MAHARSHI BHARADWAAJA'S

VYMAANIKA-SHAASTRA

OR

SCIENCE OF AERONAUTICS

Part of his unknown work

"YANTRA SARVASVA"

or

"ALL ABOUT MACHINES"

as revealed to venerable

Pandit SUBBARAYA SASTRY

and recorded in hand-written

Sanskrit Manuscript Form

translated into English by

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Vymanika Shastra Rediscovered

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CONTENTS

KEY NOTE

Among many significant contributions of ancient Indian scientists, Vymanika Shastra is notably a towering work dealing with vimanas and allied topics. Aviation as a subject, wrests its own charm over other disciplines even today. This makes the presence of this work even more glamorous. For a casual reader this work may appear to be a fantasy, for a researcher on first reading, curiosity gets kindled. Successive readings see the cream slowly surfacing commensurate with ones ability to comprehend concepts, tolerance to appreciate the depth of basic researches preceding the technologies and systems of aviation science.

It is the firm view of many researchers that mere knowledge of Sanskrit or science or both synthesized plays little role in true understanding of such works. The authors were intelligent to use coded terms, symbolic expressions, archaic language to safeguard knowledge falling to unauthorized sources. For right understanding true flair and that much of extra perception to decode and interpret with reference to context plays the decisive role. This is where many with correct approach succeeded while others failed. This logic remains the same be it a scientific work such as this or Indian philosophy. Both form two sides of the same coin, the coin being 'Knowledge'. As study of philosophy demands faith, perseverance, genuine insight, ancient Indian science is no different.

No one ventures into pronouncing a scientific work unless one has something meaningful to convey. The author, whether he was Maharshi Bharadwaja or Mr. X must have known this too.

The work "Vymanika shastra" is not meant for the biased scientist of the day who prefers to believe what he wants to believe.

PREFACE

It all started on a pleasant winter evening of 1998. During a discourse on renowned mythological epic Mahabharata, the eminent scholar sidestepped to make reference to the existence of vimanas in epic era. He further elaborated to aver the existence of **ancient Indian treatise** "Vymanika Shastra" dealing with Aviation science and Technology. He indicated that this work had been ascribed to **Maharshi Bharadwaja** and conveyed to the world, in Sanskrit narration, through Late Pandit Anekal Subbaraya Shastry in the first decade of twentieth century. Not many in the audience had known this before. At the end of the discourse most of them had appreciated what they had heard, but forgot it as well. There were exceptions too. Musing over the interesting revelations, probing started in right earnest. The scholar delivering the lecture had nothing more to contribute. Nevertheless, he was firm on what he had conveyed.

Perseverance led to location of the work in a primitive library and a solitary bookstall in Bangalore. Cleaning the dust-clad copy of the work was not a pleasant experience. A few copies had reached the curious brains long ago, many of them being foreigners. The rest had found their way to the condemned cellar.

Debut reading of the work conveyed mixed feeling of amazement and skepticism. Patient successive readings generated conviction and added interest. The eerie feeling 'Is it a wild goose chase? However, lingered on for a while. On gathering more information about the work, it was discovered that we were not alone in our pursuit. We had company. Reportedly many had studied the work. Some liked it and others dumped it. Many others not willing to be bystanders went skin - deep and wrote derogatory reviews. It was not their cup of tea. They had no clue of understanding such works. They trailed from where others moved ahead. Their success was merely in creating roadblocks to genuine researchers.

Scientists with true resolve carried on with incessant efforts. This group included freelance researchers, science laboratories, and scholars. Dedicated topics were taken up for study as specific projects. While freelancers, with their limited resources, came out with impressive results, science laboratories succeeded in fabricating hardware from the treatise as per prescribed formulae. Scholars and scientists from abroad did not lag behind. "**Vymanika Shastra**" is quoted by many of them for its relevance in many scientific literatures, particularly in USA. Germans were reported to have bought fifteen copies of the work within few days of its release in 1973.

Just quoting the summarized findings from a report of *Birla Science Centre*, Hyderabad, relating to researches on three types of alloys developed by them as described in the textual content of this work, they find:
"As these materials were found to be novel in their compositions and preparations patents have been asked for them. The experimental results in BISR

laboratory established the originality and textual description of the materials in "*Vimana Shastra*". Therefore there is a strong possibility that the large number of descriptions of other new materials described may also yield good experimental results in the laboratory."

The study team found company and enough company too, inland and foreign. What is sighted at the turn of the century appears to be still the tip of the iceberg. There is more and much more the work "Vymanika Shastra" has to convey, hidden in the potent future.

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CHAPTER – 1

VYMANIKA SHASTRA - A BACKGROUND

The work "Vymanika Shastra" has appeared in twentieth century in Sanskrit transcript form and subsequently translated versions in Hindi and English have been derived. There are different versions with different titles leading to possible confusion among the readers and research scholars. We have therefore devoted some effort to place the facts in the right perspective.

In this process, it is appropriate to commence this topic with the narration front-lined on G.R. Josyer's publication, which reads as follows.
"Maharshi Bharadwaja's 'Vymanika Shastra' or 'Science of Aeronautics' as revealed to venerable **Subbaraya Shastry** and recorded in hand written Sanskrit script form, translated to English by **G.R. Josyer**.M.A [hons] FRES, MRSE.

Four variants with different titles are as follows:

a) Vymanika prakaranam
b) Vymanika sahastra
c) Vimana sahastra
d) Bruhad Vimana Shastra

We clarify here that the base work for all the four versions are common-sourced from the Sanskrit transcript of Pandit Subbaraya Shastry's revelations and recorded by his close associate and Sanskrit scholar **Sri. G. Venkatachala sharma.** They were recorded in 23 exercise books during the period 1903 to1918. Manuscript copies of this were sent as Vymanika Prakaranam to two Oriental Institutes in India. One was sent to Oriental Library at Baroda on 3rd June 1919 and the second sent to Oriental Research Institute, Poona on 19th August 1919. Hence the work has been referred to by many as Vymanika Prakaranam even though only Sanskrit parts of the published versions carry this title. These exercise books suffered long hibernation. A work called "*Vymanika shastra*" in Sanskrit alone seems to have come out from Dayanand Bhavan, Delhi in 1943. This is the second variant.

The third variant is based on the copy of "Vymanika prakaranam" sent to Baroda Oriental Library. A Hindi translated version of this book titled '*Brihad Vimana Shastra*' was edited by Swami Brahma Muni Parivrajak Gurukul Kangdi, Hardwar and published by Sarvadeshika Arya Pratinidhi Sabha, Dayanand Bhavan, New Delhi in the year 1959. In the publication of this Hindi version, the initiative taken by Air commodore **S. N. Goyal** of the Indian Air force has been particularly appreciated. 'Bruhad Vimana Shastra' became the reference work for many researchers in North India.

The variant referred to as '*Vymanika Shastra*' published in Sanskrit- English languages had its base on the copies sent to Oriental Libraries in 1919 and something more. The work remained in manuscript form till 1923 and even later. But between 1919 and 1923 there is evidence of 'add on' textual content to the work in the form of description and diagrams of **four types of representative vimanas** -- Sundara, Shakuna, Rukma and Tripura vimana.

The work of making drawings was entrusted to a draughtsman **T.K. Ellappa** working in an engineering school. The drawings were prepared by him and appended as approved by Sri Subbaraya Shastry on 2nd December 1923. This is the last occasion that any material went into the Sanskrit transcript. The transcripts remained in exercise-book-form for the next three decades under the joint custody of Sri Shastriji's adopted son and Sri Venkatachala Sharma. It was in 1952 that the books found the light of the day when they were brought into an exhibition of antique works conducted by International Academy of Sanskrit Research, Mysore. **Mr. G. R. Josyer**, being the Honorary Director of the Academy showed tremendous initiative. Translation work took a long time and eventually "Vymanika Shastra" was published on 15th March 1973. This book became the reference work for many in South India & abroad.

A short brochure of about 30 pages was reportedly published by Acharya Charanathirtha Maharaj from Sri Bhuvaneshwari Ayurveda Vidya Peetha, Gondah in Sourastra in September 1952.

Swany Dayananda Sarswathi, a towering scholar of the last century, while referring to **flying machines** in his commentary on Rig-Veda Bhashya Bhumika, narrates certain aspects of propulsive thrust of vimanas in directional control. This was in 1875.

Another book called '*Vimana vamanam*' authored by **Nathumal Brahmachari**, finds its place in Udaipur palace library.

For practical purposes, only "Vymanika Shastra" and 'Bruhad Vimana shastra' can be taken as reference, the other titles are only of academic nature. **Sri Josyer**'s publication is taken for reference by the study team.

Going into essential differences between the two variants, apart from English-Hindi translations, Maharshi Bharadwaja's original version extracted from 'Yantra Sarwaswa' contained 500 Sutras {rules}, 8 Chapters and 10 Adikaranas. 'Vymanika Shastra' [English version] contains six chapters, 2972 verses.*Bruhad vimana shastra* contains 40 rules in 3 chapters and 2657 verses.

In substance, Bruhad Vimana Shastra has 315 verses less. This is possibly because of addition of descriptions of 4 vimanas that '**Vymanika Shastra**' contains today. This

difference will not matter as much as the difference we see from the original work to the transcripted work. The reasons for this could be ascribed to various factors:

- The period of transcription spanned for over 15 years and the manuscript copies waited in the freezer for 3 to 4 decades. As **G. R. Josyer** observes 'The transcripts came in various forms of decay'.
- Loss of such literature through pests, quality of paper, loss during transit, change of hands could well be imagined. Further, such works that claimed to be of ancient Indian origin did not find recognition during the British colonial rule facing freedom struggle. It is said that even possession of such literature was considered *Anti-British.*
- The scholars who possessed such works had to keep them concealed. Loss of sheets, obliteration of manuscripts, environmental influences could have taken a heavy toll.

CHAPTER – 2

AUTHORSHIP AND DATING —VYMANIKA SHASTRA

The work 'Vymanika Shastra' has been ascribed to the great sage of ancient India, **Maharshi Bharadwaja**. From the data available, references related to the work have transited through earlier times of known history. It is also claimed that the work is among forty topics of 'Yantra Sarwaswa' that dealt with '*All about machines*'. It is not a matter of dispute that basic work for translated variants of Vymanika Shastra (English & Hindi) published in the country was originated from Sanskrit manuscript dictated by **Pundit Anekal Subbaraya Shastry** to a Sanskrit scholar, **Sri G Venkatachala Sharma**.

There have been doubts and controversies raised in some earlier reviews regarding the authorship and dating. Treatises of this nature where documented records of the past are not available due to various reasons naturally attract such issues. This aspect needs careful and logical scrutiny. This is especially so in the face of some critics having made generalized statements that Indians have a habit of eulogizing the authors and works of such genesis.

Many scientists today look at Mythology with skepticism and accept only recorded history as gospel truth even if recorded history itself has suffered distortions. They are antagonistic to the belief that Mythology preceded history in civilizations the world over. This is primarily because the links between history and mythology are loose and not conclusively established. Periods of vacuum between mythology and history have compounded the problems in the efforts to bridge the gap. Repeated invasions before and during the Mogul rule, colonial rule under the British put together spanning nearly ten centuries (with occasional breathers of domestic supremacy) contributed a great deal towards suppression and hibernation of ancient Indian works, Scientific, Spiritual and literary.

It is in the backdrop of such observations that this study exercise has probed into the subject of authorship and dating. It is for this reason alone that 'Background of the work' conforming to recorded data from the genesis of Sanskrit manuscripts conveyed by **Pundit Sri Subbaraya Shastry** has been separately dealt with in earlier discussion.

Discussions:

Several natural questions do come up in this context.

- Who was Maharshi Bharadwaja, ascribed to be the author of this work 'Vymanika Shastra', supposedly a part of 'Yantra sarwaswa'?

- Is this work of Vedic origin? Is it in Vedic language? If not, why so?
- Who is Bodhananda that has written 'Vritti' or 'commentary' on this?
- Why did he have to write commentary? What is his role?
- What are the scholastic credentials of seer Bharadwaja for being ascribed with the authorship?
- Did the textual content culled out from Vedic origin all by himself or others also featured?

Collection of answers to questions of this nature brought out interesting answers both from Mythology and History.

Regarding **Maharshi Bharadwaja:**
He is known to be a towering scholar both in science, philosophy and warfare. His is an august name in the pantheon of Hindu sages who recorded knowledge in the spiritual, intellectual and scientific fields. During his period, knowledge was transmitted from mouth to mouth and ear to ear.

Maharshi Bharadwaja, according to some scholars, belonged to Thretha Yuga and to Dwapara Yuga to some others, linking him with Dronacharya's ancestry. He is known to belong to sixth mandala of Rigveda. He has also authored *Srauta shastra and smriti* work. He figures in the genealogy of Bruhaspati, the principal preceptor of all Hindu deities and his son being seer Bharadwaja. Bharadwaja's son**Dronacharya**, again was the preceptor of Pandavas and Kauravas during **Mahabharata** era. It should be no surprise that a seer with this background of generation possessed a vast variety of knowledge to author a work such as 'Yantra Sarwaswa'. In this connection, discussions on the subject with a well-known scholar of Bangalore **Dr.V.Prabhanjanacharya** spotlight the subject. This is enclosed as an appendix to this chapter, which clarifies many doubts.

Maharshi Bharadwaja transcended from one Yuga to another. He is among the seven prime seers of Mythological era. Whether there were other seers by his name is not known. It is possible that seers succeeding him in his Gothra could have been known by the same name. Nevertheless, he is the only Bharadwaja referred to as one among Maharshis. He has also authored '*Anshu Bodhini*' dealing with cosmology, few sections of which are still available. Its reference is made to several topics in '*Vymanika Shastra*'. It again features commentary from Bodhananda. The style of Sanskrit in 'Vymanika shastra' and 'Anshu Bodhini' have been studied by Sanskrit scholars for a possible commonality of authorship. Their opinion confirms common authorship.

The introductory part of the subject work clearly avers as follows. **Maharshi Bharadwaja**'s 'Vymanika shastra' or 'Science of Aeronautics' is a part of his unknown work 'Yantra sarwaswa' or 'all about machines'. Here we see no reason why anyone should be attributing the work to him without any gain for himself. No one else down the line has claimed the authorship nor has anyone disputed.

Deliberating on the dating aspect of the work, the data gathered by the study team

explains certain crucial issues. The work itself is not a part of Vedas as is misunderstood by many. Nowhere it is claimed so either. It is claimed to be the essence and offshoot from the principles of Vedic knowledge. It is necessary to understand that **Vedas** are 'Anaadi' or 'from-time-immemorial', they had no relationship with time cycle.

The basic structure of Vedas has remained unaltered, interpretations however could be different. Nevertheless, essence could have been communicated by preceptors at many points of time, in any style of Sanskrit, which could be even in a contemporary structure of the language. It could even be in a different language conveyed to someone distant in any part of the world. Hence, going into the exercise of verifying the number of Vedic Sanskrit words Vis-a-Vis medieval or modern Sanskrit language is a tangential approach and serves no useful purpose. In fact, **Sri.G.R.Josyer** who was himself an eminent Sanskrit scholar has paid tributes to the high fidelity of Sanskrit language of the text.

Despite being one of the most knowledgeable seers himself, **Maharshi Bharadwaja** has chosen to quote lucid definitions, rules or soothras of other sages and preceptors. Bodhananda's commentaries have referred to expressions from these sages and Acharyas and works on related ancient sciences. Brief descriptions of other scientific guides / works in this book have been given in another work of **Sri. Madhusudhana Saraswati**, 'Prasthana Thraya'.

Discussing the dating of the work, all that can be said with a fair degree of certainty is that the work, being a part of 'Yantra Sarwaswa' featured at several points of time in known History. Science of aeronautics was in existence even earlier than Bodhananda. **Bodhananda** chose to write 'Vritti' or commentary or explanatory notes on the seer's pronouncements for ease of understanding by the users. This was a traditional treatment given to very many works of philosophy as well. Bodhananda was known to be in 10th century AD according to some research sources.

Confirmation on references to the textual content of the work during the 19th century is discovered by an observation in which **Maharshi Dayananda saraswati** had given clarification on the direction of thrust of propulsive devices of **Vimanas** quoting Rig-Bhashya Bhumika. This was dated to be in 1875. As we notice from that text of 'Vymanika Shastra' it is a work based on many disciplines of science and technology, described by core researchers of several fields. Each 'sootra' or 'rule' contains references to several topics of science or technology. Under the given conditions, there is adequate logic to accept that 'Yantra Sarwaswa' was an offshoot of Vedic knowledge. The **Vymanika Shastra** came into being in manuscript form between 1903 to 1918 as revelations by Mystic scholar **Anekal Subbaraya Shastry.**

While this much of discussion is devoted for protagonists of Vedas, mythology, the seers and the like, let us turn to the antagonistic scholars and scientists who prefer to view the subject of authorship and dating under their self-imposed scientific frame work. If it is appropriate and tenable to go by recorded history and ignore the mythological relationship, let us go by the validation of textual content and correlate with modern

science wherever possible. Let not such critics be concerned with Bharadwajas of the distant past.

Life-sketch of **Sri Anekal Subbaraya Shastri:**
In the chain of relating the work to Pundit Anekal Subbaraya Shastry's revelations, propriety demands deliberations on his life sketch as well as linking his work up to the stage it was printed and published in 1973. This data has been collected from his biographical sketch, his descendants, younger associates of his time and other detailed inquiries during the probe of the study.

An autobiography of **Sri Anekal Subraya Shastry** was published by **Sri M.C. Krishna Swamy Iyengar** and **Sri Venkatachala Sharma** on 12th March 1972. This was an English version; translated by Sri G.V. Sharma based on the narration of Sri Shastriji in his vernacular. From this autobiographic sketch it is evident that Sri Shastriji had committed to Dr Jagdeesh Chandra Bose, an eminent scientist of the yester years, that he would send his biographic script. This has been addressed separately to both Dr. J.C. Bose and Sri Babubhai Iswardas Ichcharam whom Sri Shastriji had met at Bombay and had close interaction. Sri Ichcharam, besides being his ardent disciple had supported him financially too. This biographic sketch, though in minute detail, has an abrupt ending. It covers his life story up to the year 1918. Curiously, this sketch does not include a significant part of a special message conveyed by his godfather **Sri Guruji Maharaj**. This special message, however, features in another Biographic sketch (a much-abridged version) also brought out by Sri Krishna Swamy Iyengar.

According to his autobiography **Sri Shastriji** was born in 1866 AD in a village called Togare Agraharam in Hosur Taluk, Dharmapuri Dist of Tamil Nadu. He was born as the eldest son in a large orthodox Brahmin family. His father was a learned and benevolent individual who supported many students at home. As his own family grew in size, he found it increasingly difficult to maintain. Eventually he became penniless even when children were still urchins. Sri Shastriji lost his parents early in life and had to bear the brunt of supporting all his younger ones. From then onwards, it is a story of misery and poverty. Soon he had to take up begging. Compounding his travails was his marriage with an eight-year-old girl, his own age being twelve. Fortunately his infant wife had not yet joined him to undergo suffering. It did not take very long for the lot of children to choose the pavements for their living. As though this was not enough, cholera and small pox broke out in the district, killing people in hundreds. Sri Shastriji's family was not spared. All but two brothers fell prey to the deadly epidemic. Eventually it was his turn to invite infection. His body became a home of infectious blisters, puss oozing out. His sight was abhorring. People drove him out. He survived on tender leaves and vegetation around. In short he felt that the world just discarded him. Left with no option, he sent his brothers away to fend for themselves.

Then came the ultimate decision to call it a day from this world. He kept walking for days and reached a forest near a place called Avani in Kolar Dist. He lived in the wild, visited

often by snakes and tigers. He wondered how he survived in this deadly company, living on vegetation and water for many years.

There is an end for everything and possibly, for his travails too. One day, while he was roaming in the forest, he entered a cave and after some distance he found a vast under-ground enclosure. There, he came across a woman whom he recalls as his dead mother. He was consoled and taken care of for some time and she vanished as mysteriously as she had appeared.

According to **Sri Shastriji**'s life sketch it was in this underground cave that he sighted **Sri.Guruji Maharaj** who bore super human features. Sri Guruji played a significant role in the rest of his life. He took care of him and cured his obnoxious disease with one healing touch. The young lad recovered his normal health.

During this unspecified period of association with **Sri Guruji**, he learnt a number of rituals, physical sciences or Bhoutika Shastras. Sri Guruji, while precepting Bhautika Shastras had put a stringent condition that his disciple should assure him of protecting these shastras from use on for destructive purposes. He had even imposed total restraint on his participation in debates, social gatherings, associations with political parties etc., Thereafter, Sri. Guruji administered a brilliant light on him, which touched his 'Saraswati-Nadi'. He started making utterances in Sanskrit, involuntarily.

Then **Sri Guruji** wrote something on his tongue with a twig. This consummated the process of Divine Enlightenment. This was followed by teaching of Bhoutika shastras. On completion of these rituals, Sri Shastriji felt that Bhautika Shastras were visible and accessible to him. At this juncture, he honestly expresses that till that point of enlightenment in life, he was an illiterate, not having gone to any school nor learnt any language. He was amazed to discover in himself not only the knowledge of – Sanskrit but also to convey Bhoutika Shastras through that medium. In his own admission he reveals that he learnt the alphabets of Kannada and Telugu after his return to his village during the post-enlightenment period. There ended the divine association of Sri. Shastriji and Sri Guruji Maharaj in the wild forest. He was sent back after serene blessings to return to his village and continue his mission in pursuit of propagation of knowledge of Bhautika shastras. Though unwilling to part from the company of Sri. Guruji, he returned to his village with a heavy heart, but with a mission ahead. Strangely, a native Brahmin of a village Malavalli had a premonition that a young lad of a particular description would appear in the village and he should take care of him for two months and let him proceed on his mission.

On completion of his sojourn with the noble Brahmin at Malavalli, **Sri. Shastriji** left that village again to face the wide world, under more positive circumstances this time. Feeling physically fit, psychologically sound, he decided to go to Hosur. There, he met his surviving brother. A little latter he joined his wife at Anekal and started a family life. Sri Shastriji spent subsequent twenty-five years at Anekal. During this period he had three sons and three daughters. All his sons and one daughter died very young. He moved to

Bangalore and stayed in a locality called Cottenpet in the midst of the old city. For some time he remained an unknown individual, but not for long.

The news of his potent knowledge of Bhoutika Shastras had reached many intellectuals. Visitors streamed in to discuss with him. His recitations and pronouncements from Bhautika Shastras impressed many.
The breakthrough in his life came with a visitor from Bombay, **Sri. Poonjilal Giridhar**, a noted industrialist of Bombay and Ahemdabad. He had come at the instance of one Sri. Babubhai Iswardas Ichcharam, who invited Sri. Shastriji to go over to Bombay. On acceptance of their invitation, elaborate arrangements for a sizeable retinue of Sri Shastriji was made. He received a rousing welcome and was their guest for several months.

