

Ancient Indian Science and Technology in Sanskrit Texts (śāstras)

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Abstract:

To celebrate India, the best way is to remember all the times we have contributed to the scientific and technological advancement of the human race. Our ancient science was so developed that if anyone tries to study it, a lifetime would prove small. However, the problem with us is that we have not stored our heritage of knowledge properly. Hence, now we are almost forced to find Western sciences as more advanced than that of us.

Keywords:

Vimāna Śāstra, Maharṣi Bharadvāja spectrometer, Yantras, Rasaśālā, Agastya's battery

Introduction:

In Mahābhārata, the Kauravas were born by assisted reproductive technology (ART) in which the embryo was formed inside Gāndhārī's uterus. After about two years she gave birth to a lump of living meat which was divided into 101 pieces by Sage Vyāsa and placed in different pots inside a cave that replicated the inside of a womb. The Kauravas were born from these pots. It is believed that the daśāvātāra of Viṣṇu was nothing but a concept of evolution. Charles Darwin is world famous as Father of Evolution but Indians were well-known of evolution many thousand years ago. Starting from Matsya (fish), Kūrma (giant tortoise), Varāha (boar), Narasimha (the half-man/half-lion), Vāmana (the dwarf), Paraśurāma, Rāma, Kṛṣṇa or Balarāma, Buddha or Kṛṣṇa, and Kalki. Ancient India was better known as Viśvaguru due to its contributions to many fields such as astronomy, mathematics, metallurgy, *yoga*, medicines and many such arenas.



Figure 1: Similarity between Darwin’s evolution and daśāvatāra of Viṣṇu

Some of the principles of metallurgy which are brought out in the textual description indicate an advanced development in technology and engineering in ancient India. About 31 machines (*yantras*) are also described with their construction procedures. Experimental investigation has been conducted for the material part of the text. Several materials can be reproduced in the laboratory. By proper investigation, it was found that they have special properties that are not available in any known materials of modern times. One machine “*Vakra-Prasāraṇa-yantra*” was reproduced as a working model and is found to be novel gear mechanism with sixteen gear wheels. In addition, “*Agni-Sthambana*”, a fire proofing spray, “*Anāhāra*” a food substitute have also been produced. Patents are also being obtained for some of these items.

1. Evidence of ancient Scientific Sanskrit texts (śāstras)

There are several Sanskrit Śāstras which deal with the Ancient Scientific elements:

- **Vimāna Śāstra (or Vaimānika-Prakaraṇam)** and **Amsu-Bodhini**– by Maharṣi Bharadvāja
- **Rājya-tantra**- by Maharṣi Yānjyavalkya
- **Kṛtakavajra-Nirṇaya (of Ratna-Pradīpikā), Jalatattva-prakarṇa and Āpatattva-upanyāsa**- Authorship not known

Our ancient seers knew the technology for radars and laser weapons as given in the Sanskrit text *Samarāṅgaṇa-Sutrādharma*.

Similarly, Āyurveda (‘āyur’ means life, and Veda means knowledge) is most probably the oldest structured system of medical science in the world containing proper knowledge of various ailments, diseases, symptoms, diagnosis and cure. Many scholars like *Charaka* and *Suśruta* have made invaluable contributions to Āyurveda. Suśruta mentions about various surgical procedures and surgical instruments in his *Suśruta-Saṃhitā*.

Ancient India not only had a medical science for the humans (Ayurveda) but also for plants, called *Vṛkṣāyurveda*. A Sanskrit text of *Vṛkṣāyurveda* of Surapala is a systematic composition starting with the glorification of trees and tree planting. The text discusses about various topics connected with the science of plant life such as procuring, preserving, and treating seeds before planting; preparing pits for planting saplings; selection of soil; method of watering; nourishments and fertilizers; plant diseases and plant protection from internal and external diseases; layout of a garden; agricultural and horticultural wonders; groundwater resources; etc. The topics are neatly divided into different sections and are internally correlated.

The other texts like *Atharvaveda*, *Bṛhatsaṃhitā* of Varāhamihira, *Sārṅgadhara* of Sārṅgadhara, etc. also deal with the botanical and agricultural aspects. The *Samhitās* of Caraka and Susruta deal with the medicinal aspect; and works such as *Gṛhyasūtras*, *Manusmṛti*, *Arthaśāstra* of Kautilya, *Śukranīti*, *Krishisaṅgraha* of Parāśara, *Kāmandakīya Nītisāra*, *Buddhist Jātakas* and the *Purāṇas* like *Matsya*, *Varāha*, *Padma*, *Agni*, etc.

