Cotton heritage of India and improvements trialled on cotton germplasm in the Madras Presidency during the 19th Century

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Cotton has been known to Indians for long. Greek historian Herodotus (5th Century BC) in his chronicles indicates that cotton material was the customary wear of Indians. Fibres of Gossypium arboreum were used by early Indians. Three other species of Gossypium, viz. G. barbadense, G. hirsutum, and G. herbaceum were independently domesticated in other parts of the world. Up to the time of Hendrik Adriaan van Rheede (1636–1691), the Dutch Governor of Cochin, only G. arboreum was used in India for making fabrics. In later decades, but before the time of British surgeon–botanists, such as William Roxburgh and John Royle, many foreign species and natural hybrids of Gossypium were introduced into India, either deliberately or inadvertently. Thomas Munro (1761–1827), the Governor of Madras was keen to cultivate G. barbadense in Salem and Coimbatore. Robert Wight, another key surgeon–botanist of Madras made great strides in cultivating various species and hybrids of cotton in Coimbatore and Tirunelveli (Madras Presidency). In addition to capturing the pre-British days of cotton use in Madras and India, the present note highlights the efforts made by Wight and the Government of Madras in improving cotton agriculture in Madras Presidency and how these efforts were abruptly shut down by Henry Pottinger, Governor of Madras, in mid-19th Century. This note concludes with a brief remark on how the introduction of various species and hybrids of Gossypium has today changed India's status as a key cotton producer and fabric manufacturer in the world.

Cotton has been a part of Indian heritage for long[1]. The earliest reference to cotton occurs in the *Śrauta Śutra* of *Aśvalayanã* (estimated 8th Century BC), in which the cotton fibre is compared with other fibrous materials, such as silk and hemp[2] (note 1). Herodotus (*c*. 450 BC)[3] indicates that cotton material is the customary wear of Indians: 'India has wild trees that bear fleeces as their fruits ... of this the Indians make their clothes'.

During the reign of Çandragupta Mauryã (321–297 BC), 'high-quality' cotton fabrics were produced in Magadã (parts of Uttar Pradesh, Bihar, and Bengal today)[4]. The *Periplus* (estimated 1st Century AD) mentions cotton fibres and fabric exported to Arabia and Greece from Ariãke and Barygãzã (townships in the Runn of Kutch?) and Masãliã (modern Masulipatnam; note 2)[3]. The *Periplus* mentions that superior cotton called the Gangitiki (from the land of Ganges) – produced in modern Bengal area – was sent to Greece[5]. Flavius Arrianus (*c*. 150 AD, note 3) writes (ref. 6, p. 213):

> 'Indians wore linen garments, the substance whereof they were made growing upon trees; and it is indeed flax, or rather something much whiter and finer than flax. They wear shirts of the same which reach down to the middle of their legs, and veils which cover their head and a great part of their shoulders. The Romans also used Indian cotton clothes.'

Pliny the Elder (AD 73) in *Natural History Book 7* indicates that Indians use cotton wool to drape themselves[7]. Marco Polo, the Venetian traveller who travelled in India in the 13th Century, refers to the production of 'woven' cotton material in Gujarat, Cambay, Telengana, Malabar and Bengal. He indicates the Masulipatnam cotton as the finest fabric known in any part of the world[8]. A comprehensive treatment of large-scale production of cotton in India from ancient to modern times with illustrations of the churka and bows (danûhí, dûnãki) used until the 20th Century are available in Schlingloff[9].

