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Indian *Guinée* Cloth Revisited:
Indigo Dyeing Methods, Mass-Produced Items, and the Rise of Global Capitalism

Toyomu MASAKI

tmasaki@staff.kanazawa-u.ac.jp

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金沢大学経済学経営学系
〒920-1192 金沢市角間町
Faculty of Economics and Management, Kanazawa University
Kakumamachi, Kanazawa-shi, Ishikawa, 920-1192, Japan
https://keikei.w3.kanazawa-u.ac.jp/research_dp.html

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Indian *Guinée* Cloth Revisited: Indigo Dyeing Methods, Mass-Produced Items, and the Rise of Global Capitalism

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Toyomu MASAKI[1]

Abstract

This study explores technological transformations, the commodification of industrial products, and the development of global capitalism through a lens of indigo-dyed guinée cloth manufactured in French India and exported to the Western Sahel in the nineteenth century. While previous scholarship often characterises guinée as a high-quality commodity, this research argues that it was, in fact, a mass-produced textile catering to West African consumers who could not afford locally made, high-quality fabrics. After tracing the evolution of indigo dye production—from vernacular techniques practised since antiquity to the large-scale industrial methods established through transregional knowledge exchange during the Age of Exploration—this study demonstrates that following the loss of Saint-Domingue, France attempted but ultimately failed to modernise indigo dye production in Senegal due to high costs. It further argues that, in response, the guinée cloth production reforms were also introduced in Pondicherry to simplify the manufacturing processes and minimise costs, drawing on the records of Michel D. Gonfreville, a dyeing expert dispatched there in 1827. Ultimately, this research concludes that global capitalism has created a hierarchy between those with capital and those without at regional and individual levels. This point is often critically discussed from the perspective of the latter's exploitation by the former. On the other hand, it is true that the rise of global capitalism has contributed to the efficient production of goods through the transfer of knowledge and technology and has raised the standard of living of mass consumers, thereby contributing to the world's economic growth.

Keywords: Indian cotton cloth, western Sahel, French colonial empire, Global capitalism, 19th century

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[1] Kanazawa University, Japan. tmasaki@staff.kanazawa-u.ac.jp. The author has written about guinée cloth since 2006, initially in Japanese. See Masaki (2006), (2007) and (2015). In this stage, the author refrains from providing detailed information on some historical records and reference materials because her English articles always take a long time to get published.

I. Introduction

What is guinée cloth? In general, guinée is a French term referring to Guinea in English. In the mid-eighteenth century, however, Guinée referred to a larger geographical area than today's Guinea, specifically almost all of Sub-Saharan Africa.[2] Like the English guinea cloth, guinée was initially just a generic French term for Indian cotton cloth brought to this region.[3] However, in the early nineteenth century, when French colonial rule started in Saint Louis in Senegal, the term seems to have come to refer to indigo-dyed cotton cloth, the most in-demand textile in this area. Although this cloth was exported from India to several territories in Asia and Africa, the Western Sahel was its primary market. In particular, the indigo-dyed cotton cloth produced in Pondicherry, the capital of French India, which became a French colony at the same time as Senegal, was sought after by the Maures, who are of Arab-Berber descent, speak the Hassaniya dialect, and live in the Western Sahel.[4] As the gum Arabic that they collected was essential to the European textile industry, which developed in the 19th century, France established a modern industry in Pondicherry in the late 1820s to begin mass-producing guinée cloth, which was required as a means of payment for it.[5]

This fact sometimes invites the misconception that the guinée cloth produced in Pondicherry during the nineteenth century was a quality textile. For example, Kazuo Kobayashi asserted that 'West African consumer taster for quality textiles shaped a pattern of global trade'

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[2] Denis Diderot and Jean D' Alembert, *Encyclopédie ou dictionnaire raisonné des sciences, des arts et des métiers par une societé de gens de lettres,* 7 (Paris, 1757), 1009. This encyclopedia also defines guinée as a vast region that covers Sudan (*Nigritie*) in the north, Abyssinia in the east, and South Africa (*Caffrerie au midi*).

[3] Colette Establet, *Répertoire des tissus indiens importés en France entre 1687 et 1769* (Aix-en-Provence, 2017), 103, 106–7.

[4] These people are generally referred to as Moors in English. However, as the English word ‘Moor’ contains a variety of meanings, this study describes them as Maures, who form the major ethnic group of present-day Mauritania.