The *Vṛkṣāyurveda* of Surapal (a text on plant science composed in the 10th century) gives us a rare insight into extensive mathematical calculation techniques of the times, involving in particular fractions, progressions, measures of time, weight and money.

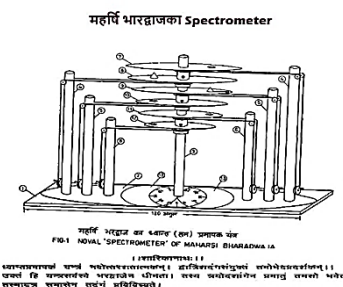
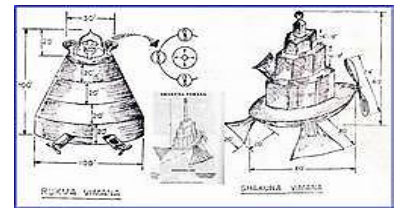
During the first war between the Indians and the British at Mysore during reign of Hyder Ali, the Indians had rockets and missiles besides guns and cannons. Śatāgni is a missile containing 100 bullets (śata means 100 and Agni means fire). It is launched from a cannon and explodes after reaching its destination. *Śukra-nītisāstra* contains several formulas for making gunpowder. The first item exported by the then East India Company was Indian nitre or saltpeter. Śusruta is treated as the "**Father of surgery**" and "**Father of Plastic Surgery**". He successfully performed the nose surgery. *Śusrutasaṃhitā* is one of the oldest treatises dealing with surgery in the world.

Brahmagupta (AD 628) defined zero and its operation for the first time and wrote rules for mathematical operations (addition and subtraction) using zero. His *Brahmasphuṭasiddhānta* deals with mathematical astronomy containing significant mathematical content, including understanding the role of zero, rules for manipulating both negative and positive numbers, methods for computing square roots, methods of solving linear and quadratic equations, and rules for summing series. Then Āryabhaṭṭa a great mathematician and astronomer used zero in the decimal system and wrote *Āryabhaṭṭīya*.

Maharṣi Gautama mentioned 32 models of aircraft used in Tretā-yuga of which only one model (Puṣpaka-vimānam) became popular in the Rāmāyaṇa. The *Vaimānika-śāstra* describes *Tripura-vimānam* which uses solar-powered engine to travel at three levels: on the land, under the surface of water and in the air. Śakunavimānam is a cross between an aircraft and a rocket (space shuttle).

Figure 2: Model of Vimāna and aircraft

In 1895, Shivashankar Bapuji Thalpad of Bombay constructed an



aircraft with an engine that flew to an altitude of 1500 feet. He was a Vedic scholar and used to teach at the J.J. School of Arts and he obtained the technology from some rare Sanskrit texts. He also wrote a book in Marathi named *Prācīna-Vimāna Vidye Chā śodha*. Lalaji Rayanji, Maharaja of Baroda, was one of the many witnesses who had seen the flying of that aircraft. After the untimely death of Prof. Thalpad, his legal heirs sold all his scripts and materials to the British.

The earliest known spectrometer (study of the interaction between matter and radiation which is used as a tool for studying the structures of atoms and molecules) was recorded by that of Maharshi Bharadvāja.

Figure 3: Ancient spectrometer

Agastya-samhitā (written by Rishi Agastya around 7000 years ago) explains the methodology involved in the construction of an electric battery (with copper as cathode and zinc amalgam as the anode). Here it is described that water can be split into oxygen and hydrogen. Thus, Agastya battery (having components like Copper plate, Earthen pot, Copper sulphate,



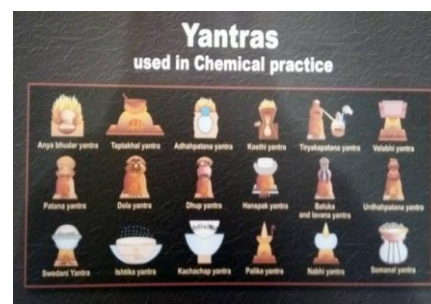
Wet sawdust, Zinc amalgam), claimed to be the oldest battery and the oldest manifestation of electro-chemical knowledge.

