

Second Dr. Frank C. Chookolingo & Evamaria R. Chookolingo Memorial Lecture 2017

Chola and Vijayanagara Bronzes

Archaeometallurgical Mapping of Shifting Iconographies



Sharada Srinivasan

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Department of History of Art, Faculty of Arts, Banaras Hindu University, Varanasi

**Second Dr. Frank C. Chookolingo and Evamaria R.
Chookolingo Memorial Lecture 2017**

(01 March, 2017)

Chola and Vijayanagara Bronzes :
Archaeometallurgical Mapping of Shifting Iconographies

by

Sharada Srinivasan

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FOREWORD

I am very happy that the Department of History of Art & Tourism Management of Banaras Hindu University is publishing the Second Dr. Frank Chookolingo & Evamaria Chookolingo Memorial Lecture, delivered by Prof. Sharada Srinivasan on 1st March 2017, on the topic “Chola and Vijayanagara bronzes: Archaeometallurgical Mapping of Shifting Iconographies”. Prof. Sharada Srinivasan is Professor, School of Humanities, National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore. She is eminently qualified to speak and write on the topic of archaeometallurgical mapping of metal icons because she combines a sound grounding in scientific knowledge with training and experience in art history and iconography.

South Indian copper alloy icons represent one of the great artistic traditions of the Indian subcontinent spanning the Pallava, Chola and Vijayanagara eras and spreading across Tamil Nadu and Karnataka. Since Hindu bronzes in particular were rarely inscribed, it is often difficult on visual and art historical criteria alone to tell apart bronzes of different eras. This paper highlights the usefulness of archaeometallurgical investigations and finger-printing techniques, such as lead isotope analysis, in aiding the art historical classification of South Indian bronzes. The author first describes the lost wax process used in the making of these metal images and then she explores the iconographic trajectories of bronzes over different periods by focussing on certain specific icons, such as the celebrated Nataraja-murti. Using the archaeometallurgical study, some Nataraja icons, which were commonly attributed to the Chola period, have been identified by Dr. Srinivasan as belonging to the Pallava period. Besides the Nataraja icon, the paper highlights how studies of iconometric conventions in the modelling of icons, seen in conjunction with archaeometallurgical finger-printing, also throw interesting light on the iconographic developments from the Chola to the Vijayanagara period of images of Parvati, Rama and so on. The continuing traditions of metal icon making at Swamimalai in Thanjavur district are also touched upon by the author in the light of the above studies.



Dr. (Sister) Anila Verghese
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A Report on Second Dr. Frank C. Chookolingo and Evamaria R. Chookolingo Memorial Lecture 2017

Department of History of Art, Banaras Hindu University (BHU) organized the second Dr. Frank Chookolingo and Evamaria R. Chookolingo Memorial Lecture on Wednesday, March 01, 2017. The lecture was held at the Seminar Complex, Institute of Science, BHU from 12.30 p.m. to 2.00 p.m. The lecture entitled '*Chola and Vijayanagara bronzes: Archaeometallurgical Mapping of Shifting Iconographies*' was delivered by Prof. Sharada Srinivasan, Professor, School of Humanities, National Institute of Advanced Studies, Bangalore.

Prof. Sharada Srinivasan is an eminent scholar of Art History, Heritage Studies, History of Science and Technology, and Archaeological Sciences. She is a B.Tech. from I.I.T. Mumbai and earned her Master's from the School of Oriental and African Studies, University of London in Art and Archaeology with Distinction. Her Ph.D. in Archaeometallurgy from the Institute of Archaeology, London on '*The Enigma of the Dancing 'Pancha-loha' (five-metal) Icons: Art Historical and Archaeometallurgical Investigations on South Indian Metal Icons*' is highly acclaimed. Prof. Srinivasan has delivered lectures at various important places in India and abroad. She has authored seminal books and research papers and is a recipient of several national and international awards including "Dr. Kalpana Chawla Young Women's Scientists Award 2011". She has been a member of many National/International bodies including Member, Advisory Board-Centre for South Asian Studies, University of Exeter; and Member, Advisory Board Institute of Archaeometallurgical Studies, Institute of Archaeology, London etc. Presently Prof. Srinivasan is the Dean and Professor, School of Humanities, National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore. Her research interest ranges over archaeological science, metallurgy and material characterizations of ancient artifacts, the implications for history of arts and crafts and performing arts.

The above programme was chaired by the eminent art-historian Dr. Anila Verghese, Mumbai. The session commenced with a welcome address and introductory remarks by Prof. Atul Tripathi, Head, Department of History of Art. It was followed by the Memorial Lecture delivered by Prof. Sharada Srinivasan. In her lecture Prof. Srinivasan spoke about the advantages of archaeometallurgical investigations and finger-printing techniques in aiding the art historical classification of South Indian

bronzes particularly of artifacts belonging to the Chola and Vijayanagar eras. Her presentation threw interesting light on the iconographic development from the Chola to the Vijayanagara period. She also discussed the continuing tradition of metal icon making at Swamimalai and other parts of Thanjavur District. The Lecture concluded with a vote of thanks proposed by Mrs. Shikha Misra, Assistant Professor, Department of History of Art. Ms. Anuradha Raturi conducted the event.

The lecture was attended by many eminent luminaries from the academia including Prof. Anura Manatunga, Director, Centre for Asian Studies, University of Kelaniya, Sri Lanka; Mr. K.K. Muhammed, Regional Director (Retd.) ASI; Mr. Rajesh Purohit, Director, Allahabad Museum; Prof. K.D. Tripathi, Centenary Professor, Bharat Adhyayan Kendra, BHU, Varanasi; Prof. Vibha Tripathi, Professor Emeritus, Dept. of AIHC & Archaeology, BHU; Prof. Debashish Nayak, Director, Centre for Heritage Management, Ahmedabad University, Ahmedabad; Dr. B.R. Mani, Vice-Chancellor, National Museum Institute, New Delhi; Prof. Abhay Kumar Singh, Dept. of History, School of Social Sciences, Gujarat University, Ahmedabad; Prof A. P. Ojha, University of Allahabad, Allahabad; Prof. D.N. Tripathi, Former Chairman, ICHR, New Delhi; Prof. Mala Malla, Central Department of Nepalese History, Culture and Archaeology, Tribhuvan University, Kathmandu, Nepal besides Professor, academic/non-academic staff and students of Banaras Hindu University.



Prof. Atul Tripathi
Head, Dept. of History of Art,
Banaras Hindu University, Varanasi

Second Dr. Frank C. Chookolingo and Evamaria R. Chookolingo Memorial Lecture 2017

(01 March, 2017)



Prof. Sharada Srinivasan, speaker of the second Dr. Frank C. Chookolingo and
Evamaria R. Chookolingo Memorial Lecture 2017

Chola and Vijayanagara Bronzes:

Archaeometallurgical Mapping of Shifting Iconographies

Sharada Srinivasan

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Abstract

South Indian copper alloy statuary icons represent one of the great artistic traditions of the Indian subcontinent spanning the Pallava, Chola and Vijayanagara eras and spreading across Tamil Nadu and Karnataka. Since Hindu bronzes in particular were rarely inscribed, it is often difficult on visual and art historical criteria alone to tell apart bronzes of different stylistic genres. This paper highlights the usefulness of archaeometallurgical investigations and finger-printing techniques such as lead isotope analysis in aiding the art historical classification of South Indian bronzes drawing upon past studies undertaken by the author (Srinivasan 1996, 1999, Srinivasan 2016a). The implications of such studies in exploring the iconographic trajectories of bronzes over different periods is explored such as the celebrated Nataraja with the probable attribution of some examples from archaeometallurgical study to the Pallava period. The studies of iconometric conventions in the modeling of icons, seen in conjunction with archaeometallurgical finger-printing also throw interesting light on the iconographic developments from the Chola to the Vijayanagara period of images of Parvati, Rama and so on. Continuing traditions of metal icon making at Swamimalai in Thanjavur district are also touched upon in the light of the above studies.

Brief history of metal icons

Devotional statuary metal icons were made across the Indian subcontinent and indeed elsewhere in vast tracts of Asia with the spectacular spread of Indian religious influences, into South East and East Asia, encompassing the Indo-Tibetan regions, Thailand, Indonesia, China, Japan, Korea and Sri Lanka. These were made by the lost wax casting process, a process of casting metal artefacts in the round, also known as the *cireperdue* process and or investment casting in modern terminology. In this process, a model or pattern of the artefact to be cast is made, of a low melting material like wax or resin which can also be easily modelled to suitable shapes, and which can be duplicated in metal. To do this the wax model is invested or covered with refractory clay to form a mould and then, upon the heating of the mould, the wax is melted out to give a hollowed pattern in reverse of the object to be cast. Molten metal when poured into the hollowed mould replicates the shape of the lost wax model, and can be retrieved it has solidified and the mould has been broken. A unique casting is yielded by this process.

The earliest and finest known surviving sculpture in the round from the Indian subcontinent, the petite Mohenjodaro dancing girl, *c.* 2500 BCE, from the Indus Valley civilisation, of barely 10 cm is likely to have been made of the lost wax or lost resin process from its fluid lines. Archaeologist Mortimer Wheeler was struck by the characterful image and wrote in 1973, 'She stands there with bangles all the way up her arm...perfectly confident of herself and the world. There's nothing like her, I think, in the world.' Although the post-Harappan period is marked by a longed hiatus in terms of figurative sculpture, there are nevertheless some noteworthy exceptions. A tiny mother goddess figure from Adichanallur in Tamil Nadu (*c.* 1000 BCE) seems to recall to Indus terracotta mother goddess figurines. The exceptional Daimabad hoard from Maharashtra (Agrawal *et al.* 1978), *c.* 1500 BCE includes an elephant, rhinoceros (an animal popular in Indus seals) and a charioteer with elements that seem to somewhat bridge the Harappan and later periods. The elephant (Fig. 1) has four holes in the legs below its feet bringing to mind the processional icons of southern India. A tiny, remarkable tiger figurine was excavated from Kodumanal, Tamil Nadu, 3rd century BCE, inlaid with lapis lazuli and carnelian in filigree.

Metal figurines seem to have come properly into vogue in the Indian subcontinent in the aftermath of Alexander's incursions into northwestern India, and with the ensuing Greco-Bactrian influence. In the late centuries BCE to early centuries CE diverse metal images were cast under the various dynasties of northwestern, northern, central, peninsular and northern India which were predominantly of Buddhist and Jain faiths. In northern India, by the Gupta period, large Buddha images were made by the hollow lost wax process following Hellenistic practices whereby the wax model was built up on a clay core iron armatures. A spectacular example is the life-like Sultangunj Buddha in Birmingham Museum of cast copper, *c.* 6th century.