[5] Toyomu Masaki, 'Indian Guinée Cloth, West Africa, and the French Colonial Empire 1826–1925: Colonialism and Imperialism as Agents of Globalization', *Economic History of Developing Regions* 37, no.2 (2022), 101–27.

after explaining that France established this cotton cloth industry in Pondicherry in the early nineteenth century.[6] Kobayashi's intention in recognising this cloth as high-quality fabric seems to be to deny the views of the dependency theory school by emphasising that the African Agency proactively shaped globalisation.[7] Indeed, his attempt has successfully attracted the attention of his fellows. However, as Figure 1 shows, the guinée cloth, which France produced in India in the first half of the nineteenth century and exported to Senegal, is not what we can call a quality textile. This cloth was sent as a sample to France when the French government issued royal ordinances in 1843, setting out the standards for the guinée cloth that could be exchanged for gum Arabic on the Senegal River. These decrees were intended to give preferential treatment in the Senegalese market to this cloth that had become possible to mass-produce in Pondicherry in the 1840s.[8] However, the Maures did not voluntarily choose this machine-made guinée cloth.[9] It is often the case that different people will have different opinions about whether or not an object in front of them is a luxury item. However, the question arises as to why, during the nineteenth century, France had to repeatedly introduce protective measures to favour this cloth in its West African market if the cloth in Figure 1 is so good that Africans proactively chose it.[10]

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[6] Kazuo Kobayashi, *Indian Cotton Textiles in West Africa* (Cham, 2019), 203.
[7] The same sample is also presented in Kobayashi's book from a different angle. Kazuo Kobayashi, *Indian Cotton Textiles in West Africa*, 83.
[8] Masaki, 'The Export of Indian Guinée to Senegal Via France', 101–3. Roger Pasquier, "Rouen, Le Havre et la côte occidentale d'Afrique au milieu du XIXe siècle." Annales de Normandie 49, no.2 (1999), 182.
[9] 'Au sujet des guinée réglementaires' in the Conseil d'Administration, Saint Louis, Sénégal, Session on 2 February 1849, and an extract from the minutes of the Conseil d'Administration, Session on 16 June 1849, Archives national d'outre-mer (ANOM), Senegal, IX, 26 bis a.
[10] Regarding these tariff protections, see Toyomu Masaki 'The Export of Indian Guinée to Senegal via France: Inter-Colonial Trade in the Long Nineteenth Century', in Tomoko Shiroyama (ed.), *Modern Global Trade and the Asian Regional Economy*, trans. Helen Ballhatchet (Singapore, 2018), 87–115; Masaki, 'Indian Guinée Cloth, West Africa, and the French Colonial Empire 1826–1925.'

Fig. 1. A sample of the guinée cloth manufactured in Pondicherry circa 1843. Source: ANOM, Aix-en-Province, France, Inde 494, Dossier 871.

People tend to see what they want to see. However, this should not be the case for historians. It seems to be a fact that at the beginning of the nineteenth century, the Maures preferred Indian indigo-dyed cotton cloth to European products, as many authors pointed out.[11] However, based on the records of Michel Gonfreville, it seems to be more accurate to understand that the quality of blue-dyed cotton cloth produced in Europe at the time was not real indigo-

[11] Philip Curtin. 'Africa and the Wider Monetary World, 1250-1850'. In John F. Richards (ed.) *Precious metals in the later medieval and early modern worlds*(Durham, N.C., 1983), 261;Golbéry, Sylvain-Meinrad-Xavier de. *Fragmens d'un voyage en Afrique* Tome I (Paris, 1802), 250; Saugnier, M. *Relations de plusieurs voyages à la côte d'Afrique, à Maroc, au Sénégal, à Gorée, à Galam, etc.: avec des détails intéressans pour ceux qui se destinent à la traite des nègres, de l'or, de l'ivoire, etc.* (Paris,1791), 287.

dyed cotton cloth.[12] Furthermore, one of the missions given to Gonfreville, who was sent to Pondicherry in 1827, was to improve the efficiency of the production of guinée cloth and reduce its cost, as we will discuss in the second half of this paper. Therefore, the term' good quality' often found in historical accounts about Indian guinée cloth is most likely compared with poor-quality or more affordable European products introduced in African markets since the nineteenth century.