Figure 4: Agastya’s battery

An earthen pot is taken and covered with a clean copper plate. On the copper plate is copper sulphate above which moist sawdust is placed. On top of all these, a zinc amalgam sheet is placed on the energy known as Mitra – Varuṇa. Here Mitra means the cathode and varuṇa means anode. To intensify the power of electricity a hundred of such jars known as Shata Kumbha are connected in series. When the reaction takes place water is split into *Prāṇavāyu* (Oxygen) and *Udānavāyu* (Hydrogen). The floating hydrogen is air-tight cloth and can be further used in aerodynamic applications. This proves that, the making of dry cells was definitely a contribution by the great ancient sage Agastya.

2. Yantras (instruments) used in Chemical Practices in *Rasaśālā*:

The *Yantras* were the appliances required to prepare the standard quality of chemical substances, materials or medicines. These were designed specifically for certain procedures. Chemical treatises of ancient India refer to various types of *Yantras* for different applications. Some of these *Yantras* and their applications are given below:



Svedani-Yantra: *Svedana* in Sanskrit means sweat. The material after

heating process looks covered by water as if it had sweated, this is called *svedani-yantra*. It was used for softening of substances, *Svarasa* extraction, *Pārada-saṃskāra*, *Rasa-dravya-śodhan* and continuous slow heating of ingredients.

Dolā-Yantra (Swing apparatus): The material for purification is kept swinging in the liquid in a pot, this is named as *Dolā-yantra*.

It was used for *Rasa-dravya-śodhana*, *Pārada-śodhana*, Pottali preparation, purification of crude drugs, etc.

*Dravadravyeṇa bhāṇḍasya pūritārdhodarasya ca/
Mukhasyobhayataḥ dvāradvayam kṛtvā prayatnataḥ//
Tayostu nikṣīped daṇḍam tanmadhye svedyapoṭṭalīm/
Pralambya sūtrayogena svedayecca yathāvidhi//
Dolāyantram idaṃ khyātam munibhiḥ sūtravedibhiḥ//5*

Sthāli-Yantra: In any earthen or metallic vessel, the metallic and mineral drugs are filled with specified ‘*amla-dravya*’. The mouth of the vessel is closed and sealed with a suitable lid. The vessel is placed over fire and the contents are cooked up to the stipulated time.

This yantra is called “*Sthāli-yantra*” which is used for heating various *Rasadravya* and for *Somanathi Tāmra Bhasma* preparation.

Ulukhala-Yantra: A deep vessel shaped wooden, stone or iron mortar, having height of 16 *aṅgula*, width of 10 *aṅgula* and depth of 13 *aṅgula* is identified

as ‘*ulukhala*’. It should be very soft, shiny and strong. The pestle used should be of wood, stone or iron with enough thickness and length of 20 *aṅgula*.

It is used for powdering purpose.

Khalva-Yantra: It is used for *Bhāvanā*, preparation of *Khalviya* formulations, *Pārada-Sanskāra*, powdering, *Bhasma*-preparation etc. There are two types of *khalva-yantra* used for all the pharmaceutical procedures:

1) **Vartulākāra-(Circular)-khalva-yantra**: used for triturating different types of herbal and mineral drugs during pharmaceutical procedures.

The circular shaped iron or stone mortar with width of 12 *aṅgula*, depth of 9 *aṅgula* and height of 11 *aṅgula* is identified as *Vartula-khalva*.

2) **Droṇirūpa-(Elliptical)-khalva-yantra**: The elliptical shaped iron or stone mortar

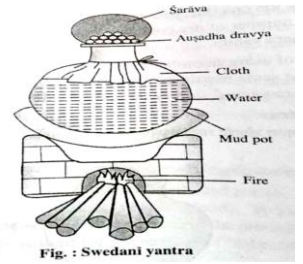


Fig. : Swedani yantra

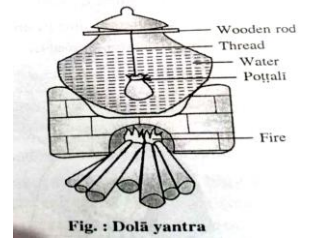
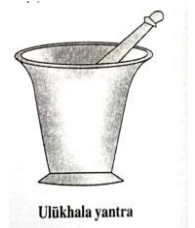


Fig. : Dolā yantra



Ulukhala yantra

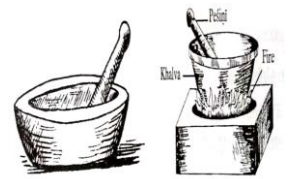


Fig. : Khalva yantra



Vartula khalva yantra



with height of 7 *āṅgula*, length of 16 *āṅgula* and width of 12 *āṅgula* is identified as *Droṇirūpa-khalva*. This *khalva-yantra* is used for pounding or triturating different types of herbal and mineral drugs during pharmaceutical procedures.