A significant meeting at Bombay was with **Dr. Talpade** who had conducted experiments on constructing aeroplanes. Dr. Talpade consulted him in this matter. It was here that Sri. Shastriji first referred to Sri. Maharshi Bhardwaja's Vymanika Shastra, which he explained it to Dr. Talpade. The latter continued his experiments but suffered a serious set back in the progress due to ill health. The project came to a halt on his demise. By then he had conveyed that **vimanas** were not toys of someone's fancy nor were objects of mythology. Possibly this is the first attempt of construction of aeroplane around 1900AD by an Indian. Unconfirmed reports have talked of Dr. Talpade's successful flying of aeroplane over Chowpati beach, Mumbai in the last decade of the nineteenth century.

The visitors at Sri Shastriji's flat at Bombay multiplied day by day. They included Philosophers, Scientists, Rulers of erstwhile princely states of India and the elite of Bombay and outside. He thanks Sri Guruji Maharaj for his guidance in answering questions of his visitors and discussions with them. His audience was spell bound by his mystic knowledge. Some called him a walking lexicon, a genius and a super human.

A number of Sri.Shastriji's followers met at Bombay to decide that the treasure of spoken knowledge of "Bhoutika Shastras" should be scripted by him and published. Sri Babubhai agreed with this proposal and offered to fund the activity. Sri Shastriji agreed to undertake this request but not before he got the consent from his Guru. It is thus seen in his life that before taking any major decisions Sri. Guruji had guided him all along. He agreed to do so on his return to Bangalore.

Sri Shastriji returned to Bangalore after an emotional farewell from a host of his admirers. In the next three years not much of progress could be made in writing of Bhoutika Shastras for various reasons. All through this period Sri Bhabubhai had been regularly funding him.

This is where the autobiography being conveyed to **Dr. J. C. Bose** ends abruptly. In the concluding paragraphs Sri Shastriji recalls his meetings with Dr. Bose at Bombay. From his life sketch it becomes evident that he was a honest and unassuming person. All along

he maintained that he was a mere conveyer of the Shastras pronounced through him by divine source.

As an appendage to his biographic sketch, **Sri G.V. Sharma** had made some interesting remarks. As per this the former had been specially chosen for his Sanskrit knowledge to transcript dictations of the latter's revelations and he associated with him all through his life. Even later he was a joint custodian of his works. Sri Sharma refers to a brief life sketch brought out in January 1911 as a part of '*Bouthika Kala Nidhi*' published by **Sri B. Suryanarayana Rao**, a noted astrologer and a staunch admirer of the pandit. Sri Sharma has also given a list of published works of the pandit which include 'Anshu Bodhinee', 'Prasthana Thraya', 'Bruhad Madhusudana Smriti' 'Raja Bhakti', Desha Bhakti', 'Panchagavya Shastra', 'Jala Tatwa Prakashika', 'Maha Sankalpa Vichara' etc., espounded by Sri Guruji through the pandit.

Drawing curtains on Sri Shastriji's life- sketch a few observations seem to be appropriate. Even though he had set forth on a mission to convey Bouthika Shastra for the benefit of mankind, he had an innate feeling of a lost mission. The contemporary political situation in the country must have had adverse impact on propagation of such native scientific knowledge.

The latter part of **Sri Shastriji**'s life found him to be a dejected and disappointed person with an unfulfilled mission. Freedom struggle in the country barricaded his routes to the elite. This legendary person left behind him a treasure of works with his adopted son **Sri Venkatrama Shastri.** The surviving members of the family living in an innocuous house in Bangalore hardly know what their illustrious ancestor had left for the intellectual world. It is ironical that his life story makes a pensive reading. He did not live long to see his contribution freezing in cold storage for many decades. It would have been even more agonizing had he stayed long enough to see his work hibernating.

CHAPTER – 3

LITERATURE SURVEY

Probes of the study team, in fact had started from early 1999. Extensive correspondence, leg work in contacting and meeting persons connected, even remotely, with the work and its conveyor Shree Anekal Subbarayashastri, his associates, descendants, research workers within and outside the country was an intense exercise and interesting too.

The starting point was, of course, the acquisition of **G.R.Joyser**'s published work 'Vymanika Shastra', from a less known book stall in Bangalore. A few leading libraries had just one copy in their reference sections. During this process several sources confirmed that many a copy have been taken by foreign researchers. Over eight universities libraries in USA and UK accessed through the Internet confirmed availability of copies in their libraries. It was interesting that some individual research workers had been working seriously on the work. From the collation of information, it is noted that a majority of researches conducted abroad belonged to post 1985 period. Here again, some of the published books abroad indicate that researches there have been continuous and steady till current times. One has to acknowledge the seriousness with which works of this nature pertaining to ancient India has been taken. Needless to say that inland scholars have a lot more to emulate. A more incisive observation is that focus on research of this works both in India and abroad has come about pointedly after 1988.

A study is conducted by our team on the chronology of Indian researches from various reports and claims. The turnkey for researchers was the publication of 'Vymaanika Shastra' by **G.R.Joyser** (English) and 'Brihad Vimaana Shastra' edited by Swami Brahmamuni Parivrajaka Gurukul Kandgi of Haridvar and published by Dayanand Bhavan, New Delhi in Sanskrit-Hindi. The first known research appears to from **Sri Naren Sheth** of Mumbai, a freelance enthusiast. His research as claimed by him spans nearly thirty years. Due credit goes to him for his zeal and dedication even with meager sources of laboratory facilities. His reports mention the assistance sought from IIT Bombay, BARC, TIFR etc. in preparing laboratory samples of 'Chumbakamani', 'Panchadharaloha'. Sri Naren Sheth is seventy years of age now. He is keen to demonstrate the preparation of the materials he developed for the benefit of genuine researchers on invitation basis. Extract of his report is appended (Appendix – A)

The second known attempt was a 'A Critical study' of the work by a team of scientists from Indian Institute of Science, Bangalore, from 1973-1974, soon after the publication of Joseyer's translation. Notably this review undertaken in the backdrop of principles of modern science did not find favour with the critics. Contemporary aerodynamics and propulsion principles were heavily superimposed during this review. Had the study gone deeper into **Yantras**(machines) and advanced material technology dealt in the text they would have had second thoughts. The text, seen under the principles of mercury vapour

propulsion, Levity, anti-gravity material, interesting ideas being brought out by western researchers would have found more relevance. It is to be widely appreciated that aviation today is not only a science of structure and aerodynamic phenomena but equally or more prominently contributed by associated sciences in systems such as optics, guidance, navigation, tactical and strategic concepts being developed not under one roof but being integrated out of deliveries from discreet sources of technologies. As seen by this review team, our study team also identified two essential aspects corrupting the understanding of the readers. They are usage of unstandardised units of measurement such as those relating to speed, length, resistance, force, heat and so on adding enough confusion. Secondly the drawings of the vimanas and its components drawn by local draughtsman under instructions from **Sri. Shastriji** seem to have been influenced by his own imagination. Nevertheless, we request I.I.Sc., team to have a relook at the work in the context of adequate validation of other parts of the text in the last two decades. Their report published in 1974 is appended. (Appendix – B)

Then on, there seems to be fairly a long gap till late eighties when **Dr.Roberto Pinotti** a scientist from Italy reminded Indian scientists to take ancient Indian scientific works seriously (with reference to 'Vymaanika Shastra'). What a paradox! Assuming that he must have made this statement from a serious study of the work, he had extensively noticed features other Indian scientists had missed to note. **Dr.Pinotti**'s address was not to a casual gathering of orthodox Indians. He was addressing a seminar of International Astronautical Congress in October 1988. The seminar had been organized by Indian space research organization at Bangalore. Extracts of his report is appended. (Appencix – C)

It was the department of chemistry, Indian Institute of Technology, Bombay that contributed towards laboratory development of materials like Chumbakamani, Panchadhara-loha and Paragrandhika-drava. **Dr. Maheshwar Sharon**'s report throws light on the equivalence of these materials to those developed by modern science during the later part of 20th century. Relevant extracts of his report are appended as Appendix – F. However **Dr. Sharon** has expressed that many of the tests could not be concluded because of limitations of translational skills and decoding.

Next it was **Dr. Balachandra Rao**'s turn to remark on the work in his book titled 'Tradition, Science and Society" published in 1988. Dr.Balachandra Rao, a professor of Mathematics at a science college in Bangalore attacks the work, almost lethally. We request him to review the work in consultation with experts in the field of aviation and related sciences.

Some time in 1988, **Dr. David Childress**, an eminent scholar from USA, published the first edition of his Book 'Vimana Aircraft Of Ancient India And Atlantis'. This book has been updated with research information and published every year till 1999. In this book, he has also chosen to reproduce completely 'Vymaanika Shastra' (Joyser's English version) for the sake of readers. Detailed discussions on propulsion conceptual techniques such as mercury vapour propulsion, thrust vector engines, solar energy employment etc., have been introduced for prospective contemporary thinkers. The book is thought-provoking

and makes interesting reading. He has sighted principles and concepts that had evaded conventional Indian scientists.
The next milestone the work '**Vymanika Shastra**' saw was a kind of miniature revolution set by a group of scientists from Hyderabad starting with a country wide search of ancient Indian scientific literature. During their visit to Bangalore, they obtained copies of some of Sri. Shastry's works including 'Vymanika Shastra' from the author's descendants. This was in 1991-92, as learnt from the grand children of the pandit. The team from Birla Science Centre, Hydrabad composed of **Dr. B.G. Siddarth** and **Sri. C.S.R. Prabhu.** It appears that out of the ancient works they had gathered in their collection-drive 'Vymanika Shastra' prominently struck them and from that they found topics relating to materials suited for their research. Materials developed in accordance with formulae given in the text validated textual contents. The brief report is appended Appendix – D

The unique treatise with a highly technical scientific outlook on development of materials and yantras as per ancient scientific formulae is from a task force sponsored by Indian National Science Academy, INSA. The topic, though not directly a part of 'Vymanika Shastra', is related to work 'Anshu Bodhini' of the common author, **Maharshi Baharadwaja.** Hence the special mention of this research work made here. This piece of research is undoubtedly a benchmark in the conduct of researching ancient Indian works. The task force consisted of Dr. Dongre, P.G.College of Varanasi, Dr.P.Ramachandra Rao, Director of National Metallurgical Laboratory, Jamshedpur and others. We are appendaging their report in full as a part of our study report. We are thankful to them for the valuable co-operation extended to us. Their report relates to development of a novel spectrometer / monochromeater called 'Dwanta Pramapaka Yantra' and an Infra-Red transparent material (non-hygroscopic) called 'Prakasha Stambhana bida'. Their latest report on this research is as recent as Dec 1999. A relevant extract is appended as appendix – E. This is undoubtedly the best report in our literature survey and raised our curiosity into the way technical interpretations are required to be made on works evolved by 'Scientists' carried through earlier civilizations. This aspect needs a positive bent of mind than just ridiculing ancient works with sheer disdain.

The next to appear is **Sri. M.K. Kawadkar** of Nagpur whose interpretational skills and sixth sense are seen to manifest at their best. He has taken up study of some chapters of 'Vymanika Shastra' and brought out fascinating exposures on **yantras**, atmosphere, in particular 'Parivesha Kriya Yantra' discussed in the work interpreted as 'Auto-pilot/Auto guidance system'. His articles published through 'Bharatiya Boudhiks Samapda' a quarterly magazine published from Nagpur are thought-provoking and fall in line with the kind of research-insight vitally needed in studying ancient works of Sanskrit. More about Sri. Kawadkar's analyses later through his comments.

Distinct commonality with three major contributors viz., B.M. Birla Science Centre, **Dr. Dongre**'s research report, Sri. M.K. Kawadkar's Analyses lies in their way of approach in research. They all emphasize that knowledge of Sanskrit and/or science does not help in understanding of ancient scientific work. In addition to the above aspects what is even

more important is the ability to interpret with reference to context. That bit of sixth sense is a vital attribute.

This understanding alone has contributed to their success and rendered purposeful results. Laboratory development of materials has gone through the following process.

- Understanding of poetic form of Sanskrit version
- Convert to prose form, decode the terms wherever required and arrive at ingredients
- Use modern equivalents / substitutes, wherever required
- Determine proportions of mixing
- Use process details to obtain the materials.

This methodology has worked so well that it must have boosted their confidence as well. Thus a closed mind set in studying such works will lead one nowhere. 'Birla Science Centre' report claims such a high level of confidence that they are categorical to state that most of the materials in the text can be obtained through laboratory tests. Extrapolating this logic, if textual contents of one part of this work could gain a high degree of validity there should be no reason why other chapters in the same text should be any different. Adverse reviews of some critics should be questioned under the spotlight of this logic.

One of the most exhaustive studies made on ancient Indian aviation is by **Prof. D. K. Kanjilal.** His illustrious work 'Vimana In Ancient India' refers to Indian epics, Vedas in great detail and describes usage of vimanas in the prehistoric era. This work, by itself is a milestone and makes very interesting reading.

Reports from Aurobindo Ashram, Pondichery hint that research relating to Propulsion Systems & Artificial Intelligence based on Vymanika Shastra are being carried out.

In response to its request the study team generated valuable data from inland and overseas sources relating to studies / researches on this text. The data has gone into our report in some form or the other. We have reasons to believe that many texts and treatise referred to by preceptors in this work are still available in obscure collections of individuals and libraries. Perseverance in locating them should yield useful results.

CHAPTER – 4

STUDY TEAM'S COMMENTS AND DISCUSSIONS ON 'VYMANIKA SHASTRA'

It is necessary to mention that the study team has mainly referred to "Vymanika Shastra" published in Sanskrit-English by **Sri G.R. Josyer.** Hindi version "Bruhad Vimana Shastra" has not been referred to on the basis of the fact that, textual content compared, there is no difference. The only exception is while referring to researches made by others based on 'Bruhad Vimana Shastra'. Fidelity of English translation by Sri G.R, Josyer deserves special appreciation. It is taken as accurate and correct, barring decoding and interpretation needs. This is with full regard to him as a Sanskrit scholar of the yester years.

The scope of the study and presentation is confined to the extent of textual material available. Incompleteness of the text, as observed by many researchers, will be outside the purview of this study.

A significant aspect in the presentation of this report is to dispense with the reproduction of Sanskrit-English version of "Vymanika Shastra". It is decided deliberately so in order to avoid a bulky report. The textual content has been restricted to bare minimum. However, we are confident that the readers will be able to comprehend what the original text portrayed.

With the aforesaid Introductory Reference we begin the restructuring, analyses and discussions on the core of the scientific work "**Vymanika Shastra**".

The text in the form presented by the author covers the subject under the following topics.

1. Definition.
2. The pilot.
3. Aerial Routes
4. Airplane parts.
5. Clothing (for aviators).
6. Food (for aviators)
7. Metals and heat absorbing metals.
8. Melting.
9. Mirrors.
10. Power.
11. Yantras or Machinery.
12. Parts of Yantras.
13. Varieties of Vimanas:
    - Shakuna
    - Sundara
    - Rukma
    - Tripura

CHAPTER – 5

DEFINITION OF VIMANA

The word "**Vimana**" originates from the Sanskrit words **Vi-Mana**, '**Vi**' meaning 'Bird' and '**Mana**' meaning 'like'. The interpretation will be 'like bird'. Owing to similarity with birds, it is named 'vimana'. The word 'andaja' as related to birds means 'egg-born'. The word **vimana**, though of purely ancient Indian origin, is widely adapted and used by not only writers on this science in India, but also extensively quoted as such by the researchers the world over. Basis of arriving at this definition is not strange. Researchers on flying machines from other parts of the world have also looked at flying birds as their origin of inspiration and conceptualization. Ancient Indian scientists were no different in their approach.

The interesting feature of Maharshi Bharadwaja's soothras or rules is that he recalls various definitions of other **Acharyas** or preceptors. The table given below elucidates this.

Maharshi Bharadwaja refers to seven acharyas connected with works on **aviation science.**

Acharyas name	**Reference to work**	**Definition**
Narayana	Vimana chandrika	That which can speed on earth, on water and through air, by its own power, like a bird
Shownaka	Vyomaayaana Tantra	As per experts in aeronautical science, that which can fly in air from one place to another.
Vishwambhara		As per experts one which flies from one country to another, one island to another and one world to another
Garga	Yantra kalpa	
Vachaspathy	Yaana bindu	
Chakrayani	Kheta-yaana Prdeepika	
Dhundinatha	Vyomoyana-arka Prakarana	

Notable observations:

- Besides **Maharshi Bhradwaja**, several other preceptors were also associated in the field of Aviation studies and researches. Several works quoted herein deal with this discipline as well. This observation holds good for all the succeeding topics of the work where several preceptors and their quotations from related works feature.
- Definition of '**vimana**' has been wide and comprehensive ranging from simple flying machines to spacecraft.
- Knowledge of this science was not confined to few individuals. Ancient scientists believed interaction and communication with others in the field and their works
- Their keenness to go with open mind and highlight views of other preceptors in the field is self-evident.
- Works of the preceptors brought out, evidently at different periods, were available for reference of other contemporary or succeeding scholars.

CHAPTER – 6

THE PILOT

Vymanika Shastra projects the pilot as a special craftsman whose training and qualitative requirements are specific. He is referred to as 'Rhahasyagnodhikari', implying that he is the authorized custodian of the secrets of the **Vimana** and its systems. The qualitative requirements of training and skills mentioned in the work have strikingly analogous to those prescribed for modern combat pilots.

The features of the vimana are referred to as **secrets**, possibly used in a generic sense. The correct interpretation should be that the pilot is the skilled operator who alone is entitled for the full knowledge of the features provided on the vimana. Thirty-two such secrets or features have been mentioned. Very high levels of proficiency and learning have been prescribed for him. Specific reference to the structural knowledge of the vimana, flying skills including combat maneuvers and aerobatics are noticed. **Vymanika shastra** quotes the work "Rahasya lahari" and other work by **Lallacharya** and others.

Special observations:

- Stringent training and operational standards stipulated are in consonance with similar standards prescribed for modern aviators.

- It is to be noted that spectacular feats performed by the pilot are included in his skill expectations. Evidently combat maneuvers are being talked about at the time of verbal narration of the text {before 1918 AD}, when the contemporary military aviation {corresponding to the end of I-world war} was yet to conceive aerobatics and combat maneuvers.

- The pilot talked about in the text is a full-fledged combat pilot capable of engagement in military roles. 'Rahasya lahari' and other works by Lallacharya are quoted in this context.

While this work talks of the pilot as a master aviator, Vedas, Epics and Samarangana suthradhara of Bhoja Raja have looked at him in an identical manner. 'Arthashastra' of Kautilya (3rd century BC), essentially dealing with political economics, also refers to the pilot as '**Saubhika**', a term derived from Soubha Vimana featuring at several occasions in Mahabharata and Bhagawata. The pilot is also referred to, more appropriately, as '**Aakaasha Yodhah**', a warrior in the sky. He is even called a 'fighter in the sky'. Mahabharata stipulates at least ten types of aerobatic movements for combatants.

CHAPTER – 7

SECRETS (SPECIAL FEATURES) OF VIMANA

One of the most distinct and attractive essence of Vymanika Shastra is its explanation of certain special operational features provided on **Vimanas**. Later in this presentation, the features and systems provided to operate the devices are discussed under 'Yantraadhikaranam'.

The **secrets** or features are:

1 . MAANTRIKA	2 . TAANTRIKA
3 . KRITAKA	4 . ANTARAALA
5 . GOODHA	6 . DRISHYA
7 . ADRISHYA	8 . PAROKSHA
9 . APAROKSHA	10 . SANKOCHA
11 . VISTRITA	12 . VIROOPA KARANA
13 . ROOPANTARA	14 . SUROOPA
15 . JYOTHIRBHAVA	16 . TAMOMAYA
17 . PRALAYA	18 . VIMUKHA
19 . TAARA	20 . MAHASHABDA VIMOCHANA
21 . LANGHANA	22 . SARPAGAMANA
23 . CHAAPALA	24 . SARVATOMUKHA
25 . PARASHABDA GRAHAKA	26 . ROOPAKARSHANA
27 . KRIYAAGRAHANA	28 . DIKPRADARSHANA
29 .AAKAASHAAKAARA	30 . JALADA ROOPA
31 . STHABDHAKA	32 . KARSHANA

CHAPTER – 8

SPECIAL STUDY ON ROLE- SPECIFIC FEATURES OF VIMANAS

Narration of specific features (32 features) deserves special attention. Hence this part of the report is dedicated specially to these features of the **vimanas**. Original text is placed under quotes and comments / observations of the team are noted below each item.

1. Mantrika:
"As prescribed in 'Mantradhikaranam', by invoking the mantras of chhinna masta, Bhairavi, Veginee, Siddanatha, acquire the powers of ghutikaa, paadukaa, visible and invisible and other mantraas with potent herbs and efficacious oils, and Bhuvaneshwaree mantra which confers spiritual and mesmeric powers, to construct aeroplanes, which don't break, cannot be cut, cannot be burnt, and cannot be destroyed."

- By invoking certain identified mantras to obtain spiritual and mesmeric powers to construct flying machines that cannot be destroyed by any means.

2. Tantrika:
"By acquiring Mahaamaaya, shambara, and other taantric powers, to endow the plane with those powers."

- By invoking specific tantric powers to endow the vimana with some special powers.
- Note: The above two categories as clarified in the later part of 'Vymanika Shastra' have no relevance in the current Yuga (a scale to measure the cluster of years representing certain generations of mankind). They are ascribed to the earlier yugas. For this reason as well as lack of literature on these disciplines the study team keeps them out of its scope in this present report.

3. Kritaka:
"By study of architects like Viswakarma, Chaayaapurusha, Manu, Maya and others, to construct planes of various patterns."

- Definition is suggestive of real hardware, without intervention of super natural or extraordinary powers.
- Applicability of this type of vimana to the current Kaliyuga is dwelt upon later in the work.
- Quoted authorities on these architectural sciences are noted personalities of epic era.

4. Antaraala:
"In the wind swept atmospheric region of the sky, in the clash at the borders of the mighty currents, an inadvertant plane is likely to be smashed to pieces. But by getting warned of the approach of such danger spots, the plane could be halted and steered with care"

- Danger faced by the flying machine in certain cross sections of the atmosphere is referred to. Advance-warning to the pilot on such zones is discussed. Avoidance action through a detour of such zone forms the special feature.

- Knowledge of atmosphere and danger zones therein was evidently available leading to the concept of an avoidance technique.
- Primarily an advance weather warning feature as an on-board system to assist the pilot is under discussion. Perhaps, analogues to weather-warning radar as a flight safety device.