In the main shrines of Buddhist and Jaina faiths, large images, sometimes life-size or larger were installed of stone, wood, stucco or metal. Votive images were carried around by monks and traders and often had donor inscriptions. On the other hand, few Hindu images were inscribed, intended as representations of divinities. From Kashmir and eastern sites such as Kurkihar and Nalanda, several remarkable Buddhist and gilt Mahayana Buddhist images are known. Early Jain images are found in western India and Gujarat. Brahmanical bronzes prominently emerged at least by the 6th century in the art of Kashmir in the north and in southern Indian Pallava art. Such Pallava bronzes include a Vishnu from Thirunelveli, *c.* 750 CE, the Kuram Natesha, of dancing Shiva, now in the Government Museum, Chennai and a splendid Natesha from Madhyarjuna temple, Nallur, with both the latter images in *urdhvajanu* pose (Nagaswamy 1988 : 144). The Nallur Natesha prominently features the *prabhavalli* or ring of fire around the figure of dancing Shiva. Whereas 'Nataraja' and 'Natesha' have been sometimes used interchangeably to describe the dancing Siva

images such as by Sivaramamurti (1963 : 48, 70), in the author's study 'Nataraja' is used to refer to the pose with the left leg extended fully in *bhujangatrasitakarana*, while 'Natesha' is used to refer to other depictions of dancing Shiva. Curiously, while few Hindu, Buddhist or Jaina images from northern India show the lugs or holes for processional worship, the Pallava images for the first time have prominent lugs. These are evidence of ritual processional worship following Agamic traditions which has remained an enduring feature of Tamil temple ritual practice.

The most spectacular and world renowned of south Indian bronzes, the Shiva Nataraja bronze (Fig. 2), uniquely depicts the Lord Shiva dancing with the leg extended in the dance movement of the *bhujangatrasitakarana*. This posture is popularly mirrored in the south Indian classical Bharatanatyam dance derived from the Sadir temple tradition (Fig. 3). In earlier papers the author (Srinivasan 2004) has argued that this image probably dates back to the Pallava period on the basis of leadisotope ratio finger-printing, and as recapitulated further. Religious iconography in metal was fully developed and canonised in artistic treatises such as the *Shilpasastras* during the Classical Gupta period (3rd-5th centuries) and taken further from the 6th century Chalukyan period onwards. The legacy of Chola bronze casting is still followed in Thanjavur district of Tamil Nadu, especially in the village of Swamimalai (Srinivasan 2016b). These distinguished families of hereditary icon makers or *Sthapatis*, are one of the last links in India to the great traditions of bronze casting.

Bronzes in southern India and dynastic histories

According to Shaiva Siddhantic worship, South Indian Hindu metal icons were intended for ritual and festival procession around the main sanctum. The Pallavas, originally feudatories of the Andhras, ruled in the Tamil region from the 5th-9th century. The Chola dynasty, established by Vijayalaya Chola in 850 CE, became pre-eminent in Thanjavur after his son Aditya quelled Pallava ruler Aparajitavarman around 875 CE. The 'Imperial Cholas' refers to the direct lineage of Vijayalaya Chola, including the monarch Rajaraja Chola under whom the spectacular granolite colossus of the Brihadiswara temple at Thanjavur was consecrated in 1010 CE. This period was an artistic watershed during which metal images were cast in great profusion. One of the most illustrious patrons was queen Sembiyan Mahadevi (c. 940-1006 CE) after whom the town of Sembiyan Mahadevi is named.

The 'Chalukya-Chola' lineage relates to the ascent to the Chola throne of an Eastern Chalukyan prince, Kulottunga I, in 1070 CE which continued until about 1279 CE. Madurai which was the capital of the Later Pandyas from 1190 to 1310 CE, came under Muslim Sultanate from Delhi from 1310 to 1340 CE (Srinivasan 2016a). The production of metal images, which had declined during this period saw a revival with the ascent of the Hindu Vijayanagara kings of Hampi in Karnataka in 1336 CE.

The flourishing metropolis of Vijayanagara drew comparison to Rome from Portuguese Domingo Paes. The celebrated monarch Krishnadeva Raya appointed governors, the Nayakas, at Gingee, Tanjavur and Madurai in Tamil Nadu from about 1512 CE who continued to rule in Tamil Nadu after the sack of Vijayanagara in the battle of Talikota. Thereafter Thanjavur came under western Indian Maratha Bhonsle rule (1676-1839 CE). Generally speaking, an overwhelming number of south Indian bronzes are from the Thanjavur region of Tamil Nadu. In fact, bronzes found in the Tamil regions in the later medieval period classified as Vijayanagara may be more accurately Nayaka. Therefore in this study for clarity, images that are classified as Vijayanagara, (not so much by virtue of the region or findspot but by their appearance as later bronzes), are instead described as Vijayanagara/early Nayaka taking into account the prospect of their actual provenances being in the Tamil regions.

Though the Cholas were predominantly worshippers of Shiva, images related to the worship of Vishnu and Jaina and Buddhist bronzes were also widely patronised. From the Nayaka period as well, Shaiva and Vaishnava are to be found, although with Vaishnava worship becoming more prominent under the Vijayanagara rulers, it seems more Vaishnava bronzes have come to light from later periods. Uniquely in the Tamil region, from the Chola period, the casting of figures of devotional saints also came into vogue, apart from the pantheon of Brahmanical deities: which also give a certain additional human touch to South Indian bronzes. These included the Nayanmar and Alvar who are believed to have lived from about the 7th century onwards, under whom a rich body of Tamil devotional poetry emerged. This laid the foundations of the Bhakti mode of worship, stressing on direct communication and devotional expression to a personal deity without requiring the mediation of the priest or temple rituals. An extraordinary example is also provided by the case of the remarkable Chola dowager queen Sembiyan Mahadevi (c. 940-1006 CE), a great patroness of temples and bronzes, who it appears came to be revered like some of the saints. An inscription of Rajendra I mentions offerings for worship to deified images of Sembiyan Mahadevi which would have been taken in processional worship Balasubrahmanyam 1971 : 182. The Devi image at Freer Gallery of Art (Fig. 4) is speculated to have been the remarkable queen's portrait (Dehejia 1990: 36-8). Indeed, this may well be the case as the crown of this image is simpler than the more elaborate stepped crowns adorning Chola Parvati images such as from the 9th century Okkur Parvati (Fig. 5) discussed further. Running parallel to a more classical tradition of Indian religious images drawing upon codified artistic treatises of the *silpashastras*, there has been also been a vibrant tradition of folk and votive bronzes which are still cast in various parts of northern and southern India.

Some literary references to the lost wax process

The Sanskrit term for the lost wax process is '*madhuchehishthavidhanam*'. Several Sanskrit texts have dealt with the technical investigation of the lost wax

process. It is described in the 68th chapter of the *Manasara*, a work based around the 5th-7th century CE of the Gupta period and attributed to the sages Kashyapa and Agastya (Gangoly 1915:30, Reeves 1962:29). Another significant reference is found in the medieval text from the Deccan region, the *Abhilasitartha-cintamani* or *Manasollasa*, attributed to the Chalukyan King, Someshvara, dated to 1131 CE.

The *Caraka Samhita*, a medical treatise (c. 2nd to 3rd c. CE), lyrically compares the casting process with the impregnation of the womb and formation of the foetus in human form (Von Schroeder 1981:17). The metaphoric aspect of the lost-wax process is beautifully described by Tamil women poet-saint Andal (c. 800 CE) who lived in the great era of Pallava and Chola bronze casting and wrote of her devotion to the Lord Vishnu in the genre of the lover-beloved model of Bhakti devotional poetry. Her description betrays a good knowledge of the lost wax process where she compares the dark clay mould to rain clouds, which upon heating for dewaxing, would release the liquid wax:

'Ó rain clouds,
seeming like dark clay outside,
liquid wax within ,
rain down on Venkatam,
where the handsome lord dwells..', (Dehejia 2002: 13).

Casting techniques in the light of literary texts

South Indian images are overwhelmingly made by the solid casting process as discussed further whereby the entire model is made of solid wax. This technique is described as *madhuchhehistavidhana* in Indian artistic treatises such as the 12th century *Manasollasa* (Reeves 1962), is still largely followed by traditional hereditary families of icon makers or *sthapatis*, especially in the village of Swamimalai in Tanjavur district of Tamil Nadu (Srinivasan 1996, 1999, 2001, 2011). On the other hand, north Indian bronzes were often hollow cast, reminiscent of Hellenistic practices where iron armatures were used to reinforce clay cores and which seem to have come in from the Gandharan world into the north-western part of the subcontinent by the early common era. An example is the Gupta era Buddha from Sultanganj in Bihar, c 6th century in the Birmingham Museum, an imposing life-size copper image at 2.28 m, made by the hollow cast process with iron armatures inserted within the clay core.

The hollow lost wax casting process involves the incorporation of a clay core within an outer wax layer corresponding to the shape of the statue to be cast is applied. This core with a wax layer would then be further invested with layers of clay to form a mould. Chaplets or small metal pieces may be introduced to hold the core in place, and then the wax is expelled by heating and metal is poured into the mould. A

lower weight of metal is thus used in the casting while the core is retained inside the image.

Shastraic texts point to different methods of casting. The *Vishnudharmottara-purana* (III: 43-4) apparently discuss both the solid and hollow cast methods (Reeves 1962:32). The Jaina *Anuyogadvara* mentions hollow casting. Indeed, several western Indian Jaina images appear to be hollow cast such as from the Akota hoard in Baroda Museum, which reveal the clay core in damaged portions.

The Gupta era *Manasara* probably discusses the hollow cast process 'in preparing the wax model of these *murtis* (images), at the jointures of the component parts of the body they should be re-inforced with copper rods or nails; and although the wax model will melt away, there should be no objection to using those supports' (Reeves 1966). These refer to chaplets used to reinforce the model in hollow casting which are often found intact in early medieval hollow cast copper alloy images in the Himalayan and Indo-Tibetan region (Reedy 1986:148).

The use of spacers was also noted by the author in the case of the traditional casting of blanks of mirrors of high tin bronze of 33% in the mould, made of the same alloy which would then melt into the overall casting (Srinivasan and Glover 1995). In some solid cast Chola Nataraja bronzes, the circular *prabhavalli* or circle of flames was re-inforced by inserting an iron armature since the tensile strength of bronze is not as good as iron.

The *Manasollasa* of the 12th century mentions the following which seems to refer to a solid wax model: 'According to the *Navatala* measurement as mentioned before, the expert should first prepare the image (i.e., the model) complete with all its limbs, yellowish in colour, beautiful to look at, and with the weapons and arms as described (Reeves 1962 : 32-3)'. It may be inferred that this Deccan text refers to the solid casting method which is consistent with the fact that south Indian and Deccan bronzes seem to be overwhelmingly solid cast, cutting across Hindu, Buddhist and Jaina affiliations.

The present day *sthapatis* or icon makers explained it was inauspicious to hollow cast metal deities for processional worship in temples, although this need not be the case for *vahana* or the animal vehicles associated with deities. This resonates with Chola inscriptions which suggest that the main deity was made as *ghanamagha* or dense, i.e. solid, and the bull or *rishabha* was described as *chhedya* or hollow cast (Nagaswamy 1988). One may correlate this with a fine set of Chola bronzes from Tandantottam which has solid cast main images of Rishabha vahana and consort while the damaged bull is hollow cast as illustrated in Sivaramamurti (1963: 14).