Nevertheless, this does not necessarily mean that Africans have always demanded cheap cotton cloth produced outside the continent. In her recent research, Colleen Kriger, who has expertise in West African cotton cloth, emphasises that indigo-dyed cotton cloth, described as 'black cloth', was the quality textile worn by elites in Muslim society in West Africa.[13] According to her other research, cotton cloth was being produced in some regions in West Africa by the tenth century at the latest.[14] The cloth produced there was distributed throughout West Africa. For example, Renée Boser-Sarivaxévanis, another specialist in African textiles, mentioned that fabrics dyed blue and produced in the great Hausa towns of northern Nigeria

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[12] Gonfreville explained that the blue cotton cloth made in Rouen was dipped lightly in indigo and finished with campêche, with alum and blue vitriol mordant, or with sandalwood, Bixa Orella, or even burnished first with a foot of sumac and dissolution of iron peroxide solutions. See, M. D. Gonfreville, 'Mémoire sur la teinture en bleu des toiles dites guinées, selon le procédé des Indiens (Pachnampett, Montrepaleum, Ellapack, côte de Coromandel), 1829', in *Recueil de la Société polytechnique, ou recueil industriel, manufacturier, agricole et commercial, de la salubrité publique et des beaux-arts, et des actes de l'administration, propres a encourager les diverses branches de l'économie publique,* 28 (1845), 84. This report seems to have been published in at least two journals, in *Recueil de la Société polytechnique*, 28, no.10 & 11 in 1845 and *Le technologiste*, 7 in 1846. At that time, the concept of double publications may not have existed. The hand-written prototype of this report dated on 17 Janvier 1830 was submitted to the colonial office in Pondicherry. It is found in the French National Archives (ANF) .

[13] Colleen E. Kriger, '‘Black Cloth’: Status and Identity in Islamic West Africa, c. 1500–1900', in Christopher Breward, Beverly Lemire and Giorgio Riello (eds.), *The Cambridge Global History of Fashion: From Antiquity to the Nineteenth Century* (Cambridge, 2023).

[14] Colleen E. Kriger, 'Mapping the History of Cotton Textile Production in Precolonial West Africa', *African Economic History,* no. 33 (2005), 87–116. She mentioned the following three locations as the centres of cotton cloth production formed around the tenth century: the Lake Chad region, the Upper Niger Delta area, and the middle Senegal Valley.

were sought by all Sudanese and Saharan peoples.[15] The Kofar Mata dye pits for indigo dyeing at Kano, said to have been established in the fifteenth century, are very well known. Henry Barth, a German explorer who travelled West Africa from 1849 to 1855, recorded that the cloth produced in Kano (northern Nigeria) spread to the shore of the Atlantic and that the inhabitants of Arguin were dressed in clothes woven and dyed in Kano.[16]

As a matter of course, the indigo-dyed cotton cloth in West Africa, as of then, was a hand-made craft that not everyone could afford. In contrast, massively imported indigo-dyed cotton cloth from Pondicherry in the nineteenth century to West Africa was produced using mass production methods. However, it should have still appealed to those who could not afford luxury goods. A French traveller and merchant, Jacques-Joseph Le Maire, who visited the coast of what is today Mauritania at the end of the seventeenth century, reported that the people whom he encountered, with a few exceptions, were unclothed or wore coats made from split leather and sought blue cotton cloth in exchange for the gum Arabic that they provided.[17]

These facts suggest that there were at least two markets for indigo-dyed cotton cloth in Western Africa in the nineteenth century: mass-produced items manufactured outside the continent for the masses and hand-made in the region for a select few. This assumption is also consistent with the argument of recent research that African cloth producers showed a certain

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[15] Renée Boser-Sarivaxevanis, *Recherche sur l'histoire des textiles traditionnels tissés et teints de l'afrique occidentale* (Basel, 1975), 332.
[16] Heinrich Barth, *Travels and Discoveries in North and Central Africa*, ii*: Being a Journal of an Expedition Undertaken Under the Auspices of H.B.M.'s Government, in the Years 1849-1855* (London, 1857), 510–1.
[17] Jacques-Joseph Le Maire, *Les Voyages du sieur Le Maire aux îles Canaries, Cap-Verd, Sénégal et Gambie: Sous M. Dancourt, directeur général de la compagnie roïale d'Affrique* (Paris, 1695), 75–6.

resilience to the influx of inexpensive, mass-produced cloth imports by taking ownership of the production of labour- and skill-intensive cloth in the nineteenth and twentieth centuries.[18]

Mass-produced items were enabled by the division of labour and specialisation first highlighted by Adam Smith in his book *The Wealth of the Nations*, published in 1776. As is well known, this made it possible to mobilise large numbers of unskilled workers in the industrial sector by specialising them in multiple divided processes, and the introduction of capital standardised the know-how of skilled workers, enabling the transition to a system of mass production. Concerning indigo dyeing, Spain's establishment of a standardised technique that enabled the mass production of indigo dyes at a low cost in the Americas in the sixteenth century was a significant breakthrough. Unlike cotton cloth production, the mass production system of the indigo manufacturing industry established in the Americas a century before the Industrial Revolution in Europe did not require large-scale machinery. Instead, it needed significant capital and many enslaved Africans. This know-how for the mass production of indigo dyes later spread to French and British territories in the West Indies.