5. Goodha:

"As explained in 'Vayutatva prakarana', by harnessing the powers, yaasaa, prayaasa in the eighth atmospheric layer covering the earth to attract the dark content of the solar ray, and use it to hide the vimana from the enemy"

- Concept is one of concealment of vimana from vision.
- 'Vayutatwa-Prakarana' is quoted as the reference text.
- Principle of achieving invisibility or camouflaging of aircraft from enemy is clear. Notably enemy may include enemy aircraft or ground forces. Strategic and tactical roles of the vimana are distinctly conceived.
- 'Harnessing the dark content of solar rays' as a feature is significant.
- Concept of concealing aircraft from enemy's vision was evolved in modern military aviation only in the latter part of twentieth century. Invisibility technique spans from simple camouflaging methods to stealth features to circumvent radar detection. Here the principle is beyond conventional camouflaging.

6. Drishya:

"By collision of the electric power and wind power in the atmosphere, a glow is created, whose reflection is to be caught in the 'vishwa kriya darpana' or mirror at the front of the vimana, and by its manipulation to produce a maaya-vimana or camouflaged vimana"

- Primarily a concept of decoy and / or diversionary technique.
- Using refection of a glow generated by electrical and wind energies in the atmosphere and manipulating the reflection of the vimana through ViswaKriya Darpana in creating a decoy Vimana is hinted.
- Obviously suggests use in course of vimana performing strategic and tactical roles to mislead enemy's air and ground attacks.
- Could be a concept of creating mirage of vimana as a decoy.

7. Adrishya:

"According to 'Shakti tantra', by means of the Vymarathya Vikarana and other powers in the heart centre of the solar mass, attract the force of the etherial flow in the sky, and mingle it with Balaahaavikarana shakti in the aerial globe, producing thereby a white cover which will make the vimana invisible."

- By definition, to produce the effect of a white glow around the vimana by attraction of ethereal flow in the atmosphere and mixing it with the energy in the aerial globe.
- A cocooning technique to achieve invisibility.
- Harnessing energy sources in atmosphere for on-board use is interesting.
- Evidently, strategic and tactical applications in aerial warfare.
- Refers to specific work "Shakthi tantra"

8. Paroksha :

"According to 'Meghotpatti prakarana' or the science of the birth of clouds, by entering the second of the summer cloud layers, and attracting the power therein with the shaktyaakarshana darpana or force attraction mirror in the vimana, and applying it to the parivesha or halo of the Vimana a paralyzing force is generated, and opposing vimanas are paralyzed and put out of action"

- Principles of formation of clouds referred to as "Meghotpatti-prakarana" indicate the possession of knowledge of science of atmosphere.
- Derivation of energy from clouds through "Shaktyakarshana yantra" eventually to generate paralyzing force and directing this energy against enemy planes.
- A lethal measure in combat flying in strategic attacks.
- Could be both in strategic or tactical roles of mission.
- Used in the event of multiple air attack.
- Distinctly can be categorized under the concept of Biological warfare.

9. Aparoksha:

"According to 'Shakti-tantra', by projection of the Rohinee beam of light, things in front of the vimana are made visible."

- Shakti tantra is referred on the principle underlying this on-board feature.
- To achieve a kind of visibility in front of the vimana using Rohinee Beam. This may be a special optical beam employed for flying during darkness for the purpose of sighting or landing/take off.
- Possibilities of this beam not being a conventional light source, but for other applications like radar beam cannot be over ruled.

10. Sankocha or Contraction:

"As prescribed in the Yantraangopasamhaara section, when the vimana is flying at a speed with fully extended wings and there is danger ahead, turning the seventh switch in the vimana, its parts can be made to contract."

- Contraction of the wings of the Vimana while flying at high speed.
- "YANTRANGOPASAMHAARA" quoted as the guide containing this principle of operation.
- Evidently a mechanical contrivance provided as an on-board control feature.
- Could be to gain add-on speed by constricting the profile
- Concept of variable geometry swing-wing / flapping-wing configuration is evident.

11. Vistrita:

"According to 'Akaashatantra', when the vimana is in the central air flood in the third and first regions of the sky, by turning the switch in the eleventh section of the plane, it becomes expanded suitably according to 'Vaalmeeki Ganita".

- An inverse function of Sankocha, again with variable geometry configuration of the structure

- Employed for expansion of wings while flying through certain atmospheric zone as a flight protection measure.
- 'Akaasha tantra' quoted as the guiding text.
- 'Vaalmiki ganitha' is quoted possibly in relation to variable geometry principle.

12. Viroopa karana:

"As stated in 'Dhooma prakarana', by producing the thirty second kind of smoke through the mechanism and charging it with light of the heat waves in the sky and projectiong it through the padmaka chakra tube to the bhyravee oil-smeared Vyroopya-darpana at the top of the vimana, and whirling with 130 second type of speed, a very fierce and terrifying shape of the vimana will emerge, causing utter fright to onlookers.

- By definition means change of appearance.
- With combined use of specified smoke and light of the heat wave in the atmosphere, and projecting through Padmaka chakra tube on oil smeared Vyroopya darpana, creating artificial fierce shapes of the vimana.
- Causing fright among the enemy forces aimed at through this on board system.
- 'Dhooma Prakarana' is the guiding text.
- Partially a Biological warfare concept to psyche viewers.
- Use of this feature in strategic and tactical air warfare roles.
- Fierce shapes produced could as well be to convey coded signals. Each shape denoting a signal.

13. Roopaantara:

"As stated in 'Tylaprakarana', by preparing griddhrajihwaa, kumbhinee, and kaakajangha oils and anointing the distorting mirror in the vimana with them, applying to it the nineteenth kind of smoke and charging with the kuntinee shakti in the vimana, shapes like lion, tiger, rhinoceros, serpent, mountain, river will appear and amaze observers and confuse them."

- By definition means 'conveying varied appearances'
- Guiding text is 'Tylaprakaranam'
- Application of mixture of specified oils on distorting mirror in the vimana, applying specified smoke and charging with Kuntinee shakthi appearance of special shapes is effected.
- Changes in the looks of Vimana might be aimed at for use as coded signals to convey particular status of operation, or may even convey specific messages to ones own ground forces in the form of operational communication.
- Though not mentioned as a means to tackle enemy forces, this technique could also be to psyche them with scary shapes and divert their attention.
- It could also be to escape pinpoint sighting and targeting of the vimana itself by opponent forces. Hence it seems to include both evasive and communicational roles.
- Technique is on the lines of colour emission producing aesthetic effects in air shows in modern aviation

14. Suroopa:

"By attracting the thirteen kind of karaka force mentioned in 'Karaka prakarana' applying snow-surcharged air and projecting it on the right side of the vimana and focusing on it

the suragha beam, a heavenly damsel bedecked with flowers and jewels will appear to onlookers of the vimana."

- Projecting the appearance of a damsel adorned with jewels and flowers
- Use of Karaka force and snow charged air, projecting it to Pushpinee-pinjuala mirror and focussing a special beam results in creation of such shape
- 'Karaka Prakaranam' is a treatise dealing with this technique
- Concept possibly intended to convey aesthetically pleasing look on the onlookers (obviously not for enemy's consumption)
- Concept is on the lines of Roopantara but appears for employment in friendly territory on tactical role
- Interesting interpretation of a damsel bedecked with flowers may be intended to announce victory or a favourable status
- Could be a mode of entertaining own forces
- The technique is similar to modern air displays.

15. Jyothirbhaava:

"As stated in 'Amshubodhinee', out of Samgnaana and other sixteen digits of the solar glow, by attracting the twelveth to the sixteenth digits and focusing them on the air force in the Mayookha section in the fourth pathway in the sky and similarly by attracting the force of the etherial glow and mingling it with the glow in the seventh layer of air mass and then by projecting both these forces through the five tubes in the vimana on to the section of the guhaa-garbha mirror, a rich glow like the morning glow of the sun will be produced.

- Meaning refers to rich glow of rising sun.
- Effect derived from a combination of specified digit of solar glow energy and air mass of specified sections of atmosphere, etherial glow coupled with Guha garba mirror.
- Guiding work quoted is "Amshubodhini". This work also ascribed to Maharshi Bharadwaja, deals all about solar rays and energy harnessing from these rays. This text is referred to many a time in 'Vymaanika Shastra'
- Possibly employed as a 'time-diversionary' tactic during night aerial battles. Creating such an effect could be very useful in confusing enemy ground forces and upset their operational movement plans.
- Employment in strategic role is useful.

16. Tamomaya:

"As described in 'Darpana Prakarana', by means of the dark force mirror, capture the force of darkness, pass it through the Thamo Yantra in the north-west side of the vimana and by turning a switch produce at noon-day the utter darkness of the night of the new-moon."

- 'Tama' basically means darkness. Tamomaya means Illusory darkness.
- Employing dark force creating mirror, capture darkness energy and using Tamo yantra to produce total darkness at the brightest part of the day.
- 'Darpanaprakarana' is the guiding text and Tamoyantra is the contraption effecting it.

- Instant confusion is created in enemy forces, movement of troops could be hampered.
- Sighting of the Vimaana instantly affected, thus helping a quick escape, possibly one of the best methods of self concealment for a Vimaana.
- A very useful tool in strategic attacks during daytime.
- A clever deception tactic in a situation when trapped in the midst of enemy forces and while the Vimana is caught in crisis situation.

17. Pralaya:

"As described in the magic book of destruction, attract the five kinds of smoke through the tube of the contracting machine in the front part of the vimana and merge it in the cloud-smoke mentioned in 'Shadgarbha Viveka'. Pushing it by electric force through the five limbed aerial tube, destroy everything as in a catacyclism."

- Total anhilation concept.
- Using five kinds of smoke, merging it with cloud smoke and directing electrical energy to push through five on board naalas create massive destruction of enemy forces.
- Evidently the most lethal strategic weapon discussed so far.
- In strategic role, could be even meant as a suicidal action in a desperate situation.
- In a way, can be termed as a Biological weapon.
- Guiding text-"Shadgarbha-viveka".

18. Vimukha:

"As mentioned in 'Rig-hridaya', by projecting the force of Kubera, Vimukha and Vyshawaanara poison powder through the third tube of the roudree mirror and turning the switch of the air mechanism, produce wholesale insensibility and coma."

- Using prescribed substances including poisonous materials in conjuction with Roudree mirror bringing about insensibility in enemy forces.
- Guide qouted is "Righridaya"
- Unmistakably a Biological weapon.
- Confirms conceptualization and knowledge of biological weaponry.
- Deployment of similar weapons like "Sanmohanaastra" to cause such effects as mentioned at a number of occasions in epics such as Mahabharata and Ramayana War episodes.
- Full strategic role of Vimana to be noted.

19. Taara:

"By mixing with ethereal force ten parts of air force, seven parts of water force and sixteen parts of solar glow and projecting it by means of the star-faced mirror through the frontal tube of the vimana, the appearance of a star-spangled sky is created."

- In combination of ethereal energy, air and water forces and sunglow projecting the resultant light through star faced mirror to obtain the effect.
- Creation of such effects in combat flying during nights can be useful in both strategic and tactical roles.

- In strategic role it could be to generate a night sky where artificial dispositions of stars generated could mislead the enemy forces on navigation and movements.
- In tactical role, the effect is either to create an aesthetic effect or conveying coded signals to friendly troops.

20. Mahaashabda Vimochana:

"By concentrating the air force in the seven tubes of the vimana and turning the switch, produce, as stated in 'Shabda Prakaashikaa' a crescendo of thunderous din, which stuns people and makes them quake with fear and become insensible."

- Using the Air force through multiple naalas of Vimana to produce a thunder sound to unnerve the forces.
- Analogous to the technique of domination over the enemy troop-locations and causing insensitivity to put them out of action.
- Biological warfare in strategic application.

21. Langhana:

"As stated in 'Vaayu tattva prakarana' when crossing from one air stream into another, the vimana faces the baadaba glows of the sun and catches fire. In order to prevent that, the electric force and air force in the vimana should be conjoined and centred in the life-centre of the vimana, and by turning the switch, the vimana will leap into safety."

- Avoidance of Badabda glow of Sun while negotiating from one atmospheric zone to another and using air and electric energy (captive in the Vimana) to provide a leaping force.
- Essentially a measure to achieve safe flying in specified atmospheric zone.
- Use of captive energy is interesting.
- Indications that knowledge of danger zones in atmosphere existed.
- Guiding text "Vayutatvaprakarana".

22. Sarpa-Gamana:

"By attracting the Dandavaktra and other seven forces of air and joining with solar rays, passing it through the zig-zagging centre of the vimana and turning the switch, the vimana will have a zig-zag motion like a serpent."

- By combining the use of Dandavaktra and other seven forces of air and solar energy and passing the resultant in zig-zag manner.
- Clearly an evasion technique to thwart attempts to pinpoint sighting of the Vimana.
- To evade enemy sighting on detection systems like Dishampati yantra (discussed later).
- An evasive tactic while on strategic role.

23. Chaapala:

"On sighting an enemy plane, by turning the switch in the force centre in the middle section of the vimana, a 4,087 revolutions an hour atmospheric wave speed will be generated and shake up the enemy plane."

- Using on board energy to impinge shock waves on enemy plane.

- From the manner explained this is used as a specific weapon to counter enemy plane to cause damage or destruction.
- Can be in strategic or tactical role.
- Partly a Biological weapon since shock waves cause serious impact on opponent air crew
- Could be a useful weapon in close attack roles and in crisis situations.

24. Sarvatomukha:

"When a formation of enemy planes comes to attack one's viamana, by turning the switch at the crown of the vimana, make it revolve with agility and face all sides."

- To achieve Omni-directional view as enemy planes attack from multiple directions.
- Essentially a detection system.
- Concept of multiple aircraft attack in formation is interesting.
- In the mode of Sarvathomukha the pilot knows his own disposition and status of safety and combat capacity with reference to each attack plane. This will enable him to decide the course of action and type of attack / defense.
- In combination with Sarpagamana, chaapala, Sankocha, a useful on-board device.

25. Parashabda Grahaka:

"As explained in 'Sowdaaminee kalaa' or science of electronics, by means of the sound capturing yantra in the vimana, to hear the talks and sounds in enemy planes flying in the sky ."

- Using the sound sensing yantra, to intercept intra crew communications from enemy aircraft.
- Guiding principle is 'Soudaminee Kala' (of Anshubodhinee).
- Clearly a frequency interception technique
- 'Shabdakarsha Yantra', later discussed among Yantras, is one such yantra though for a different purpose.
- Concept of devices on the lines of electronic counter measures did exist. Advanced knowledge of communication-interception of frequencies must have prevailed.
- As a prelude, basic transmitter and receiver devices must have existed.

26. Roopakarshana. :

"By means of the photographic yantra in the vimana to obtain a television view of things inside an enemy plane."

- Obtaining view of actions inside an enemy plane.
- Clearly a counter measure concept in reconnaissance / surveillance role.
- Means more than mere Photography of inside of vimana. To be useful, has to be relaying pictures penetrating the body of the vimana.
- Simple aerial photographic systems in reconnaissance role must have preceded this technique.

27. Kriyaagrahana:

"By turning the key at the bottom of the vimana, a white cloth is made to appear. By electrifying the three acids in the north-east part of the vimana and subjecting them to the seven kinds of solar rays and passing the resultant force into the tube of the Thrisheersha

mirror and making the cloth screen face the mirror and switching on the upper key, all the activities going on down below on the ground, will be projected on the screen."

- Use of screen cloth projection, combined use of acids and solar ray, sand using 'Trisheersha Mirror, all actions going on the ground can be obtained.
- Trisheersha mirror is possibly to obtain a three dimensional effect.
- Technique is to obtain a running relay of pictures of ongoing actions on the ground.
- Clearly a combination of strategic air surveillance possibly to warn the trailing aircraft about ground situation of enemy forces ' KRIYA GRAHANA ' meaning motion-picture reception could be used for assessing damages inflicted.
- In a battle role it seems to be for planning attacks on enemy ground forces.
- Yantras dealt with later explain the translation of this technique.

28. Dikpradarshana:

"Turning the key at the front of the vimana Dishaampati yantra will show the direction from which the enemy plane is approaching."

- By using a device named Dishampati yantra the direction of approach of enemy aircraft is indicated.
- A specific yantra later described under yantras is under discussion.
- Concept seems to be on the lines of early warning radar.
- Seems to be in a limited sense of direction-finder and not range-finder.
- This concept, in modern military aviation came around 1935 and used during second world war.

29. Aakaashaakaara:

"According to 'Aakaasha-tantra', by mixing black mica solution with neem and bhoonaaga decoctions and smearing the solution on the outer body of the vimana made of mica plates and exposing to solar rays, the plane will look like the sky and becomes indistinguishable."

- By applying black mica and decoction of neem etc. over the body of the vimana, obtain an appearance merging with the colour of the sky and become indistinguishable.
- A stealth technique limited to the extent of escaping visual detection. An effective detection avoidance system
- Use of solar ray to achieve this effect is clear.
- Guide referred to is Aakaasha Tantra.
- Can be useful only while flying in clear skies.
- Deception against enemy surveillance

30. Jalada Roopa:

"Mixing pomegranate juice, bilva or bael oil, copper-salt, kitchen smoke, granthika or gugul liquid, mustard powder and fish scale decoctions and adding sea-shell and rock-salt powder and collecting smoke of the same solution and spreading it with solar heat enveloping the cover, the vimana will have the appearance of a cloud."

- Use of Botanical preparations and calcium materials and solar rays for application , a cloud like appearance of vimana is obtained.

- The concept and technique are similar to that of 'Aakashakaara ' except to achieve cloud-like appearance.
- Intended to be employed against detection while flying through overcast skies.
- Useful in strategic roles

31. Stabdhaka:

"By projecting apasmaara poison-fume smoke through the tube on the north side on the vimana and discharging it with stambhana-yantra, people in enemy planes will be made unconscious."

- Use of Aapasmara poison fumes and discharging through stambhana yantra to render crew in the enemy planes unconscious.
- Can be an effective tool both in strategic and tactical roles
- Clear bio-weapon
- Specifies only in aerial engagements
- Aapasmara is one of the deadly poisonous

32. Karshana:

"When enemy planes come in strength to destroy one's vimana, by setting aflame the Jwaalinee shakti in the Vyswamara naala or pipe located at the navel of the plane, and switching the keys of the two wheels to 87 degrees of heat, the burning shakti will envelope the enemy plane and destroy it."

- To set fire to attacking enemy planes approaching in numbers
- Use of 'Jwalinee Shakti' through ' vyswa maara naala' is implied
- An effective defense tool in multiple attack situation
- Could be in strategic or tactical roles in crisis situation

Summary of observations on 32 special features:

- Most of the secrets (or features) are based on principle-specific texts, an indication that each principle was broad-based and evolved on scientific perceptions.
- Strategic/ Tactical / reconnaissance /communication roles of employment for attack/ defense purposes are clear.
- Many features are safe-flying requirements, many of them relating to atmospheric zone
- A number of advance warning features are enunciated.
- Many interesting avoidance features are seen
- Biological warfare concept is in clear manifestation
- Utilization of energy and properties of sunrays, ethereal flow, air and cloud energy are seen.
- Read in correlation with system- specific yantras under the yantradhikaranam the study will be interesting.

CHAPTER – 9

THE ATMOSPHERE (AERIAL ROUTES) – AAVARTAAS

Knowledge on atmosphere is an integral part of aviation science. This need has evidently been felt by ancient Indian scientists of **Vimaana Shastra**. An exclusive section, though brief, has been dedicated for discussion on aerial routes and 'Whirl Pool' or 'Aavartaas'.

Seer shownaka's classification of five layers of atmosphere is:

- Rekha patha
- Mandala
- Kakshya
- Shakti
- Kendra

Discussion:

Knowledge of this branch of science was mandatory in the training of the pilot of vimaana.

Air routes at each atmospheric zone running into lakhs of routes and suitability of vimaanas of different lokaas for flight compatibility in atmospheric zones have been covered under the topic. However it is not very clear as to what are being called aerial routes numbering into several lakhs under each zone mean. Mention of seven lokas or world is noticed. As a ground rule, study team has chosen only aspects relating to earth (Bhooloka) and related matters and kept others out of scope of the study.

Dhundinatha and 'Valmeeki Ganita' are quoted in support of aerial routes in five zones of atmosphere.

Interesting feature on aavarthas or whir-pools is the correlation stated between the zones of atmosphere and the zones of energy.

- Rekha pathaa: Shaktyaavarta or whirlpool of Energy.
- Mandala pathha: Vaataavarta whirl pool of winds.
- Kakshya patha: Kiranavarta whirl pool from Solar rays
- Shakti patha: Shaktyaavarta or whirl pool of Cold Currents.
- Kendra patha: Gharshanaavartha or whirl pool by collision.

Here it is relevant to bring in interesting analyses made by **sri.M.K. Kawadkar**, a researcher with incisive interpretational skills. This is taken from his article in Bharatiya Bouddika Sampada, a quarterly journal from Nagpur. The exclusive efforts being contributed by their team is laudable. Considering the yeoman service being rendered by their group in the field of unraveling the veil around ancient scriptures, we prefer to reproduce the entire report concerning this topic.

Description of Atmospheric layers in ancient Indian Vimana shastra

By **M.K. Kawadkar**.

It may be mentioned here that original text of Bharadwaj Muni on Viman Shastra contained 500 rules in eight chapters and 100 adhikaranas. The currently available copy of the book contains only 40 rules in three chapters and 17 adhikaranas. This shows the extent of loss of literature. I have selected only one topic for the present study i.e., knowledge of air routes (Description of Atmospheric layers) in ancient Indian Viman Shastra.

Maharshi Bharadwaj summarizes this subject in a keyword 'Panchadnyasch' and 'avartashek' i.e., one must know the five parts of the sky to be able to pilot a flying machine into the skies and turbulence in it.

The secret science as stated in earlier verse is provided here.

- In this text the five eddies are stated
- With the knowledge of these sciences the technological expertise is measured
- For the proof two verses are quoted
- The five eddy concept is as per 'Shounak'
- The Rekha and other five routes are described here
- The five routes are:
    - 1. Rekha
    - 2. Mandal
    - 3. Kakshya
    - 4. Shakti
    - 5. Kendra

Shounakiya:

I sequentially state the air routes, Rekha, Mandal, Kaksha, Shakti, Kendra each one contains different powerful currents. As a winged projectile gets stalled vertically up words (Baman avashtombhya) it is from 41 @ Horizon to 51 lacks, 9 thousand, 8 hundred by numerical measurement. This area contains all the routes in which seven types of viman (aircraft) fly Viz., Bhuviman and others.