The *Sariputra*, a Ceylonese text (c. 12th-15th century CE) based on South Indian sources, warns that the making of hollow images would result in calamities of

famine and warfare (Coomaraswamy 1956:154 and Von Schroeder 1981:19). Indeed, whereas often early historic images from southern India (such as Amaravati) and Sri Lanka tend to be hollow cast, they seem to have been predominantly solid cast from the early medieval period. The radiograph of a 7th century Pallava Vishnu which was largely free of defects indicated mastery of solid casting (Srinivasan 2016a).

Icon making traditions of Swamimalai and Thanjavur area

The temple towns of Thanjavur and Kumbakonam in Tamil Nadu are home to the most spectacular Chola monuments, included in the circuit of the world heritage sites, namely the Brihadeeshwara temple (Thanjavur), Darasuram (Kumbakonam) and Gangaikondacholapuram. The early medieval Chola bronzes of the 9th-13th century rank amongst the finest forms of Indian artistic expression, which have been uncovered in abundance from the sacred and economic spheres of the Thanjavur-Kumbakonam region, where clusters of artistic and artisanal activities have continued to flourish over generations. These included metalworking workshops or '*pattarai*' for bronze and bell metal casting of images and ritual objects.

The Thanjavur district still has traditional families of *Sthapatis* or icon manufacturers of the status of *shilpacari*, or Brahmin art teachers. The making of processional images and related rituals has followed Shaiva Siddhantic and Agamic practices. Thus, according to the *agama* texts, the *achalamurti* is the immovable image installed in the shrine, usually of stone, wood or stucco, while the *utsavamurti*, made of metal or wood, is the movable image taken out on processions or displayed during festivals (Nagaswamy 1988:143). In Shiva temples the *achala* or immovable image is the aniconic, formless manifestation of Shiva, i.e. the *lingam* or cosmic pillar, while the *utsavamurti* takes several forms of Shiva such as Nataraja and invariably with the consort Parvati.

Bronze casting at Swamimalai

The accounts of bronze casting reported here are drawn from field studies made in Thanjavur district by the author over a couple of decades (Srinivasan 1996, 1998, 2015, 2016b), particularly at the workshop of the distinguished family of the mastercraftsman late Shri Devasenasthapati and his son Shri Radhakrishnasthapati.

Even in the present day the *sthapatis* of Swamimalai model the wax following traditional '*talamana*' systems of measurement. To mark out the *tala* measurements to obtain the dimensions of the icon, strip of coconut palm frond, the *odiolai* is used. As told by Radhakrishna Sthapati (Fig. 6), the male figures were made by marking out 124 parts and the female figures of 120 parts.

Wax models were traditionally made of a mix of equal parts beeswax, powdered dammar resin (*kunkuliyam*) with a little ground nut oil or sesame/gingelly oil. The limbs, attributes and head were separately modelled and several of these were

kept solid in buckets of cold water. Then they were heated over a brazier and attached to the main torso and contours were merged. Fine wax threads were pressed on for the decorative details. Sandalwood and steel spatula were used for modelling the wax.

To facilitate the even distribution of viscous molten metal, sprues, and runners of wax had to be added to the model which would form hollow channels in the mould once the wax was melted out and into which the molten metal would flow. After solidification the runners would be cut off. A vent for escape of gases was also required. Interestingly, the *Manasollasa* also mentions that wax tubes should be placed on the back, shoulders and neck or crown of image of the 'length of a *dhatara* flower'. This clearly implies that the runners that would have facilitated the flow and distribution of viscous metal. An unfinished Vishnu from Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS) Museum of the 13th century clearly shows runners connecting the shoulders to the arms (Fig. 7). During casting, the *Manasollasa* (Reeves 1962 : 32-33) mentions that a lighted wick should be used at the mouth of the casting. During casting in workshops in Kerala and Thanjavur (Fig. 8), it was observed that sometimes during casting, a wooden stick wrapped in cloth at the end which was flaming was held at the mouth of the crucible at the time of pouring which correlates to the above description and would have served the purpose of maintaining reducing conditions and minimise formation of an oxidised fire skin.

In Swamimalai, these days, images are cast of brass consisting of a few percent of zinc and lead. This is an alloy that can be cold worked much more easily than bronze. As told to the author in 1990, late master craftsman Devasenasthapati of Swamimalai Sthapatis mentioned that in the past metal was poured from more than one sprue, one of which was placed along the rear torso of the image and the other near the base. Interestingly, this account tallies with the evidence for such a pouring practice with remnants of a sprue on the rear torso of an unfinished 12th century Vishnu in the collection of CSMVS Museum, Mumbai (Fig. 7). The author's investigations show that bronze was generally used for making south Indian images, which might have needed more sprues for efficient flow of metal than brass which is more fluid and used more in the present day. An *in situ* photomicrograph (Fig. 9) of an unfinished Vishnu from CSMVS Museum shows impregnation of mould matter into the copper alloy matrix (undertaken in a collaborative study by the author with BARC and then Director, S. Gorakshekar in 1988). This could happen if the mould was much cooler than the metal poured in, ie. if it had not been pre-heated adequately and may be a reason why the unsuccessful casting was abandoned. An unfinished bronze reported in Johnson (1972) showed a similar pouring practice from the rear torso.

Insights on the *pancha-loha* prescription

The *Shilapasastras* and the *Agamas* make intricate prescriptions for the casting of Hindu metal images and the ritual significance. The Sthapatis who work in

bronze at Swamamali and stone in Mammallapuram claim to follow these. The iconometric aspects of Murthishilpa or proportions for carving of the icons were delineated in the '*Talamanapaddhathi*'. For visualising the icons, the *dhyanasloka*s or meditative and mnemonic verses were memorised (Gangoly 1915:30-1, Reeves 1962: 114). Textual recommendations were specified on the types of metals to be alloyed for images such as *asta-dhatu* (eight metal alloy), *nava-loha* (nine metal alloy), *sapta-loha* (seven metal alloy) and *panca-loha* (five metal alloy). South Indian bronzes are popularly called '*pancha-loha*' or five metal alloy icons. Chola inscriptions referred to them as *chepputhirumeni* or copper images (Nagaswamy 1988 : 146-7). However, actual analyses of ancient copper alloy statuary from the Indian subcontinent, East Asia and the Mediterranean world indicate that the major alloying additions to copper over 1% were tin, lead or zinc, making them either bronzes or brasses. In practical terms, a large number of metals cannot be alloyed in large proportions.

Indeed, in 1990 late Devasenasthapati of Swamimalai clarified to the author that the '*pancha-loha*' proportion was not to be taken literally of five alloys in major amounts, but referred more the addition to the alloys of major and minor element of copper, lead, tin or zinc, of very minor traces of gold and silver, more for the sake of *shastra* or ritual. To this end, the client could purchase minor amounts of a few grams of gold and silver which were melted inside a ladle or *karandi* along with a little bit of molten copper alloy. The ladle was held jointly by the client and the Sthapati and melted constituents were poured into the casting at the end. Analysis of South Indian bronzes suggested the possibility that such traces of gold and silver might have been added which would in any case not reflect as more than 1% of the metal image (Srinivasan 1999). The *siras chakra* at the rear of the head onto which the wheel shaped ornament was affixed might have also served another purpose. As told to the author by late Devasenasthapati in 1990, the ladle with small amounts of gold and silver could have been also poured from the runner behind the head which was believed to have improved the lustre of the face of the image.

Breaking open the mould and ritual significance

The process of breaking the mould is done with the purpose of re-cycling and re-using with as little wastage as possible. A hammer is used to break open the mould and to remove the debris to retrieve the image. The mould was broken with a hammer and then the refractory materials were powdered akin to brick dust and re-used to make fresh moulds. The scrap metal from the casting processes was also collected meticulously by sieving for remelting by a specific person, the *Manalashubhavar*, thus ensuring effective re-cycling and minimisation of debris. (Levy 2008 : 56)

These days the sthapatih finish the cast images by chasing and polishing extensively (Fig. 10) and the detailing is done by chiselling after casting. According to the *Manasara*, when the Sthapati is satisfied with the cast image it should be

adorned with sandalwood paste and flowers and taken out in procession. Defects in the *pratyanga*, i.e. the major parts of the body such as the torso, would have required the image to be recast (Von Schroeder 1981:18). An important ceremony performed is the 'opening of the eyes' of the icons, known in Tamil as '*kannatharakkarudu*' amongst the *Sthapatis*, through which the metal icon is ritually invested with divine significance.

Compositional and lead isotope analysis in classifying icons

While the iconography of South Indian images has been studied, there has been a lack of consensus amongst art historians on stylistic, chronological, and provenance attributions so that it is useful to explore objective technical criteria for making such attributions. Although Jaina and Buddhist images often have donor inscriptions, Hindu icons were rarely inscribed as they depicted deities for worship. This makes it more problematic to make stylistic attributions for Hindu icons. Furthermore, south Indian icons are predominantly solid cast without a clay core so that archaeometric techniques of dating such as Thermoluminescence (TL) dating of the clay core or radiocarbon dating of charcoal in the core are not options.

There are nevertheless prospects in terms of metallurgical characterisation of artefacts, whereby by calibrating the metallurgical profile of different groups of bronzes a method of relative dating and stylistic authentication can be attempted. In the most comprehensive technical and archaeometallurgical study to date on south Indian images, involving frontline techniques such as lead isotope analysis, the author undertook technical analysis as doctoral research (Srinivasan 1996) for the purposes of finger-printing, authentication and stylistic re-assessment of 130 artistically important South Indian bronze images. These were sampled from the collections of the Government Museum, Chennai (70), Victoria & Albert Museum, London (50) and the British Museum, London (10). Representative images ranging from the early common era to the 18th century were sampled using micro-drilling techniques. These artefacts were analysed for elemental composition of eighteen major, minor and trace elements using simultaneous multi-element analysis by ICP-OES (i.e. inductively coupled plasma optical emission spectrometry) at Royal Holloway and Bedford New College, Egham. Major, minor and trace elements were analysed for 18 elements of Cu, Zn, Pb, Sn, Fe, Ni, As, Sb, Bi, Co, P, S, Cr, Mn, V, Cd, Ag and Au. In the most extensive application of lead isotope analysis to South Asian archaeology to date, sixty of the icons analysed by ICP-OES were also then subjected to lead isotope analysis using thermal ionisation mass spectrometry at Oxford Laboratory for History of Art and Archaeology using techniques standardised by Z. Stos and N. Gale.

