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Veṭikkampavidhi: A Malayalam Text on Pyrotechny

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Abstract

This paper deals with a Malayalam text named *Veṭikkampavidhi* or 'the manual of fireworks'. It details several firework 'recipes' or gunpowder preparations as mentioned in the text and attempts a comparison of these recipes with certain items and techniques in the near-contemporary and often the present-day pyrotechny. In the final part, it tries to offer an explanation for "theatrical uses of gunpowder" in early-modern Malabar Coast. It also carries tables presenting the gunpowder recipes prescribed in *Veṭikkampavidhi* for its two important firework-types i.e. 'the moonlight' and 'the flowers'.

Key words: Early Modern, Festivals, Fountains, Gunpowder, Malabar Coast, Moonlights, Political Power, Pyrotechny, Rockets.

1. Introduction

This paper deals with a vernacular text on fireworks. It is titled *Veṭikkampavidhi* or 'the manual of fireworks'. The present version of the text, being reprinted from *The Annals of Oriental Research*, Volume X, Part II, is published from the University of Madras in the year 1953(Sharma 1953). Composed in Malayalam some time before the 19th century, it explains a descriptive set of chemical recipes and technical instruments which have shaped pyrotechnic performances in the region in several local festival-complexes. The text before us, as we go by the introductory remarks of its editor K.V. Sharma, was based on a set of manuscripts from the Government Oriental Manuscripts Library, Madras and Travancore University Manuscript Library, Trivandrum. However, none of them carry any information about their date(s) and the authorship. Except a 'seemingly old' palm-leaf codex from Travancore, all these manuscripts were recent additions to their parent repositories. One manuscript from the Madras collection i.e., D.308, provides an indication of its status before it was transcribed into the present state, that 'it was acquired from the British *moffusil* Calicut and belonged to the *granthā* collection of C.M. Raricchan Mooppan'.

Before attempting an analytical description of the gunpowder recipes mentioned in the text, it is important to have a brief look at the history of pyrotechny in Southern India. This may help us to locate *Veṭikkampavidhi* within the historiography of Indian gunpowder which, among many other things, deals with the questions about the social use of technology and its possible transmission. As it is well-known, the art of fabricating recreational gunpowder displays was of Chinese origin, and its seasonal practice, at least up to 13th century, was more or less limited within the cultural world of well-settled Sung gentry (Needham et al., 1986, pp. 127-161). But, its incendiary deployment as a discreet science of making projectile-throwing devices with controllable chemical energy, especially in porous

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frontiers of war or war-like siege, goes to the credit of semi-sedentary warrior Mongols and later, perhaps through them, to the trading Arabs of an expanding Islamic polity. Its introduction to the Indian subcontinent was dated somewhere in the late 13th or in the first half of the 14th centuries when Mongol war-bands knocked Delhi Sultanate's north-western 'boarders' with their niter-enriched denotations and fire-throwing catapults (Khan 1996). Later, by the early 16th century, with the great 'Gunpowder Empire' of Mughals appearing in the sub-continental scene (Streusand, 2011), pyrotechny emerged as a specialized field of technical expertise with universal acceptance and portability (Gommans, 2002, pps.67-97 and 149-162). It also acquired serious political connotations—*vis-à-vis* the accepted norms of the kingly rule and authority—particularly when certain light pyrotechnic arms like muskets and 'rockets' were used by those who opposed an existing political order (Khan 2002; 2004).

Historians generally consider the post-16th century distribution of pyrotechnic crafts in Southern India as integrally connected with the territorial spread from the north, of the Mughal 'high-culture'. Just like courtly Persian, the culture of firearms, both in its ornamental and in war varieties, had gone deep into the making of regional aristocratic and kingly formations in Deccan and in Coromandel (Apte, 1958; Balasubramaniam et al., 2004; Roy 2014). On the Coast of Malabar or the Arabian Sea littoral lying south of Goa, the institutional presence of European trade was largely understood as playing a crucial role—perhaps much akin to that of the Imperial Mughal's in the Indian north—in the diffusion of gunpowder and its pyrotechnic adepts. For an influential section among historians, this process represented an entirely new chapter in the course of regional history and had brought unprecedented or catastrophic 'impacts'. During the 16th and 17th centuries, it simultaneously signalled the rise of European trading-companies and the political decline of the existing native principalities. Both in Keladi and in Calicut, or even in the southern kingdom of Cochin, the 'import' of gunpowder was historiographically approached as one of the most important reasons in triggering centrifugal tendencies among the native lordship and perhaps most importantly, in creating permanent political asymmetries in favour of 'foreign' powers (Swaminathan, 1957, p. 107 and 146; Chitnis, 1974, p. 163 and 188; Kudva, 1972, p. 96; Panikkar, 1929; s'Jacob, 2000, p. 77, 105 and 135; Malekandathil, 2010). The import of gunpowder ultimately culminated in the military victory over the native swordsmen and archers, at first, of the Mysore's horse-mounted gunners and shortly afterwards, almost by *c* 1792, of the English East India Company's well-drilled soldiery.