Five different routes are stated here. The statements of 'Dhudinath' are stated here. 'Rekha Marga' is seven crores, three lacks, eight hundred units. 'Mandal Marg' is twenty crores eight lacks and two hundred units. 'Kaksha Marg' is two crores, nine lacks, three hundred units, 'Shakti Path' is ten

crores, one lack, three hundred units, 'Kendra Mandal' is thirty lacks, eight thousand, two hundred units. Thus, from Rekha to Kendra mandals have been stated serially as per 'Valmiki's Ganita' (maths) in these verses.

Now the air traffic practices are stated. Summary = There are six types of Aeroplanes as for 1] Bhuvaloka. 2] Suvarloka. 3] Maholoka. 4] Janoloka. 5] Tapoloka and 6] Brahmaloka. In Rekha Patha from type one to type four can fly in Kakshya Patha from type two to type five can fly in Shakti patha from type one to type six can fly in Kendra patha, from type three to type eleven can fly. There are air routes stated by experts of Valmiki Ganit and other mathematicians.

Note:

- These verses are incomplete because nothing has been said about Mandal path.
- There is some distortion about "Ekadashantam".
- These sets of verses have ample room for different interpretation. That the six lokas are above five paths making it total eleven. I leave it to the readers.
- Thus five air routes have been stated serially. Now is stated the decision of eddies. There are many types of eddies, depending upon the path, however, only the five which are important for air routes are described.
- Whenever two currents meet each other the eddies are produced. Now they are stated serially. In Rekha path there are eddies which cause power loss, in Mandla there are air turbulence, in kakshya there are radiation eddies, in shakti path there are cold turbulence and in kendra path there are frictional or impact turbulence. Thus there are five types of turbulences. The Brahman Granth also confirms that the turbulances are five in number (This Brahman Granth is supposed to lost) The aeroplanes called as Brahmaloka vimana.
- In the transit zones the high and low temperatures can be erratic. And these can cause heavy turbulence. The turbulences are named as Shakti, Vata, Anshu, Shaitya and Gharshana. It is necessary to know these specifically, because they are obstructions in the air routes.

Relevant abstracts from **Marg Nibandha:**

A chart showing the comparison between the modern concept of atmosphere and viman shastra of Maharshi Bharadwaj, is shown below:

Chart showing comparative heights of Atmospheric layers between Vimana Shastra and today's science

Great-Grand Energy-Reservoir Aa pourusheya Shakthi Kshetra	KM 60000 50000 40000 30000 20000 10000	Total void Great sink Magneto Pause Void Magneto Sphere
Ye-ha-sa Bindu Sankash Brahma Kshetra Veda Garbha Shakthi Ardha chan-Drak brahm Kshetra –ee-ha Vu-ha Kundli-Brahm - Kshetra aa-ha-dhandak brahma kshetra	1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200	Van Allen belts (High) Magnetosphere
Tadak/Tarak Brahma Kshetra Ma-haKendra path Gharshana Vartha-3008200 Chow-Dhand Ra-ha Shaktipath Shaktyavarth 100100300 chow-Dhand Ya-ha Kaksha patha Kiranavartha Va-ha Mandala-Path Vathavartha 220800200-Chow Dhand La-ha rekha path Shakatyavartha 70300800 Sara sari samudra Pathali	100 90 80 70 60 50 40 30 20 10	Van Allen belt Lower Ionosphere/Thermo-Sphere (Ozone U.V.-Heat) mesopause Mesosphere Extreme Cold Stratopause Stratosphere Clear air Turbulence Cat jets Min Speed = 30M/sec Tropopause Turbulence Troposphere High air density M.S.L.

It can be seen from the comparison chart that there is a good amount of agreement between the two. It may be noted that in the modern distribution there are five divisions viz.,

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere
5. Van Allen belts and the ancient distribution is also in five belts

The lowermost Rekha patha matches very well with the Troposphere, along with the Tropopause and the uppermost kendramandal matches very well with the Van Allen belts (lower). The distribution Shaktipatha matches very well with thermosphere. Kakshapatha with mesosphere and mandal with stratosphere, differ in their heights. This is possible because there is a difference of about 2500 years in between and the philosophical segregation also might be different. It is also likely that the atmosphere itself has under gone a change over this period.

Viman shastra has mentioned 'Avarta' as 'Avarthascha' which means various currents in the five subdivisions of the atmosphere, which a pilot must know.

The names of various currents in the five belts are:

(Shounaka)

1. Rekha patha –Shaktyavarta
2. Mandal –Vatavarta
3. Kaksha –Kiranavarta
4. Shaktipatha –Shaityavarta
5. Kendramandal –Gharshanavarta

It is said explicitly that these currents are injurious to the flying machines and can damage and destroy it (shounaka). The shaktyavarta of rekha patha is probably synonymous with high air density requiring a great amount of power for propulsion. The vatavarta of mandal are clearly synonymous with the clear air turbulence (CAT) of the stratosphere. There is some ambiguity about the kiranvarta of kaksha. The shaityavarta of shaktipatha matches very well with the extreme cold zone of the mesosphere. The gharshanavarta of kendramandal is supposed to be synonymous with extreme heat of the Thermosphere and if kiranavarta is taken with the radiation belt of the Allen's then everything matches very well. The corrected sequence will appear as under.

Rekha patha Stratosphere High air density Shaktyavarta

Mandalpatha Stratosphere Clear Air Turbulence Vatavarta.

Kendra patha	Mesosphere	Extreme cold	Shaitya varta.
Shaktipatha	Thermosphere	Extreme Heat	Gharshanavarta.
Kakshapatha	Van Allen belt	Radiation hazards	Kiranavarta.

- Rekha Marg – Large number of powerful turbulence are produced due to very high speed and they damage the aeroplane called as Bhulokaviman.

- Mandal Marg – There are many high speed powerful air currents and they damage the airplanes of three types as Bhuloka, Svarlok and Maholok.

- Kakshya Marg – There are radiation bonds in this region which damage the Jonolok Viman.

- Shakti Marg - Extreme cold zones produce the turbulence in contact with the tracks and they damage the Kheta Vimana (There is difference between "Khet" and "Khest" Khet=low grade and Khest=Orbiting ship)

- Kendra Marg – There are many turbulences, which strikes the planes from many directions, and these damage the aircraft.

Bodhananda develops it further and with appropriate reference from Shounak states that the depth of the sky (with respect to earth's surface) is divided into five parts:

(i) Rekha patha
(ii) Mandal
(iii) Kaksha
(iv) Shakti
(v) Kendra.

The bottom of Rekha path is earth's surface called as 'Kurma' and the top of the Kendra is called 'Varunanta' i.e., the end of the atmosphere. Maharshi Sounaka has provided the measure of 'Kurma' and 'Varunanta' as 41 lacks and 51,09,800 (measurement units have not been specified.) But since, this measurement is in connection with earth's surface, it is reasonable to accept that this is the circumference of earth i.e., 24,902 miles or 40,900 Km. or about 41,000 Km. approximately.

The kurma of shounaka is one hundred times larger. Therefore the unit selected by 'Shounak" appears to be about 10 meters or 32.8 ft. This is very near to an ancient measure known as 'Danda'. Hence, the earth's diameter = 41,00,000 (Shounaka) divided by pye = 1305070.5 'danda'. For Varunanta, a circumference of 51,09,800 divided by Pye =1626499.8 'danda' is the diameter of outer atmosphere around the earth. Therefore, the height of the atmosphere above the earth's surface = (1626499.8 – 1305070.5) divided by

2 = 160714.65 ‘danda’ or 1607 km. (shounaka). This corresponds with the upper Van Allen Belts as per modern science’s estimates. This is probably the Valmiki Ganit (maths) as referred by Dhundinath.

Now, we can proceed further to evaluate the thickness of various belts of atmospheres. As stated above the following figures are mentioned for each of the five sub-divisions of the cross section of the atmosphere.

Here we have to draw a circle:

- Rekhapath = 70300800
- Mandal = 220800200
- Kaksha = 20900300
- Shaktipath = 10,0100300
- Kendra mandal = 30,08200

Observing the above diagram, it appears that the provided measures are the areas of five air route spaces.

- Rekhapath = 7,03,00800 divided by 41,00,000 = 17.15 & cumulative height 17.15
- Mandal = 22,08,00,200 divided by 41,00,000 = 53.85 & cumulative height 71.00
- Kaksha = 2,09,00,300 divided by 41,00,000 = 5.09 & cumulative height 76.09
- Shaktipath = 10,01,00,300 divided by 41,00,000 = 24.39 & cumulative height 100.48
- Kendramandal = 30,08,200 divided by 41,00,000 = 0.73 & cumulative height 101.21

The circumference of the earth has to be increased progressively as height increases. However, because last figure 101 is too small with respect to 41, 00,000 and also because of approximation this is neglected.

There will be a temptation to take these measures also as ‘Danda’. However, looking to the fact that the period of Shounaka is about 500 BC and that of Dhundinath not earlier than 1600 AD. There is a time gap of about 2100 years. Therefore, it is highly probable that the units may be totally different. A comparison with the modern belts of atmospheres shows that these air-routes match very well, if these measures are taken in kilometers. This is only a matter of coincidence.

It is note worthy that the kendra means a centre and kaksha means outermost layer and thus the correction appears to be valid.

For introducing such correction, the other references will have to be seen (if available). Such a slip is likely to take place within a span of about 2500 years.

This topic is further elaborated by **Lalla**. He has suggested that there are five different types of Vimanas built appropriately for each type of atmosphere.

- He has considered 'Bhuloka Vimana' for flying in Rekhaptha or Stratosphere, which are damaged if the speed increases beyond a critical value.
- Janolok Vimana are those which can go up to the "kaksha", above which they may be damaged by the radiation's or "Kiranavarta" of modern Van Allen's belts
- 'Brahmlok Vimana' which can go up to 'Shaktipath' where it encounters the extreme cold of 'Shytyavarta' and the extreme heat of the 'Gharshanavarta' which is mesosphere of the modern concept and these planes are damaged by extreme cold and extreme hot conditions alternatively.

It is also stated that all the three types of planes are damaged by the 'Vatavarta' of the Mandalpatha or the CAT currents (modern concept). One more type stated as 'Khetayan' can be damaged in 'Shaktipatha' due to 'Shytyavarta' i.e., the extreme cold of the mesosphere. One will have to be very cautious to interpret the work **khet** as Khet or Khest. As pointed out in the translation of the appropriate verse Khet means a low quality and Khest may mean any vehicle plying regularly in sky.

As a matter of conclusion, it may be said that this study has not revealed any information not known to modern science. It has only confirmed that an ancient Indians knew the structure of the atmosphere to a degree of the precision. This exercise has showed a necessity of learning such techniques as **Valmiki Ganit** for the interpretation of ancient text, which need a very wide search of source material. This has shown a need to collect the ancient texts wherever possible. The engine and power section needs such an enrichment and correction. This may offer an opportunity for such subsequent articles.

The metallurgical study of viman shastra also deserves a careful consideration. This may provide some important clues to the aviation materials.

One more interesting and beneficial study from **Vimana Shastra** and the associated literature will be a study of toxicity during air flights. The total number of toxic forces, which exist in the atmosphere, is stated as 7, 58, 00, 700 and the same number of nourishing forces. This is also stated as per Valmiki Ganita system. This study was not contemplated for this article. However, if some reader of this article knows about the source "Visha Nirnaya Adhikara", he is requested to get in touch with the author.

After the interesting analysis of **Sri. M.K. Kawadkar,** we resume our discussion on the same topic.

Possession of a comprehensive knowledge on atmospheric science among ancient scientists is substantiated from references to the subject in other ancient works.

Doubts have been expressed in many quarters; whether ancient Indians did know that the planet earth is spherical and rotates around its axis. Ancient Greeks and much later **Galileo** are accredited with this discovery. Contrary to this belief it is seen that

chapter 13 of "Surya-Siddanta" talks of a model of earth in spherical shape with an axial rod driven through and the body rotating around a pivot. Vymanika Shastra itself in its discussion on ore–bearing crest of the earth, gives the natural conditions of gravitational forces of rotating earth and even other planets contributing into formation of different layers of earth.

Rigveda is quoted to deal with discussion on atmospheric phenomenon such as climate, seasons, rains, clouds, lightening and so on. Knowledge of different types of cumulus clouds is confirmed to have existed. Cyclic phenomenon of rain was fully known. **Atharvana Veda** cites a particular type of whirlwind as 'Resma'. **Vishnu purana** gives details of lightening in different form. Lightening is also classified based on its acoustic and electrical characteristics. A deep knowledge of climatology came from different sources of ancient works, hinting that even many scientists and works dealt with it.

Briefly narrating knowledge of cloud classification, the cloud not contributing rain was called 'Avarta' to the type providing heavy rains 'Samvartaka' (corresponding to cumulo-nimbus) and that can not provide little rain was called 'Puskara' corresponding to cirrus, clouds causing rains very helpful to crops called 'Drona' corresponding strato-cumulous.

Varahamihira gives certain principles formulated by ancient sages **Kashyapa**, **Garga** and others for determination of rain fall in an area. Disposition of planetary positions in Zodiac guided such predictions of rainfall. Natural phenomenon such as earth quake, eclipses and meteorite fall also contributed in this science of forecast.

CHAPTER – 10

ON-BOARD SYSTEMS / FEATURES

The topic 'Aeroplane parts' listing 31 parts of the Vimanas is significant. The topic is a derivative or corollary of 32 secrets of vimana discussed earlier.

- Vishwakriyaadarpana or mirror of outside views
- Shaktyaakarshana or energy attracting mirror
- Parivesha mechanism above the hood of the vimana
- Angopasamhaara yantra or folding up yantra at the 7th bindukeelaka
- Vistritakriyaa or opening out yantra, location in the middle of the 11th section
- Vyroopya darpana
- Padmachakramukha at the sirobhaaga or crest of the vimana
- The kuntinee Shakti mechanism is to be in the neck of the vimana
- Pushpinee and pinjulaa mirrors are to be in the right side of the centre
- At the front of the left side are to be located the Naalapanchaka or five pipes
- Guhaagarbha.mirror yantra is to be in the front part of the stomach of the plane
- Thamoyantra at the north western side
- Pancha Vaataskandha naala on the western centre
- Rowdree mirror
- Vaataskandha keelaka at the bottom centre
- Shaktisthaana at the front and right sides
- Shabda kendra mukha at the left side
- Vidyutdwaadashaka at the north east side
- Praanakundala at the moola of the vimana
- Shaktiudgama at the navel of the vimana
- Vakraprasaarana at the side of Vimanaadhaara
- Shakthipanjara in the central portion
- Shirahkeelaka at the head of the vimana
- Shabdaakarshaka yantra at the shoulder
- Pata prasaarana at the bottom centre
- Dishaampatiyantra at the left front
- Pattikaabhraka at the centre of the hood of the vimana
- Solar power attractor at the top of the vimana
- Apasmaara or poison gas at the sandhi naala mukha or junction tube front
- Sthambhana yantra at the bottom
- Vyshwaanara naala at the navel centre

This is the placing of 31 components of the **vimana**.

Discussions: Here parts are referred to as 'Anga'. Firstly it is noticed that these parts

are not having one to one correlation with secrets or features and more importantly, many more complex systems dealt with later in the work do not find their mention here.

While some appear to be mechanical contraptions, some others are sophisticated avionic devices.

The systems have been given distinct locations on vimanas. Propriety in location of each contraption needs special mention A quick glance at the list of 'on board' packages indicates:

Function-specific avionics systems have been conceptualized and developed to provide multiple role capabilities for **vimana**.

Systems can be generally classified under categories

- Yantras
- Darpanaa or special mirrors
- Naalas
- Energy generating devices
- Solar energy harnessing features at several places
- While some appear to be mechanical contraption, others are sophisticated special devices
- The systems have been given distinct locations on the vimana. Propriety in location of each contraption needs special notice

More of these **yantraas** are covered under "Yantradhikaranam".

CHAPTER – 11

CLOTHING FOR PILOTS

The chapter on special clothing prescribed for the aviator throws light on the comprehensive manner in which aviation and it's peripherals had been perceived. Like in modern high-speed aviation, special flying suits for pilots had been visualized by the ancient scientists as well.

Highlights of the soothras are:

- To provide season-compatible clothing
- Attire is specially provided as a protection against harmful forces, energy beams, climatic effects. It is also a means to improve his efficiency, strength and resistance.
- "Pata Samskara Ratnaakara" is the guiding text and preceptor quoted is Gaalava.
- The raw materials quoted for manufacture of the special fabric includes silk, cotton, moss, hair, mica and leather.
- Process-intensive methods of manufacture are stipulated.
- Draping of apparel is stated to be governed by the prescription of Agnimitra.

Comments:

The study team points out that this aspect on occupational clothing has not been picked-up by any researcher so far for hardware validation.

Identification of materials, development of their processing methods must have been broad based on sound textile technology, exclusive for aviation application.

Ergonomic and Aesthetic factors seem to have been taken into consideration fully up to the extent of smart draping of the apparel.

'Ayurveda' must have played a significant part in guiding this textile technology.

Raw materials going into the fabric prescribed such as silk, leather and even hair suggests that basic material research in this technology must have been highly advanced.

Note: The project study team, in course of their data generation visited a Veda Vignana Ashram near Bangalore carrying out some practical research on ancient sciences. Two researchers in the ashram, both chemical engineers have started work on synthesizing the fabric for pilots as specified here. Their research however is in preliminary stages.

CHAPTER – 12

FOOD FOR PILOTS

A few soothras of **Vymanika shastra** deal with dietary prescriptions for flying personnel. This is on the same lines on which 'occupational clothing' has been treated on scientific basis. Flying itself being a specialized field involving skills, physical fitness, endurance, alertness, decision-making and so on, the supporting elements connected with the aviator have also been appropriately conceived.

Prescriptions of food for the pilot have been dealt under the following headings. :

- Food according to seasons.
- Three varieties to ward off seasonal effects.
- Food at set timings
- Essence of fruits, roots and bulbs.
- Grasses, bulbs and shrubs.

Food according to seasons:

Type of food and diet principles are ascribed to "Kalpa sootra" and "Ashana kalpa"

Season	Liquid	Grain	Flesh
Spring-& summer	Buffalo's milk	Tuvar dal	Flesh of sheep
Rain-& autumn	Cow's milk	Wheat & Black gram	Flesh of cocks & Hen
Winter & snow	Goat's milk	Yava & Black gram	Flesh-of sparrows

- Pilots belonging to Dwija class-Brahmins, Kshatriyas & Vysyas, were forbidden to consume flesh.
- Restriction of flesh in their diet for dwija & non-dwija classes of the society focuses on two significant observations.
- Aviator could be from any branch of the community without the usual barriers of "Chaturvarna" system that prevailed in ancient India. Perhaps the vital qualitative requirements were skill and fitness.

Next the soothra dealing with three varieties of food especially to ward-off evil effects quotes the work '**Visha Nirnaya Adhikaara**'. Here note the mention of beneficial and evil effects of atmospheric heat, moisture, cycles of full moon, new moon phases and changes of seasons. Accordingly changes in varieties of ingredients is justified.

Food at set times:
In this particularly interesting soothra, frequency of food intake needs focused understanding. Quoting sage **Shownaka** and **Lallacharya** the table of diet frequency / time is as under.

Type of individual	**Number of times per day**	**Time specified**
Family men	Once or twice	End of six hours from day break
Ascetics	Once	End of nine hours
Others	Four times	Three times during day, once in night
Air pilots	Five times	Three times during day, twice during night
Yogis	Any number of times	

Note: **Pilot** has been singled out as a special craftsman with distinctly specified diet-set for himself. Prescribing five times food intake per day implies that pilot of the vimanas is not permitted to keep his stomach empty at any time. He can be called upon to perform his duties at short notice. This interpretation is both logical and appropriate in the context of similar diet regulations for pilots of Indian Air Force. A great deal of similar research-backed regulation came into being in the form of pre-flight meal before the first sortie. Many accidents due to black out were attributed to pilots flying with empty stomach.

While the soothra covered so far relates to conventionally available foods, the next three short sootras pertain to contingent conditions such as,

- Non-availability of food, possibly due to shortage, drought, famine and so on
- Adverse survival situations
- Non availability of specified ingredients necessitating substitutes

Quoting 'Ashana Kalpa', the method of preparing cooked food, preparing food for long term storage and consumption have been mentioned. Nutritive value has not been compromised.

As substitutes, even grass, roots, bulbs and fruits with other natural substances such as milk, honey, condiments etc., used in correct proportion are prescribed without prejudice to taste or energy content.

The sootra pertaining to use of natural grasses, herbs and shrubs indicates the extent to

which alternative food items had been visualized and developed to cater for extraneous conditions. This is analogous to specific foods developed for personnel of armed forces to survive in strange situations such as jungles, snow, high altitude, deserts, deep seas and so on.

Note:

A) The study team's literature survey indicates that based on this topic of '**Vymanika Shastra**', protein-rich food extract has been developed. An extract of the report reads as under:

> "A formula for producing a protein rich food extract from common Indian grasses is deciphered. CFTRI laboratory is involved in producing a low cost protein rich food product. [As powder, biscuit, malt etc.,] from Indian grass."

B) More important report on the topic of food prescriptions in the work is from an Ayurvedic Doctor of Bangalore **Dr.K.H. Krishna Murthy**whose suggestions reproduced below provide validating data.

Studies on plants from 'Vymanika prakarana'-Some suggestions

Since references on **Ayurveda** as occurring here are naturally very meager, stress is given more on the heuristic aspects of the references rather than the contents therein. The very first point that strikes one here is that these references are taken from varied sources, often not known to general ayurvedists Eg., are Shaunakiiya tantra, Bodhaayana vritti. Even a mere listing of these works and a cursory glance of the contents is of decided value.

Direct references on Ayruveda occurs in relevant aspects of this work, such as foods in consonance with the seasons, making specialized concentrated food preparations and discussing poisons plants. Among the many other uses of plants are included developing textile materials from plants for making cloth and garments for the pilots, using the oil of the seeds of 'Ghontaa' apparently for running the airplane, use of plants in running the bellows, in metallurgical practices employing plants and plant products and the like.

As such, a consistent study of references on plants as they occur through out the text is more rewarding. For most of the plants are well known in**Ayruveda** as well and clearly identifiable botanically.

Extensive account on nutrition and its many related aspects occur in any classical Ayurvedic samhita. Seasonal selection of food items, detailed instructions on dietetics, nutritional and pharmacological classification of the dietary articles, special preparation of foods for journey and the like are found in abundance even in one authour Sushruta in his chapters on annapaana idhi, procedures for taking cooked food and drinks and annapana rakshaa kalpam, methodology for protecting cooked foods and drinks [from becoming poisonous] The information given in the text here is in full agreement with what is found in Ayurvedic texts.

