special weapon which killed Salva by searching out sound. We find the description of many terrific weapons in Mahabharata, the most terrific ones are the ones which are used against Vrishnis.
We find the description of similar wars in a few other ancient civilizations. The after effects of these Iron Thunderbolts are very deadly. It had an impact even on the survivors as their hairs and nails were falling out. This war reminds us on the effects of the atomic bombings of Hiroshima and Nagasaki. This makes us think if nuclear weapons were used during Mahabharata war.

### 1.6. Criticism on Vymanika Shastra

H.S. Mukunda and team has conducted a detailed study on the work “Vymanika Shastra” in the year 1974 and published a report called “A critical study of the work Vyamanika Shastra”. This report describes Vymanika Shastra in detail as described below. Sri Bramhamuni Parivrajaka had published a book called “Brihad Vymanika Shastra” in the year 1959 which has Sanskrit verses of the description of Vimanas with Hindi translation. Similarly G. R. Josyer has published another book called “Vymanika Shastra” which has Sanskrit Verses and English translation in the year 1973. The English translation of the text provides some drawings of ancient Vimanas which is originally not available in Hindi Translation. The Hindi translator quotes Maharshi Dayananda Saraswati’s work titled “Rig Veda Bhasya Bhoomika” which was published in the year 1878. The manuscript from which Brihad Vymanika Shastra was written is said to be available at Rajakiya Sanskrit Library, Baroda since 1944. Another copy of this transcript was found in Poona with date 9th Aug 1918 and signature of G. Venkatacchala Sharma. In the introductory section of this transcript gratitude is expressed to Air Commander Goal. He might have helped them in procuring this manuscript. It is described that Pandit Subbaraya Shastry who had some mystic powers would recite the shlokas and Sri Venkatachala Sharma would promptly take down the same. After the full text was dictated copies were made and circulated to several places. After the death of Shastriji in the year 1941 his adopted son, Shri Venkatarama Shastry was in charge of these materials. Some close circles of the Shri Venkatarama Shastry knew about this manuscript and that’s how Air Commander Goel could procure it from Baroda University Library during 1944. History of Pandit Subbaraya Shastry and how he wrote Vymanika Shastra is quite interesting and will be explained in detail in further chapters. As per the report “A Critical Study of the work Vymanika Shastra” below are the observations.
Sanskrit used in the text is quite simple and modern and hence they might not be of vedic origin. Vedic Sanskrit structure is found in very few words.

There are innumerable Sanskrit texts which belong to the post vedic age, but except Samarangana Sutradhara of Bhojadeva no other texts mention about the use of aircraft in ancient era.

Shri. G.R. Josyer in the English translation of the work Vymanika Shastra mentions that the text is 7000 years old, but in Hindi translation it is mentioned that the text is of vedic origin.

Introduction to Josyer’s English translation is least scholarly by any standards.

The origin of “Vymanika Shastra” seems unclear. It might have been written between 1900 and 1922. The techniques used by the Author Pandit Subbaraya Shastry seems to be unclear.

We do not have any evidence other than textual statement in the work to prove that Maharshi Bharadwaja was the author of this work.

Vymanika Shastra gets down to detail right away, without enunciation of basic principles involved. There is no expression of generality.

Vymanika Shastra emphasizes more on propulsive devices and structures, but not on aerodynamics.

It is not possible to construct Vimanas described in Maharshi Bharadwaja’s Vymanika Shastra.

This study concludes that Vymanika Shastra cannot be dated earlier than 1904 and with our present knowledge, it is not feasible to construct heavier than air aircraft of earlier times. (Mukunda et al. 1974)

1.7. Modern perspective of Aircraft and Aircraft Technology

From the Wright Flyer in 1903 to the present cutting edge aircraft, world has advanced from a solitary flight to more than 25,000 takeoffs a day. The Aviation industry is always working towards better fuel efficiency, recyclability concerns and early adoption of useful technology.
‘Internet of things’ has changed everything. Now electronic devices are capable of communicating with each other without the need of a host system. This has helped Maintenance, repair and overhaul professionals (MRO) to communicate with plane sensors using tablets. MROs use predictive analytics to identify outcomes of a given situation. Now, instead of regularly replacing the parts they can identify the end of life time of each part and then plan the replacements.

Augmented reality has helped MROs to provide training anywhere in the world without waiting for in-person trainings.

Additive manufacturing or 3D printing is currently being used in the large scale manufacturing process. Boeing along with Oak Ridge National Laboratory has 3D printed the largest single piece ever printed using this technology – a 777x wing trim tool. A task which used to take three months using traditional methods can be completed in just 30 hours.

The Aerospace industry is currently working towards improving the efficiency in aviation to help in curbing the global warming.