Taptakhalva-yantra: Prepared by iron, measuring 9 *āṅgula* length, 6 *āṅgula* in width and depth. The pestle is also made of iron and it should be 8 *āṅgula* length.

Kachchhapa-Yantra: A wide circular vessel measuring 15 to 20 *āṅgula* width is selected. Half of the vessel is filled with water. Now the crucible filled with the medicine is placed in the middle of the smaller vessel and it is covered inverted with a strong earthen lid, the edge of the lid is properly sealed with wet mud. Above the lid on all sides of the small vessel, the charcoal is filled and ignited. By doing so the *gandhaka-jāraṇa* takes place. This *Kachchhapa-yantra* was used for Bid *Jāraṇa* in *Pārada* and *Gandhaka-Jāraṇa*.

Ūrdhva-pātana-yantra: The word *pātana* means distillation. The apparatus in which distillation is carried out is called *pātana-yantra*. It was used for extraction of *Pārada* from Hingul, for *Hartāla*, *Mānaśilā* *Sattva-Pātana* and other sublimation purpose.

Adhaḥ-Pātana-yantra: Since mercury falls down from the upper pot in this apparatus, this is called *adhaḥpātana-yantra*. It was used for *Adhaḥpātana Sanskāra* of *Pārada* and for *Gandhaka-śodhana*.

Jāraṇārtha-Tulā-Yantra (Balance): It was used for *Gandhaka-Jāraṇa* In *Pārada* and for *Dvandamelāpan* of *Dhātu*.

Pātana-yantra- Damaru Yantra: Used for extraction of *Pārada* from Hingul, for Hartal, Manashila Sattva-patana, for other sublimation purpose, purification and distillation of Mercury.

Vidyādhara-Yantra: Used for sublimation of hard material and in *Pārada-Samskāra*.

Tīryakpātana-yantra: Utilized for Distillation of *Pārada*, purification of Mercury and extraction of herbal volatile oils.

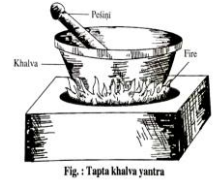


Fig : Tapta khalva yantra



Fig : Kachchhapa yantra

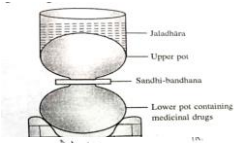


Fig : Adhab-pātana yantra

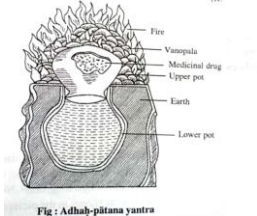


Fig : Tulā yantra

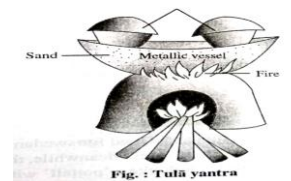


Fig : Damaru yantra

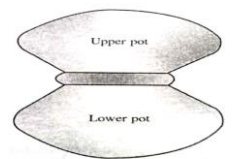


Fig : Vidyādhara yantra

Rasaratnasamuccaya - 9.47-49 says *Tīryakpātānayantra* is generally used for the collection of rasa:
Kṣīpedrasam̐ ghaṭe dīrghe natādhonālasanyute.

Tannālam̐ nikṣīpedanyaghaṭakukṣyantare khalu..

Tatra ruddhvā mṛdā samyag vadane ghaṭayor adhaḥ.

Adhastād rasakumbhasya jvālayet tīvrāpāvakaṃ..

Itarasmin ghaṭe toyam̐ prakṣipet svāduśīṭalam.

Tīryakpātānametaddhi vārtikair abhidhīyate..

(Chemicals are to be placed in a vessel having a long tube immersed in an inclined position which enters into another vessel arranged as a receiver. The mouth of the vessel along with the joints should be sealed with clay and cloth. Strong fire blown at the bottom of the vessel containing the chemicals, while, the other vessel was placed in cold water. This apparatus (used for distillation) is called *Tīryakpātānayantra* which in modern chemistry has been scientifically modified and improved as shown below:

Figure 5: Ancient *Tīryakpātānayantra* is similar to modern distillation process

Koṣṭhīyantra: Furnace having width of 16 *āṅgulas*, length and height of one *hasta* and uniform on all sides is called *koṣṭhīyantra* which is used for extracting the *Sattva* (metal content) from *Dhātus* (ores and minerals). Fill good quality Charcoal in the furnace, blow

air in sufficient quantity through the lower opening burning fire:

ṣoḍaśāṅgulavistīrṇā hastamātrāyatāśubhā.