Unlike the British, who replaced Indian cloth with theirs for the West African market after the Industrial Revolution, France brought European capital goods to Pondicherry to produce guineé cloth using cheap indigo dyes. Pondicherry's strength was dyeing cloth, not weaving it, before France began modernising cotton cloth production in Pondicherry in the 1820s, which had

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[18] Katharine Frederick and Elise Van Nederveen Meerkerk, 'Local Advantage in a Global Context. Competition, Adaptation and Resilience in Textile Manufacturing in the "Periphery" 1860–1960', *Journal of Global History 18*, no.1(2023). Emiliano Travieso and Tom Westland. 'What happened to the workshop of West Africa? Resilience and decline of handicraft textiles in colonial northern Nigeria, 1911–52'. *The Economic History Review* 77, no. 4(2024): 1123-551. Also see, Marion Johnson, 'Technology, Competition and African Crafts', in *The Imperial Impact: Studies in the Economic History of Africa and India*, eds. Clive Dewey and A. G. Hopkins (London: The Athlone Press, 1978), 259–69; Richard Roberts, *Two Worlds of Cotton: Colonialism and the Regional Economy in the French Soudan, 1800-1946* (Stanford, CA: Stanford University Press, 1996); Colleen E. Kriger, *Cloth in West African History* (Oxford: AltaMira Press, 2006).

France procure cloth from British territories. As of 1825, two-thirds of the indigo-dyed cotton cloth exported from Pondicherry was woven in British India.[19] Thus, in the mid-1820s, the French colonial government embarked on a project to manufacture yarn and cloth in Pondicherry. With the cooperation of the home government, the colonial government of French India invited experts and entrepreneurs from France to modernise the industry under its generous protection. This process has already been summarised in detail by Mireille Lobligeois (1972) and Richard Roberts (1992) (1996).[20] However, these studies do not include much information on the changes in the dyeing and production of guinée cloth before and after the reforms or information on the quality of the fabric.

This study challenges existing scholarship that characterises guinée as a high-quality textile, instead demonstrating—based on the report submitted by the French dyeing specialist Michel D. Gonfreville—that the primary objective of the French administration, which implemented production reforms in Pondicherry in the nineteenth century, was to manufacture guinée as cost-effectively and efficiently as possible. Furthermore, after showing how the people of the West Sahel region, who most wanted this cloth, used it, this research examines how, following the loss of Saint-Domingue, France attempted to manufacture indigo dyes in Senegal but ultimately abandoned the endeavour due to prohibitive costs, leading to the emergence of indigo-dyed cotton cloth production in Pondicherry in the 1830s. Finally, these outcomes are interpreted within the broader framework of expanding production scales and the geographical

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[19] Mireille Lobligeois, 'Ateliers publics et filatures privées à Pondichéry après 1816', *Bulletin de l'Ecole Française D'extrême-Orient,* 59 (1972), 7–8.
[20] Lobligeois, 'Ateliers publics et filatures privées'; Richard Roberts, 'Guinée Cloth: Linked Transformations in Production within France's Empire in the Nineteenth Century', *Cahiers d'Études Africaines* 32, no. 4 (1992): 597–627; Richard Roberts, 'West Africa and the Pondichery Textile Industry', in *Cloth and Commerce: Textiles in Colonial India*, ed. Tirthankar Roy (Thousand Oaks CA: Sage, 1996), 142–74.
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division of labour—key dynamics driving the rise of global capitalism and the proliferation of mass-produced goods.

II. The indigo-dyed cotton cloth sought by inhabitants in the Western Sahel

As is well known, from the fifteenth century to the early nineteenth century, large quantities of cotton textiles were exported from South Asia to West Africa as a means of payment for African commodities, including enslaved people. However, it would be inappropriate to understand the guinée cloth supplied to the Maures in the nineteenth century in the same context. Indeed, although the Maures were the first Sub-Saharan Africans to come into contact with Europeans, they have a cultural and historical background very different from that of black Africans in Sub-Saharan West Africa. The Maures are a mixture of Berber Sanhaja and Bedouin Arabs from the southern part of the Arabian Peninsula from the eleventh century onwards. Furthermore, after the Shar Bouba war (1644-1677), their society was radically Arabised, with the latter dominating the former. Given this historical background, it may be undeniable that their community has had a sense of superiority towards black Africans in Sub-Saharan West Africa. They have sometimes been inappropriately proud of this and used it as an excuse to enslave black people or put them in a lower social class.