However, if one looks at the usual (or perhaps, the remembered) pattern of gunpowder use in medieval Malabar, the catastrophic impact of pyrotechny is less discernable. Even in the context of chronic political rivalry or status-dispute; the variety that one often finds as existing between the Zamorins of Calicut and the 'kings' of Valluvanāḍu (Haridas, 2016, pp.290-303), the incendiary deployment of gunpowder, despite its popular familiarity within the native realm,[1] was

[1] Though lacked onboard artillery, the medieval Malabar trading-ships were reportedly equipped with incendiary devices called 'stinkpots'. By the early 15th century, the fleet of Zamorin was said to have comprised "160 *paros* and each *paros* had two guns" (Stanziani, 2014, p.22). When the Portuguese first reached Malabar, "they found people with the technology of manufacturing gunpowder. Gasper Correa's chronicle *Lands da India* mentioned a 'gunpowder house' (*a casa de pollvora*) at Calicut" (Buchanan 2006, p. 184). For Faria y Souza, "Zamorin's fleet in 1503, carried 382 guns" and for the Italian Ludovico Varthema, 'the number of guns was somewhere between 450 and 500' (Partington, 1999, p.223). By the late 17th century, the port-city of Calicut presented, in comparison with contemporary Surat, an affordable gunpowder market for the English East India Company (Young 1937, p. 63).

almost a rare-occurrence. Rather, the contemporary sources talk about several instances of non-military pyrotechny spectacles. They were seen primarily as symbolic embellishments of political power and audacity. The preferred weapons of real combat, however, remained more or less 'conventional', including swords, pikes and spears (Devi, 1976). References to 'firework castles' in the river-side festival of Māmānkam (Ayyar, 1939, p. 100) and the legendary tale of a 'deceptive fire-work box'[2] indicate a deep-rooted familiarity among the native population about the technique of pyrotechny. It also underlines fast routinization of gunpowder within the contemporary political culture.

Iqtidar Alam Khan had already suggested the possibility of an unmediated Chinese connection for the gunpowder use in South Western India. 'As early as *c.*1419, Chinese trading ships were reported as bringing *bombarde* to the port of Calicut' (Khan, 1996, p.43) and 'the record of Chinese missions of 'diplomatic' nature in fact dates back to the late 13th century'. "By the first half of 14th century, these vessels were no longer a rarity along the shipping lanes across the Bay of Bengal" (Sen 2006, p.425) and some of them, if we follow certain recent conclusions from numismatics (Sarasan, 2014) and medieval archaeology (Karashima, 1989; 2004), went well into the Arabian Sea, towards Malabar ports such as Quilon, Cochin, Calicut and Dharmapattanam (Rockhill, 1915; Ptak, 1989; 1987; 2003). In his discussion on 'Thikkal-Kadakkarappally boat' (Nair et al. 2004) historian Tansen Sen indicated the 'transmission of Chinese shipbuilding technique and its local adaption in Malabar Coast during this period' (Sen, 2006, p.425). 'Frequenting Chinese ships had not only introduced their designs to the local ship-builders' but, perhaps more pronouncedly, they transacted some of the key ingredients crucial to the regional craftsmanship in early modern metallurgy and alchemy. In an interesting discussion of the trade between 'Kerala' and China between 10th and 16th centuries, Raghava Varier showed the Chinese imports contained articles like copper, tin, lead, quick-silver, dammar, mercury and camphor (Varier, 2010).[3] All these items, apart from their familiar use as 'qualified substances' in regional pharmacopeia and occult, were also used by the makers of countryside fire-works for which the text *Vemikkampavidhi* provides an important testimony. Even after the official cessation of India-bound voyages from China late in the 15th century, Arab and the South East Asian traders might have continued to circulate materials for the workplaces of Malabar fire-workmen. Given the high level of sophistication in the festive pyrotechny in the contemporary Sino-Arabic civilizations, it is quite appropriate (unless one succumbs to the idea of extremely incompatible and insulated medieval cultures) to argue for a possible transmission of technical inputs from the Far-East and West Asia. They probably functioned not as absolute standards diffused from an alleged 'grand-tradition'. Rather, if we adopt a broad parallelism from early modern literary practice, these inputs worked as meters of adaptable craftsmanship which allowed meticulous sculpting of diverse and context-sensitive concoctions.

2. Date of Composition and Authorship

K.V. Sharma introduces one Tiṛumaṅgalattu Nīlakaṇṭañ Mūssatu as the author

[2] There is an interesting account of fire-work competition in the Madras Oriental Manuscript Collection. It is titled *Upāyatantrabalam* and the text talks about the story of a 'deceptive wooden box' or the *pemmi* containing camouflaged fire-works. The 'box' was being sent, as if a good-will gesture, to embarrass the king *Zamorin* by his northern contender; the king of Kōlam Svarūpam or the Kōlathiri. It "was so constructed as to burst into flames when opened" (Mukundan 1961; Eraly 2006, p. 48).

[3] For a more detailed and perhaps less a conjectural inventory of the 12th and 13th century Chinese trade in the Indian Ocean, see; (Hirth and Rockhill 1911).

of *Veṭikkampavidhi*. To him, it was written in 16th century. But, as mentioned above, neither the date of composition nor the authorship are indicated anywhere in transcribed portion of the text. Rather, just like many other museum-transcribers of his generation, K. V. Sharma perhaps followed an existing belief, alive in the regional literary tradition, to decide *Veṭikkampavidhi*'s authorship. For him, Tiṛumañgalattu Nīlakaṇṭan, 'a half-Brahmin' of Mūssatu variety (Thurston, 1909, p.121 and 124-125), lived during the middle of the16th century CE, around the old Vishu shrine of Rayirimangalam in the Tirur division of British Ponnani (Sharma 1953, p.2). Nīlakaṇṭan had been famed for his profound exegetical enterprise in different fields of contemporary technical cannon. His contributions were surprisingly eclectic and diverse, and included in their purview fields as different as elephentology, architecture and traditional rhetoric. But, like most of the scholarly figures from medieval 'Kēṛaḷam', both his historical personality and his contributions still remain enigmatic.