Past compositional analyses indicate that brass, i.e. an alloy of copper with zinc was used more frequently in northern India (Reedy 1997), whereas in eastern India the use of bronze or copper alloyed with tin is seen. South Indian images seem to have been made largely of leaded bronze and some of leaded brass (Srinivasan

1996). Predominantly copper images and gilt copper images are also seen from the various regions. About 80% of the analysed south Indian images were bronzes (ie alloys of copper and tin) with only 20% being brasses (i.e. alloys of copper and zinc) with less than 1% tin. The overall average composition was 5% tin and 7% lead, i.e. of leaded alpha bronze. In the analysed bronzes, although lead varied from 1-24%, the tin content did not exceed 15%, recorded in a 9th century Bhudevi image of the early Chola period from Victoria and Albert Museum. This implies that the limit of the solid solution for as-cast bronzes was not exceeded, beyond which brittleness sets in. In the south Indian images analysed, there seems to have been a deliberate choice of leaded bronzes not exceeding 15 percent, at the limit of solid solubility of tin in copper, beyond which bronze becomes brittle. That this was a deliberate choice can be discerned from the finds of unleaded high-tin bronzes in southern India for special purposes of making hot-forged and quenched 23% tin vessels going back to megalithic times and continuing into the present day (Srinivasan and Glover 1995, Srinivasan 2010). In contrast, as-cast Himalayan images with over 20% tin are reported to be brittle and damaged (Reedy 1991) and there are also such southeast Asian examples.

Amongst the medieval images the highest average for tin is recorded in Early to Middle Chola images (c. 850-1070 CE) of 6.8% tin for 28 images, which represent the High Chola period when the finest images were cast (Srinivasan 1996, 2004b). A decline in tin to an average of 3.5% for 11 images is seen by the Later Nayaka period (c. 16th-18th century). Lead, which is usually added to make bronze more castable was found to be higher in bronzes usually described as late Chola or post Chola bronzes [which were classified for the purposes of the above study as Early Chalukya-Chola (c. 1070-1125 CE), Later Chalukya-Chola (c. 1125-1279 CE), Later Pandya (c. 1279-1336 CE)], going up to 24% in some pieces. Brass which is typically an alloy of zinc and copper was found to be in use right from the early historic period as seen in a 4th century lamp from Krishna delta in V & A Museum (Srinivasan 2016a). In this light, it is interesting that a Chola inscription from Rajaraja's 11th century Brhadiswara temple mentions the donation of lamps of pittalai (South Indian Inscriptions, Vol II, Part II, No. CLVII), which is the colloquial Tamil word for brass. However, more images from the Vijayanagar and Nayaka group of later medieval images, [described here Vijayanagara and Early Nayaka (c. 1336-1565 CE) and Later Nayaka and Maratha (c. 1565-1800 CE)] were found to have appreciable zinc contents going up to 20-25% with some examples discussed here further.

Lead isotope ratio analysis is a powerful method for archaeological fingerprinting and classification because artefacts from similar sources of lead will have similar lead isotope ratios characteristic of the ore source. As discussed in Srinivasan (1999) it was found from this study that, from the lead isotope ratios and trace element profiles one could identify characteristic chemical 'finger-prints' for different stylistic groups of South Indian metal icons. Furthermore, the analytical signatures

identified from chemical finger-printing for different stylistic groups of images could then be used to 'date' South Indian images; i.e. to make stylistic re-assessments for images of uncertain attributions. Discrete trends were noted in the lead isotope ratios for different stylistic groups of bronzes (Fig. 11) which, when taken together with the discrete trends also detected in the levels of the trace elements of Ni, Co, As, Bi and Sb, could be used to construct a characteristic metallurgical profile for the different stylistic groups of bronzes against which a bronze of uncertain attribution could be re-assessed. Using these analytical signatures, the sampled south Indian images were stylistically re-assessed and classified under the groups of Pre-Pallava, Early Pallava and Andhra (c. 200-600 CE), Middle Pallava (c. 600-850 CE) and Later Pallava (c. 850-875 CE), Early and High Vijayalaya Chola period (c. 850-1070 CE), Early Chalukya-Chola (c. 1070-1125 CE), Later Chalukya-Chola (c. 1125-1279 CE), Later Pandya (c. 1279-1336 CE), Vijayanagara and Early Nayaka (c. 1336-1565 CE) and Later Nayaka and Maratha (c. 1565-1800 CE) (Srinivasan 1999, 2004b). Thus on the basis of the lead isotopes and trace elements, about half the sampled collection was reclassified. Although some of these technical aspects have been mentioned in previous papers, some of these are recapitulated here to be able to explain the findings related to the bronzes under discussion in this paper.

Distinguishing Chola and Vijayanagara bronzes

Cholas in general exhibit reflections of dual forms of Shaiva worship which included the linga worship and public worship of *utsavamurtis* (the worship of metal deities) during the public processions. The mythology and poetry associated with the Tamil Saiva bronzes played with opposites: the human and the cosmic, the dreadful and the sublime, the supreme and individual, creation and dissolution and macrocosm with microcosm. This dual nature which was opposing, yet complementary is understood by comparing two fine 10th century Chola bronzes from the British Museum which depict Shiva's benign aspects. The image of Shiva as Chandrashekhara, the Lord crowned with Moon captures an intense atheistic dimension. Another equivalent depiction is provided by the image of Shiva as Shrikantha, who holding a serpent sits with flared nostrils and a quiet smile (Srinivasan 2006). The finest articulation of Chola bronze workmanship is exhibited in the mid 11th century Ardhanarishwara image in Government Museum, Chennai which is composed of the half male, half female body.

The Vijayanagara dynasty rose to political power in 1336 CE under the Sangama brothers Harihara I and Bukka Raya I. The four dynasties who ruled under the Vijayanagara included the Sangamas (1336-1485 CE), Saluva (1485–1505 CE), Tuluva (1505–1570 CE), and Aravidu (1570-1646 CE). Vijayanagara inscriptions extensively record the construction of new temples and expansion of existing temples through land grants, and donations of jewellery for the deities and related rituals. It is often difficult to distinguish Chola from Vijayanagara images since the Vijayanagara

dynasty often followed Chola artistic conventions. The architectural style of the Vijayanagara kings was heavily borrowed from Tamil standards (Michell 2000 : 168). There are often problems in telling apart Chola from Vijayanagara bronzes on stylistic grounds alone due to continuing conventions of iconography over several centuries and due to a conscious harking back to Chola traditions in the Vijayanagara/Nayaka era. The archaeometallurgical investigations involving lead isotope and trace element analysis proved particularly effective by yielding different analytical profiles for Chola and Vijayanagara bronzes, probably due to different ores sources.

In that light the use of archaeotechnological investigations was found to be particularly useful in providing a tracer method to tell apart bronzes of different styles. A majestic Somaskanda bronze set of Shiva, Parvati and the boy Skanda, from Needur, Tanjavur district was consistent from both technical finger-printing and stylistic study with an attribution the Vijayalaya Chola period (c. 850-1070 CE) with lead isotope ratios falling in Group 1a of this group of bronzes. This seated Parvati (Fig. 12) with 12.8% lead and 7.8% tin showed affinities in the attenuated and erect torso to a spectacular Parvati from Karaiviram of Parantaka Chola's reign (c. 907-955 CE). This latter image is one of the few known inscribed Chola Hindu images (Nagaswamy 1988).

A charming image of a goddess with attendant from Tiruvengimalai, Government Museum, Chennai (Fig. 5), had technical fingerprints matching a late 9th century attribution. The posture with the attendant to a similar bronze of Adippur Amman in the Tyagaraja temple in Tiruvarur (Nagaswamy 1988) attributed to Aditya Chola (c. 875-900 CE). Its lead isotope trends closely marched an inscribed seated CheraLaxmi (OA-1935-12-14-1) in British Museum of the 9th-10th century. The inter-element ratios of Cu/Ni, Sn/Sb and Pb/Ag were also consistent with early Vijayalaya Chola trends of the 9th century (Srinivasan 2016b). The image with 4% lead and 2.7% of the goddess and attendant were both skilfully cast in one piece on a flatter oval base which was then inserted in a separately cast pedestal. The style of the image with the hand resting on a more diminutive attendant bears similarities to images from Kashmir such as a smaller 9th century Vaikuntha Chaturmurti image (illustrated in Tejpal Singh et al. 2016: 50). However, in later pieces such a depiction of an attendant is not commonly seen.

The sthapatis in Swamimalai believe that images in antiquity were less finished or not chiselled much after casting. It appears too that earlier images were indeed more 'carved in wax' whereas these days the efforts are moving more in the direction of fine sculpting in metal. Runners left intact on a delicate copper 8th century Pallava image of Somaskanda from Tiruvelangadu, in Government Museum, Madras, indicate it was barely finished after casting. The fine relief details seen in the Chola Nataraja image (Fig. 2) from Kankoduvanithavam in Government Museum, Madras (mid 11th century) suggest that finer details were transferred from wax to

metal intact and that it did not need much final chiselling. The early medieval Pallava and Chola artisans were clearly better metal casters with greater mastery over moulding, gating and pouring techniques. Analyses by the author that this image is a tin bronze with 12% tin and 8% lead, while the modern day bronzes are much easier to work after casting. Here the *prabhavalli* or the ring of fire is cleverly used as a channel for more effective distribution of metal into the central image through the portions joined to it such as the head or hands. These details may be contrasted with those on a 13th-14th century image of Parvati from Vadakkapoyur (Fig. 13) in Government Museum, Madras where hatched incised designs made by cold working are visible on the pedestal, which is increasingly seen in later bronzes.

A typical Vijayanagara/Nayaka image is that of the child poet saint Tirujnana Sambandar in Government Museum, Chennai which had lead isotope ratio trends that well fitted those of the Vijayanagar and Early Nayaka group, while also matching this group stylistically (Fig. 14). The story of Sambandar goes that he was left unattended by his father as a child when he went to bathe in the temple tank. When the hungry child began to cry Shiva and Parvati appeared to give him a bowl of milk. On his father's return when he asked where the milk came from, the child Sambandar pointed up in the direction of the heavens that the divine couple appeared from. Thus in the bronze versions, such as this, Sambandar is depicted joyfully dancing with the right index finger pointing upwards. Sometimes, Sambandar bronzes are confused with Balasubramaniam or dancing Krishna; however the uplifted finger facilitates the identification of this piece. Given that this is clearly a later medieval piece both on stylistic and technical grounds, it points to the continued popularity of Shaivite worship and is more likely a Nayaka piece from Tamil Nadu than a Vijayanagara piece which may be associated with Karnataka.

The technical analysis also indicates that although the yardstick is usually adopted that well made bronzes are classified as Chola and less well modelled pieces are described as Vijayanagara, this may not necessarily be accurate. For example, a fine Kudiakadu Parvati (Fig. 15) from Government Museum Chennai which was finger-printed to the Vijayanagara period from lead isotope and trace element analysis along with an aristocratic looking Rama image (acc. IM-71-1927) from Victoria and Albert Museum with 21% zinc found near Madurai, Tamil Nadu (Srinivasan 2016a). This indicates that Vijayanagara bronzes also included some fine or 'classic' pieces following the high Chola style, and that it may not be easy to distinguish well made Vijayanagara bronzes from Chola bronzes through visual analysis alone.