Details of using plants for textiles are not available in Ayurvedic texts. This and the dyeing by plant pigments are better searched in the relevant local oral traditions. No textbook seems to have been written on textiles.

Kalpasuutra, Anshu Kalpa and Vaalmikiya Ganita are not referred to in ayurveda. No mention is made of Valmikiya ganita even in the dictionary by **Monier Willams** or Shabda Kalpadruma, the standard works of reference.

Ayurveda covers Visha Nirnayaadhikaara under agada tantra and garas that are man made mainly chemical poisons. Toxicology was very well developed in ancient India.

No Special food is prescribed for military purposes, but for Chaanakya who advises eating special leaves by the soldiers on a long march. These will mitigate their hunger and fatigue. This was probably an Erythroxylon Sp., much like the red Indians of South America, using cocaine plant during hard, manual labour that would consume much time.

Lalla Kaarikaarika is not mentioned in ayurveda anywhere. Lalla was an astronomer. Patasamskaara, Ratna samskaara as advised regarding clothing do not occur in Ayurveda. Lalla was also a mathematician. His Kaarikaarika can be loosely translated as 'factoral hypothesis'.

CHAPTER – 13

VIEWS OF A COMBAT PILOT

No study on a subject of aviation will be complete without the views of an Aviator going into it. It was with this intent that the study team referred a few chapters of Vymanika Shastra to a modern combat pilot. Group captain **Matheeswaran** V.M. is an accomplished fighter pilot of the Indian Air Force and a Test Pilot as well. Presently he is engaged on a research assignment at Chennai. His views on the concepts underlying the precepts of the work are interesting. His valuable views validating the substance in the text are produced herewith. Though brief, his views are concise and to the point. We are grateful to him for responding to our request. He has found the textual content of the work revealing and has expressed his keenness to study other chapters of the treatise in the coming months.

His Views:

The treatise Vymanika Shastra is very interesting, considering the fact that it has been written many centuries before modern aero planes began to fly. It is worth studying in great detail so as to establish the scientific basis of this treatise. It is very important to note that many centuries ago Indian scholars have written expositions on aviation. When we consider the fact that **India** had great astronomers such as **Aryabhatta**, **Varahamihira**, and **Bhaskara** who analyzed various aspects of the universe in the early centuries of the Christian era, it is a pity that appropriate recognition of them in the scientific world has not been given.

The primary reason for this anomaly lies with Indian researchers who have not done the interpretations in a modern scientific manner. The world of modern science is largely dominated by western scholars. This explains why **Galileo**, **Keppler**, and **Copernicus** are credited with discovering the truths of the universe, while indications of this were actually given 1000 years earlier by **Aryabhatta**. It is, therefore, very important for Indian researchers to analyze ancient scripts with an open mind and not close any possibilities of inventions by ascribing reasons of farfetched literary imaginations.

It is in this light that the above treatise on aviation must be analyzed. According to the modern world, **Leonardo da Vinci** is credited with being the first man to have seriously studied the science of flight on a scientific basis. This was 500 years ago. The Vymaanika Shastra, on the other hand, is far older. It, therefore, deserves to be analyzed in great detail and interpreted positively and with an open mind.

Definitions:

There is considerable clarity in the definitions. What is surprising is the fact that the definitions could be easily seen in terms of today's environment and understanding. The definition of **Vimana** is one example. The explanatory definition of a pilot is very interesting. Fundamentally the entire description can be converted in today's relevance as one of physical and mental alertness, quick reaction, ability to grasp and understand

complex issues rapidly, and, more importantly, the ability to build situational awareness all the time.

Atmosphere

On page 7 and 8, the atmosphere has been described briefly as falling into five divisions. Could these be studied in terms of the divisions as we know, that is stratosphere, ionosphere etc. More information in other chapters will have to be searched. Similarly the treatise talks about various types of vimanas that can operate in various layers. If we remove the frills and legends from the text, we may be able to discern some facts about the awareness that existed on the need for different platforms that were required in lower atmospheric layers and higher layers, eventually stepping into outer space.

Similarly, in the paragraph that describes various whirlpools, an interpretation towards understanding of wind shears and its effects could be discerned.

Location of Vimana components:

Most of the parts descriptions need to be interpreted with more technical help. However, there are a few very interesting parts described. For example the solar power attractor is probably one of the crucial power generators of the platform. The logic of locating it on the top of the Vimana goes well with established scientific procedures. In all the document lists 31 components crucial in the Vimana.

Pilot's Clothing:

This is an important section. Relevance of temperature conditions are well described. The document describes the special treatment that is required to be carried out for the material of pilot's clothing. When compared to modern aviation clothing, this aspect is absolutely in line. The objective is to ensure that the clothing is fire resistant, light-weight, and provide adequate protection from effects of temperature.

Diet Recommendation:

The composition of prescribed food appears to be well balanced in terms of proteins, carbohydrates and lot of liquids. This part needs to be studied with the help of medical experts.

An important observation is the recommendation that **pilots** should take food five times a day. The fact that modern flying, particularly fighter flying, is a heavy energy draining exercise is established. In fact, doctors advise frequent replenishment of food in small quantities during flying activity as against standard three meals a day. This is particularly important when a pilot starts his first sortie in the morning. It is a taboo to fly on empty stomach.

Metals:

This is again an important section as it describes the various types of metals used for making Vimanas. The characteristics of metals described in terms of heat-absorbing, non-conducting etc need to be studied in depth.

Thirty two Secrets:

The document describes thirty two secrets that form essential knowledge for a pilot. This could be interpreted as the need for a pilot to be knowledgeable about the profession, be a skilled flier, and be a good strategist and tactician. Only then can he exploit the aerial weapon system.

The thirty two secrets described can be seen or interpreted to signify various techniques and technologies such as radar, stealth, combat maneuvers, basic flying, awareness about weather hazards etc.

- For example 'Antaraala' may be interpreted as indicating the dangers to the safety of the aircraft while encountering wind shears, down drafts on the leeward side of the hills, thunder clouds etc. For example if the pilot cannot recognize a building, cumulonimbus cloud and enters it he may lose control of the aircraft, or in extreme cases the aircraft may even break up.
- The description of 'Drishya' can be seen in terms methods used to 'boost' or 'reduce' radar signature of the aircraft.
- 'Adrishya', on the other hand, relates to a technique akin to 'stealth' technology.
- 'Paroksha' describes a technique which can be related to today's 'Electronic Warfare', wherein the enemy aircraft's systems are paralyzed through jamming.
- 'Aporoksha' talks about a 'Rohini' beam of light that makes targets in front visible. This is similar to the radar technology, wherein radio waves are used to detect the targets in front.
- 'Sankoch' describes a variable sweep technology.
- 'Pralaya' and 'Vimukha' appear to be some sort of beam weapons. Modern aerospace technology is already talking about the use of beam weapons in the near future.
- 'Saarpa-gamana' describes aircraft maneuvering in rapid fashion, that is today achieved through use of vectored thrust.
- Similar is the description of 'Sarvatomukha'.
- A lot of technology in terms of radio, electronics, and guidance are indicated.
    - 'Parashabda Graahaka' describes essentially voice communication and signal intelligence.
    - 'Roopakarshana' describes television view inside the aircraft.

- 'Dikpradarshana' can be interpreted as target information provided on the radar.
- 'Aakaashkaara' describes the technique of achieving 'stealth'.

Conclusion:

This analysis pertains to the first chapter of the '**Vymaanika Shastra**.' Most of the details are short and appear to be introductory descriptions. I presume greater details will be available in subsequent chapters. These need to be analyzed in depth and arrive at a logical conclusion. The concepts of the author should be deduced while disregarding superfluous literary descriptions. This will throw a more balanced light on the whole document and lead to a very productive conclusions.

CHAPTER – 14

METALS FOR VIMANAS –LOHADHIKARANAM

Out of many topics of 'Vymanika Shastra', the one picked up by most Indian researchers is on metals and materials. In particular metals conclusively categorized for use on **vimana** have incited curiosity.

Three ancient scientists quoted are Shownaka, Manibhadra (in his Manibhadra Kaarika) and Saamba.

All the three sages commonly point at three kinds of root metals for aviation applications - Somaka, Soundaalika, and Mourthwika. Apart from lightness, metallic property targeted is heat absorbing / resistance.

The root metals [in ore form] are described to be available at identified layers of earth's crust out of about three thousand metal bearing layers. Different layers contain different metal ores in varying grades.

Loha Kalpa and Lohatantra are described as the master texts on metallurgy.

To obtain different **alloys** for manufacture of varieties of vimanas, sixteen alloys have been stated to be processed from the three core metals by mixing in different proportions. They are given in the table.

Ushmambhara	Sheetahana
Ushnapaa	Garalaghna
Ushnaahana	Raajaamlatrit
Amlahana	Veeraha
Vishambhara	Panchagna
Vishalyakrit	Agnitrit
Vijamitra	Bhaarahana

The ancient scientists have propounded that formation of metallic ores is attributed to forces of:

- Gravity of the centre of earth
- Gravity of global earth
- Solar flood
- Air force
- Planetary forces
- Sun's gravitational force
- Moon's gravitational force
- Interplanetary gravitational forces in the universe

Each in proportion 3, 8, 11, 5, 2, 6, 4, 9 and combined with heat and moisture inside the crest.

The work ponders a great deal over various forms of energies [forces] that lead to the synthesis of each of the three types of core metals. For the benefit of the readers summery is given in table form.

Core metal or Beeja loha With exponent sage and governing text.	Alloys under each category
Souma [sage Atri] in Naamaartha kalpa Related-works— Paribhaasha chandrika--Vishwambhara kaarika	Souma,Sowmyaka,Soundaasya,Soma Panchaanana,Praanana, Shankha, Kapila.
Soundala Type	Viranchi, Souryapa, Shanku, Ushna, Soorana, Shinjika, Kanku, Ranjika, Soundeera, Mughdha, Ghundhaaraka
Mourtwika type	Amuka, Dvyaamuka, Kanka, Tryamuka, Svetaambara, Mridambhapa, Baalagarbha, Kuvarchaa, Kantaka, Kshvinka, Laghvika.

Important observations:

- Knowledge of metals in ancient India was not confined just to basic metals such as Iron, Copper etc., Development of **metallurgical technology**apparently scales up to aviation requirements. Enormity of basic research in the entire process can be visualized.

- Knowledge of factors causing formation of ores in earth's crust must have existed. How far this theory matches with geo-physical phenomenon of modern science can be a separate study.

- Geological studies and mining of ores apparently existed.

- Discussion on interplanetary forces influencing earth's crust stated here are indicative of comprehensive and deep knowledge that existed in ancient India.

- Considering the number of alloys mentioned, very fine property-specific developments must have been aimed at in metallurgical processes.

A brief chapter thereafter deals with the purification [more appropriately, refining] process of metals and alloys. The processes are slightly different for each class of metals. Guiding text is 'Samskara Darpana'.

Several types of acids, decoctions, charcoal, salt and native materials of **Ayurvedic** origin feature in these processes. Modern metallurgists would find it strange that a variety of organic substances participate in the process of refining.

Deliberating on production of Ooshmapa metals [heat resistant] under the category of Souma, Soundala and Mourtwika, mixing of each alloy under each variety and their proportion of mix has a special connotation. Each alloy is given a number under the three core metals against which proportions are prescribed for the mix to obtain the desired quality of alloy Deeper study should be very gainful.

Lallacharya's classification of metals is distinct in it's own way and it is source-related as follows:

- Kritaka or artificial
- Corrupted
- Mud-born
- Aquatic
- Mineral-born
- Vegetation born
- Evolved from vermin
- Flesh born
- Grown from salt
- Hair born and egg born

Crucibles – Mooshadhikaranam:

- Ancient metallurgists seem to have developed a wide variety of crucibles to suit each process. Guiding text is Moosha Kalpa.
- The process of manufacture of 'Antarmukha' [Inward looking] crucible stated to be prescribed for preparing metals for **vimana** is given in detail.
- Fire place [furnace] or kunda – vyaasaatikaadhikaranam.

- Kunda Kalpa, the guiding text stipulates the use of koorma or tortoise shaped furnace for melting aircraft alloys.
- Kunda Nirnaya goes further to outline the constructional aspect of these furnaces.

Bellows - Bhastrikaadhikarana:

- Guiding text—Bhastrika Nibandhana. For the purpose here, a specific type of Bellows to match with Tortoise shaped furnace is prescribed.
- The constructional details include specific leather for the body of the bellows and a variety of organic and inorganic materials.

Comments:

Specific-to-type crucibles, furnaces, bellows selected from amongst a wide-ranging types and numbers hint at very fine development of metallurgical processes.

CHAPTER – 15

MIRRORS—DARPANADHIKARANAM

The chapter dealing with '**Darpanaas**' or 'Mirrors' in the text 'Vymanika Shastra' is particularly significant. The term mirror has been referred to in a very generic sense. It is observed during the study of this topic that they are reflectors, deflectors, absorbers, radiators, augmenters of light and energy beams and so on.

The guiding text is 'Mukura kalpa', the author being **Lallacharya**. Seven such darpanas narrated are:

- Viswakriya darpana -- Television aid
- Shaktyaakarshana darpana -- Power capturing mirror
- Vyroopya darpana -- Appearance changing mirror
- {Kuntinee darpana, Pinjula darpana
- Guhagarbhadarpana,Roudreedarpana } -- Energy related

Study of later part of the work shows that these **darpanas** are parts of system -specific on board contrivances grouped under '**Yantraas**'. The object of treating them exclusively under darpanas is obvious. They form the core components of yantraas. In fact we notice that many Yantras have derived names from the mirrors incorporated in them.

1) Vishwa kriyaa darpana:

Provided as a visual display for the pilot in his cabin [cockpit], providing high resolution live picture relay of activities all round the**vimana** and hence called 'Vishwa kriya darpana'. Kriyaasaara is the text of reference.

Note:

Some of the researchers have interpreted as activities going on all over the world, possibly based on usage of the term Viswakriya.

Composition:

Satva (2), Shundilaka (2), Eagle bone (1), Mercury (5), Foot nails of Sinchoranee (2), Mica (6), Red lead (5), Pearl dust (5), Eye balls of Sowmyaka fish (15), Burning coal (1), Snakes slough (8), Eye Pigment (3), Granite sand (10), Salts (8), Lead (4), Sea foam (2), White throated eagles skin (3), Five parts of Vyrajya or Keg tree bark.

A finely mixed powder of the ingredients in beaked crucible ® Chandodara furnace® 800° heat® Melt to be poured in to mould.

Observations: Ingredients are organic and inorganic substances including animal, birds, reptiles, oceanic and botanical origin.

--Hypersensitive optical properties of eagle, fish and pearls are well known.

--Display to the pilot is a useful Pre-flight and In-flight information to decide suitable course of action and may even relay the activities in the environ to the vimanas trailing. Notice the usefulness in reconnaissance and surveillance roles. More of this during discussion on the main yantra later.

2. Shaktyakarshana darpana:

Shaktyaakarshana yantra derives its name from its prime component Shktya karshana darpana.

--Use of this drapana is to counter the dangerous elements of energy due to solar ray, ethereal wind and heat in specified layers of atmospheric zone. The mirror enables in subduing or neutralizing the effects of this energy and protects the vimana.
--Dhundinatha and Paraankusha have discussed such dangerous energy sources.

Composition:

Haritaala (5), Virinchi (5), Salts (8), Gingelly husk (4), Diamond (6), Red mica (1), Burning coal (8), Sand (3), Tortoise egg (2), Bhaarami (3), Kanda (3), Powshkala (5), Coral (5) Pearl (2), sea shell (6), Borax (8), Shankha (5), Bengal Quince Seed (3).

Powdered and mixed ® in swan crucible ® heated in Mandooka furnace ® Boiled to 500 degree and poured in to vistrita mirror.

Observations:

A flight safety device against harmful atmospheric effects.

3. Vyroopya darpana:

Recalling the concept of Vyroopya under special features dealt with earlier and later covered as a yantra under relevant chapter, vyroopya darpana is discussed here.

--To project a distorted or changed appearance of vimana, this mirror is made use of. It is a magical reflector intended to project / relay illusory shapes primarily to produce scary decoy images or animations, confusing the attacking pilots.

Composition:

Bone salt (5), Zinc (3), Lac (3), Iron (8), Shashabola (3), Raajakuraantika (2), Charcoal Ashes (8), Borax (3), Rakshaa (8), Sand (7), Liquorice oil (25), Maturna (6), Suncrystal (2), Kravyaada (3), Garada (8), Pistha (3), Arshogna Root, Varaaha Pitha (3), Ammonium Chloride (3).
Mix in crucible ® Boil to 800 degree in furnace ® Pour into Darpanasara yantra

4. Kuntineee mirror:

To counter poisonous and evil atmospheric effects that derange the minds of the pilots, this mirror is provided as a safety gadget.

Composition:

Saurastra earth (5), Snakes slough (7), Sea foam (3), Shanmukha seeds (5), Zinc (8), Rhinoceros nails (3), Salts (8), Sand (7), Conch (4), Mercury (4), Yellow orpiment (4), Suranghrika (7), Gingely oil (5), Pearl shells (8), Sea shells (3), Camphor (4).

Purify in Shinjhika crucible ® heat in Shinjheera furnace at 700-degree ® produces morning-sun like kuntinee mirror.

5. Pinjula Mirror:

In simple terms pinjula has been defined as conflicting interaction of solar rays. Quoting 'Anshu Bodhinee' propounded by Maharshi Bharadwaja, resultant force from interacting forces of solar energy, winds, heat (having different intensities from different directions), cause harmful effects on the eyeballs of flying crew. They are Andha, Andha kaara, Pinjoosha, Taarapa. These effects lead to blindness.
--Essentially conceived as a protective device for the pilots.

Composition:

Goat's milk (6), Red lead (5), Salts (8), Sand (7), Tree gum (5), Copper (2), Lead (2), Surolika essence (4), Twak (8), Vaardhyushika (3), Kanda (3), Pistha or Gingelly husk (4), Orpiment (3), Timevellesema (3), Vrikodaree seed (4).

Purified, powdered, mixed, placed in crucible® heated in furnace to 700 degree ® poured in to mould.

6. Guha garbha darpana:

Harnessing harmful energy of electricity from clouds, winds, rays and directing them against the enemy planes to disable, incapacitate them to fight.

Observation:

Using harmful energies available from the environment as a weapon against enemy forces-Distinctly a **biological-weapon.**
--Guide quoted is 'Prapancha saara' and 'Sanmohana-kriyaa-kaanda.
--Preceptors quoted- Vashistha, Lalla.

Composition:

Cowries (7), Manjula or Madder root (3), Sea foam (3), Ranjaka (8), Mandoora or Rust (6), Mercury (8), Orpiment's (3), Matrumna (6), Mridani garbha essence (5), Sphatika (5), Industatwa (15), Sand (8), Kishora (6), Brahmika (7), Lead (2), Eye Pigment (6),

Muchukunda (5), Gingely oil (2), Lohika (25), Sowrastra earth (8), Bones (3), Dambholi stava (5).

Purify the mix, powder, place in crucible ® melt up to 700 degree ® cooled, results in Guha garbha Darpana.

7. Rowdree Darpana:

Mixing of rays of Rowdree beam and solar rays and projecting the resultant energy on enemy planes as a lethal weapon. The resultant energy appears to possess a high heat content and therefore melts everything it is projected upon.

Paraankusha and 'Sanmohana Kriya Saara' are the guiding references.

Composition:

Lead (8), Shalmali (3), Durvaa (7), Kudupinjara (8), Dronee (21), Sun crystal (8), Rudraanee Graavoshara (27), Betel leaves (6), Kowtila (8), Veeraabhra Linga (36), Salts (8), Sand (7), Matrumna (6), Dimbhika (3), Zinc (8), Ant hill earth (3), Gum (6), Kumbhinee (3), Sweta oil (3), Timmnevelli sema (27), Goodhaamla (6), Silk cotton (8), Virinchi Satva (8), Kada (5), Yellow Orpiment (3), Kaarmusha (7).

Purified, mixed, placed in crucible ® melted up to 800 degree ® yields Rowdree Darpana.
Summary of observations on mirrors:

- On an average there are 20 ingredients in making of each mirror and 75% of these components are common factors, proportions being different.
- Specific-to-type and unusual ingredients are Rhinoceros nails, Eyeballs of fish, Snake's slough, Eagle's skin, Eye pigments, which may be imparting particular properties. They are also of natural origin and were perhaps available in abundance from natural sources.
- Characteristics or properties appear to be derived from strange and remote substances.
- Most of the strange ingredients listed have something to do with optics.
- **Ayurveda** and ancient chemistry need to be consulted in a big way to decode some of the materials.
- Similar coded materials mentioned in the preparation of 'Prakaasha sthambhana bhida' have been successfully deciphered through suitable analyses and interpretation at National Metallurgical laboratory, Jamshedpur. (A copy of their report is appended as appendix - E).

CHAPTER – 16

SHAKTYAADHI KARANAM – THE POWER

This topic deals with power (forces) related to functioning of **vimana** in its flight and other operative modes to achieve the desired effects of motion. The manner in which different sages have viewed this aspect makes it thought–provoking.

'Yantra-Sarvaswa' of which '**Vymanika Shastra**' is a derivative, groups the power into seven categories. Each of them vis-à-vis actuating forces are stated as follows.

- TUNDILA -- UDGAMA SHAKTI
- PANJARA -- PANJARA SHAKTI
- AMSHUPA (SHAKTIPA) -- SOLAR POWER ABSORPTION
- APAKARSHAKA -- ABSORPTION OF POWER-FROM ALIEN VIMANAS
- SAANDHAANIKA -- GROUP OF 12 FORCES
- DAARPANIKA -- KUNTINEE SHAKTI
- SHAKTI PRASAVIKA -- MAIN MOTIVE POWER

Shounaka sootra is in agreement with the classification of forces as seven. Another guide 'soudaamini kala' featuring in 'Anshu bodini' is also in tandem with this manner of grouping though based on a different theory.

'Kriyaa-saara' goes further in explaining these forces more understandably as follows.

- Ascent of vimana : Udgamashakthi
- Descent of vimana : Panjara shakti
- Solar heat absorption : by Shaktyaapa-karshini
- Alien force restraining : Parashakti
- Spectacular motion of the vimana : By Vidyutdwadashaka Shakti

All the above are stated to be basically from the primary force of the **vimana**. The twelve activities involved in performing spectacular motions have been separately mentioned as follows.

- Proceeding : Shuddering
- Mounting : Descending
- Circulating : Speeding
- Circumbulating : Sideways motion
- Receding : Anti-clockwise motion
- Motionless : performing miscellaneous motions

In yet another classification sage **Narayana** classifies the forces as just five and attributes the forces generated to perform all activities to the power derived from "Sadyojaata yantra".