For instance, *Mātaṅgalīla* (literally, 'the play of elephant'); a *maṇipravāḷam* treatise on rearing captured and domesticated elephants was credited to him (Ganapatisastri, 1910), though the text "says nothing about its author nor is there any evidence as to its date of composition" (Edgerton, 1985, p. vii). *Mātaṅgalīla*, following an indication in its opening and closing couplets, was considered to be an abridgement from Pālakāpya's much elaborate *Hastāyurveda* or 'the *Āyurveda* of elephants'. Similarly, *Manuṣyālaya Candrikā* a popular *vāstu* instruction, drafted after the late-15th century treatise on local *tantra* liturgy; *Tantrasamuccayam* (of 'Jayantamaṅgalam' Cennās Nāṛayaṇan Nampūtiri), was also been stated in his account. The name 'Nīlakaṇṭa' is mentioned in *Manuṣyālaya Candrikā* (Namboothiri, 2011, p.5) but the text doesn't carry any indication regarding his date. Early antiquarian transcribers, assuming Nīlakaṇṭañ as a near-contemporary of 'Jayantamaṅgalam', tagged Manuṣyālaya Candrika and its alleged author with the early -16th century (Ganapatisastri, 1917) and this wisdom was *inter alia* received by K. V. Sharma in conjecturally allocating *Veṭikkampavidhi* a same provenance. Meanwhile, K. Parameswara Menon, one of the early commentators of *Manuṣyālaya Candrikā*, questioned its date and authorship and pushed its alleged composer; Nīlakaṇṭa into the 17th century (Menon 1103ME, pp. iv-vi). Ulloor S. Parameswara Iyyer, one of early chroniclers of Malayalam literature, did not even accept *Veṭikkampavidhi* , on the basis of its nondescript meters and language, as a text authentically authored by 'scholarly Nīlakaṇṭa' (Iyyer, 1990, p. 627).

Uncertain authorship is not particular to *Veṭikkampavidhi* . Instead, it, as a trait, was shared by many pre-modern Malayalam texts, particularly those discussing certain aspects of technical information, often written in an exegetical fashion. Vernacular works, literary or otherwise, when written or re-composed (or even, sung) could be named after some iconic 'authors'; those who already had attained a real-like template persona in ongoing intellectual tradition. An author's name may appear somewhere in their conventional colophon, but other than appearing as if an auspicious motif, (perhaps to catch a wider acceptance, and to ward-off potential discredit) it does not carry any authorial finality. Texts, imparting practice-based secular information, are more inclined towards abrupt interpolations and periodical revisions than those dealing with regional sectarian cannon and frozen literary treatise. In its usage of vernacular, *Veṭikkampavidhi* moves closer with other 'minor' technical texts in Malayalam like *Kūpaśāstram* (Achari, 1997),[4] *Khaḍgaśāstram* (Kunhanpilla

[4] A slightly different version of the *Kūpasāstram is* also available as '*Jalaparijānam*'. See; (Nambuthiripad 2004)

1958), *Kṛṣigīta* (Kumar 2008) and *Nāyāṗṗuvidhi*.[5] All of them, after their style of presentation, language and subject, were agreed upon as 'recent compositions' being produced in, perhaps not earlier than, the 18th century. In its presentation of factual descriptions, *Veṭikkampavidhi* is notably similar to the texts like *Kṛṣigīta* and *Kūpaśāstram*. In designating its otherwise mysterious chemical recipes with interesting (metaphorical) titles and taxonomies, it is comparable with *Nāyāṭṭuvidhi*. All of them are strikingly empirical in presenting information pertaining to their respective fields, and remember us of an early-modern ethnographic and observational paradigm which was recently argued as informing South Indian realms of imagination and creativity (Shulman, 2012).

3. *Veṭikkampavidhi* : Body of the Text

Veṭikkampavidhi is divided into two 'usual' segments (*bhāgam*). The *pūrva* or the first contains 59 *slōkas* including a *maṅgala ślōka* in praise of lord Śiva of Sṛīmaṅgalam (in his *nīlakaṇṭa* from), Gaṇapati and the *guru*. The *uttarabhāgam* or 'the following segment' is comparatively small with 17 couplets and has a separate *maṅgala ślōka*. While the first deals the preparation of firework varieties, the second has a short, but an unequivocal instruction for setting up a firework display; *kampa prāsāda* or 'a castle of fireworks'. The present version also carries brief descriptions of pyrotechnic 'batteries' (*kaṛimaṛunnin-prayogam*), the preparation of purified (non-deliquescent) nitre and a recipe of *cīnaccaṭṭi-parāgam*. In its first segment, *Veṭikkampavidhi* explains three major firework-types. They are the following; (a) *nilāvu* or the 'moonlight', (b) *pūkkal* or 'the flowers' (c) *ākāśa-vāṇam* or the sky-rocket. Minor but indispensible attractions like hand-held sparklers (*pūthiṛi*), cakes (*miśukku*) and starry-balls (*nakṣatramuṇḍa*) are also found a place in the text. Firework-types and performances are of course, seem 'old-fashioned', and it is nearly impossible to seek their parallels from the present day industry. However, this paper believes that without such occasional cross-references, many among *Veṭikkampavidhi* recipeis may sound unintelligible and mysterious.

3.1 *Nilāvu* or the 'Moonlight'

In its opening section, *Veṭikkampavidhi* deals with the preparation of a spectacular burning effect called *nilāvu* which, if we could afford a literal translation, poetically connotes 'an awesome moonlight'. Since we are not left with any clues regarding its noise-effect or report, *nilāvu* perhaps corresponds to those out-door firework varieties producing a coloured fire-spectra, familiar in the contemporary theatrical pyrotechnics as 'the coloured fire'(Werrett 2010, p.229). Five recipes [Table 1(a) to 1(e)] are classed under this title on the basis of their desired colour-tones. Hence, being seen from *Veṭikkampavidhi*, 'moonlights' could never be monochromic rather they, if well-prepared in their respective *vidhi*, can light as *tūveṇṇa* or snowy-white, *śuddha* or clear, *nīla* or bluish, *pacca* or greeny and at last, *ṛaktam* or the red; but all species of visible light are dependent on certain chemical addictives or colorants (Russell, 2009, p. 133). Unfortunately, though the illuminant compositions for each