Although the Kudiakadu Parvati was previously mistaken to be Chola, on closer inspection it has shares marked features with the Vijayanagara era Rama bronze discussed above such as the wire jewellery, the missing amulets, wavy sacred thread and stiffer *bhanga* or flexion compared to Chola bronzes. Similar decorations are found in a seated Parvati, from Vadakkapoyur (Fig. 13) with analytical trends

consistent with the Later Pandyan-Early Vijayanagara transitional group. Parvati sits with her knee resting on a cushion which typically recalls to depictions in Vijayanagara stone sculptures at Hampi of seated female figures.

Telling apart images from mainland Tamil Nadu and Sri Lanka

Gilt Jaina and Hindu images are reported from Karnataka while gilt Buddhist images are known from Tamil Nadu sites such as from Nagapattinam and Kanchipuram. An impressive gilt Buddha image, thought to be from Nagapattinam, Tamil Nadu in Victoria and Albert Museum investigated by the author was of predominantly copper with no more than 1% lead. Lead being low melting can interfere with the gilding. The colossal Brhadiswara temple built by Rajaraja Chola (1010 CE) has a small stone relief depicting Buddha who was also accorded a place in the Hindu pantheon as an avatar of Vishnu.

Lead isotope investigations point to interesting prospects in terms of differentiating Buddhist bronzes from Tamil Nadu from those from Sri Lanka. As pointed out in Srinivasan (2016b), a preliminary comparison between the south Indian bronzes analysed by the author and a dozen analyses of Sri Lankan bronzes in the British Museum published in Schroeder (1991: 551), indicated that the iron trace element content was generally noticeably greater in Sri Lankan bronzes sometimes going up to 1%. This might relate to the fact that Seruwila in Sri Lanka has large copper-magnetite ores, which could provide a discriminating feature from south Indian bronzes. The gilt Buddha attributed to Nagapattinam mentioned before from the Victoria and Albert Museum had trace element trends consistent with a Southern Indian affiliation of the Later Chalukya-Chola period, c. 1125 C.E. (Srinivasan 2016a). The style of the smooth robe falling on both sides and the prominent lotus pedestal is more typical of Buddha images uncovered from Nagapattinam in Tamil Nadu of the 11th-13th century, whereas in contrast gilt Sri Lankan Buddhist images usually have folded robes. Interestingly, its lead isotope ratios fell in Group 5a along with the famed gilt Tara image (Fig. 16) in the British Museum. Art historian Douglas Barrett had opined that it was of south Indian rather than Sri Lankan provenance (Nigel Seeley, pers comm., Srinivasan 1996), more so as it was dredged off the sea coast of Batticaloa in northeastern Sri Lanka. Indeed, its gentle hip flexion perhaps recalls more to the *bhanga* of Tamil Chola goddesses, whereas Sri Lankan examples are more erect. The execution of the standing Tara also calls to mind Chola Parvati images in the torso and gestures held in the hands of *kapita* and *varada mudra* as seen in the Chola Needur Parvati image (Fig. 12). There is also a missing gem in the hairlocks as in a Kuniyur Nataraja ascribed to the Pallava period by archaeometallurgical studies discussed further (Fig 17). The above findings raise the prospect of a southern Indian connection, at least perhaps in terms of metal source or artisanship if not actual provenance such as Nagapattinam. This is also re-inforced by its findspot of the northeast sea coast of Sri Lanka, rather than the mainland, raising speculation whether it was transported by boat.

Ramayana images and iconometric studies

Rama is revered as the seventh incarnation or avatar of the Lord Vishnu and the protagonist of Valmiki's celebrated Sanskrit epic the Ramayana, as the banished prince of Ayodhya who slayed the demon king Ravana of Lanka. This stirring epic has widely inspired numerous literary, artistic and sculptural works and performing arts traditions across India and Southeast Asia. The hymns of the devotional Bhaktapoet-saints, the Alvar who worshipped Vishnu, of Tamilnadu of the 7th-8th centuries such as by Nammalvar allude to Rama as an avatar of Vishnu. The grief of king Dasaratha over the banishment of his eldest son Rama, child of queen Kaushalya to the forest, engineered by the designs of his youngest queen Kaikeyi, is poignantly captured in a poem by the saint Kulashekhara Alvar (Dehejia 1988: 95; Perumal Tirumoli 7.8) as below:

*O child Kaushalya
of radiant eyes
your strong broad shoulders
carry the bow-
Used to sleep on a soft bed
your bed will now be one of stines
beneath the shade of forest trees-
How will you learn to do this?
O unfortunate that I am!*

Interestingly, it seems that it is really in the Chola period that rounded sculptural depictions of bronzes related to the Ramayana came into vogue. From earlier periods, although terracotta panels such as of the Guptas and narrative stone reliefs such as of the Chalukyas there is a paucity of bronzes related to the Ramayana. It is in the art of Chola bronzes that the full blown royal form of Rama is best visualised as exemplified by the Paruthiyur Rama comprising a set with Sita and Lakshmana dated to Raja Raja's period (985-1010 CE) (illustrated in Nagaswamy 1983: 154-7). The Chola Leiden copper plates from Anaimangalam plate (Krishnamachari 2011) make a reference to these bronzes with respect to records of grants made by Raja Raja Chola to the temple.

An image of Rama, the exiled warrior and prince of Ayodhya (Fig. 18) from Tiruvelangadu, Chingleput district had trace element and stylistic trends consistent with the Late Chalukya-Chola or Later Chola period (c. 12th century). The god king Rama, also popularly depicted in southeast Asian art, is regarded as an incarnation of the major deity Vishnu, associated with forces of preservation. Interestingly, the iconometric proportions of this late Chola Rama image followed the *ashtatala*

measurements of eight proportions associated with an idealized man. This may be contrasted with a Rama image (Fig. 19) from Ramnad Zamindari in Victoria and Albert Museum (acc. no. IM-1-1934) which fitted well Vijayanagara finger-prints, and followed more the *navatala* proportions of a major deity. This perhaps reflects an iconometric shift whereby the stature of Rama increased to that of a major deity by the later Vijayanagara period with a full-fledged temple dedicated to Rama at Hampi as exemplified by the Hazara Rama temple. As suggested by Dallapicolla and Verghese (1998 : 5), the influence of the Rama cult and the homology between king and the divine hero Rama in the Vijayanagara period contributes to this elevation from a folk or minor deity to a mainstream divinity. A Rama image in Victoria and Albert Museum, with lead isotope ratios falling in Group 2a of Vijayanagara bronzes (Srinivasan 2016a) was also attributed to the Vijayanagara period by Michell (1995: 199). This brass image with 21.3% zinc also had the most significant traces of cadmium of 0.008%. It might have been made by alloying metallic zinc to copper rather than as cementation brass; as cadmium traces could be expected in smelted metal zinc. This also suggests that Group 2a could represent a lead-zinc source discrete from the one used in Chola times.

Unravelling the enigmas of Shiva Nataraja

The Nataraja bronze has been one of the most of Indian objet d'art which has intrigued connoisseurs, artists and scientists alike the world over such as sculptor Auguste Rodin (1913). Its mystique ranges from the enigmatic imagery of Chola bronzes, to the rich body of devotional poetry associated with its worship over centuries and the distinctive rituals associated with temple worship at Chidambaram. A uniquely Tamil icon, the Nataraja image is worshipped in most temples as the *utsavamurti* or festival processional icon, while the aniconic cosmic pillar of the lingam is worshipped in the innermost sanctum. However, the Shri Nataraja temple at Chidambaram is the only exception, with Nataraja being worshipped in the sanctum sanctorum itself. Until recently, there been a tradition of worshipping next to it, an empty curtained space, framed by *bilva* leaves, to symbolise the *akasa* lingam or ether. This has been described as the Chidambaram Rahasya or the revelation of Chidambaram (*chit*: mind, *ambaram*: cosmos).

Ananda Coomaraswamy (1924 : 87), celebrated geologist-turned art historian, wrote evocatively of the significance of the dance of Shiva as Nataraja, drawing from the 13th century Tamil text Unmai Vilakkam (verse 36), composed around Chidambaram, 'Creation arises from the drum: protection proceeds from the hand of hope; from fire proceeds destruction: the foot held aloft gives release... this is poetry, but nonetheless science'. The five activities (*pancakritya*) are represented by the

dancing figure of *Shrishti* (creation), *Sthiti* (preservation), *Samhara* (destruction), *Tirobhava* (illusion), and *Anugraha* (salvation). He also pointed to the *Tirukuttu Darsharna* from *Tirumular's Tirumantiram* which resonates with the cosmic underpinning that this icon thereafter came to be associated with: ' He dances with water, fire, wind and ether', his body is Akash (ether), the dark cloud therein is *Muyalaka* (the dwarf demon below Shiva's foot)'. T.S. Eliot's evocative words in *Burnt Norton* seem to echo the artistry of the image, 'at the still point of the turning world, there the dance is...'

The Nataraja bronze has also been identified as the '*ananda-tandava*' *murti* or 'awesome/furious dance of bliss' The word '*tantu*' may be derived from the Tamil/Dravidian word for leaping over (Zvelebil 1985 : 2). In their hymns, the Shaivite saints and the Nayanmar, often sang of the sacred landscapes where Shiva was worshipped (Peterson 1989). These devotional poems seem to grapple with the conundrums and fragility of the human condition in their own way. At times they allude to its morbid mortality when describing Shiva's ghoulish dance in the cremation grounds as in 6th century woman saint Karaikkal Ammayar's verses. At other times, they are suffused with a sense of the transcendental, as in Manikkavachakar's evocation of Nataraja as *Oru Unarve*, or the one consciousness (Srinivasan 2004, 2011, Yocum 1983 : 24), also bringing to mind the etymology of 'Chidambaram' that might imply the cosmic consciousness. In a more pragmatic sense, that the image could have also represented an emblem of power and political might of the Cholas is also suggested from gleanings of iconography and poetry (Kaimal 1999).

Stone depictions of the Nataraja image are prominently found in temples patronised by 10th century queen Sembiyan Mahadevi as seen in the Aditurai temple. The Konerirajapuram temple dedicated by her late husband Gandaraditya Chola has a most exquisite sculptural depiction of Nataraja. Perhaps the best known depiction of a stone Nataraja (Fig. 20) is on the colossal Gangaikondacholapuram built by Rajendra Chola in the mid 11th century which has the lifted leg re-inforced by a basal strut to counter the poor tensile strength of the granulite stone. However, archaeo-metallurgical investigations made by the author on a couple of Nataraja images by lead isotope ratio and trace element analysis suggested that the image was already in vogue by the Pallava period. This is indicated by a delicate Nataraja bronze (Fig. 21) in British Museum (Srinivasan 2004) with a forward facing dwarf akin to the Pallava Nallur Natesha and Kuram Natesha. Another is a Nataraja image (1.16 m) from Kunniyur which, also from stylistic grounds of the absence of the matted locks, may be attributed to the pre-Chola or later Pallava period, c 800-850 CE. Closer

examination affirmed their stylistic connections to Pallava stone sculpture such as at the monoliths of Mahabalipuram (Srinivasan 2013). The missing gem in the locks of the Kuniyur Shiva Nataraja image is similar to the case of the gilt Tara image from Sri Lanka. A Pallava attribution for Nataraja correlates with a 7th century verse by Appar, mentioning the festival procession of a Nataraja image at the temple of Kurukkai Vrattam (Dehejia 2003: 103). Significantly, from the finger-printing technique none of the Nataraja bronzes sampled by the author could be attributed to the Vijayanagara/Nayaka period, suggesting that its popularity was at its peak during the Chola period (Srinivasan 2001).