ṣoḍaśāṅgulavistīrṇā hastamātrāyatā śubhā.

Dhātusattvanipātārtham̐ koṣṭhikā parikīrtitā..

Vanśakhādiramādhukavadarīdārusambhavaiḥ.

Paripūrṇam̐ dṛḍhāṅgārair adhovātena koṣṭhake.

Bhastrayācāntaramārgeṇa jvālayecca hutāśanam..

Dheki-Yantra : Below the neck of the pot is a hole into which is introduced the upper end of a bamboo tube, the lower end of it fitting into a brass vessel

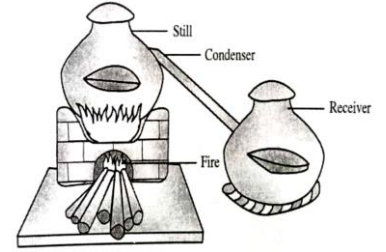
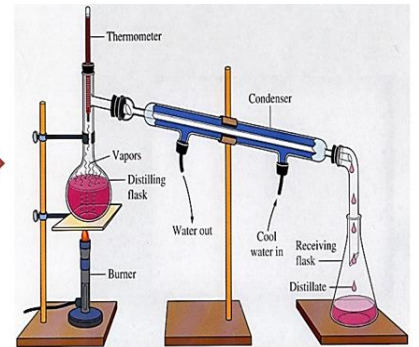
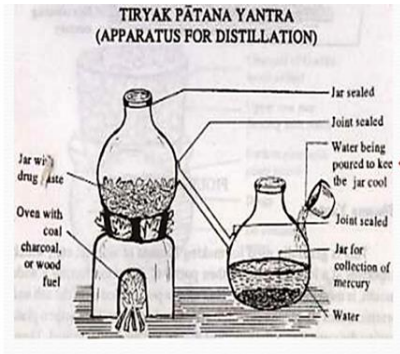


Fig. : Tīryak-pātana yantra



filled with water and made of two hemispherical halves. Mercury mixed with the proper ingredients is subjected to distillation till the receiver gets sufficiently heated.

Pālikā-Yantra: This had been used for Parpati-preparation, during preparation of various formulations and for stirring purposes.



Fig. : Pālikā yantra

Pātāla-Yantra: Used for Oil-extraction e.g. Bhalattaka oil

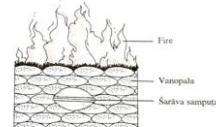


Fig. : Pūṭa yantra

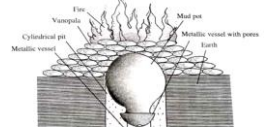


Fig. : Pātāla yantra

Puṭa-Yantra: Utilised for Bhasma-preparation, Jārana, Bhasma-testing, Sattva-pātana and for Amritikaraṇa

Vālukā-Yantra (Sand-apparatus): Used for Kūpi-Pakva-Kalpa preparation

Lavaṇa-Yantra: Similar to ‘vālukā-yantra’. Here instead of ‘vālukā’ (sand), Lavaṇa (salt) is filled around the bottle in the cylindrical iron vessel. The procedure of heat application is same as the preparation.

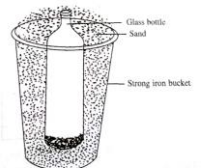
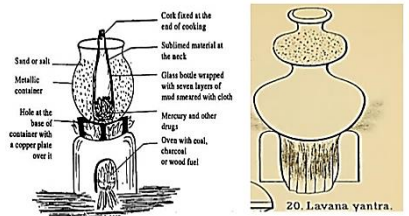


Fig. : Vālukā yantra

Bhudhārā Yantra: A wide and circular earthen vessel of cylindrical Bucket-like structure is selected. At its base, two aṅgula sand is spread. Above that, the tightly enclosed and sealed crucible containing medicine is firmly placed. Above and on all sides of the crucible, two-aṅgula thick sand is filled. Above this sand the specified number of dry cow-dung-cakes are placed and ignited. This ‘Bhudhārā-yantra’ is used for Pāradasamskāra and Gandhaka-jāraṇa in Pārada.



20. Lavana yantra.

Ghaṭa-yantra: A pot with capacity of ‘four prastha’ of water having neck of 4 aṅgula circumference is called ghaṭa-yantra or āpyāyanakayantra.