[5] The text *Nāyāṭṭuvidhi* is a pre-19th century *vidhi* or the 'prescription' drafted supposedly for the conduct of community hunting. It contains encrypted descriptions of various wild animals and the manner of hunting them down (Kunhanpilla 1956). Ritual specialists form the nāyar-owned Śāsta and Vettakkorumakan temples in North Malabar connect this text with a hunting-ritual named 'Tulām Pathu'. It was held on the tenth day in the Malayalam month of Tulam (October-November). The whole text, they say, was recited aloud in front of the deity as the hunting party leave towards forest with bows, arrows, knives and sometimes, with country-made matchlocks. They also carried trained hunting-dogs, net traps and harpoons. The rite of recitation, as if in Teyyam performances, was intended to invoke the guardian spirits of the hunting-grounds and solicit their permission for the safe conduct of the hunters. Though written in Malayalam, Nāyāmmuvidhi's style of narration is noticeably diffident from the known versions of contemporary prose, as it is available from the texts like *Keralolpathi* and *Brahmaṇṭṇapurāṇṇam*. For a comparison see; (Gundart 1868; Sastri 1936).

'moonlight' type are well described with specific ingredients and their relative measurements, the text does not talk us about the causative agents (or about a particular chemical process) which render a firework its characteristic coloured glare.

Interestingly, this silence in explaining apparent reason(s) behind an observable physical effect is not particular to the 'moonlights'. Instead, it is been maintained, as if a narrative trait, in all *Veṭikkampavidhi* sections and this, in effect, makes the text highly condensed and *sūtra*-like: at times hard to understand! What all we could possibly achieve in this direction is through a delicate comparison among these five given recipes. A finely ground mixture of saltpetre (*uppu*) and sulphur (*gandhakam*) is prescribed as the essential component (but being concocted in appropriate proportions) for all *Veṭikkampavidhi* varieties. But, for 'moonlights', which are indeed burn-slow flares, this extremely inflammable compound is directed to be prepared in a semi-liquid base of a coolant pulp, made of rice-starch (*kaṇji-vellam*), egg-white (*kōlimumma jalam*) and ' the seeds of wild-castor'[6](*āvaṇukkin bījam*). Surprisingly, the charcoal (*kaṛi*), an unavoidable fuel element in pre-modern incendiary gunpowder (Marsh and McLaren, 1982) is almost absent from the 'moonlight' recipe. Out of five, it does involve in the preparation of only one 'moonlight' i.e., in the red variety. However, this entry is after its enticing capacity to produce lasting reddish-golden sparks when ignited in small quantities in a mixture of saltpetre and sulphur. Recipe of the 'red moonlight' includes significant quantities of an indigenous botanic substance called *paṇtan* or dammar which is a resinous extract from the 'Poinou' tree or *Vateria indica*, Linn (Anonymous Author 1833, p.282). Being known to Dr. Francis Buchanan as *Dupada Maram* (Buchanan, 1807, p. 89 and 101), this tree was been tapped for its ignitable resin which was used, owing to its 'superior hardness, agreeable fragrance and the capability to give clear light with little smoke', in Malabar to make candles and country-varnish (Cooke 1874, p. 88).[7] It is this quality of being smokeless while burning made dammar's entry into the red 'moonlight' recipe, perhaps as an organic substitute for the opacifying charcoal.

[6] These are the seeds of *Ricinus communis* Linn. It is one of the most common medicinal plants found in Malabar. Interestingly, due to some reasons yet unknown, the plant was called 'figueira de Inferno' or 'the little fig-tree of the hell' (Birch 1877, p. 79) and its seeds were significantly used for extracting a much demanded slow-burning 'lamp-oil' (Hawkes 1858, p. 2)

[7] History of candle making in Malabar, though the technique was never surfaced as a *jāti*-bound 'guild craft', is of great importance. Just like fire-works, chandlery when it was attempted in this region represents an interesting instance of early-modern technological adaptation. Despite the natural preference for vegetable oil-laps in tropical, Hinduised, liturgy (Devarajan, 1981), wax-candles make their appearance (perhaps, for the first time) by the early 16th century. It was possibly one of the results of the 'cross-cultural communication' between *Serra* Christians and the Goan *padroado*. As early as 1523, (altar) candles appear in a 'letter of alliance' written by Mar Jacob of Ankamāli to the then Roman Pope (Frykenberg 2003, p.41). This was almost a century earlier than the date that the Indologist, P. K. Gode had ascribed to the introduction of candles into Indian subcontinent (Gode 1951). By the 17th century, the use of candles, as a household artefact, had become popular, at least among Latinized Christians and the Cochin Jews. The latter group reportedly was fast in replacing their stone-made *Sabbath* lamps "with tallow candles in candlesticks" (Slapak 1995, p. 91) The decree 23rd of the Synod of Diamper (1599) however restricted its prescription to 'the candles, made of wax', as they "be the best" on "the day of our lady's purification" either "in the Church before the mass" or that "shall be brought by the people out of devotion" (Geddes 1694, p. 366). The substance of which these candles were been made is still a matter of high speculation. Unlike in contemporary Europe, the use of purified animal fat or the stearin for making candles was almost unknown in entire Malabar. Instead, beeswax and "cinnamon wax" were the easily available options (Seba 1729, p. 106). In the Indian north, including Maratha Deccan, the technique of making beeswax candles was influenced by the courtly traditions of Islamicate artificial lighting (Habib1985). But, both beeswax and cinnamon-wax were highly expensive and predictably unaffordable to an expanding popular need. In the history of Chinese chandlery, Joseph Needham talked off a gradual substitution of beeswax with easily obtainable substances such as mineral wax and tallow-tree wax by the Yuan period (Needham et al. 2004, p.80). As the social demand for a safe and sweet-smelling in-door light became widespread in Malabar, the technical possibility of tapping certain native resinous trees might have explored. This apparently led depending two wax-producing tropical species i.e., Illupie tree (*Bassia longifolia*) and Peynie marum (*Veteria indica*). "The