In his best selling book, *Cosmos*, astronomer Carl Sagan (1980 : 214) wrote that the image, conveyed, something of 'a premonition of modern astronomical ideas', seemingly balancing creation and destruction. Indeed there are some intriguing aspects suggesting an attempt to connect nature, divinity and cosmos. The ten day festival of '*ardradarshanam*' in December, is designated when the moon is full in the lunar asterism of the *nakshatra ardra*, or the red star Betelgeuse or α Orionis which falls on the shoulder of the image. The ritual procession of the Nataraja image in the Chidambaram temple takes place during this festival. Indeed, there are grounds to conjecture that the iconography of the Nataraja image may have been linked to the star positions in or around the Orion constellation at some time in its historical trajectory. Late Ganapati Sthapati (2002:78), master stone sculptor from Mahabalipuram revealed that the Nataraja image was derived from the sightings of Nataraja's *nakshatra* (astrological *moon sign*), Thiruvadurai or *ardra*, and the six white stars around it. In a 20th century Tamil book from Chidambaram by A. Cokkalingam (1946 : 298), there is an illustration of Nataraja with some of the star positions of Orion marked around it and captioned below as '*ardratandavadarsanam*' (personal communication with late Raja Deekshitar). In a collaborative archaeoastronomical studies done by the author with late astrophysicist Nirupama Raghavan, a star chart of 800 CE was mapped onto a Nataraja bronze from British Museum technically finger-printed by the author to the Pallava period (Srinivasan 2006, 2011). It is also tempting to speculate about the lifted leg pointing to the star Sirius. The Vedic god Rudra is associated with the wrathful hunter, while the star Sirius also finds mention in Vedic literature as Mrgavyadha or the hunter of the deer (Kramrisch 1988 : 44).

At one level, Chola bronzes have a very tangible beauty to them, yet at another level, there is something intangible and transcendental about them, which goes beyond vision. This is reflected in devotional poetry as seen in Manikkavachakar's 9th century verse 'Ah, When will I get to gaze upon the Unique

One, to whom no other compare, him who is earth, wind, fire, water and ether..' (Yocum 1983: 20). Appar in the 7th century beseeches Nataraja worshipped at Tillai or Chittambalam/Chidambaram or the little hall), 'to fill him with sky (*nilavu*) and make him be' (Handelman and Shulman 2004 : 48). There is a notion of drawing the cosmic outer space, into the inner space. This also echoes of the *akam* (inner space)-*puram* (outer space) interplay of the poetics of the Tamil Sangam genre discussed by Ramanujan. This negotiation, from without to within and vice versa, also resonates of the sensibilities of the classical dance tradition. As indicated in the verse below, the Shaiva Siddhanta devotee could break into ecstatic dance: when blessed with a vision of the graceful lifted foot of the dancing Nataraja.

*He...revealed His foot
which is like a tender flower,
caused me to dance
entered my innermost part (akam)
became my Lord...* (Yocum 1983 : 30)

A spectacular set of Nataraja and Sivakami is displayed for public worship at the colossal Brhadishwara temple built by Rajaraja Chola on special festivals (Fig. 22).

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Acknowledgements

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Fig. 1 : Elephant, Daimabad



Fig. 2 : Nataraja, Kankoduvanithavam, Government Museum, Chennai

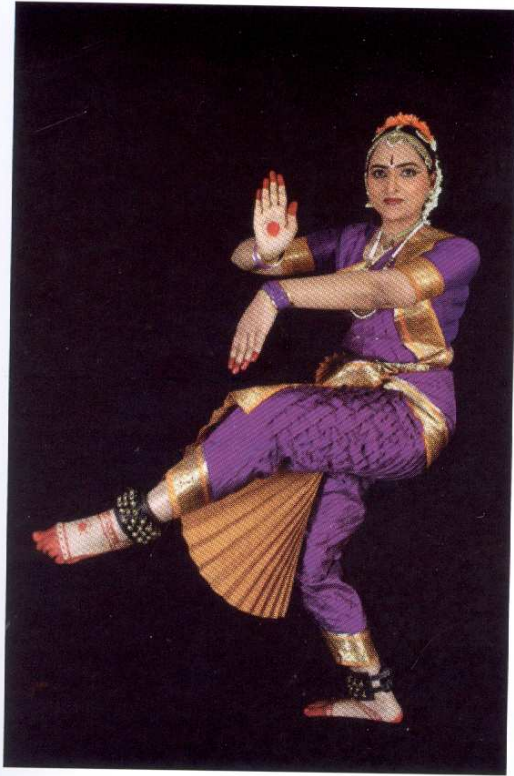


Fig. 3 : Bharatanatyam posture of Bhujangatrasita Karana (demonstrated by the author Sharada Srinivasan)

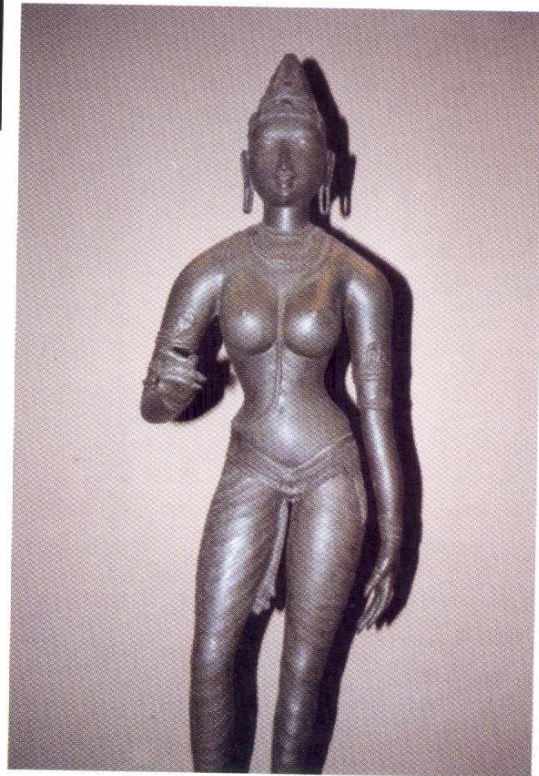


Fig 4 : Devi, Freer Gallery of Art, Washington, DC



Fig 5 : Parvati with attendant, Okkur, Government Museum, Chennai



Fig. 6 Wax model being made at Swamimalai by Radhakrishna Sthapati



Fig. 7 : Rear of unfinished Vishnu, CSMVS Museum, Mumbai



Fig. 8 : Pouring and casting of copper alloy icons, Swamimalai

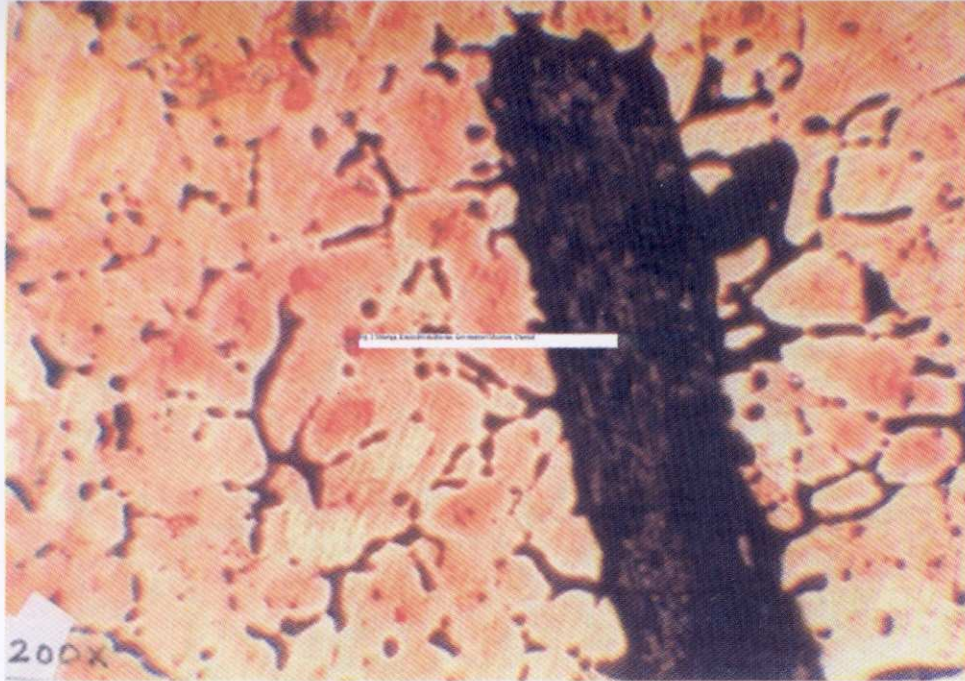


Fig. 9 : *In situ* metallograph from unfinished Vishnu image, CSMVS Museum, Mumbai