Another work 'sphotayana' hold the view that spectacular motions are achieved

by **Chittinee Shakti.** The guide Kriyaa-saara is also in support of this theory. Other guides Shaktibeeja and Shaktikoustuba are firm that Panjara Shakti generated by Sadyojaata yantra performs all motions and all other forces are incidental to it.

Amidst numerous views of several sages and texts stated above **Maharshi Bharadwaja** analyses and emphatically rules that only seven forces are relevant and distinct, all others are corollaries of these seven forces. Essentially Panjara Shakti is the primary motive force.

Observations and discussions:

- Sages and texts quoted have some diverse views. This is possibly due to the type of flying machines they had conceived. They seem to have differentiated forces depending on how resolutions of force components were done.
- Ex.: Force required for Udgama ie., take off on vertical mode will be one, where as if it is on normal roller take off, the forces can be resolved in to vertical components and horizontally forward components- Hence it becomes two distinct forces.
- Forces required for aerobatic maneuvers have been conceived. An indication that **Vimana** with capability for combat maneuvers have been referred to.
- It becomes necessary to understand what type of flying machines are kept in view to arrive at controlling forces required. As we see in modern Flying machines, Conventional aeroplane, Rotary wing machines, Vertical take-off and Landing machines, Hover Craft etc., all have different principles of operation. For example, a VTOL aircraft and conventional aircraft are different, a helicopter is different from a conventional aircraft. Achieving zero forward velocity is possible in a VTOL aircraft and helicopter and is not possible in a conventional aircraft. Sideways movement is possible in helicopter and the same is not possible in a conventional fixed wing aircraft. Similarly a glider is distinctly different from other powered aircraft.
- It is interesting to see that Rolling, Yawing, Banking, Spinning, Accelerating, Zero-velocity principles are under mention.
- Another way of understanding this is with a comparison with modern aeroplane. The engines, though meant for propulsion, generate a number of power sources that are driven by it, eg. Generator to produce captive power, hydraulic and pneumatic pumps for controls of various services, pumps to generate fluid pressure and the like. In such an arrangement these accessories driven by the engine can themselves be viewed as sources of power.
- Later in the text under the topic Yantradhikarana there are references that each system had its own source of power drawn from **Panjara shakti**.
- 'Sadyojaata' as a form of power has been introduced briefly by **Sri M.K. Kawadkar** in his article on atmosphere.

CHAPTER – 17

YANTRADHI KARANAM

In the earlier part of this report several features of on-board systems on which the pilot should be proficient were introduced. Yantradhikarana chapter forms the core content of 'Vymanika Shastra'. Highly technical in-flight packages described in this part of the text comprise of nearly one half of the work. While highlighting the basic scientific research underlying the technologies, this topic adds substance to the belief that ancient India had a high level of scientific knowledge.

In this chapter relating to **yantras**, many mirrors, crystals or manis, naalas etc., feature as components of yantras. The text deals with details of on-board fitments, their constructional and operating methods, preparation process of special materials and the like. Before going into details, general points of observation are as follows:

- What are referred to as 32 secrets and 31 special on-board packages (referred to as **yantras**) have no one-to-one relationship in terms of their serial mention.

- As it has been confirmed from several researchers on this work as well as similar works of ancient science, interpretations with reference to context plays a pivotal role in correct understanding. Virtually it forms a gate to make entry into disguised, coded and veiled textual contents. Once this barrier is crossed the rest seems to be relatively simpler. This need should be appreciated. A positive look notwithstanding, many scientists of modern school of thought may criticize this approach as 'attaching meanings'.

- Like in other parts of the text, there have been references to other works or principles of scientific subjects and technologies developed. The enormity of basic science behind development to evolve a variety of contrivances can be visualized. Quotations from experts in each discipline of science have been cited; showing the vast amount of knowledge that must have prevailed. It gives credence to the depth and profoundness of 'Yantra Sarvasva' to an extent that 'Vymanika Shastra' itself looks too innocuous.

- Each system package seems to be conceived with compactness supplied with power source, using recycling process and modular in nature. From the manner in which it is explained in the text it is even possible that designs catered for using each system as a well conceived and need based entity. It could even be that selection of each on board **yantra** could have been based on mission role.

- The locations of the **yantras** prescribed in the text seem to be apt and function related.

- Many of the alloys and materials have organic and inorganic contents. This may look strange to metallurgists of modern science.

- Each process of manufacturing of metals, alloys and Naalas gives:
    - a) Ingredients and their proportions of mix.
    - b) Use of specific-to-type crucibles.
    - c) Specific to type furnaces and bellows.
    - d) Specific melting or fusing temperatures on ancient scale. (kaksya)

- Usage of a number of **alloys**, special materials indicate that they were definitely based on specific applications for which they were conceived and developed. Conceptualization and visualization of techniques must have logically prompted development of applied research.

- The techniques that have followed concepts of application-specific systems developed to perform specific roles or functions were exclusively evolved for strategic and tactical roles, flight safety, communication and navigational needs. A variety of roles include photo reconnaissance, camouflaging, detection-avoidance, electronic warfare role, variable geometry, Biological warfare roles, remote sensing, evasion tactics, in air combat. In fact the applications seem to be more for use on aircraft in full-fledged military roles than for other purposes.

- There is more than adequate substance in the concepts and techniques to substantiate that unless aircraft existed in those times and extensively used in various roles, development would not have been necessary or possible.

- The term 'enemy' has been used in a generic sense with the interpretation that it denotes anything that can cause danger, harm or adversity. All these have been referred to as 'enemy'. It could be the aircraft, ground or maritime forces of the opponents, it could be adverse environment, climate or space conditions, and it could be a biological weapon or any other adverse situation. Appropriate contextual interpretations in each case hold the key in meaningful deductions and understanding.

With these general observations we now go into discussions on the topic 'Yantradhikarana' or 'Subsidiary yantras'. Efforts have been made to gather literature on research from other sources. The views of the study team are dovetailed in such cases. Whenever the discussion is exclusively from study team no reference is mentioned. In spite of constraints of time all efforts have been made to cover as many **yantras** as possible.

Before discussing various devices referred to as 'Yantras' in this chapter of the work, it is

interesting to ponder over prevalence of yantras during earlier phases of Indian civilization. **Dr. V. Raghavan**, a former professor of Sanskrit in Madras university, has brought out a brief treatise, published by Indian Institute of Culture, Bangalore in 1956. In this booklet, the author has dealt with the subject in fair detail.

Starting from origin of the work **Yantras** from the root word 'Yaan' meaning 'to control', his narration starts form very rudimentary contrivances such as

- Water pulley = Ghati Yantra
- Oil presser = Taila Yantra
- Cane presser = Ikshu yantra,

and goes on to more advanced devices such as those used for protection of fortresses, operation of fort gates, appliances used for bridge construction, weight lifting devices etc., His quotes refer to specific chapters and slokas from epics Ramayana, Mahabharata, Harivamsha, Buddist literature, Koutilyas's Artha Shastra. Some of the **yantras** even relate to acquired technology from Persia. Valmiki Ramayana quotes use of several yantras in the fortifications of capital cities of Ayodhya and Lanka. They included devices to shoot arrows, stones at attacking enemy forces.

Among a variety of **yantras**, some interesting ones are auto-driven Rathas, water jet mechanisms for fire quenching, surgical instruments and strangely, some of the yantras seem to be for the purpose of torturing convicts. Contrivances used for battles included devices that hurled huge boulders at the enemy. He quotes some researches concluding that **yantras** with firearms and combustibles were widely employed in ancient Indian warfare. 'Samarangana Sutradhara' of **Raja Bhoja** is a unique work on this subject. To quote one of them mentioned by **Dr. V. Raghavan**, is the yantra 'Parjanyaka' a device which was used for **causing artificial rain.**

Many devices of architectural engineering applications include those developed for human pleasure, entertainment and the needs of the royal and the rich. What seems to be most amusing note is the use of 'Robots' employed for guarding security gates of palaces and mansions.

Dr. Raghavan's discussions on **yantras** make very interesting reading. To top his treatment of the subject, it is appropriate to cite the 'merits of good yantra or 'machine'

The merits of a good machine, Yantra-gunas, are as follows:

- Proper, proportionate utilization of the elements constituting it
- Well-knit construction
- Fineness of appearance
- Inscrutability
- Functional efficiency
- Lightness
- Freedom from noise where noise is not part of the scheme
- A loud noise when noise is intended as an end
- Freedom from looseness

- Freedom from stiffness
- Smooth and unhampered motion
- Production of the intended effects (in cases where the ware is of the category of curios)
- The securing of the rhythmic quality in motion (particularly in entertainment wares)
- Going into action when required
- Resumption of the still state when not required (chiefly in cases of the pieces for pastime)
- Freedom from an uncouth appearance
- Verisimilitude (in the case of bodies intended to represent birds, animals, etc.,)
- Firmness
- Softness
- Durability

Note: The reader's attention is brought to the comprehensive and fine details to which machine-design aspects could be perceived and structured.

With the above discussion on **yantras** brought in from **Dr. V. Raghavan**'s noted work, we resume discussion on more advanced and highly technical contraptions in the work of our study.

Vishwa kriya darshana darpana:

This is a photo device coupled with telescopic arrangement to obtain pictures from aerial reconnaissance of activities on ground. Essentially it is the photo reconnaissance role of the **Vimana** being talked about.

The interpretative skills of **Sri M.K. Kawadkar** on the analysis of the functioning and operative details his interpretation is attached as appendix.

Discussion:

The description of this device is mentioned as the first item under 31 parts of the Vimana for on-board use. Photoreconnaissance and Air surveillance are integral parts of air-warfare. Reproducing the function of this device from the work we read as follows '------ and enables the pilot to realize the conditions of the concerned region, and he can take appropriate steps to ward-off danger and inflict damages on the enemy'.

Analysis of the concept indicate that as the **Vimana** is engaged in offensive and defensive roles, the pilot is provided with the display of visual aid of the area around and take decision for defensive action as well as to assume attack mode. Tactical and strategic roles are thus covered. Employed possibly in reconnaissance role, pictures taken could be screened through photo-interpretation to decide the course of action and work out suitable plans.

Going through the constructional details, use of Vishwodara metal, crystals or glass beads,

special mirrors for attracting solar rays, image reflectors, joint use of solar and electric power, mercury, universal reflecting mirrors, lenses together with actuating mechanisms have been discussed in the text. The end objective is to obtain 'true-to-life' pictures of the ground environment.

A careful examination of the expression 'true-to-life' pictures indicates that the pictures relayed to the pilot are not mere still photographs, but a continuous relay of all activities on the ground. Use of telescope and camera confirm this. Activities here should mean movement of troops, their strength, formation and deployment including their weaponry. In support of this interpretation it is necessary to closely observe the title of this device. **Kriya** meaning (activity) and not merely roopa or picture. It is logical to interpret as a continuous relay of all that is happening on the ground. In brief, use of cameras, telescopes, photo -chemical processes and the mechanisms of operating them are noticed.

Shaktyakarshana yantra:

One of the on-board features, this device is meant to neutralize and dissipate the effects of radiation occurring in the upper regions of the atmospheric frictions which generate dangerous forces. Severe forces are caused by winds and ethereal waves. This could be harmful to the structure of the Vimana. It is noticeable that this device is a flight protection contrivance against vagaries of dangers from atmospheric phenomenon. Constructional and functional details mention use of krowncha metal, special glasses, mirror made of Aadarsha glass, globular ball of Vaatapaa glass, liquefied mixture of load-stone, crystals, mica, serpent's slough, mercury and crystals. The essential function is from six crystals or manis which are placed at specified dispositions. Further description explains that the influence of harmful forces and waves are absorbed through these crystals gradually and converted to heat before dissipating into the atmosphere. Rohinee Shakti and Bhadra Shaktiare to be treated in a similar manner through a different arrangement in order to neutralize or mitigate the dangerous effects.

Here a study of upper atmospheric regions dealt with in Mc Grawhill series indicate that the eddy currents in higher regions are a potential danger to flying craft transiting through them.

Brief analysis of this yantra by **Sri M.K. Kawadkar** is appended separately along with Parivesha kriya yantra, Vistrutasya yantra, Vyrupya darpana, Padma chakra Mukha yantra, Kuntinee shakti yantra, Pushpini and Pinjuladarsha yantra, Nala panchaka etc., refer to appendix - G.

Angopasamhara yantra or folding up yantra at the seventh Bindu keelaka:

This yantra is basically a mechanical contraption installed for In-flight use. It is for protection of vulnerable parts of vimanas against intense heat. This heat is expected to develop under seasonal conditions. As the **vimana** is traversing with fully extended wings, Possibilities of exposure of some parts to this heat exists and this should be prevented.

This relates to 'sancocha', a special feature provided for the pilot and features as Angopasamhara yantra.

Discussions:

It is essentially a protective device conceived for protection against overheating of the vimanas component while flying with fully extended wings. Here we also note the provision of variable geometry construction. When over heating takes place the pilot gets the feed-back of rising temperature. Depending on the requirements he selects and deploys the protective cover, shielding the parts from the heat.

We note here that temperature measuring device is also provided for relaying the data from the location to the pilot as his cabin display. Constructional and operating details explain use of metals Sumrileekas and Manjeera, probably in the form of thermo-couple device. Jacks and actuators to open or close the hatch are also mentioned. Pilot selects to operate only the required hatch depending upon the need.

For more analysis of this yantra **Sri M.K. Kawadkar**'s report is appended separately.

Guhagarbha yantra:

This refers to the special feature prescribed for on-board use in battle related vimanas.

The **yantra** called in full, as 'Guhagarbha Aadarsha Yantra' is to be located in the front bottom of the fuselage of the Vimana.

Its purpose is to detect presence of mines and explosives hidden by the enemy forces underground and transmit their pictures for the pilot's display to know the location and shape of such destructive material. The end-use is to achieve precise location and defuse them in achieving safe passage for friendly ground forces. In this role the Vimana performs the function of tactical support to ground forces.

Constructional details of the **yantra** include use of different geometrical-shaped special mirrors in specified arrangement.

Through a sequence of reflecting mirrors, images/ pictures are captured and developed in-situ through chemical process. Special reflector called chumbakamani having a property of absorbing reflection from objects is used in the contraption. Solar rays and electric current are made to act on an acid vessel containing the crystal Chumbakamani. Electrified rays from the crystal are made to impinge on a downward facing mirror and this in turn will scan the ground underneath to take pictures of mines and explosives. The pictures are amplified and communicated to the pilot on a specially prepared screen.

The main constituents of the **yantra** are:

- Fasteners made of Panchadhara loha
- Wooden frame of Anjistha tree

- Chumbakamani
- Screen cloth coated with mirror-like gum

Details of fabricating include the following constituent parts:

- Suranjeetaarsha mirror (72nd type)
- Anjistaa tree
- Paaragrandhika Drava
- Chumbakamani
- Pigments for coating the screen (to obtain clear picture)
- Reflector or Virinchi varnish
- Pathadarpana

Observations:

- The appropriate location of the **yantra** related to its function is to be noted.
- Clear indication of use of concealed mines and explosives in battles of olden times. As a corollary knowledge of explosive materials and pyrotechnic devices should have evidently prevailed in advanced form.
- Detection of such explosives through remote sensing gadgets had been envisaged.
- Detection of underground objects through aerial remote sensing hints at use of special technology in the field.
- The strategy in such detection hints at closely coordinated tactical air support roles to the ground forces.
- The system indicates that technology existed in not merely detection of hidden explosives but also in defusing them.
- Photographic and projection technique must have been in advanced stage of technology.
- The surveillance role should be useful both in strategic and tactical role.
- It is of interest to note that materials stated in this **yantra** have been developed by many science laboratories in the country. The materials are:
    - Chumbakamani (IIT, Bombay)
    - PanchadharaLoha, Paragranthika Drava (Birla science centre Hyderabad and Mumbai)
    - Reports from these labs have been appended to this report.

- Multiple applications of crystals in digital technology are already seen in- modern times. It is no wonder if ancient scientists had employed this technology in a much wider sense.

Tamogarbha yantra:

Thamo yantra (darkness capturing device) is dealt with in fair detail in English translation of Vymanika Shastra.

The device is meant to protect **vimana** from poisonous fumes of Rouhinee or Kraakachaarimani rays projected by the enemy. This is in essence, achieved by creating a

darkness around the Vimana to make it invisible to the enemy aircraft (ground forces as well) and make their target-sighting impossible. In this contraption Thamogarbha loha plays a key role.

The device works with revolving two faced mirrors collecting solar rays, activation of acid in the vessel on the opposite side, of mirrors, allowing solar ray to enter the crystal in an acid vessel. By turning a separate wheel in the west, darkness-intensifying mirror begin to function. By operation of a central wheel the rays attracted by the mirror will reach the crystal and envelop it. By operating the main wheel at high speed, darkness will envelop the entire Vimana making it invisible.

Preparation of the all-important Thamo garbha loha is as follows:
Black lead, Anjanika (collirium), Vajra Tunda ® In equal parts mixed and powdered® fish shaped Crucible® in crow shaped furnacre ®heated 100° or 354° C.

Discussion:

- Concept clearly hints at a highly advanced concealing technique on the lines of stealth concept.

- Visualization of such a need in air defense role in an attack mode is to be noted. It could also be a protection against similar offensive weaponry (biological & optical) in surface to air/air to air modes.

- The technique somewhat resembles the creation of darkness (tama) using solar rays as seen in Dhwanta pramapaka yantra (refers to a research study on Anshubodhinee of **Maharshi Bharadwaja – Dr. Dongre**'s research, even though it discusses spectroscopic measurement.) In the three bands of solar radiation Tama (darkness) being the infrared band, if used for creating this darkness around the Vimana, the purpose of camouflaging is achieved in the same way. It is therefore interesting to study if the concepts are interrelated. Correlation of the two principles should be an interesting exercise.

- Solar rays used in a big way here as well and hence there is every possibility of its direct derivation from Anshubodhinee.

- It is appropriate to bifurcate, the sources of danger and their targets here. Poison gases targeted against aircrew and dangerous rays against both **Vimana** and aircrew. In either case Biological warfare concept is evident.

- To note that the type of **yantra** prescribed here is one of the 132 types indicates vast ranges, basic research and development and much wider applications.

For more details on the above two yantras please refer to the analysis of **Sri M.K. Kawadkar** appended separately.

For the following yantras too, please refer the analysis of **Sri M.K. Kawadkar** appended separately.

- Pancha vataskanda nala on the western centre
- Rowdree mirror
- Vataskanda keelaka at the bottom centre
- Shakthistaana at the front and right sides
- Shabdha-kendra-mukha at the left side
- Vidyutdwadashaka at the north-east side

Shabdhakarshaka yantra:

This yantra is covered in a fairly descriptive style. This device is essentially a warning device to the pilot to get In-flight information on the presence of birds, quadrupeds and soldiers to facilitate taking deviation to safer routes during a mission. Broadly speaking the device is an audio sensor working on the principle of sensing audio waves within a range of twelve kroshas or 27 miles. Evidently its working is around the VHF range. It is significant to note that the Shabdhakarshaka yantra mentioned here is just one out of 32 varieties of devices developed under this category. This hints that other such devices for similar applications under other frequency bands from originators of sound sources had also been conceptualized and developed. Further from the description given the device appears to be basically a receiver-mode communication device.

Discussion:

- It is understandable from the description that warning pickup signals in such cases should be from sources in short distance range (about 27 miles).

- In case of warning by sensing sounds of birds it is a logical assumption that the warning needed is against bird concentrations. Birds do form a serious flight safety hazard as seen even today. Visualization of this concept as a flight safety requirement is to be noted.

- Even if the 'bird' referred to is a 'flying machine', advance warning of location of vimanas in numbers and the need for advanced warning would still be valid.

- In respect of quadrupeds and soldiers talked about the interpretation seems to be to get a warning against cavalry and infantry forces largely used in battles of ancient times. Locating such concentrations through distant-sensing should enable a flying craft to opt for safer courses of flying. Such an option would be particularly useful for vimanas not capable of defending themselves.

- Discussing the technical details, eight mechanisms constitute this interesting device.

- Location of the device at the shoulder of the Vimana seems to be very aptly conceived from the point of view of good reception.

- Use of a rotary system in the device with a pivot and rotating component to receive audio signals from all the directions adds credibility to the concept of an Omni directional audio receiver with hyper sensitivity.

- Use of materials such as Rourava bird skin, metals specified for this technology, special dravas such as katana drava (acid), use of domes lined with birds skin (probably act as super sensors), ghantara metal, covering with kwanaka glass, capturing and processing sound inputs, amplifying them, use of rotating device for reception from all the eight directions, transmitting the terminal output to the pilot, all point to a well designed system developed for a well perceived purpose.

- For the purpose of operating the system to capture sound waves, use of airflow to set in motion shabdhathene wheel has been mentioned. This will set in motion audio sensitive ghantara metal rod which in turn transmits to the dome lined with birds skin. Passing through simhasya tube and dronasya vessel amplification takes place.

- Further description in the text includes methods of preparation of special metals forming the parts of the **yantra**

CHAPTER – 18

ADDITIONAL METALS, ALLOYS AND MATERIALS

Metal / Materials and reference	**Process of preparation**
1. Darpana for Kiranaakarshana yantra or Solar ray capturing mirror – in pariveshakriyaa yantra	Prescribed ingredients in specified proportions purified and mixed ® filled in frog-shaped crucible ® placed in frog shaped furnace ® use two winged Bellows and melt up to 300° d ® pour the molten liquid in to mould.
2. Prathibhimba-Arka-Kiranakarshana Naala. For attracting reflections of solar Rays. Text: Nallika nirnaya	Prescribed ingredient in specified proportions purified and mixed ® filled in Samavargika crucible ® placed in Samavargika furnace ® using Suragha bellow melt up to 315° ® pour in to receptacle ® darpana suitable for attracting reflected solar rays is obtained.
3. Sunda-mud made glass in puspini –yantra. Text: Parthiva paka kalpa	Prescribed ingredients in specified proportions purified and mixed ® filled in crucibles ® heat in Tortoise shaped furnace for 32 times at 100° using 2 faced bellows ® pour in to cooling yantra to get the mirror.
4. Abhra-mrid Darpana in Padma Chakra Mukha yantra. Text: Yantra sarvasva and Darpanaprakarana.	Prescribed ingredients in specified proportions purified and mixed ® filled in crucible ® placed in Varrathakunda furnace ® boiled to 200 ° and poured in to mould
5. Cold producing cristals in pushpini --yantra. Text: Maniprakarana	Prescribed ingredients in Specified proportions purified and mixed In Mritkundala moosha ® heated in Kula kundika furnace ® using Trayambaka bellows up to 300° ® pour the boiled liquid in to crystal forming yantra to get pure hard and intensely cold crystal
6. Vaataayanee metal or window metal In Pinjoola Adarsha Yantra.	Prescribed ingredients in specified proportions purified and mixed ® filled in crucible and heated in furnace up to 100° ® pour and cool.