Greeny 'moonlight' has a more complex recipe with customized measures of red-orpiment[8] (*maneyola*), tutenag (*tūttināk*am) and a couple of substances referred to as '*nīlam*' and *cempiṅpūppu*. '*Nīlam*' could either, as if in Chinese coloured fireworks (Perkins 2013, p. 159), be the plant-indigo or involve tiny particles of an alumina-rich blue-gemstone; the Sapphire (Hoey1880, p.55). Similarly, though '*cempiṅ-pūppu'* literally points to the pale-green patina layer, usually appears in exposed copper objects; it, in our case, can either be the carbonate of copper or the cupric acetate. Despite this ambiguity in the text, all these components were familiar to the contemporary pyrotechny as green colouring agents (Anonymous Author 1835, p. 35)

In many south Indian languages, '*Tūtthanākam*' referred zinc (Ainslie 1858, p.13). But, *Tūtthināk*am, as it was used in *Vemikkampavidhi* , could be a sulphate of zinc or *tutenag*; a white-metal which was known for its capacity, when used as fillings with gunpowder, 'to produce brilliant stars and spangles' (Bingley 1821, p.210). 'Bluish' and 'Clear' 'moonlights' have a similar composition. They contain the colorants like *nīlam* and *aritālam* or the orpiment.[9] Only difference is the presence of powdered copper (*cempiñ-paṛāgam*) in 'clear-moonlight's recipe which was supposed to render it a perfect yellow tone. The moonlight 'snowy-white' has antimony (*pācāṇam*), camphor and pearl as its colorants. Among these, the camphor or *karpūram* is included in significant quantities. It could be a recent derivation from the mediaeval Arabic alchemy where "it, since 9th century, was used as a light pigment in explosive *mçlange du salpêtre* (Donkin 1999, p.160). In India, none of the existing Sanskrit sources refer it to as a gunpowder ingredient (Gode 1960).

3.2. Flowers; but made of Fire!

Veṭikkampavidhi presents a good variety of coloured-spark emitting fountains, known by a generic name; *Pūkkal* or 'the Flower'. They sit on ground and produce an upward, lasting shower of sparkling stars and glitters which, if we look at present-day Sivakasi (Moulik, and Purushotham 1982), preparations, can rise up to twenty feet from their burning base. Flowers normally don't shoot fan-shaped or starry high-blasts into the sky; rather, they are, as their specific *vidhi* names indicate, predominantly blooming ground-flowers. Out of eighteen preparations of 'flowers', only two—the saucer shaped flower-wheel or *kapāla-cakrappu* and the throw-wheel (*ērucakram*)—are seemingly kinetic devises with some kind of areal effect. All others, but one—known as *kaippū* or hand-held flower—are stationary and produce falling fire towers.

The text talks about nineteen separate 'flower' recipes (Table 2). However, a nitre-sulphur-charcoal mixture, giving allusions to the quasi-mythic *agnicūrṇa* (Oppert 1888, p. 65; Mithra1963) appears as their fundamental chemical base. Interestingly, in a couple of 'flower' preparations given in *ślōkas* 31 and 37, *Veṭikkampavidhi* does, perhaps following its Sanskritic forerunners (Sarkar 1975, p.236; Dikshitar 1944, p.105) stick on to the use of *arka*

oil expressed from the seed of *Bassia longifolia* was white and solid at common temperatures" (Anonymous Author 1852, p. 82). Butter or the *doopada* was obtained from the fruit of *Veteria indica* which was large and quick growing tree, abundant in Malabar and Canara. "It is a consistent hard salt-butter of white or yellowish white, and in the shade, it always remains solid". Edward Balfour has in fact provided a detailed account of the native method of preparing wax from *Veteria indica* by boiling its crushed seeds with water (Balfour 1873, p. 186). Though the volume of native production of wax-candles along the Coast of Malabar is unknown, it was no way insignificant. In 1750, Zamorin's functionaries at Calicut were seen introducing a 'custom-duty' at the port on the wax-candles exported by the English East India Company (Malayil 2016, p121).

[8] Arsenic realgar or the bi-sulphate of Arsenic

[9] Tri-sulphate of Arsenic or the 'Yellow Arsenic'