Fig. 10 : Finishing of metal icon, Swamimalai

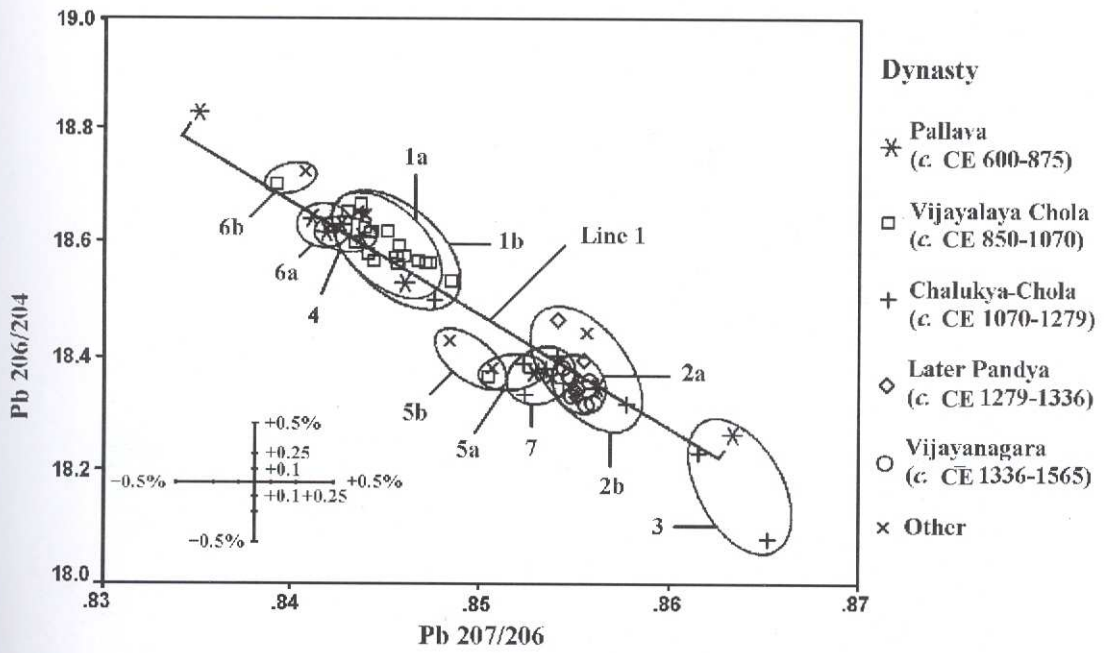
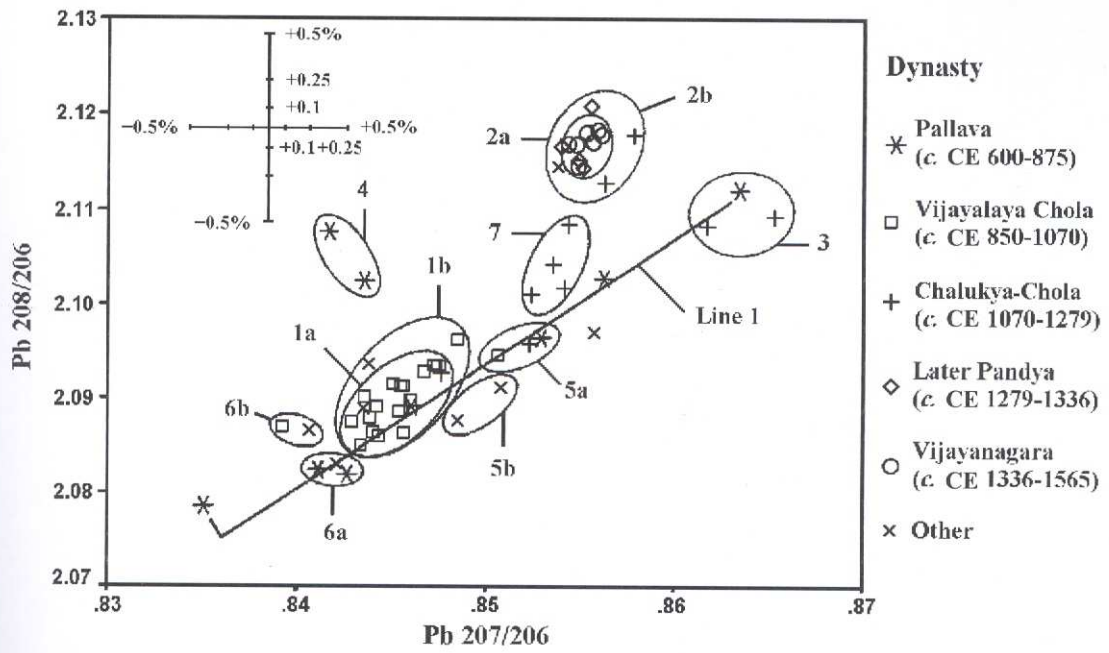


Fig. 11 : Lead isotope ratio plot for analysed south Indian bronzes



Fig. 12 : Parvati, Somaskanda, Needur,
Government Museum, Chennai



Fig. 13 Seated Parvati,
Vadakapaniyur

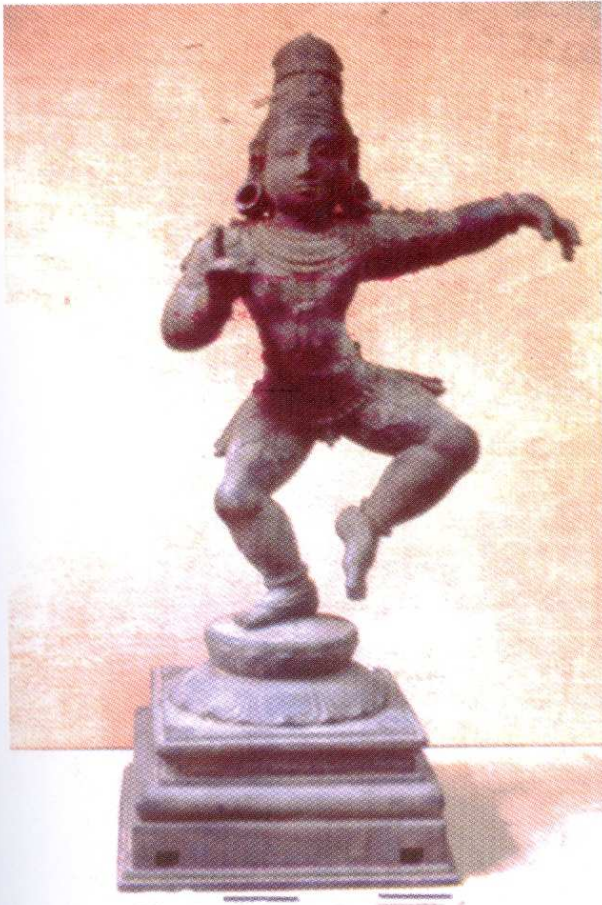


Fig. 14 : Sambandar, Government
Museum, Chennai



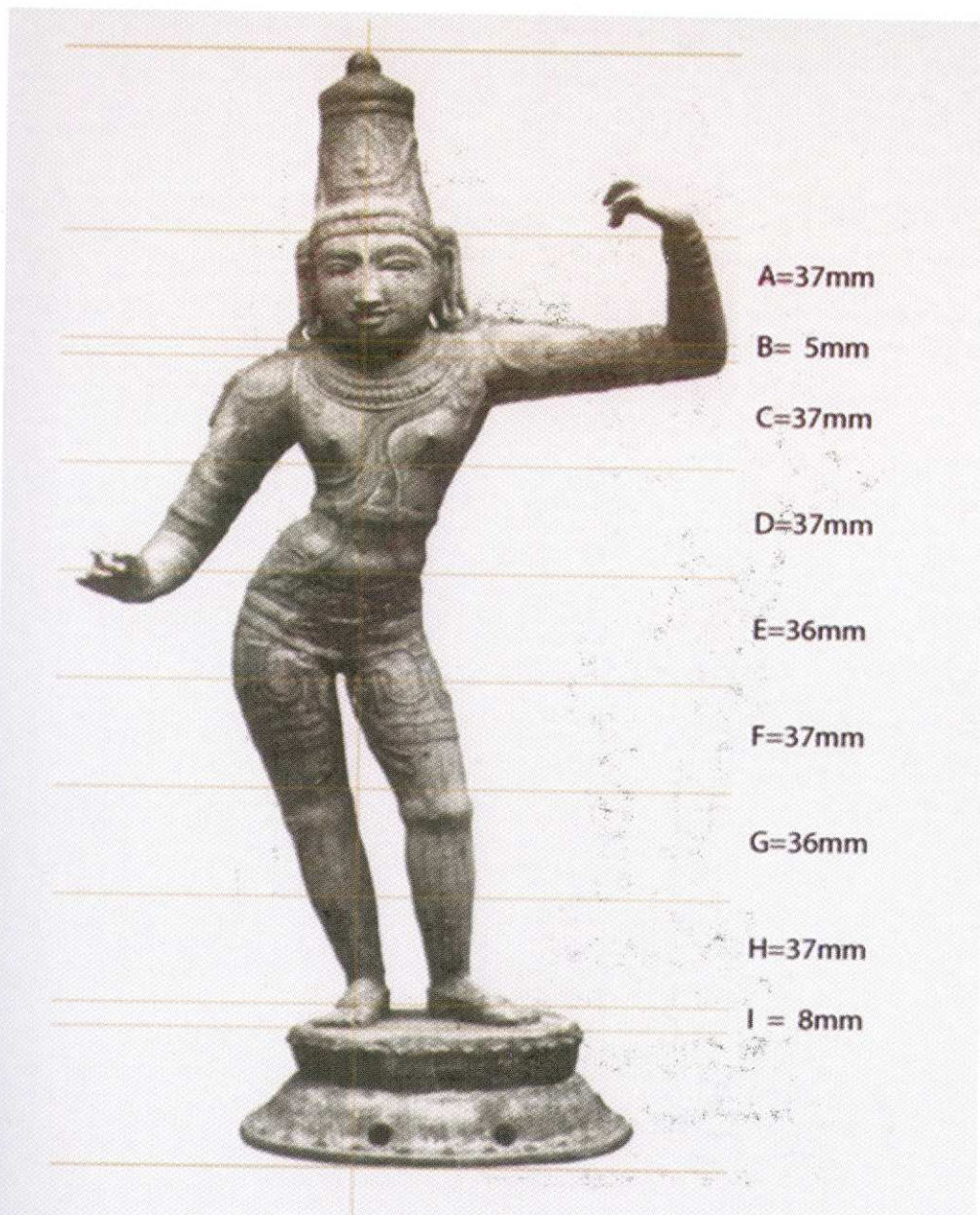
Fig. 15 : Parvati, Kudiakadu,
Government Museum,
Chennai