- **Electric Planes** - Airbus is currently testing a battery powered electric plane prototype E-Fan 2.0 which completed its flight across the English Channel. The E-Fan 4.0 which is a hybrid electric plane has the potential to change the future of airplane design. The expectation is that this would burn 25 to 50 percent less fuel. (‘What the Aerospace Industry Is Doing Right Now to Help Curb Global Warming’)

- **Solar Powered Flight** - The Solar Plane, Solar Impulse 2 has created history by completing the world trip. This plane has successfully travelled 40000 kilometres by charging the plane’s batteries through solar panels during day light which weights around 2.3 tons almost a quarter of the plane’s weight. It has reached up to the height of 29000 feet during day and flew down to 5000 feet during night to conserve the power. Comparison between Solar Impulse 2 and Boeing 747 is as shown in the Figure below. Bertrand Piccard was alternated with André Borschberg in this Solar Impulse round-the-world journey. Bertrand describes that, their aim was to show the capabilities of renewable energy rather than developing solar powered planes for widespread use. (‘Solar Plane Makes History after Completing Round-the-World Trip’
Bio Fuel Flight - Now biofuel has reached the aerospace fuel sector. Honeywell Green Jet fuel, which is a biofuel derived from dedicated energy crop camelina is being used as fuel for some of the aircraft. Camelina has 35-38% oil and is highly rich in omega 3 fatty acids. This makes the oil fit for biofuel production. It originated in Northern Europe and has many names like gold-of-pleasure, false flax, wild flax, German sesame. This provides new profit opportunities to farmers in the US and Canada.

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The major challenges are in reducing the fuel cost and making it competitive with petroleum-based fuel cost. Currently biofuel costs 40% - 75% more than petroleum-based fuel cost. Research is going on to reduce the cost of biofuel. (Fellet 2016)

• Currently the world is focusing on creating Personal Air Vehicles which are secure, less expensive and easy to operate, while having less negative consequences for the earth. Personal Air Vehicles (PAVs) are generally flying machines that can be utilized for individual travel like an auto in the sky. NASA aeronautics built up the PAV idea with the thought of transporting individuals to their destinations just a couple of miles away from their doorstep with the speeds three to four times quicker than the cars. NASA predicts that PAV’s will mitigate traffic jams at metropolitan hub air terminals and the freeways that encompass them, decrease the need to construct new thruways and spare a great part of the 6.8 billion gallons of fuel squandered in surface gridlock every year as told by NASA. (“International Aerospace Discussion - Bharat Rakshak”)

1.8. Comparison between Ancient Vimanas and Modern Aircraft

When we think of Ancient Vimanas the first thing which comes to our mind are Vimanas described in Ramayana, Mahabharata, Srimadbhaagavatam and the Vedas. We then think of Vimanas described in Vymanika Shastra, flying machines, aerial chariots and space travel

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described in ancient Chinese and Greek literary works followed by ancient vimana carvings and paintings in various heritage sites across the world.

As mentioned in Hypothesis statements of this research, Pushpaka Vimana described in Ramayana is a thought powered aircraft. This can be compared with ‘Thought powered aircraft’ described in “Quadcopter control in three-dimensional space using a noninvasive motor imagery-based brain–computer interface”. Destruction caused by Flying Palaces like Hiranyapura described in the Mahabharata and Saubha Vimana described in Srimadbhaagavatam can be compared with that of the best bomber aircraft used in modern wars. Daaru Vimanas described in Samaranga Sutradhaara of Bhojadeva can be compared with Hasti Yantras mentioned in Kautilya’s Arthashastra. The concept of using mercury as a propellant can be compared with the Mercury Vortex engine designed and tested by NASA. Different modes of transportation described in the Vedas can be compared with amphibious assault vehicles, aircraft with three wheels in its landing gear, electric aircraft, wind powered gliders, etc. When we compare Vimanas described in Maharshi Bharadvaja’s Vymanika Shastra with modern aircraft we can find conceptual similarities in the components of vimanas and modern aircraft. Vymanika Shastra describes around 32 secret features of the Vimanas which a pilot should be trained on. Each of these features can be compared with the corresponding ones in modern aircraft. All these features are in many ways comparable with the features of advanced aircraft. This research describes in detail about these features.

1.9. Conclusion and introduction to next chapter

In this introductory chapter we have discussed the definition of Vimanas, Shastra and Vymanika shastra, understood the main objectives and scope of this research, have come up with Hypothesis statements for this research, discussed the description of vimanas in vedas, our great epics like Ramayana, Mahabharata, Maharshi Bharadvaja’s Vymanika Shastra and Bhojadeva ’s Samarangana Sutradhara, “Marutsakha” vimana designed by Professor Talpade, Criticism on Vymanika Shastra, advancements in the field of aircraft technology to design and fly farther, faster, safer and greener aircraft and finally comparison between ancient and modern aircraft mainly the secret features of Vimanas described in Vymanika Shastra in comparison with features of advanced aircraft. All these introductory concepts motivate us to proceed further and study in depth on all these topics. In this chapter we have just listed out ancient Indian texts
where Vimanas or flying machines are described and can be compared with modern aircraft. Next chapter deals with the detailed study of Vimanas or aerial chariots described in the classical texts. We will mainly discuss the description of Vimanas in detail in Ramayana, Mahabharata, Srimadbhaagavatam, Vedas, Vymanika Shastra and Samarangana Sutradhaara of Bhoja deva.