(or *Calotopis gigantea* R. Br.) charcoal. Remaining recipes go for a local, but an excellent, charcoal source. This is *Erythrina indica* Linn.(or *muṛikku*); a deciduous, medium-sized, spiny tree which was abundant in this region as a cultivated/ living pepper-(vine)-stand (Innes 1908, p. 223) and it, 'being light and not spongy', was ideal for making quality gunpowder' (Braddock 1832, p. 12) Country-steel or the 'wootz' (Buchanan, 1807, pp. 436-440; Srinivasan and Rahgunathan, 2004) is another important constituent that it appears in sixteen 'flower' preparations. Known as *uṛukku* (Yule and Burnell 1903, p. 972), it, along with its less-carburetted relation; wrought-iron (*iṛumbu*), was a chief ornamental ingredient in pyrotechny "from the property which it has of burning with brilliant sparks when highly heated". When compared to malleable native crude-iron *or pacciṛumbu* (Gundart 1872, p. 558), carburetted iron varieties are "more combustible and yield the most sparks and the finest light" (MacCulloch, 1832, p. 222). In their fleeting atmospheric effect, these 'flowers' might have brightening golden issues. But, *Veṭikkampavidhi* does not offer any conclusive answers. However, in *slōkas* 30 and 32, 'flowers' with identifiable colour effects, other than the crimson or the golden, are described. In *slōka* 32, a 'flower' named *nīlappū* or 'the blue flower' is described. Its recipe contains copper, brass and *tūtthināk*am, and it could be capable of producing sparkling fire in aquamarine since the sulphate of zinc must have assured a law rate inflammation of blue and greeny colorants like copper and brass. *Slōka* 30, dealing with *puṣpam nūttemmumannam* or 'the flower of one hundred and eight earths' has the most exciting recipe among all *Veṭikkampavidhi* 'flowers'. It has the highest variety of chemical agents and desired effects. Among other things, it mentions a measure of '*cīnaccammi-paṛāgam*' as an important ingredient. If we follow the information given in 'appendix II' (Sharma, 1953, p. 54), *cīnaccammi-paṛāgam* is described as a blend of glass (*cillu*), clay (*śīlamṇṇu*) and a substance called *veḷuthīyam* (white-metal zinc or the white-lead;[10] all well-powdered and melted together in a metallic flux of cast-iron. Broken pieces of *cīnaccaḥḥi* (the round-bottomed, deep-cooking wok),[11] when this mixture was put in crucible (*mūśa*), could provide a fine cast-iron base. The recipe also contains colour giving and illuminating metallic dusts of copper, lead, wootz and a sulphate of zinc. However, we are left with no clues regarding the inflammable effects of its organic—carbon and calcium bearing—ingredients like shell and grained coconut husk.

With regards to their projectile containers, 'flowers' fall into two broad categories. The first variety is cylindrical. They are referred to in *slōka* 33 as made of 'bamboo' (*muḷa*), perhaps from some sturdy verities of locally available *bambusa* like *kāllañ muḷa* ('male bamboo' or *Dendrocalamus strictus*) or *kāyaí* ('the giant clumping bamboo' or *Bambusa arudinacea*). In one case, (*śloka* 31) the cylinder is specified as of *vṣṇu kāṅṭam* or the light hedgerow-bamboo. Two *ślokas* (i.e. 23 and 34) give allusion to a second type which was oval-shaped moving containers of unknown made with cascading sky issues (Sreedharan, 2005, p. 271).

In *Veṭikkampavidhi*, the description of 'flowers' is followed by a small section (*slōkas* 39 and 40) explaining the preparation of 'Roman-candle'-like multiple areal effects or *pūkkiḷāvu* which were stated as being enclosed in green bamboo shells and presumably launched by a 'lifting charge'(Russell,2009 104-109). These shells enclose compressed partitions of

[10] White-lead or '*Ceruse':* It is "made by suspending thin plates of lead over heated vinegar in such a manner that the vapour which arises from the acid may circulate about the plates. By this process the plates become at length entirely corroded and converted into a heavy white powder". Bingley 1921, p. 205.

[11] The traditional iron cooking-wok of Malabar is believed to be of Chinese origin (Malekkandathil, 2004, p. 32).It is called '*cīnaccammi'* and is a common household utensil in Kerala. It is used almost like a deep frying-pan (Kannampilly 2003, p.16).

'moonlight' and 'star-emitting' recipes and were divided by a wall of secured paper or *kaḍalāssu* sheets. The 'lifting charge' propellant was made by mixing sulphur with cotton seeds (*paṛuthi kkuṛu*) and coconut oil (*nāḷīkēṛa tailam*). The latter was intended to bring down heat in the sulphur combustion chamber which, if left uncontrolled, could have eaten up the whole otherwise delicate apparatus.

4. Rockets

In the early histories of Indian technology, *bāṇa* (written also as '*bāṇ')* had a special position. The term often meant an arrow or war-rocket with a limited filed use (Shakespear 1834, p. viii; Elliot 1875, p. 470). But, it was considered by many as belonging to an antique class of *puṛāṇic* incendiary devices with an enormous (almost unbelievable) strike force (Ray1938). Duarte Barbosa, while visiting South Western India (Cambay) in the first half of 16th century, had reported, possibly for the first time, its use in an event of festive pyrotechny (Dames1918, p. 117) which, according to P. K Gode, had later turned out to be its principal domain (Gode, 1960, p. 42). The present version of *Veṭikkampavidhi* mentions firework-rockets of toy-type in two separate sections. The first, (*slōka* 18 to22) where toy-rockets are called by a generic name '*ākāśa-vāṇa*', deals with their technical design. The second, starting from *slōka* 46, contains '*Vāṇalakṣaṇam*' or 'a classification of rocket-types'. It also provides details on the composition of gunpowder propellants which, as this text argues, differentiates one firework from the other. Let us have a look at the *Vāṇalakṣaṇa* section. It classifies, seemingly on the basis of desired visual effects and propelling compositions, nine toy-rockets. While the first four rockets are explained by their discreet visual effects, the second group of five is classed as per the colours of their ejection charge. *Cāntrikāvṛtijam* or 'the moon-like wick' is explained as an ascending (*paśccād-āṛōham*) rocket-spindle or *cakram* (*slōka 47)*. The second is *Chatrākāram* or 'the umbrella type'. This could be a rocket-spindle with the capacity to emit fan-shaped multi-shots. *Puṣpa-cakram* or the flower-spindle is presented as a high powered rocket that it can 'rise up to the height of a mountain' (*śringha cakram).* The next toy, *Cāmaṛam* or 'the flywhisk-shaped' does not belong to the class of rocket-spindles. Instead, it is described as a rocket-multi-shot, capable of carrying silver (*mallika*) coloured showers in its front 'head'. On the basis of their ejection charge (colour and velocity of which, in turn, were defined by the chemical composition of the chamber payload) rockets are of five types. They can be of white (*veḷutha*), smoggy black (*kaṛutha*), red (*cuvanna*), pink (*pāṭala*) and swift (*āśuka*) according to their meticulously differentiated gunpowder load. Its final *ślokas,* instead, present a less-interesting list of different propellant compositions with saltpetre, sulphur and charcoal.