7. Suranjitaadarsha Darpana in Guhagarbha Yantra. Text: Darpanaprakarana.	Prescribed ingredients in specified proportions purified and mixed ® filled in beaked crucible ® placed in Varaaha furnace ® using tortoise shaped bellows ® heat up to 100° and pour in to mould.
8. Anjishta Tree (Madder root) in Guhagarbha yantra. Text: Aagatatwa Lahari	The wood of the tree best suited for capturing reflections.
9. Dravapaatra or Acid vessel in pushpini yantra Text: Darpana prakarana.	Prescribed ingredients in specified proportions purified and mixed, filled in lotus shaped crucible ® heated in lotus shaped furnace using five mouthed bellows to 323° ® pour in to cooling yantra to get Sheeta ranjikadarsha or cold-receptacle glass.
10. Panchadhara Loha in Guhagarbha--yantra. To make metal pivots in yantras. Strong and heavy	Prescribed ingredients in specified proportions purified and mixed ® filled in Mrugendra Moosha crucible placed in furnace ® using beaked bellows heat up to 300° ® pour in to the mould to get a fine alloy metals
11. Paaragrandhika Drava. An acid for insertion of crystal Chumbakamani in Guhagarbha Yantra	Ingredients to be heated in big bellied earthen pot to yield drava shining like gold.
12. Chumbakamani. One of the finest crystals to capture Reflections—guhagarbha yantra. Text: Manipradeepika.	Prescribed ingredients in specified proportions purified and mixed, placed in Karpalaa crucible ® baked in furnace using owl nosed bellows up to 100° yields Chumbakamani.
13. Image producing Niryaasa or Roopakarsha Niryaasa or Special Varnish ® a pigment for coating Ascreen-cloth in Guhagarbha yantra. Text: Niryasa Kalpa	Detailed process given in the text.
14. Patadarpana in Guhagarbha yantra. Text: Darpanaprakarana.	Prescribed ingredients in specified proportions purified and mixed ®heated in a vessel up to 100° ® hold on a flat surface to obtain a sheet like cloth.
15. Tamogarbha loha in Tamogarbha yantra.	Prescribed ingredients in specified proportions purified and mixed, filled in

Against poisonous fumes and Dangerours rays from enemy. Light and strong	fish shaped crucible ® placed in crow shaped furnace ® heat up to 100° and pour in to cooling receptacle. It will yield fine darkness capturing metal
16. Vaatadhaarana Loha in panchavaataskanda-Naala. Nice, soft, strong, cool, light metal.	Prescribed ingredients in specified proportions purified and mixed ® filled in Meayooka crucible ® placed in Jamboomukha furnace ® using Kakamukha bellows ® heat up to 102° ® cast in the yantra.
17. Rowdree darpana in Rowdree darpana yantra. A flame-proof-glass. Text: Darpanaprakarana.	Prescribed ingredients in specified proportions purified and mixed ® filled in Padmasya crucible ® placed in Viswodara furnace ® heat up to 200° ® pour molten liquid in to a mould
18. Vaatastambana metal in Vaatastambana Naala. Text: Lohatatvaprakashika.	Prescribed ingredients in specified proportions purified and mixed ® filled in Matsya shaped crucible ® placed in Maghima furnace ® using Vijrimbhana bellows ® pour in to the mould.
19. Vidyut Darpana metal in Vdiyudarpana yantra. Text: For protection against lightning from clouds. Yantrasarvasva, darpanaprakarana.	Prescribed ingredients in specified proportions purified and mixed ® filled in padmasya crucible ® placed in vishwodhara furnace ® using five mouthed bellows ® heated to 500° results in the alloy.
20. Badhira Loha or Deaf proof metal In Shabdha Kendra Mukha yantra. Text: As per Loha Tantra.	Ingredients in equal parts ® cleand and purified filled in Triyuti Crucible, placed in furnace heated ® cast in receptacles produces metal cold, dark, sound proof, powerful, able to control bleeding and draw out particles from wounds of soldiers.
21. Anti-Lightning [lightning proof] glasses in Vidyudwadashaka yantra. Text: Darpana prakarana.	Prescribed ingredients in specified proportions, purified and mixed, filled in crucibles ® placed in padmakara furnace ® using simhasya bellows ® heated 300° and poured in to reseptacles.
22. Dambola Loha or Thunderbolt Metal in Vidyutdwadashaka yantra. Text:	Prescribed ingredients in specified proportions, purified and mixed, filled in Mandooka or Frog shaped crucibles ® placed in five faced furnace ® using

Lohatatwaprakarana.	panchamukha bellows ® heated to 500° will yield this alloy.
23. Mahorna Acid – dravakaprakarana.	Purified ingredients in equal parts and boiled will yield this acid.
24. Vrishala Metal: in pranakundalini yantra.	Process details not given.
25. Shytyagrahaka Loha: in Shatyudgama yantra. Cold absorbing metal. Text: Loha Tantra.	Prescribed ingredients in equal parts purified and mixed in shundaalaka crucible ® placed in Chanchoomukha furnace® using Panchanana bellows will yield a fine cold absorbing alloy.
26. Sheetaghna Glass: Cold-proof Glass: in Shaktyudgama yantra. Text: Darpanaprakarana.	Prescribed ingredients in equal parts filled in Simhika Crucible ® placing Padmakara furnace ® using Shoorpodara bellows® heat up to 300° ® pour in to mould and cool
27. Araara Alloy: in Vakraprasaarana yantra. A copper alloy, goldish colour, Light and hard.	Purified and boiled at 100°.
28. Shaktigarbha Metal: in Shaktipanjara keela of Shaktipanjara yantra.	Prescribed ingredients in specified proportions purified and mixed, filled in crucibles ® placed in Aatapaa furnace ® heating to 100° ® Charged with electric current results in this alloy.
29. Vishakanta Metal: in Shiraahkeelaka yantra.	Process details not given.
30. Katana Drava: in Shabdhakarshana yantra.	Process details not given.
31. Kwaanaadara Glass: in Shabdhaakarshana yantra.	Process details not given.
32. Vajeemukha Metal: in Shabdhaakarshana yantra.	Process details not given.
33. Byndala Metal: in Shabhdaakarshana yantra. A fine light, blue alloy. Text: Lohasarvaswa.	Ingredients in equal parts, powdered, purified filled in Shashamoosha crucible and heated in Mandooka furnace ® using five mouthed bellows to 200° will yield a metal.

34. Rutana Acid: in Shabdhakarshana yantra. Text: Moolikarkaprakashita.	Ingredients boiled in vessels to 108° yield fine yellow dravaka.
35. Ghantarava Metal: in Shabdhakarshana yantra. A fine, light, scarlet colour metal, which records all sounds. Text: :Lohatantra.	Ingredients powdered and purified filled Shukti crucible wrapped all round with earth ® placed in Alaabu shaped furnace ® boiled to 500° ® poured in to the mould.
36. Pingala Darpana: in Dishampatti yantra.	Prescribed ingredients in specified proportions purified and mixed filled in Matsya crucible ® placed in Naalika furnace ® using Gowmukhi bellows ® boiled up to 99° and poured in to the mould.
37. Somabhra: in Pattikaabrata yantra. A particular variety of mica, sky colour, fine, strong, absorbent, cure for eye diseases. It has diamond content and cool to touch.	Process details not given except purification process.
38, Ravichumbakamani:	Process details not given.
39. Special mirror for attracting solar Heat: in Suryashaktyaprakaashana Yantra. Text: Darpanaprakarana. A fine, light, strong. Golden colour solar heat collecting glass	Prescribed ingredients in specified proportions purified and mixed filled in Antarmukha crucible ® placed in Shuka mukha furnace and boiled ® poured in Antarmukhi yantra and churn thoroughly.
40. Shyvaala or Moss acid, Shrini acid, Chaaya mukha crystal, Jyotsna acid.: Suryashaktapakarshana yantra.	Process details not given.

41. Kshowndeera Metal: in Apasmaradhoomaprasarana yantra Text: Loha tantra.	Prescribed ingredients in specified proportions purified and mixed filled in crucible ® placed in Chhatreemukha furnace using Surashi bellows heat up to 100° ® pour in to mould.
42. Vakratunda Metal: in Sthambhana Yantra. Text: Kriyasaara.	Process details not given
43. Naaga Metal, Prajwalakamani, Mahoshmikamani, Manjishta acid, Jwalinimukhimani.: in Vyswamaara yantra.	Process details not there.
44. Raaja Loha or King of metal: In the manufacture of Kritaka type of Vimanas. This alloy, a heat resistant metal of Ooshmapaa category is specially prescribed. This is the fourth in the series of alloys of Ooshmapaa category having sixteen types. Use of Raaja -Loha in Rukma vimana is mentioned, Rukma means gold. Yaana-bindu stipulate that only after obtaining gold colour on Raja-loha by due process, it can be used for covering the vimana. Text: Yantrasarvasva.	Mix Soma, Soundala and Mourtwika metals in the ratio of 3:8:2. Add Borax to be filled in crucible and melted in furnace up to 272° and churned. Process of imparting gold colour on Raja-loha: Prescribed ingredients in specified proportions purified and mixed filled in smelter and boiled to draw the liquid through two outlets and filled in the crucibles and again boiled up to 800° and transferred to the cooler.
45. Haatakaasya Metal: in the construction of Mast in Shakuna vimana. Prescribed by Lallacharya. Text: Yantra-kalpataru, Lohatantra.	Ingredients: Suvarchala or Natron (8), Laghu Kshwinka or light Zinc (16), Laghu Bambhari (6), Copper (100) filled in crucible ® placed in Yasastika furnace and use Mahormi bellows ® heat up to 507°.
46. Dhoomagarbha alloy: in	Ingredients: Himasamvardhaka, Soma and Sundala in proportions 32:25:38

Dhoomodgama yantra of Sundara vimana.	filled in five crucibles ® placed in Chakramukha furnace ® use Ajaamukha bellows ® heat up to 712° ® properly churned.
47. Special cloth for making Sundaleeka or fabric nozzle for obtaining crust through exhausting of energy as described in Sundara vimana. Preceptor: Lallacharya. This fabric is a strong, soft, Cool, heat-proof, tear resistant, ash coloured cloth.	Ingredients filled in a vessel ® prepare another mixture in equal parts of Naga metal, Granthi metal, Vajra, Vynateya, Bambharika, Kanduru, Kudapa and Kundalotpala ® boiled to 92° ® pour the molten liquid in to milk cloth machine and churned. Resultant product to be cooled and put through levelling machine to obtain the special cloth.
48. Chapalagrahaka Metal: in electrical energy storing device in Sundara Vimana. Specified for the central vessels of storage apparatus. Text: Lohatantra.	Prescribed ingredients in specified proportions purified and mixed, filled in Uraana crucible ® placed in Kundodhara furnace ® use three faced bellows and melt up to 427° ® pour in to receptacle and cool.
49. Shaktiskanda Metal: in electricity Storage vessel.	Preparation details not given.
50. Ghrinyakarshan Glass: Or Solar heat absorbing mirror in Sundara vimana. Preceptor: Lallacharya.	Preparation details not given.
51. Vaatamitra Metal: in Vaataprasarana yantra in Sundara vimana. Text: Lohatantra.	Prescribed ingredients in specified proportions purified and mixed, filled in Sarpasya crucible ® placed in Chakramukha furnace ® using Vaaranaasya bellows heat up to 216°.
52. Kundodhara Metal: in construction of Chaturmukha owshnasya yantra of Sundara viamana. A blue, fine, light alloy capable of withstanding heat up to 2000 d and glass proof against canons,	Ingredients: Soma, Kanchuka and Soundala in proportions 30:45:20 cleaned and filled in Padma crucible ® heated in Chatraamukha furnace ® using Vasuki bellows and heated to 716° and poured for cooling

Shatagni and Sahastragni.	
53. Mica: for manufacture of pillars in Sundara vimana.	Prescribed ingredients in specified proportions purified and mixed, filled in Kurma crucible ® placed in Padma furnace ® using bellows heat up to 800° ® pour in to cooler results in Mica alloy, very attractive for pillars.
54. Trinetra-loha: in Tripura vimana. Explained by Shakatayana Shines like peacock feather, fire proof, unbreakable, weight less. Impregnable by water, fire, air and heat, and indestructible	Three ingredients: Jyothismati-loha (10), Kantha-mitra (8), Vajra-mukha-loha (16) to be filled in crucibles ® add Tankana or Borax (5), Trymika (7), Shrapanikaa (11), Mandalika (5), Ruchaka or Natron (3), Mercury (3), filled in crucible ® placed in Padma-mukha furnace and heated to 631° using Trimukhi bellows ® resulting in liquid poured in to cooler.
55. Pure Mica: Text: Dhaatu-sarvasva. Fifty different varieties classified as follows: White Mica - 16 types Red Mica -12 types Yellow Mica - 7 types Black Mica -15 types Out of the above Pundareeka from the first type Rohineeka from the second , Panchadhara from the third, and Drownika from the fourth type to be used for vimana.	Detailed purification process as per Samskararatnaakara, Detail process of preparation is also given in the main text.
56. Vaaruna Metal: in Tripura Vimana—a light, smoke coloured, impregnable alloy.	Prescribed ingredients in specified proportions purified and mixed, filled in crucibl ® placed in Padma-mukha furnace ® use five faced bellows and heat up to 700° ® pour in to yantra and churn ® further purification of metal as per Kriyaasara.
57. Krowncha Metal : in rain protection yantra, under	Prescribed ingredients in specified proportions purified and mixed, filled in crucibles and placed in Padma furnace ®

Tripura vimana. Text: Yantrasarvasva. Light, strong, honey coloured, rain- water and heat impregnated.	heated up to 512° using three face bellows ® pour in to churning yantra and cooled.
58. Aathapaashaana-Loha: in Surgaathapopasamhara yantra in Tripura vimana. Text: Kriyasara. Light, orange colour, heat proof, and unbreakable.	Prescribed ingredients in specified proportions purified and mixed, filled in crucibles ® placed in Nallika furnace ® using Mooshakasya bellow heat up to 725 ° churn the liquid and pour in to the cooler. Further purification as per Kriyasara
59. Somasa-loha: for housing in electric generator in third floor of Tripura vimana. Text: Lohatantra. A fine, light, suitable for use in electrical machinery.	Prescribed ingredients in specified proportions purified and mixed, filled in crucible (sarpamukha) ® placed in Naaga furnace ® using Shashamukha bellows and heat up to 350° ® churn the molten metal in mixer and pour the metal.

Special observations / remarks on Additional material, metals, covered above.

- Metals, Alloys, Mirrors, Manis covered in the text under respective chapters are much less as compared to those covered under Yantraadhikaranamand vimanas.
- Detailed processes of manufacture of metals and alloys include specific-to- type crucibles, furnaces and bellows, hinting at, the vastness of prevalent metallurgical sciences.
- Melting temperatures are generally from 99° to 1000° ancient scale, the only exception being in **Kundodhara metal** that has melting temperature 2000°.
- Temperatures specified such as 99°, 712°, 353 °, indicate that fine regulation of temperature control had been achieved and each alloy had a distinct melting temperature.
- As a corollary, pyrometry, that too with high degree of accuracy and precession seems to have existed.

CHAPTER – 19

JATYADHI KARANAM: CLASSIFICATION OF VIMANAS

In this chapter on classification of vimanas as per different Yugas and Yugadharma, the text explains the types of vimanas and their names featuring in the yugas. In **Krita-yuga**, people by their own powers acquired through righteous living could fly on their own volition from place to place without the aid of flying machine.

- In Threthayuga flying machines were of **Mantrika** category.
- In Dwaparayuga flying machines under classification **Tantrika** were used.
- In Kaliyuga, flying machines of Kritaka category were specified.

Prominent works referred to in Yuga-wise classification are as follows:

- Vimana Chandrika
- Vyomayaana Tantra
- Yantra Kalpa
- Kheta-yaana-pradeepika
- Vyomayaana-arkaprakashika

Observations:

- Yuga-wise classification needs deeper study.
- Many texts seem to have existed covering vimanas; their authors however are not mentioned.
- The next sootra deals with the names of vimanas as classified **yuga-wise:**
    - Tretha-yuga – Mantrika type – 25 varieties of flying machines starting from Pushpaka.
    - Dwapara-yuga – Tantrika type – 56 varieties starting from Bhyravi.
    - Kali-yuga – Kritaka type – 25 varieties starting from Shakuna.

- Besides Maharshi Bharadwaja the other preceptors detailing the classification are Shounaka, Goutama, Manibhadra and Lallacharya.

Observations:

- The large number of **vimanas** hints at conception of application-specific varieties.
- It is significant to note that 'Tripura' vimana covered in the text is distinctly missing from the **Kritaka variety.**

CHAPTER – 20

KRITAKA VIMANAS

Four Types of Vimanas:

The last few sections of the work **Vymanika Shastra** deal with four types of kritaka vimanas, Shakuna vimana in the lead.

Twenty-five vimanas of this category of the current Yuga are stated as follows:

- Shakuna
- Sundara
- Rukma
- Mandala
- Vakratunda
- Bhadraka
- Ruchaka
- Virajaka
- Bhaskara
- ajaavarta
- powshkala
- Viranchika
- Nandaka
- Kumada
- Mandara
- Hamsa
- Shukaasya
- Sowmyaka
- Krownchaka
- Padmaka
- Symhika
- Panchabana
- Owryaayana
- Pushkara
- Kodanda

The text Manibhadrakarika, quoting sage **Gowtama** as also Shounaka sootra indicates the same number of vimanas in the same order.

This perhaps reflects that both the sages had the same origin of study. Prescribing specific alloys for the structure of **Kritaka variety**, the text Kriyasara dictates use of Raja-loha. This prescription is echoed by Vishwambhara also. The process of manufacture of **Raja-loha** is discussed in brief.

Here all the **three Ooshmaapa core-metals figure.**

Soma, Soundala and Mourthweeka in proportion of 3:8:2 mixed with borax and melted 272 ° and churned form this alloy.

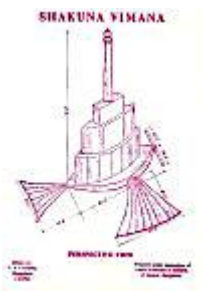
Observations:

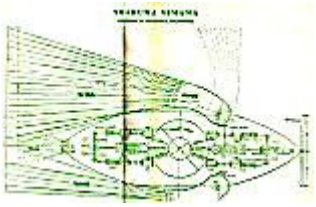
- While Shakuna, Sundara and Rukma appear in the list, **Tripura vimana** discussed in the work is conspicuously missing. In fact,Tripura does not feature among vimanas of Tretha and Dwapara categories as well.

- The core metals of heat resistant variety discussed under the Lohadhikaranam form the alloying components of Raja-loha. This indicates continuity from the said chapter and the current one.

- Lohadhikaranam dealt with core metals of specific thermal resistant variety. Raja-loha among them is an exclusive alloy developed for very specific properties.

Shakuna Vimana:



This **vimana** contains twenty-eight parts. They are Peetha or Floorboard; hollow mast; three wheeled keelakaas; four heaters; air suction-pipe; water jacket; oil tank; air heater; heater; steam boiler; viduyut yantra or electric generator; air propelling yantra; vaatapa yantra or air suction pipe; dikpradarshana dwaja; shakuna yantra; two-wings; tail portion; owshnyaka yantra or engine; kiranaakarshana mani.

Constructional aspects of the **vimana** are given too briefly and also without clarity. However, from the English translation (literal and frequently sprinkled with modern terminology) we have made an effort to analyze. Floorboard is a sheet-metal structure made of Raja-loha options have been offered to make the shape circular, rectangular or cradle shaped. Weight of the Peeta or Base is one hundredth of the total weight of the plane. Width of the peeta is half the height of the mast. Hollow mast is to be erected by suitable joinery at the center of the peeta.

Lallacharya quoting yantra-kalpataru prescribing only Haatakasya metal for the mast or stambha specially describes hollow mast. In this particular case a quadrangular base with two ends converging into triangular form has been opted. Hollow mast or Naala stambha is a three tiered-construction inside and outside diameter reducing with each tier upwards. Wheels provided on the length of the Hollowmast are not meant for movement of the **vimana**. From the description available two outer fixed wheels and the central rotating wheels, some kind of a compressor / turbine arrangement seems to be under discussion to obtain higher pressure and velocity.

Window-Dome provided at the top of the **vimana** accommodates the sun crystals crowning the dome. Sun crystal is big in size. In the three vertical tiers of vimana, the first tier rests on the peetha. They are separated by thick floorboard. First floor houses four heat engines at the corners. Supporting pillars in the ground floor accommodates passenger cabin. Second floor or tier accommodates angayantras.

Below the ground floor a cellar houses some yantras, four air compressors are provided and around the bottom of Hollow-mast. Air compressors are supposed to be driven by steam power.

The arrangement described for the wing is interesting. The wings are made of a number of feather-like structure stacked one over the other and move around a common pivot. They can open out or close as seen in a feeler-gauge. The wing will also flap along hinged joints to generate lift.

A separate tail plane to facilitate elevation or take-off is provided. As per the description the heat engine drives the propeller to produce usual aircrew action. Controlling of wing feathers and tail units is through control cables originating from the cockpit.

Ignition of the oil (fuel) seems to be by electrical means. For storing compressed air leather bellows have been suggested.

Observations:

- Preparation of Hatakasya alloy has been covered earlier in this report.
- Construction of the structure and a hollow mast hints at attempts to achieve streamlining.
- Units of measurement like Vitista needs to be verified and established conclusively.
- Three sets of wheels along the length of the hallow mast, hint at their being power developing source. Wheels for the movement of the**vimana** on ground are separate.
- Use of sun crystal is obviously for solar energy extraction.
- Use of steam power to drive air compressor seems to be strange since steam generation during flying is itself strange.
- Possibly Shakuna is one of the early variants of Kritaka type, deriving its name from the basic definition of bird. Hence the arrangement of flapping and spreading wing and tail construction feature.

- In essence Shakuna is a rudimentary type with aircrew arrangement.

Sundara vimana:

Eight constituent parts are:

- Peetha or ground plate Smoke chimney
- Five gas engine Bhujya metal pipe
- Wind blower Electricity generator
- Four phased heater Outer cover

Peetha or ground plate of Raja-loha with options to have square or round shape. In the centre of the peetha Dhoomaprasaran Naala or pipe is provided. Hollow mast is a tall cylindrical member with provision to store gas energy at the bottom portion. Water vessels, oil tanks are housed at the centre. At its foot electricity is stored in a container.