Fig 16 : Tara, British Museum



Fig. 17 : Kuniyur Nataraja,
Government Museum,
Chennai



Photoshop Image size = width 224.5 mm X height 407 mm

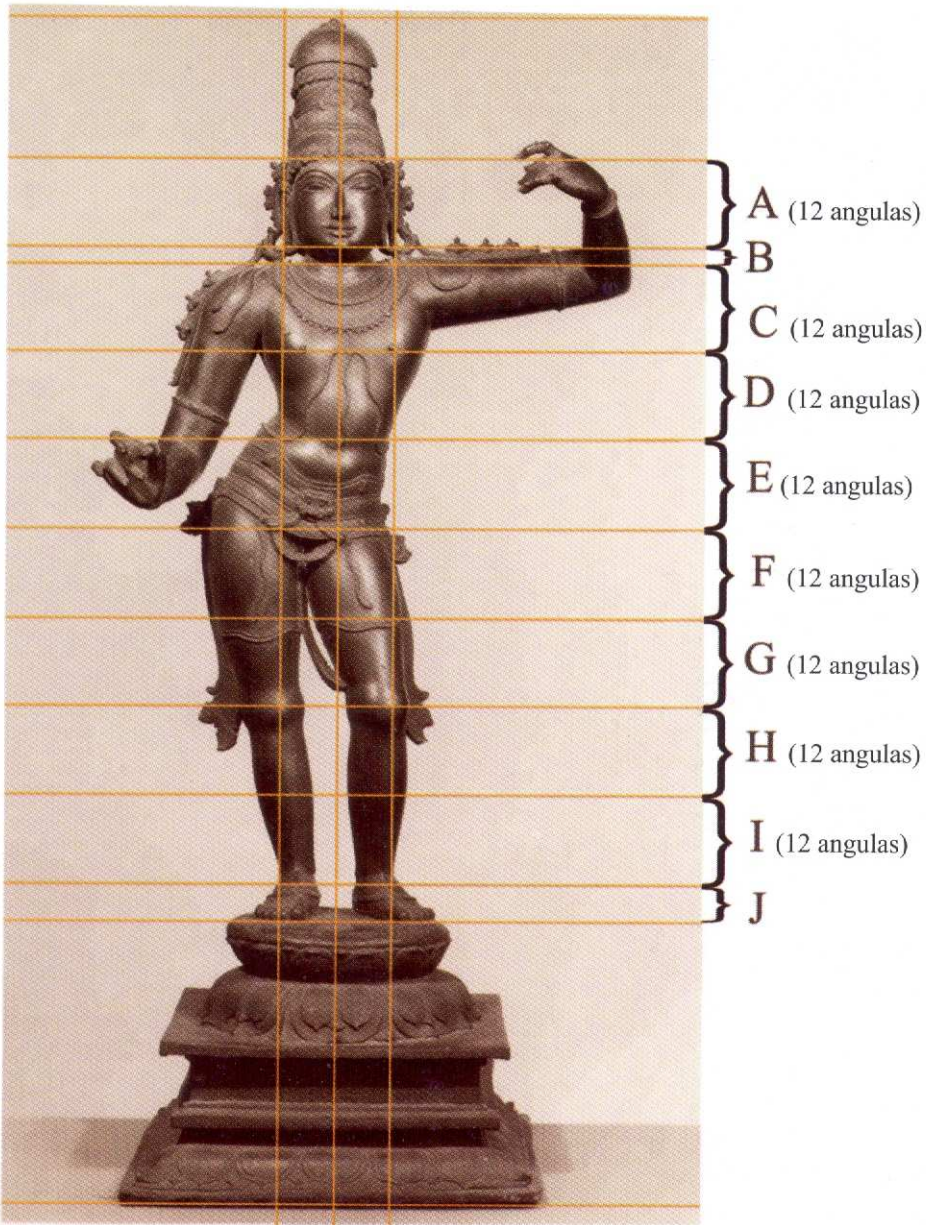
Image Body Size = 379 mm

Divisions : A =37mm,C=37mm,D=37mm,E=36,F=37mm,G=36mm,H=37mm.

Average Divisional Height (ADH)= $(A+C+D+E+F+G+H)/7 = (257/7) = 36.71\text{mm}$

$B+I = 5+8 = 13\text{ mm}$ which is $[(13/36.71) \times 100] = 35.41\%$ of ADH

Fig. 18 : Rama, Tiruvelangandu, Government Museum, Chennai with iconometric proportions. (B/W photo Courtesy of Government Museum, Chennai)



Photoshop image size : Width = 591.18mm length = 950.97 mm

Image body height = 920mm

[A=68mm, C=68mm, D=68mm, E=69mm, F=69mm, G=68mm, H=69mm, I=69mm,]

Average divisional height ADH = $(A+C+D+E+F+G+H+I)/8 = 548/8 = 68.5\text{mm}$

(B+J) = 13 + 28 = 41mm which is 59.5% of ADH

Fig. 19 : Rama, Victoria and Albert Museum (IM-1-1934) with iconometric proportions (B/W photo Courtesy of Victoria and Albert Museum)



Fig. 20 : Nataraja stone sculpture, Gangaikondacholapuram

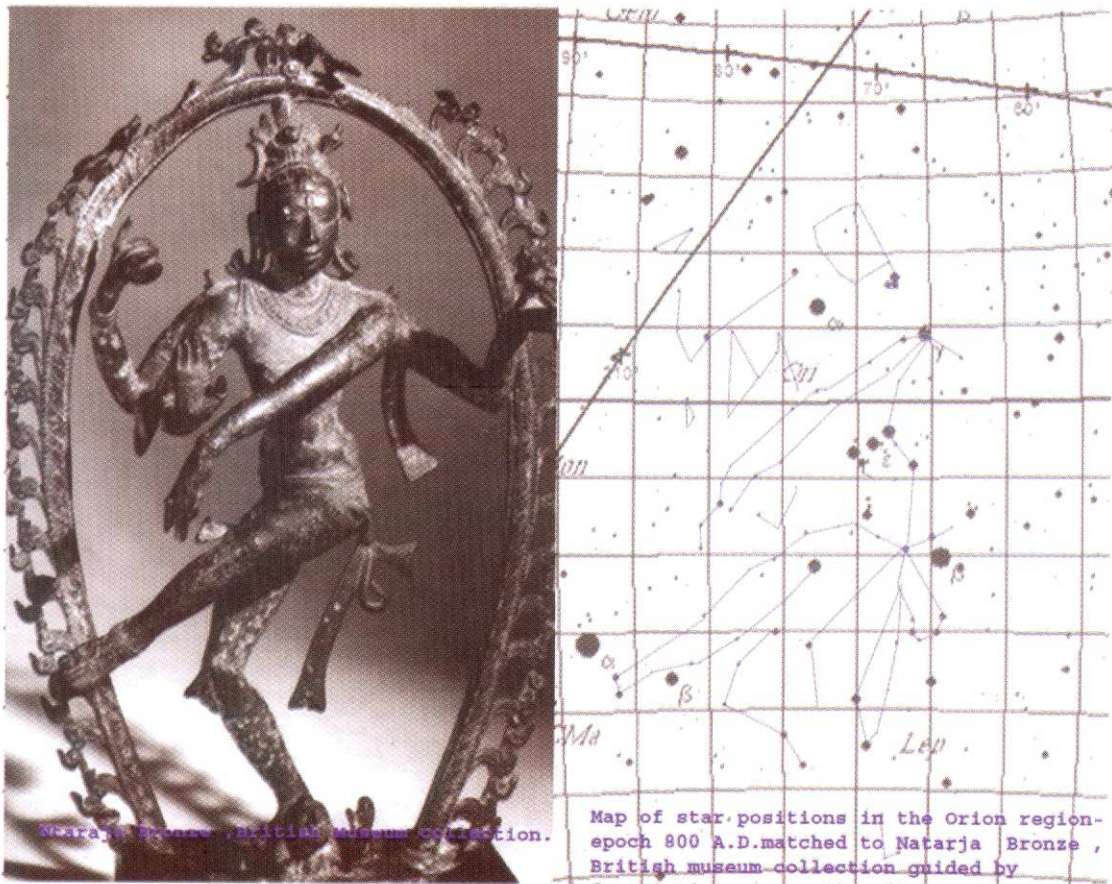


Fig. 21 : Nataraja British Museum, with star chart superposition
(B/W photo courtesy of Trustees of British Museum)



Fig. 22 : Nataraja and Sivakami in worship, Brhadiswara Temple

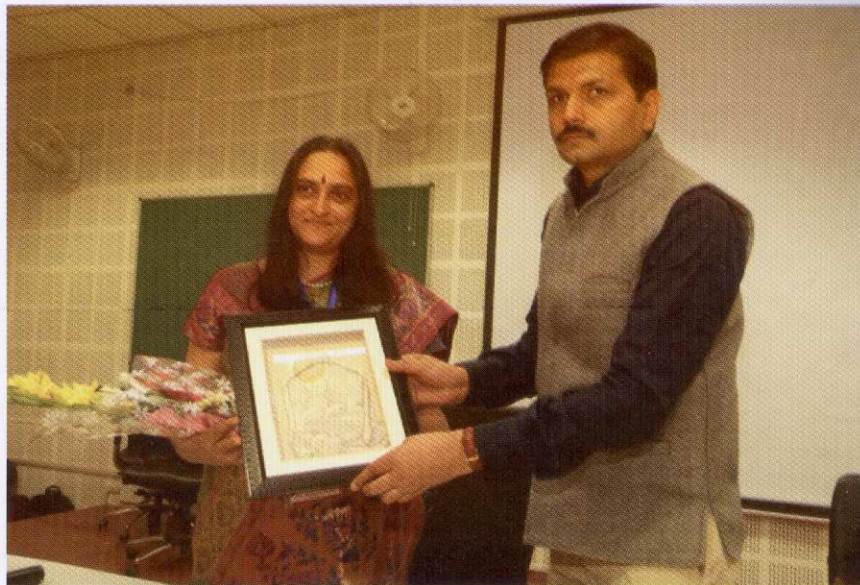
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**Glimpses of the Second Dr. Frank C. Chookolingo and Evamaria R. Chookolingo
Memorial Lecture 2017**



Prof. Sharada Srinivasan being felicitated by Prof. Atul Tripathi, Head of the Department.



Dignitaries on the Dais during the Second Dr. Frank Chookolingo and Evamaria R. Chookolingo Memorial Lecture at the Seminar Complex, Institute of Science, BHU, Varanasi on 01.03.2017.



Prof. Atul Tripathi delivering the welcome address



Prof. Sharada Srinivasan delivering the second Dr. Frank C. Chookolingo and Evamaria R. Chookolingo Memorial Lecture



Dr. Anila Verghese, Guest of Honour, delivering her concluding remarks



Ms. Anuradha Raturi, conducting the event



A view of the audience at the event



Mrs. Shikha Misra, Assistant Professor, proposing the Vote of Thanks

ABOUT THE DEPARTMENT

The Department of History of Art, Faculty of Arts, Banaras Hindu University, Varanasi is one of the premier centre in India devoted to Art Historical Studies. The Department (initially known as the Department of Art and Architecture) is also the oldest Institution in the country established in 1950.

The Department has been navigated through by reputed authorities on pre-modern art traditions of India namely Professor V.S. Agrawal, S.K. Saraswati, Anand Krishna and so on and bulk of the research output of the Department has been on the pre-modern phase of Indian Art. The Department has the pride of producing great scholars in the field of Indian Art like Dr. Kapila Vatsyayan and Prof. P.L. Gupta. Dr. N.P. Joshi, Prof. R. Das Gupta, Prof. L.K. Tripathi, Prof. Prem Lata Sharma etc. are among other few outstanding scholars who have also been associated with this department. The Department has produced standard works on Ancient Indian Art and Aesthetics, Iconography, Painting, Indian Architecture, Costumes, Textiles and Decorative Art. The Department offers courses on History of Art, with a focus on Indian Art, Painting, Sculpture, Iconography, Architecture, Textile and Decorative Art, Folk and Tribal Art, Aesthetics, Art of South East Asia, Art and Environment, Myths and Symbols under one roof.

The Department introduced Tourism Management (M.T.T.M.) as a Special Course at Post Graduate level in the Golden Jubilee celebration year (1999-2000). At present, the Department coordinates courses from Diploma to Ph.D. level, which are offered at Main Campus, B.H.U. and M.T.T.M. programme offered at Rajiv Gandhi South Campus, Barkachha.

With an intention to make people aware of their rich legacy, the Department organizes time to time events focussing on the rich art heritage of India. In this context events like 'International Seminar on Sir Alexander Cunningham and the Art Heritage of India', 'National Workshop on Varanasi: The Eternal City', 'National Seminar on Art Heritage of India: Legacy and Relevance', 'International Seminar on Indian Art Heritage in a Changing World: Challenges and Prospects' are of much significance.