When compared with the classificatory *ślokas* in *Vāṇalakṣaṇam*, those in the first section, dealing with the design of toy-rocket fireworks, are more explanatory. They start with describing *akāśa-vāṇam* or the sky-rocket. *Akāśa-vāṇam* has an effect-containing 'head' in the front which would work as a 'rocket-shell' till the end of an ignited flight. This 'head' has to be well-packed in advance with a *kiḷi-pramāṇam* or a payload, being coiled in cloth (*vastram*) and should contain 'moonlights' and starry illuminates (*nakṣatṛam*). The 'head' portion is followed by a 'motor'-chamber (or the rocket-case) being loaded with a quantity of gunpowder propellant (*maṛunnu*) though its volume varies according to the rocket type. With regards to the toy-rocket design, *Veṭikkampavidhi* gives no clear answers. Rather, it offers a passing note that rocket-bodies can have two parts i.e. *kutti* (the cylinder or peg) and *vāl´* (the *tail*). The cylinder or *kutti* portion, like in the case of aforesaid *akāśa-vāṇam* may contain a simple petition with a single areal-effect. But, as suggested in *śloka* 57, a rocket, if intended to function as a double-break, must have a cylinder

with multiple partitions, made of clayey choke of earth or mud (*maṇṇu*) where gunpowder could be packed in greater densities. Rocket-tails, except in a couple of preparations, are to be static and, in the case of a large *akāśa-vāṇam*, the tail is specified in the form of 'a stick', but in same weight as of the entire cylinder segment. However, for small *akāśa*-rockets, the tail tend to be much elongated and a little falling; as if in the present day 'festoons' or bag-rockets (Russel, 2009 , p 54). There are special instructions to drill (multiple) nozzles (*tuḷa*) and to fix fuses (*tiri*) in the cylinder against its desired direction of areal motion.

Despite providing all these apparent factual details, the text gives no answers against a crucial question which has been repeatedly raised in the history of Indian rockets. What was material with which these rocket cylinders were made or directed to be made? Any indications in this direction could have helped us in comparing them with their near-contemporary war-rockets from 18th century Mysore (Narasimha, 1999). 'Mysore Rockets' were country-made, iron-cased rocket artillery which was extensively deployed in all Anglo-Mysore wars (Roy 2005). These 'flying plagues' "combined missile power of a javelin with an impulse of gunpowder" and often worked 'considerable havoc'. 'It was difficult avoid them' (Anonymous Author 1804, p.130). Their technology was concluded as 'decisive' in informing both the technological (Jaim and Jaim, 2011) and the disciplinary makeup of early 19th century English rocketry (Warrett, 2009). 'Mysore-rockets' were acclaimed for their innovation of incorporating heat-enduring metallic cylinder-chambers for carrying the propellant (Baber 1996, pp. 68-69) with an ordinary country sky-rocket (Anonymous Author 1804, p.30). 'Iron-tubes' or cylinders (of malleable crude-iron) rendered them higher range and thrust and made these gadgets 'fly like an arrow to the distance of upward of a thousand yards' (Dirom, 1793, p. 295). But, except this supposedly new technical addition, Mysore Rockets, as one authority has recently commented, 'maintain a strong resemblance to Dīpāvalī rockets' (Narasimha 1985, p. 6); , a pyrotechnic type much akin to those pre- improvised, toy-rockets referred to in *Veṭikkampavidhi*. Interestingly some contemporary observers have noted this connection. According to them, the Mysore War Rocket "received its projectile force from the same composition which was used in rockets of ordinary fireworks" (Wilks, 1817, p. 27) and it was "made in the same form as those used by school *boys*" (Munro, 1789, p. 132). We may not be wrong in assuming both these types as belonging to a same continuum of technical development. The altered form, or a delicate improvisation, could be a regional variant of the base pyrotechny type, perhaps resulting as an unavoidable artisanal response to certain external factors like political patronage and military contingency.

5. Conclusion

Unlike in South Indian (Mughal) 'successor-states', local uses of pre-modern gunpowder in Malabar Coast were predominantly theatrical or display oriented. Gunpowder and its craft adepts appeared in various celebratory firework spectacles which, since 16th century, were found, as they figure in medieval literary verse, often in association with a regionally prominent courtly-culture or a local festival cult. Gunpowder was frequently referred to as *maṛunnu* or 'the drug' and while in 18th century, when gunpowder consignments were widely solicited, it was fashioned as a major salute producing component in unavoidable rituals, symbolizing various levels of political or sacral status. Though gunpowder did, in the form of firearms, figured in war-like contexts since early 16th century, its effect in precipitating a drastic political change, following an argument from the early-modern Nāyaka country (Narayanarao, Shulman and Subrahmanyam, 2001) could be questioned. The

field deployment of matchlocks was a slow process in early modern south India especially during the 16th and 17th centuries. Whenever used their importance in determining the course of the war was indeed limited (Subrahmanyam, 1988). In a landscape like Malabar, where political and military powers remained largely segmented and mercenary-based, gunpowder and firearms, rather than predicating a centralized polity as hinted by D. Kooiman (Kooiman, 1992), had created loose political formations with heavily compromised authority. In this milieu of 'almost constant conflict and competition' political stake-holders were bound to create certain 'Mahānavami-type' (Stein, 1984) ceremonial avenues, ensuring overt festivity and redistribution. It is interesting here to note that the early reportages of South Indian firework displays (Sewell, 1900, p. 71) come from the grand Mahānavami conclave at historical Vijayanagara. Fire recipes in *Veṭikkampavidhi* were perhaps intended for the regional kingly pageantries like *Māmāñkam* which, as the grand *duodecennium* 'theatre-festival' of Zamorin Kings, was known, *inter alia,* for its elaborate performances in non-military pyrotechny.