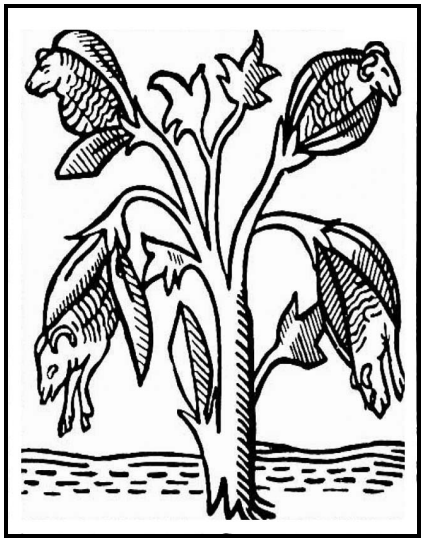

Figure 1. Fanciful depiction of cotton plant by John Mandeville features 'sheep' instead of cotton bolls (14th Century).

Historical references to cotton in India speak of 'tree' cotton, *Gossypium arboreum*[10]. Floatation samples from 12 sites in modern Karnataka and Andhra Pradesh[11] indicate that the domestication of cotton (possibly *G. arboreum*) occurred in India in the Neolithic Period (2800–1200 BC). John Mandeville, while in India in 1371 AD, is supposed to have said (note 4): 'There grew there [*sic*. India] a wonderful tree which bore tiny lambs on the endes of its branches. These branches were so pliable that they bent down to allow the lambs to feed when they are hungrie' (Figure 1).

From the time of Emperor Jalãl-ud-din Akbar (1542–1605), production of cotton fabric prospered in India, particularly in Bengal, although spinning and weaving were done manually.

> 'In spite of the raw materials not being brought to its highest state of cultivation, and with little machinery and division of labour, the products were fabrics of exquisite delicacy, unrivalled by similar products of any other nation, due to the excellence of

the remarkably fine sense of touch and the patience and the gentleness of Indians. The Dacca muslin made under names such as *Textile Breezes*, *Running Water*, and *Evening Dew* remained a class of superb finesse in the 19th Century' (ref. 12, p. 56).

Bulk of cotton fabrics imported into Europe from India bore hand-printed floral designs. White cotton materials with tulip, carnation, rose and daisy motifs were popular among 18th Century wealthy Europeans, floral 'sprig' designs with tiny motifs on pastel backgrounds were popular among the less-wealthy Europeans. In France, such printed fabrics were generally called les Indiennes, although they were also known as les toiles peintés and les toiles imprimés. In England and in the American colonies, similar terms prevailed: calico, derived from Calicut, was a general name for Indian cotton fabric; chintz, from the Hindustani 'chint' ('variegated').

Throughout the world, three other species of *Gossypium*, *G. barbadense*, *G. hirsutum* and G. *herbaceum* were independently domesticated. The epicentre of *Gossypium* is not established yet, although west-central and southern Mexico, northeastern Africa and Australia are possible key centres of diversification. Polyploidy is common in *Gossypium*; 5 allotetraploids and 46 diploids are prevalent today[13]. That the progenitors of the tetraploid cottons are *G. raimondii* of Ecuadorian and *G. herbaceum* of southern African–Arabian Peninsula distribution[14] is widely accepted, but how these taxa hybridized in spite of vast spatial separation is unclear[15]. *G. hirsutum* contributes to more than 90% of world production of the fibre. Maximal land area under cotton cultivation using the four species of *Gossypium* occurs in India today. Although the fibre quality of *G. arboreum* is inferior to that of *G. hirsutum*, the former includes several useful traits in improving cotton performance and quality. *G. arboreum* is innately hardy having evolved in Indian soil and climate conditions[16]. It attracted the attention of Hendrik van Rheede (Figure 2 *a*). Surgeon–botanists William Roxburgh and John Forbes Royle provide elegant illustrations of *G. arboreum* (Figure 2 *b* and *c*). John Forbes Royle[17] lists 11 species of *Gossypium* in British India extracting details from William Roxburgh's *Flora Indica*[18] and Olaf Swartz's *Observationes Botanicae Quibus Plantae Indiae Occidentalis*[19] (Table 1).