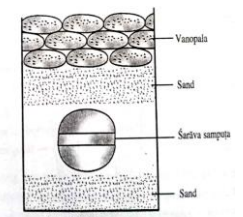


Fig. : Bhūdhara yantra

Khalva-Yantra- pestle and mortar

Figure 6: Ancient and modern mortar and pestle

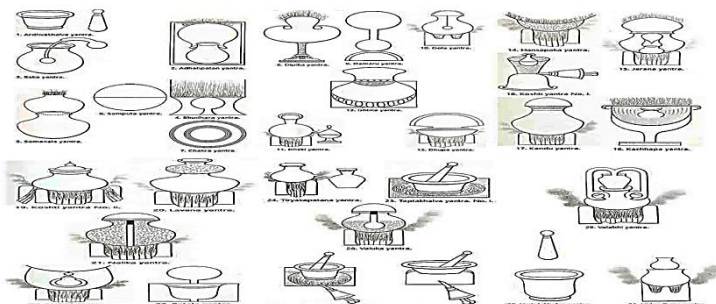


Figure 7: Different types of Yantras

Similarly, a few other yantras like Bakayantram (used as a retort for distillation), Vidyādhara-yantram (used for purification of Mercury), Bālukā-yantram (used for

purification of Medicines), Bhudhana-yantram (used for extraction of Mercury), Tapta Khalla Yantram (used for slow heating of Mercury), Vidyādara-yantra and Pātana-yantra are also described in Sankrit Texts.

3. Comparative Aspects of the Study

Ancient Indian texts pertaining to Science and Technology have been studied with the aim to decipher and decode formulae for making new materials like alloys, ceramics and glasses. A formula for making protein-rich food extract from common Indian grasses also has been deciphered. A formula for producing a protein-rich food extract (powder) from specific Indian grasses is also deciphered. The Central Food Technological Research Institute, Hyderabad has certified that the powder extracted from the specified grasses shows about 13% protein content. Other tests from nutrition and medical angles are to be taken up. This activity is aimed at producing low-cost protein rich food products (as powder, biscuits, malt etc.) based on this formula.

The modern Chemistry laboratory was utilised and the melting and cooling procedures were performed according to the directions given in Sanskrit texts. The mixing proportions were given in terms of relative units in weight. The units of temperature used were in 'Kakshyas' and the exact interpretation of 'Kakshya' is not yet known, though roughly it has been equated (as 1 Kakshya = 12.5 °C) at low temperatures (this scale may not be linear at higher temperatures). The procedure for heat treatment was also available in Sanskrit sources in terms of either sudden pouring gradual cooling or slow pouring to produce various effects and different properties. As regards the equipment to be used, in all experiments only the modern laboratory equipment was used, though descriptions in Sanskrit were varied as various types of crucibles (mooshas), bellows (bhastris) and furnaces (kundas) of ancient times (which are not available now).

Agni Sthambhana or Fire Resistance is a technique for preventing and resisting fire and burning is also developed. Two techniques/solutions have been developed for this.

- for preventing the burning of inflammable objects such as paper, cloth and wood
- for preventing burning of human body.

It has been noted that in both the above cases the fire will not be allowed to be caught (or burning to start) even after continuous exposure to flame for up to 30 seconds. (Normally fire catches any inflammable material within 0.5 seconds and any moist material within 3dampened with this liquid does not catch fire and can also be used to put off fire or escape unburnt in fire even after long exposure to flame). A patent has been obtained for this invention from Madras Patent Office.

Recently, the Birla Science Centre at Hyderabad has produced some alloys after studying some Hindu manuscripts like “**Vimāna-śāstra**” and “**Amsu-Bodhini**”. The alloys possess some extraordinary properties that are unknown to Western countries. Bharadvāja’s Vimāna-śāstra deals with advanced metallurgy, material science, machine design, mechanical engineering and rocketry. The text describes detailed procedures in the preparation of several hundreds of materials such as Alloys and Glasses which are unknown to modern science. Most of these materials can be reproduced in the laboratory even now.

Conclusion

India is so rich in the field of science and technology that even the foreigners extracted our knowledge to become modern inventors. Due to negligence most important aspects of our knowledge are either lost or stolen. Whatever is remaining there also we either lack proper technique or manpower to extract and utilise them. So, it is high time to trace the Sanskrit-based Indian knowledge system related to Ancient Indian Science and Technology which may require lots of projects to be carried out both by Sanskrit Pundits and the modern Scientists.

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