Appendix

'Moonlight' Recipes as mentioned in *Veṭikkampavidhi*[12]

Table 1(a). *Tūveṇṇa* (the snowy-white) Tabulated from *śloka* 3 (Sharma 1953, pp. 27-28)

Ingredients	Measurement
Gandhakam (Sulphur)	$3^{½}$ palam
Uppu (Saltpetre)	10 palam
Nīlam[13]	2 palam
Kaàpūram (Camphor)	12 palam
Aritālam (Arsenic Tri- Sulphate)	2 palam
Pañtam (Dammar)	a little
Mutthu (Pearl or Coral)	½ *kaḷanccu*
Pācāṇam (Antimony)	a little

Table 1(b). *Śuddha* (the clear) Tabulated from *śloka* 4 (Sharma 1953, p. 28)

Ingredients	Measurement
Gandhakam (Sulphur)	3 palam
Uppu (Saltpetre)	10 palam
Nīlam	½ palam
Aritālam (Arsenic Tri Sulphate)	1 palam
Cepmu-paṛāgam (Copper Powder)	a little

Table 1 (c). Nīla (the bluish) Tabulated from *slōka* 5 (Sharma 1953. p.28)

Ingredients	Measurement
Gandhakam (Sulphur)	4 palam
Uppu (Saltpetre)	12 palam
Nīlam	½ palam
Aritālam (Arsenic Tri Sulphate)	1 palam

Table 1(d). *Pacca* (the green)Tabulated from *slōka* 6 (Sharma 1953, pp. 28-29)

Ingredients	Measurement
Gandhakam (Sulphur)	5 palam
Uppu (Saltpetre)	15 palam
Nīlam	1 palam
Manayōla (Arsenic Bi Sulphate)	1 palam
Cempiñpūppu	1 palam
*Tūtthināk*am (Sulphate of Zinc)	½ palam

[12] All measures in the tables, if otherwise not specified, are given in *palam. Palam* was a well-circulated country measure for weighing liquids and culinary weights in entire Malayalam region. Despite regional variations, it was more or less equal to the one fifth of a British *lb* of the late-eighteenth and the early-nineteenth centuries (Maillard et al. 1789, pp. 43-44). Francis Buchanan calculated it as about one fourth of a British *lb* but, cautioned that 'it differs in almost every circle' (Buchanan 1807, 295). More *lb*s were needed while converting native measures of 'light goods', pointed P. L. Simmonds in 1858, 'like dammar and wax' (Simmonds 1858, p. 384).

[13] Nīlam, could either be 'the plant-indigo'— "for it produces a detonating powder, especially for small fireworks, by treating it with ascetic acid" (Cutbush 1825 p. 177), or sapphire; the blue-gemstone (Murthy 1977), grained in small particle. Weight of a *kaḷanccu* was calculated at 48 grains (Elliot, 1885 p. 48).

Table 1(e). *Raktam* (the red)Tabulated from *śloka* 7 (Sharma, 1953. p. 29)

Ingredients	Measurement
Gandhakam (Sulphur)	3 palam
Uppu (Saltpetre)	10 palam
Pañtam (Dammar)	2 palam
Kaṛi (Charcol)	½ palam

Table 2: 'Flower' Recipes mentioned in *Veṭikkampavidhi* Tabulated from *ślōkas* 23 to 38 (Sharma, 1953, pp. 34-40)

Names given to the 'Flower'	Measurement			
	Sulphur (*gandhakam*)	Saltpetre (*uppu*)	Charcoal (*kaṛi*)	Wootz (*uṛukku*)
Kapāla cakrappū	3	10	1	1
Koḷappū	$1^1/_4$	10	1	9
Ettam pongum nilappūvu	6	30	6	15
Ceṛu pūvu	$2^1/_4$	$2^1/_4$	9	5
Ninnimmu katthum kusumam	6	32	6	15
Kaippū	3	10	3	8
Kaippū itapp	1	10	$1^3/_{4+}{}^1/_8$	-
Kaippū- iḷampū	$1^1/_2$	10	3	4
Veñcāmaṛappū	2	4	6	9
Pucpam-nūttemmu mannam[14]	4	12	$1^{\frac{1}{2}}$	1
Kaitōlappū[15]	3	20	6	6
Vāḷakkūmpāyapū	2	10	6	-
Nīlappūvu	4	16	6	1
Veñcāmaṛa-ceṛiyapū	1	7	$3^1/_2$	4
Kōḷimummyileḷunn-apūvu	3	10	3	3
Nīlamallika-pūvu	3	8	3	3
Nīṛiípongum pūvu	$1^{\frac{1}{2}}$	10	6	9
Pongippānçrucakram[16]	1	10	3	-
Maṅticcunilkkum kusumam	2	8	4	6

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[14] The recipe of *puṣpam-nūtteþþumannam* (sl. no 10) has following additional ingredients i.e., six measures of Copper (*cempu*), five measures of lead (*īyyam*), two measures of zinc sulphate (*tūtināk*am), one measure of Iron (*iṛumpu*), one measure of *Cīnaccaṭṭi* powder, four measure of minced coconut-husk (*cakiṛippoṭi*) and a half measure of well-pounded coral (*muttu*).

[15] In the preparation of the flower named *kaitōlappū* (sl. no 11); each measure of copper, brass (*pithala*) and the sulphate of zinc are mentioned as additional ingredients.

[16] A separate recipe of saltpetre (in seven measures), charcoal (measuring about a quarter of the saltpetre's weight) and sulphur (weight unspecified) are mentioned in *slōka* 37 to "bring back" the 'flower'; *pongippānērucakram* (sl. no 18), perhaps, after the completion of its initial blaze.

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