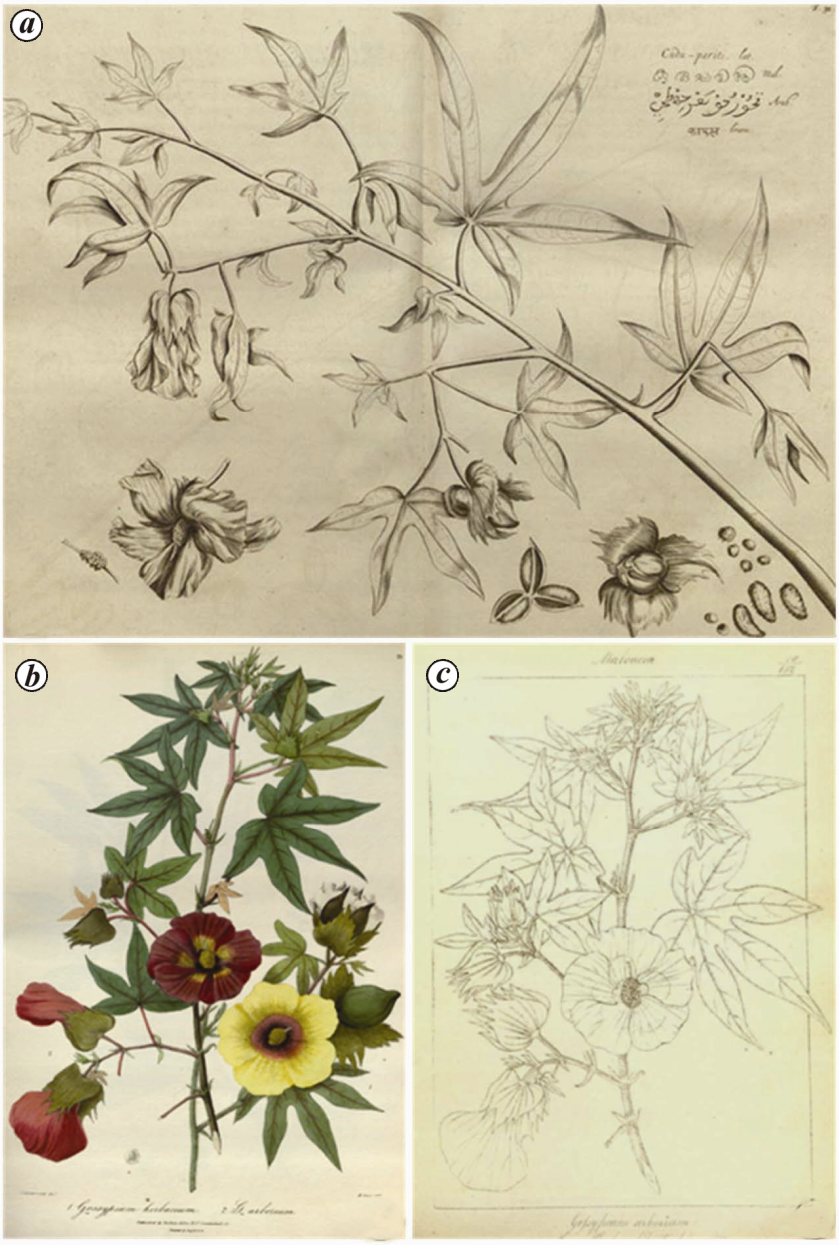

Figure 2 ***a–c***. *Gossypium arboreum* from Indian botanical classics. ***a***, From Hendrik van Rheede's *Hortus Malabaricus* (1678, vol. 1, figure 38). Vernacular names (Tamil [in Roman characters], Malayalam, Arabic and Sanskrit characters) shown at the right top of the image; Cadu-pariti (English transliteration and in Malayalam script) should be read as karum-paruti (paruti–cotton; karum–dark). ***b***, From William Roxburgh's *Flora indica* (1819, vol. 3, figure 269). ***c***, From John Forbes Royle's *Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere* (1839, vol. 2, plate 23).