Oil container will have three oils: Dhoomanjana oil, Shukatundalika oil (eggplant oil) and Kulaki or Red arsenic oil in the ratio of 12:20:19. Ignition of the oil mixture is by electrical means. Distribution of gaseous products seems to be through a special arrangement ensuring even spread of gases. Dhoomodgama yantra is meant to eject gaseous mass with speed. In constructing this only Dhooma garbha loha with composition of Himasamvardhaka, Soma and Soundala metals have been specified. Control of high-energy gaseous products is through revolving wheels (possibly to operate valves). Description indicates a hydraulic accumulator type of arrangement for storing gaseous product. Ignition of oil is achieved by combined process of electrical energy and friction.

Actual thrust is obtained by passing the high-energy product through a number of Sundalas or Jet nozzles. This obviously seems to be based on reaction principle. Manufacturing process of Sundala (made out of special metal-impregnated fabric, flexible, heat-resistant) as given by**Lallacharya** is explained in brief. These sundalas or naalas are kept rolled-up over revolving drum while not in use. They are unrolled and kept taut while in use. The gaseous products get discharged through a number of them in jets producing thrust.

Generation of electric power has also been briefly covered. The text talks of 32 types of machines to produce electrical power. Different methods broadly stated are friction, by thermal process, by waterfall, by combination of all these and also by solar rays. This technology is ascribed to sage **Agastya** in his work *Shaktitantra*. Electrical power production is described using four vessels located in four directions and a central vessel. Several types of acids, dravas are used in each vessel. Crystals or Manis such as Vidyutgama, Jyotirmukha play a key role.

Extensively treated lion's skin and deer's skin (possibly for their high insulation properties) figure in the process. Central vessel forms the accumulator of electricity generated. Anshupa Mani or Solar rays absorbing crystals is the main medium that absorbs heat that gets converted to electricity through a process not clearly described. The process of storing electricity by use of mercury has also been brought in. Stored electricity is conducted to all parts of the **vimana** through insulated cables for operating various services.

Vataprasaran yantra is described as one to generate the main Udgama Shakti or lifting force. This yantra comprises of twelve parts, including Naala-Stambha, valves regulating inlet / outlet for fresh, compressed air, exhaust, air guides, vanes. The system includes an air compressor. The description hints at using compressed air jet to obtain thrust. Further description mentions that compressed air conducted through Naala sthambha and energy product by Dhoomodgama yantra through the inside of the main mast or Bruhad sthambha. They confluence at the end and go out through sundalas with high velocity, effecting jet propulsion.

As stated for Shakuna vimana, Raja-loha is used for structure and covering of this **vimana** also. Chaturmukha or Oushnya yantra is the main heat engine. Comprising of 18 parts this includes, Peetha, Smoke accumulator, Oven, Water container, Valve controls, smoke opening, Regulatory valve, heat indicator (temperature), Time clock, Speedometer, Sound-transmitting instrument, Anthardhanda Ghata, air bellows, Long sundala pipes, Copper pipes etc. Sundala used as jet nozzles to obtain thrust are also used for vertical and aft movements and directional control of the craft. Computation of speed claimed to be achieved needs a re-look. The thrust from each contributing source seems to have been added up. Retranslation of many verses in this chapter may help in better understanding.

Observations:

- Use of specific types of oils suggests that high-energy potent fuel be under discussion.
- Some error is noticed in the direction of movement of the craft vis-à-vis jet stream from sundala nozzles. Applying the principle of reaction the movement of the craft should be in the direction opposite to the thrust line. Possibly this aspect is dealt by **Swami Dayananda Saraswati** in his *Rigbhashya Bhoomika*. Incidentally this is quoted in the report of I.I.Sc Bangalore also.

- Very importantly solar energy employment for producing electricity is a unique feature. Probably this technique was not heard of even by the middle of 20th century.
- Use of sundalas, as jet nozzles are again interesting. Operating each sundala independently and varying mass-flow and velocity of jet separately, multiple degree of craft control should be available.

Rukma vimana:

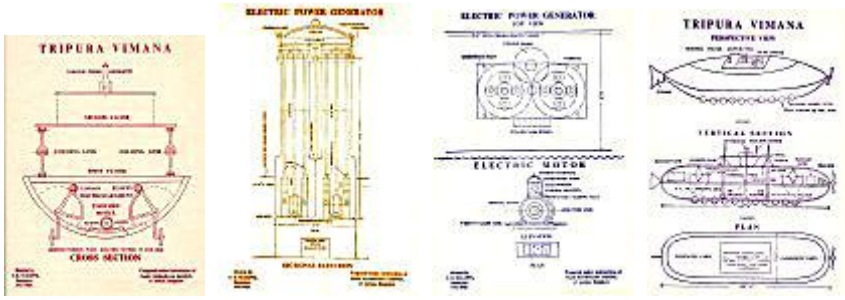
The description of this **vimana** is too brief to comprehend the principles of working. Rukma meaning gold, the vimana has been so named because of its appearance of golden colour. Impregnating gold colour on Raja-loha precedes fabrication of structural part of vimana. Yantra-Bindu and Varna Sarvaswa explain the colouring process. From the manner described it is not a plating process.

Peetha is stated to be tortoise shaped of length 1000 ft. This however is too long and needs translational, interpretational verification as well as equating units of measurements of length. The other parts are Ayaschakra pinda and Batimikaa sthambha. Description of flying lacks clarity. However, utilization of electrical energy to operate Electro-Mechanical arrangement to enable **vimana** to lift off and accelerate is hinted. A speed of 105 kroshas or 250 Mph. per ghatika is stated. Directional control as suggested by **Lallacharya** is through conventional rudder system provided at the base and articulated through crescent shaped plate by means of push pull rods.

Observations:

- Pushpaka vimana of epic **Ramayana** is also described to be golden colour and delightful looking. Aesthetic sense of the scientists to cater for the needs of the Royale manifest here. Gold colour imparted to Raja-loha is before the alloy is used in structural part. In fact it is built in the alloying process itself to make it an integral part of the metal.
- We note that the earlier two vimanas discussed did not mention of gold colouring.
- **Rukma** is stated to reach speed up to 250 miles in 24 minutes, a speed of 725 miles per hour.

Tripura vimana:



Tripura is the last of the representative vimanas discussed in the text. It has two unique features. It is a three-in-one craft and also a solar powered vehicle. Tripura means three storey or tiers. This concept is brought in the form of a three-tier construction. The first tier is for operation on land, the second one for operation on water and inside water and the third for flying in air. As an integral unit of three tiers the craft is stated to be a flying machine. Differential use of first and second tiers independently for movement on land and water is stated to be possible.

In contrast with the other three **vimanas** this is to be made of mica (first floor) and Thrinetra loha (second and third floor). The arrangement talks of wheels provided underneath peetha for locomotion on land through electric motor. The wheels are retracted from the ground before vehicle moves into water in amphibian mode. During movement on water boats provided on the deck possibly to act as buoys.

Detailed manufacturing process of obtaining particular type of **mica** has been dealt at length. Layout details of the first floor include provisions for aisle, cabins for crew and passengers and storage enclosure. Covering of the first floor is by water / air proof fabric, easy to install and dismantle.

Second floor is proportionately smaller than the first. Electric power is provided to second floor as well. When the second floor gets into water the open hatches of the wheel will be covered by special milk-cloth having full water proof property. Supply of air to the second floor is ensured through ducts made of milk cloth. This air under pressure is meant for comfort of personnel in first and second floors.

For protection, safety and comfort of crew and passengers three separate yantras are provided viz., one to protect against stormy winds, the second against solar-blaze and the third against rainstorm. Construction of the third floor is similar except that it is proportionately smaller. The special feature in the third floor is that it houses electric generator. The cabin for this is to be made of Somaka-loha.

The procedure for extracting electric power from solar rays has been mentioned. Vessels

and tubes made of Anshupa glass of a specified variety and some electricity generating crystals participate in the process. Anshupa and Sanjeeraka crystals play the primary function. Purpose and function of Ganapa yantra discussed in the text needs separate study with suitable interpretation.

Observations:

- Three-in-one concept includes amphibian and under water modes of the vehicle as well.
- Use of solar energy for powering an aircraft is a unique phenomenon, heard for the first time in the aviation technology.
- To highlight the features of Thrinetra-loha, it is flame proof, unbreakable, waterproof and above all, weightless. It has the Shane of peacock feather.

General Remarks on Vimanas diagrams and drawings:

Inclusion of diagrams and drawings was an add on activity by **Sri. Shastriji** from 1918 – 1923 AD.

This was done through a local draughtsman under the pandit's guidance. It is difficult to accept that this process also was under the divine influence. It appears that in projecting the contents of the work through pictures and drawings their own interpretations seem to have influenced. Possibly this has corrupted narration to some extent.

We are therefore not inclined to accept the drawings till further study. It is learnt that attempts are under way to build a prototype of one of these vimanas by a researcher in Hyderabad.

CHAPTER – 21

VIEWS OF FOREIGN RESEARCHERS

It is interesting that Researchers abroad have perceived Vymanika Shastra in a positive and meaningful manner. Their Interpretation and Analyses reflect commitment and open mind. Their focus seems to be on **yantras**, **metals** and **materials** and **vimanas**. They are attracted by the contents of the text that specify use of mercury, Copper, Magnets, Electricity, Crystals, Gyros and Acids. Mercury in particular is identified as a high energy-potent element. They interpret that the text talks of Mercury Vortex Engine for propulsion system. Coating Scientific Encyclopedia they point-out that mercury is known for its utility even by 500 BC. Mercury Vapour Turbine Engines are reported to use Liquid Mercury, recycled in a closed circuit system, consumption therefore being negligible. The other distinct properties are, it is a conductor of electricity, and amplifies sound waves.

Samarangana sootradhara of **King Bhojaraja** unveils the use of **mercury** in engines for aviation use very distinctly. Briefly explaining the operation of this type of engine, western researchers, quoting this treatise, mention this as a heating device placed underneath to cause ignition, triggering the potent energy in mercury to drive the whirlwind in motion. This produces highly intense impulse catapulting the flying machine into air **instantaneously**.

Use of liquid mercury in Gyroscopic applications makes it even more versatile. The characteristic features of liquid mercury are:

- Heavy Protons found in mercury atom are highly stable
- Gyroscopes of this kind do not need any warm-up
- they are vibration and shock-proof
- these gyroscopes have no moving parts and can run forever
- In addition they offer compactness and weight reduction advantages so vital in aviation use

Researchers abroad point out that Crystals, Manis and Mirrors stated in this work have potential not yet explored by modern science. Crystals today, though sparingly used in technology still play a dominant role in **Digital Technology**.

Some western researchers strongly feel that ancient Indian aviation included propulsion system from Electromagnetic Lift and Repulsion principles and vertex propulsion. Many experiments have been reported from these experimenters working on modeling vimanas with these principles inbuilt. Such trials are predominantly after 1950s. It appears from the results of these experiments that though the methods look unconventional as compared to established technology, they are not opposed to them from the point of basic

principles of science. Famous experiments on small flying crafts known as searls craft have added credence to applications of these theories in aviation.

This topic on views of foreign researchers have been briefly introduced just to give a glimpse of happenings outside the country on principles of ancient aviation science. There have been a number of books published by several authors in the recent years. We believe that researches on ancient aviation sciences receive far higher impetus in the coming decades.

CHAPTER – 22

ATYPICALS

- Vymanika Shastra, known to be one of the forty chapters of the Yantra Sarvasva, is available with some study centers, while the mother work itself is mysteriously untraceable. It could be a matter of conjecture that this Encyclopedia on machines might have accompanied Vedic Sciences into Western countries.

- English translation of the work features six chapters while the preface talks only of three chapters. This anomaly is to be reconciled.

- The treatise narrates sophisticated features of **flying machines.** Basic features of aeroplanes such as main planes, rudder, elevator, fuselage, cockpit layout, flight controls, landing gear and related systems find sporadic mention.

- Ground systems to support aviation such as control tower, communication and navigation aids, runways or airstrips do not appear in the text.

- Even though both Vymanika shastra and Samarangana sootradhara describe **flying machines,** strangely both the treatises make no reference to each other.

- Out of four vimanas mentioned in the work, **Tripura vimana** does not find place in the list of Vimanas prescribed for the current Yuga. Similarly, Soubha vimana referred to several times in Mahabharata does not appear in the list of 56 vimanas of Dwapara Yuga.

- The last few sections of the closing chapter dealing with four types of representative vimanas lack clarity. It looks as though a need was felt by the author to short-close the work in a hurry. Customary manner of conclusion and closing frills are conspicuous by their absence.

FINDINGS

Literary:

- Vymanika Shastra is a work of ancient Indian origin, an offshoot of Vedic science.
- There is enough logic and supporting mythological evidence to indicate that the great seer Maharshi Bharadwaja authored this work.
- Bodhananda's commentary and Swami Dayananda Saraswathi's references to textual content of this work indicate that the subject work featured in the earlier periods of known history.
- The work manifested for the first time in manuscript form during the end of 19th century and first two decades of 20th century. This was through revelations of Pandit Anekal Subbaraya Shastry and transcripted by Sri. G. Venkatachala Sharma. The last occasion any textual material got into the transcript was not latter than 1923.
- The transcript did not find recognition till the end of British rule in India. Follow up studies started only later.
- Studies on literary aspect of the work by several researchers continue even now.
- Foreign researchers did not show inclination till late seventies. In fact they had shown disdain at the mention of the work. Post–1985 period saw tremendous spurt in their interest.
- Approach to the study of works of this nature should be altogether different. It needs faith, open mind, genuine interest, decoding ability and interpretational skills.

Military, Aviation and weaponry:

- 'Flying', as a craft, had been perceived by Ancient Indian Scientists. Other civilizations such as China, Greece, Egypt also had the knowledge of aviation technology.
- Concept and development of aviation technology was quite advanced. A variety of flying machines with application-specific on-board systems had been conceived and developed. In fact, they stretched into full-fledged military applications more than mere mundane air transportation.
- The concept of 'pilot' as a specialist was clear to ancient preceptors. His role as a warrior in the sky reinforces the visualization of a combat pilot. Focus on his

stringent training shows the right direction of thinking. Specific dietary and clothing prescriptions further validate the scientific lines on which ancient aviation support was based.

- Natural vegetation has been harnessed fully for food processing meant for military sector.

- Besides sage **Bharadwaja**, other seers of name and fame in mythology such as Goutama, Shounaka, Vashista, Agastya, Atri, Narayana, Lallacharya and many others made in-depth contribution.

- While some **vimanas** were role-specific, others were multipurpose

- The Aviation Environment relating to support systems such as aerodromes, runways, communication and navigational aids, air traffic control etc., seem to be distinctly different from those of modern days. The concept is seen to be on the lines of self-contained flying machines capable of flying independent off ground support aids.

- Use of energy sources in the environment and on-board to achieve defensive and offensive modes are noticeable.

- Use of explosives and their detection technology is unmistakably distinct. This indicates the existence of a full-scale technology on explosives.

- **Biological warfare** in aerial-combat features at several places.

- Evasion tactics from enemy aeroplanes, avoidance-options and concealment from enemy-detection constituted special features of Air-Defense Techniques.

- Offensive strike devices even to the extent of causing catacyclic effects have been discussed.

- Aerial displays of flying machines, Manoeouvres, Aesthetic and Dominating effects discussed in the text have striking resemblance with modern flight-displays. The year 1918 AD is an interesting benchmark. Coincidentally this year saw the exit of the First World War and it also heralded the completion of the work Vymanika Shastra in written form. The levels of military aviation technologies between the contemporary technology and the textual substance of this work show that ancient Indian science was far ahead of times.

- It is revealing to compare the levels of aviation technologies that existed at the time of completion of Vymanika Shastra and the First World War, November 1918. Combat aeroplanes were used in sizeable number. All the same, the maximum level

of technology in combat aviation can be gauged from the prevailing art of war machinery. Fighter planes with piston engines and propellers flying below 15,000 ft. having twin-gun firing capability were pressed into operation. Speed of the aircraft was just over 150 Mph. Aircraft with long range capability were used for photo-recci and deep strikes. On the other side German aviation technology constituted Bi-Plane bombers of large size, 90 ft. wing span, twin engines of 200 H.P., Bomb loads of 2000 pounds and operating range of 200 miles constituted the front line up.

Technical:

- Only after 1952 researches relating to the technical content commenced. A number of groups working on this aspect increased appreciably after 1985. Foreign researchers have focused on topics like mercury vapour propulsion, anti-gravity material development, and mercury as a source of energy and multipurpose application.

- Knowledge on atmosphere was advanced.

- Deep knowledge of geological science relating to formation of core metallic ores suitable for aviation application did exist.

- Many materials and alloys discussed in the text were for exclusive applications. It would be an interesting study to find out whether modern technology offers equivalents.

- Barring a couple of oblique references, physical and archeological evidence discovered so far, there is no direct evidence to throw light on the existence of vimanas in ancient civilizations the world over. However science and technology discussed in this work amply hints that vimanas did exist. Some of the features and concepts talked about in the text do not appear mere theoretical. They could not have got generated purely by imaginary perceptions.

- Extrapolating the contents in the work over the untraced mother work (**Yantra Sarvasva** – ascribed to be an encyclopedia on machines) one has to appreciate the enormity of Knowledge-Base.

- **Over forty scientific texts** on various disciplines including aviation, metallurgy, atmosphere, yantras, manis feature in this work. This qualifies the impression that broad-based scientific research in these fields both in pure and applied sciences must have preceded. Successful development of many materials contained in this work at science laboratories in India vindicates the textual substance.

- From the references made to Kriyasaara in this work, it is evident that this treatise dealt with Dynamics of Machinery.

- Taking into account successful laboratory development of many materials as a means to validate the text, there seems to be enormous potential both for pure and applied sciences in the areas of physics [particularly optics], Chemistry [Organic, In Organic and Bio], Geology, Meteorology etc., to go deep in to the precepts and descriptions featuring in this book.

- References to a variety of texts like *Loha tantra, Loha kalpa* etc., it is evident that a comprehensive knowledge on geology, mineralogy, mining and manufacturing processes of metals and alloys existed. The researches conducted so far have been promising and in the right direction. However laboratory experiment conducted till now indicate that only such material involving few ingredients in their composition have been attempted. Other materials involving many ingredients are yet to be taken up. Strange composition in the recipes such as urines of animal origin, snake's slough, eagle's eye-balls etc., needs deep research to establish relevance and their role in the manufacturing process. Metals like Thrinetra Loha,Kundodhara Loha should be of great challenge to metallurgists of the day.

- A grey area needing immediate attention and deep study is regarding **units of measurements** relating to Length, Temperature, Force, Weight and Volumes. Their modern equivalents need to be established for correct understanding as aid to researchers.

- Some of the units are:
    - Weight Linka, Mushti, Kankusta and Pala -(equal to four tolas)
    - Volume Drona
    - Electrical current Linka
    - Length Krosha, Danda, Vitasti, Yojana
    - Temperature Kaksya Interpretational equivalence
    - Varies from 2.5° C to 4° C
    - Speed Prenkhana, Linka
    - Time Ghatika (24 minutes)

- The drawings and diagrams of the **vimana** need careful study. Possibilities of errors having crept in due to human imagination exist.

- Laboratory developments have been undertaken by units under CSIR, Birla Science Centre and IIT Mumbai. R&D Laboratories under Ministry of Defense are yet to react.

Recommendations

- To explore their intrinsic scientific value, **Vymanika Shastra** and **Anshubhodhini** should be taken up for indepth study for the benefit of Defense, Industrial and Commercial applications.

- Efforts are required to trace and locate texts and guides in this treatise. Yantra Sarvasva, missing parts of Anshubodhini a series of guides on lohas, darpanas, crystals, dravas should be traced.

- Contents of Metallurgical and Material Sciences of the work should be fully explored by Basic and Applied researches through specific project. Successful development of materials at Science Laboratories should serve as pointers to undertake such activities. Development of Lohas such as Thrinetra, Ghantarava, Thamogarbha, Kundodhara, may prove unique in nature. Similarly study on crystals may open up fresh avenues in Digital Technology. Fabrics, Glues and any other nonmetallic substances (Organic & Inorganic) may offer fresh options to modern technology.

- Prescribed Food varieties and Clothing should be taken as guide to undertake further research to develop requirements of aviation at research laboratories of defense R&D, CSIR.

- In the light of our findings that conduct of researches done so far are sporadic and disjointed. There is a need to set up an Integrated Centre to coordinate this effort. The participation of Defense (R&D). CSIR. ISRO, DSP, Science Foundations, is vital to activate research under a common name. The study team is willing to take up this task, if assigned.

- A host of data related to **Ayurveda** revealed in this text should be sisted and assigned to scholars in this discipline. Our findings indicate that most of such materials have been confirmed to be available and identifiable even now.

- A Bank of Sanskrit translators and interpreters should be formed to provide the backbone support to research centers.

- Free flow of information on Decoded Data, Development Status, Critical Findings should be arranged amongst such centers.

- Principles of Levity, Anti gravity, Mercury Vapour Propulsion etc., need serious study to be translated in to Technologies.

- AR&DB, Ministry of Defense may respond to study team proposal of a second phase of the project on **Vymanika Shastra.**

Conclusions

Project study on "Vymanika Shastra" is a humble attempt to update the views on the work at the turn of the century and therefore called "Vymanika Shastra Rediscovered". We have taken into consideration various views expressed by Individuals and Group researchers, appreciative as well as adverse. We have made honest effort to bring in reports of Literary and scientific studies, Interpretations, Laboratory tests together with our observations on the topics in the work. We are thankful to all those who contributed into this effort. Their reports form appendages to our main report.

While no direct physical evidence exist today to establish that vimanas did exist in ancient times, literary works and epics aver that they did exist. Nevertheless, there is enough evidence to say that technology of aviation and related sciences did exist. It is not our claim that vimanas can be constructed from the contents of this work. Aeronautics being a complex subject demands extensive base work before an aeroplane is developed even in rudimentary form. What need to be focused upon are the perceptions, precepts, concepts and the supporting technology discussed in this text. It is possible that interpretation of expressions may vary because of inherent nature of Sanskrit. At least one of them has to be right. An integrated effort among all research enthusiasts is vital in the process of deriving tangible benefit to the technological field.

Inspired by the thrill in this study, the Study Team has drawn Objectives for a Second Phase of study with a view to go more deeply into technical content and integrate various researches on a common platform. For this exercise we need the support of the organisations interested in this kind of Research Exercise. Takers may kindly approach us.

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- **APPENDICES**
- APPENDIX A-F: Refer to Chapter 3
- APPENDIX G: Refer to Chapter 17

*** The End ***

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