Efforts to establish cotton in the Madras Presidency in the early decades of the 19th Century

From the time of Thomas Munro (1761–1827), the Government of Madras was keen to cultivate *G. barbadense* (the bourbon cotton) in Salem and Coimbatore, and entrusted the responsibility to one Josiah Heath, Commercial Resident in Coimbatore. Heath sought advice from George Hughes, who cultivated *G. barbadense* in Tinnevelly[21] (note 5). Heath[20] talks of *oopum parutti* (note 6), which prefers black adhesive soil and *nadum*

Table 1. Species of *Gossypium* in British India (John Forbes Royle 1839) and their current status

Royle's list of *Gossypium* species	Present name	Distribution	Reference	Remarks
G. arboreum	*G. arboretum* var. *wightianum*	India	http://www.theplantlist.org/tpl/record/kew-2830994	
G. obtusifolium	*G. arboreum*	Ceylon (Sri Lanka), southern India	http://www.theplantlist.org/tpl/record/kew-2831180	
G. barbadense	*G. barbadense*	Bourbon, West Indies	http://www.theplantlist.org/tpl/record/kew-2831007	
G. vitifolium	*G. barbadense*		http://www.theplantlist.org/tpl/record/kew-2831276	Maurice cotton*, Tanjavur, India
G. racemosum	*G. barbadense*	Porto Rico	http://www.theplantlist.org/tpl/record/kew-2831219	
G. acuminatum	*G. barbadense*	Northern and western Bengal, India	http://www.theplantlist.org/tpl/record/kew-2830981	
G. peruvianum	*G. barbadense* var. *peruvianum*	Peru	http://www.theplantlist.org/tpl/record/kew-2831007	
G. micranthum	*G. herbaceum*	Ispahan, Persia [modern Iran]	http://www.theplantlist.org/tpl/record/kew-2831163	
G. herbaceum	*G. herbaceum* var. *hirsutum*	Egypt [widely cultivated in India]	http://www.theplantlist.org/tpl/record/tro-19602955	Dacca cotton, Berar cotton, China cotton
G. religiosum	*G. hirsutum*	Siam?	http://www.theplantlist.org/tpl/record/kew-2831221	
G. hirsutum	*G. hirsutum*	West Indies	http://www.theplantlist.org/tpl/record/kew-2831092	

*A search for Maurice cotton (available in Tanjavur, Madras Presidency) was fruitless. Rhind (ref. 49, p. 409) refers to *G. vitifolium* (vine-leaved cotton) as follows: 'In this species, leaves resemble those of *Vitis*. This is indigenous to East Indies and chiefly cultivated in Mauritius (Maurice, French)'.

parutti, which prefers light, loose soil derived from granite. Heath, with instructions from Hughes, succeeded in growing *G. barbadense* in Coimbatore. He also describes efforts made by Hughes in Tinnevelly to grow *G. barbadense* (ref. 20, pp. 180–183). Cotton farms, 400 acres each, were established at Tinnevelly, Coimbatore, Masulipatnam and Visakapatnam. The produce from Coimbatore (500 bales of 300 lb [*c.* 136 kg] each), shipped by Heath to England, were sent to China for sale.

Trials made on improving the germplasm and manufacture of cotton fabrics

The earliest formal document on large-scale cultivation of cotton in India was the Minute issued by George Eden, Governor-General of India (1836–1842) in response to a dispatch of the Court of Directors of the East India Company on 15 March 1839 (ref. 21). The Minute was prepared and signed by Thomas Herbert Maddock (Secretary, Government of India) on 14 August 1839 (ref. 22). Key points from this Minute are:

- The Government is keen on cultivating cotton, sugarcane and other articles of commerce suited to European markets.
- With regard to cotton cultivation thus far, success was not that great as was expected.
- As an effort to extend, improve and encourage cultivation of cotton, experimental and subsidiary farms were to be established.
- To achieve the same, seeds in considerable quantities were to be procured from Egypt, Bourbon, Brazil and North America.
- Saw gins from North America were also to be imported to produce 'finished cotton' of a quality comparable with the American cotton.
- Bernard Metcalfe, a cotton seed cleaner from New Orleans (or Georgia?) was already in Madras Presidency from 1813 to superintend the improved cotton management.
- Comprehensive information on the mode of cultivation suiting best to local soil and climate to the several varieties of the plant (*sic.* cotton) and with regard to the time and manner of gathering cotton from the pod and cleaning it with machinery sufficiently rapid to produce finished cotton with no injury to the staple was to be achieved.
- Rewards to exhibits of finished [machine cleaned] cotton of good growth, not less than 300 bales to be given.
- The Glasgow East India Association had produced an improved machine for cleaning cotton on the principle of already existing Indian churka. Three of them were sent to Bombay; two to Bengal and two to Madras were to be sent by the Government in the next few years.

The Indian cotton was not a match to the American cotton in quality. The Indian cotton wool included seeds. The East India Company officials searched for machines from Georgia and Carolina

(America) for separating wool and seeds. In 1813, they engaged Bernard Metcalfe, an experienced Georgian cotton cleaner. Metcalfe's efforts in encouraging Indians to use American gins proved to be futile[23].

The Northern Circars (present districts of Godavari, Visakapatnam in Andhra Pradesh and Ganjam in Odisha) on the coromandel coast have been the seat of production of cotton fabric, known as 'calico' (or the 'Madras' long cloth) until the 1830s. In Masulipatnam, dyed scarves were produced for trade in Africa and in the Caribbean. The dyed fabric from Masulipatnam suffered a setback in the 1830s, because of the volume of fabric industrially produced in Manchester and Glasgow. Weavers of Northern Circars depended on raw material brought by the nomadic people (note 7) from the Mahrattas (modern Maharashtra), since local cotton was neither abundant nor good. The southern and western districts grew cotton of better staple length than what grew in the Northern Circars. The East India Company had established factories for weaving long cloths and salampores (note 8) in the southern districts of the Madras Presidency. Unreliable rain pattern in the southern Madras Presidency influenced the price of finished cotton to rise and therefore, cotton materials from southern Madras were dearer than those from the Northern districts, the Circars. *G. barbadense* and Brazil cotton (the allotetraploid *G. mustelinum*[?][24]) were cultivated by Company servants and private farmers in Tinnevelly.

By late 1830s, the demand for cotton fabric intensified in Britain[25]. The Court of Directors of the East India Company, because of repeated previous failures with cotton cultivation in India (and Madras), decided that the introduction of American cotton and procuring information on the cultivation of cotton in the southern states of America was the solution. They deputed Thomas Bayles (Madras Army), to proceed to America to secure cotton seeds and details of cultivation, intending to engage parties qualified for the purpose of instructing Indians in the cultivation of cotton and methods of deseeding using machinery. Bayles mission was committed to secrecy (note 9). He was to recruit eight planters and 12 supervisors (for cleaning and packing) from America, who were to arrive in India by December 1839 (ref. 26). One of them was Thomas James Finnie. The outlay for this project was £100,000. The *Great Western* ferried seven experienced cotton planters from who were engaged by Bayles, South Carolina, Georgia and Mississippi, to India (*The Courier*, Hobart, 13 October 1840). The same news item also indicates that three more were to follow with cotton seeds, gins and agricultural implements.

Between 1848 and 1858, soil types suitable for cotton cultivation were established. Official letters from the District Collectors of Cuddapah, Madura, Tinnevelly and Coimbatore, based on the reports from the respective District Engineers, indicate the quality of black soil available in their respective landscapes. For example, Cuddapah included black soil of 20–30′ (c. 6–10 m) depth resting on either lime or sand, Madura with 5–15′ (c. 1.5–3 m) resting on black granite or white marble, Tinnevelly with 2–5′ (c. 0.5–1.5 m), and Coimbatore with 3–6′ (c. 1–2 m). Cotton-growing districts of the Madras Presidency – eight in all (Krishna, Nellore, Cuddapah, Kurnool and Bellary in the North [in modern Andhra Pradesh and Karnataka] and Madurai, Coimbatore and Tinnevelly in the South [in modern Tamil Nadu]) were recognized. While reviewing improvements necessary in the plant germplasm, a local classification was created keeping practicality in view: (1) The Indian cotton (*G. arboreum*), including the short-staple varieties from Bengal, Surat and Madras; (2) the North American cotton, which included the short-staple varieties of New Orleans source (the Mexican *G. barbadense*), West-Indian source (*G. barbadense*), and the long-staple sea-island cotton (the sea-islands were the islands of South Carolina and Georgia, a variant of *G. barbadense*), which produced the longest, finest and softest fibre, and (3) the South American cotton (*G. barbadense* var. *peruvianum*). Further to these, the local variants (*oopum* and *nadum* categories) were recognized separately. A general consensus was reached that the North and South American varieties were of superior quality to Indian native cottons in terms of staple length and softness of fibres. While referring to the highly prized long-staple *G. barbadense* (South Sea-Island variety) Talboys-Wheeler (ref. 27, p. 15) remarks:

> '... very beautiful muslins are still manufactured by the native weavers at Dacca and Arnee …'.

Possibly the weavers used the native *G. arboreum*. Whereas Dacca's relevance to cotton is well known, an explanation on Arnee is in order. Arni (Arnee) is a township 140 km southwest of Madras. From the days of James Anderson, who experimented with silkworm production and mulberry cultivation in Madras in the 18th Century[28], Arni is famous for unique-quality silk and cotton fabrics.

Robert Wight's experiments on cotton cultivation in the Madras Presidency

Robert Wight's (1796–1872) (Figure 3) contributions to Indian botany and agriculture are of no small measure; the most outstanding are *Icones Plantarum Indiae Orientalis* or, *Figures of Indian Plants* (1839–1853) and *Prodromus Florae Peninsulae Indiae Orientalis Containing Abridged Descriptions of the Plants found in the Peninsula of British India, arranged according to the Natural System* (1834, co-written with George Arnott Walker-Arnott, 1799–1868). Details on the life and works of Wight are available[29]. Here a summary of his efforts made on cotton cultivation in Madras is provided. Wight experimented in cotton cultivation under varied soil and other abiotic conditions[30–39]. After returning to the UK (1853), he published several short articles in *Gardener's Chronicle and Agricultural Gazette of London*[40] referring to his cotton experiments in Madras, and also a book recapitulating his Madras experiments[41].

A significant section of cotton experiments was carried out by American

Figure 3. Robert Wight (Source: http://en.wikipedia.org/wiki/Robert_Wight).

farmers (planters, seed cleaners) in Madras Presidency. During the governorship of Lord Elphinstone (note 10), cotton experiment farms were established in Madras. American cotton was cultivated and American saw gins (note 11) were trialled by Wight in Coimbatore. In 1845, when the Marquis of Tweeddale was Governor of Madras, Thomas Finnie was posted at Tinnevelly (Madras), and Wight remained in Coimbatore. Finnie continually evaluated the reactions of local farmers to his cotton-cultivation trials and interpreted how each year's crop performed. He concluded that the American varieties would never perform desirably in this part of India. On the contrary, Wight was influenced by the climatic factors of Mexico, the home of the New Orleans cotton. He saw substantial similarity in climate between Mexico and India (Madras). Hence he advocated continuation of experiments, arguing that tactics such as line sowing, interspace cultivation and use of sandy loam soils for cultivating American cotton were imperative. Aggressive debates occurred between Finnie and Wight. For details on these debates, the reader is referred to Talboys-Wheeler[27] and Noltie[29].

Yields were unimpressive. The Madras farmers could not be convinced to grow American cotton. These unsuccessful outcomes matched with the succession of Henry Pottinger as Governor in 1849, which marked disaster to Wight and cotton experiments at Coimbatore. The Court of Directors of East India company terminated Finnie's contract, but directed Pottinger that Wight be allowed to continue cotton trials. In 1853, the experiment farm was closed and Wight returned to the UK, retiring from active service. The Madras Government withdrew support to cultivating American cotton and importing saw gins. Experiments ceased. However, cultivation of American seed was not withdrawn completely, since private farmers continued using them. In early 20th Century, cotton cultivation in Madras Presidency had stabilized with effort made using new hybrids, particularly Cambodia cotton (*G. hirsutum*, tetraploid, $2n = 52$; also known as the 'upland cotton', 'Dharwad–American cotton'), which had 1″ (2.54 cm) staple and yielded 500 lb (226.8 kg) of lint/acre, whereas the native-Indian cotton *G. arboreum* yielded only up to 100 lb (45.4 kg) of lint/acre. The weakness in managing the industry was that the Cooperative Credit Societies in Madras were insufficiently equipped to support agriculture; the envisaged improvement would be that the Department of Agriculture was to sell selected seeds on credit to farmers[42].

Conclusion

Cotton production in India has grown immensely today. The Cotton Advisory Board has projected that cotton production in Tamil Nadu, Andhra Pradesh and Karnataka will be a stupendous 106 million bales (170 kg each) in 2014–2015 (http://cotcorp.gov.in/current-cotton.aspx?pageid=4). Indian cotton fabrics are prized across the world. Use of *Bt*-cotton has increased substantially in India in recent years. Because several collateral issues such as 'resistance' to certain cotton-feeding insects – and several other related issues – have surfaced with *Bt*-cotton agriculture, a careful scrutiny of the apparent 'progress' is imperative. Nevertheless, considering the developments and progress made today, it is gratifying to recall the efforts of several pioneers in Indian agriculture[43], who blazed new trails with limited facilities, tools and knowledge.

Notes

1. Leonard William King[44] disputes the suspected Indian origin and early use of cotton in India.
2. The term 'muslin' possibly evolved from the cotton produced in Masulipatnam, which is referred as Masula (Masalia) in Greco-Roman literature. Alternatively, muslin could have evolved from Mosul in modern Iraq, which too pioneered in producing cotton fabrics (ref. 45, p. 35).
3. Arrian of Nicomedia (*c.* AD 86–*c.* AD 160) wrote the *Anabasis of Alexander*, a document on Alexander the Great.
4. John Mandeville and his work are rated variously by literary critics. See http://d.lib.rochester.edu/teams/text/kohanski-and-benson-the-book-of-john-mandeville-introduction.
5. Josiah Marshall Heath indicates that he returned to the UK in 1825. Obviously he wrote the cited article 15 years after his return. He will be better remembered in India for his skills in metallurgy; he pioneered in making cheap steel in India by applying manganese to deoxidize steel.
6. Parutti is cotton in Tamil; the prefixes *oopum* and *nadum* imply variants. The biological name of oopum parutti is *Gossypium arboreum* var. *obtusifolium*.
7. The Lambadies – Banjara, Banjari, Lambada, and Lambani in Telengana, Sugali and Sukali in Rayalaseema[46].
8. Salampore: bright checked cotton material, exported to Africa and South Africa. In the 17th Century, similar material was made in the Dutch colony of Pulicat (Pazhaverkadu, Palea Catta, 50 km north of Madras) and exported to Africa and the islands of the French Caribbean[47].
9. America was unhappy with Thomas Bayles recruiting American cotton farmers for India[48].
10. John Elphinstone (1807–1860), Governor of Madras, 1837–1842.
11. The early saw gins imported into India in 1820–1840 were the American Whitney saw gins. Eli Whitney invented these in 1791 and patented in 1794. Whitney's gins included a wire screen and several wire hooks, which pulled the cotton through, and metal bristle brushes removed the loose cotton lint preventing occlusions. In later decades, these mechanical gins were replaced by the Manchester saw gins.

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