Notably, the role of indigo-dyed cotton cloth in Maure's socio-historical context seems to have been quite different from that of black Africans. First, the indigo-dyed cotton cloth that this research focuses on played a more important role in the exchange for gum Arabic after the Industrial Revolution rather than as a means of exchange for the Atlantic slave trade. By the beginning of the twentieth century, few people had lived in the coastal areas of what is today Mauritania, and it was difficult for large ships to access the area. Consequently, most guinée

cloth was unloaded at Saint Louis in Senegal, and although some pieces should have been provided to black Africans, most were supplied to the Maures by African merchants at designated markets (*escales*) along the Senegal River. Naturally, the type of cotton cloth appreciated by Maures and black Africans also differed. For example, Colleen Kriger (2023) depicted glossy indigo-dyed cotton cloth as a quality textile by describing a high-ranking Muslim man in the Sokoto caliphate wearing it and suggested that Pondicherry guinée cloth was imported to West Africa as a semi-finished item because no samples attached to a merchant's letter that she examined were glazed.[21] As she says, some cloth may have been processed somehow after being imported to West Africa to suit African consumer tastes. However, it is hard to believe that the guinée cloth sought by the Maures had undergone such a transformation. Furthermore, high-ranking Maurish men often wore fine white or pale blue clothes rather than indigo-dyed cotton cloth. Etienne Richet (1873-1929), a French journalist and an explorer sent to Mauritanie at the beginning of the twentieth century by the French Ministry of Colonies, noted that white cloth was reserved for religious and political leaders.[22] In contrast, ordinary people often wore this indigo-dyed cotton cloth.[23]

The dimensions of guinée were also much larger than the size of the locally produced cloth, only 10–20 centimetres in width because of the form of the specific horizontal loom. These narrow strips were often used as currencies in a form rolled up like a 'large flat disc, coil of a hosepipe or a spool of cinefilm' in the Sahel.[24] This description by Marion Johnson can also be confirmed in the catalogue compiled by Josette Rivallain, an expert on commodity money in

[21] Kriger, ''Black Cloth'', 464.
[22] Etienne Richet, *La Mauritanie* (Paris, 1920), 97.
[23] Ibid.
[24] Marion Johnson, 'Cloth as Money: The Cloth Strip Currencies of Africa,' *Textile History*, no. 11 (1980): 195.

French Africa, in collaboration with Félix Iroko.[25] In contrast, French royal ordinances dated 18 May and 1 September 1843 stated that pieces of *guinée* destined to be used as a means of exchange for gum Arabic along the Senegal River should be no less than 16.5 metres in length, 1.0 metres in width and 2.3 kilograms in weight because this size of cloth was known as *baysa,* implying the unit of account in their language and functioning as currency.[26] Consequently, when exported from Pondicherry to West Africa via France, this 16.5-metre length cloth should be folded into a pleated state with a one-metre length so that the number of pleats could be counted to determine the length without unfolding it.[27] Although this French royal ordinance of 1843 was abolished in 1853, the size of *guinée* did not drastically change, although it gradually became smaller and lighter over time.[28]

The Maures call this indigo-dyed cotton cloth *al nila* in their local language, Hassaniya. Today's most common type of *al nila* in Nouakchott's market is dark blue cloth sprinkled with black dye powders. Therefore, just touching the cloth causes the dye to get on one's hands, and everything one touches with the hands takes on that colour. One Mauritanian explained that Mauritanian women like to wear *al nila* in the countryside rather than in urban areas to protect themselves from the hot sun in their villages or the desert and make their skin beautiful.[29] On this

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[25] Josette Rivallain and Iroko A. Félix, *Les Collections Monétaires VIII* (Paris, 1986).
[26] About a piece of blue cotton cloth with a length of 15 metres and a width of 1-1.5 metres was used as currency in the Sahel as early as the seventeenth century, see Ghislaine Lydon, *On Trans-Saharan Trails: Islamic Law, Trade Networks, and Cross-Cultural Exchange in Nineteenth-Century Western Africa* (Cambridge, 2009), 251; M. Hourgat, *Code des douanes, ou, Recueil des lois et règlements sur les douanes en vigeur au 1er janvier 1848*: i, Second Edition (Paris, 1848), 525–6; Masaki, 'Export Indian Guinéé Cloth', 97.
[27] Arreté relative à la mise à execution des ordonnances royales des 1843 et 1er septembre 1843 sur le commerce des guinées au Senegal, *Bulletin des actes administratifs des établissements français de l'Inde* (1843), 333–6
[28] For example, a similar ordinance of 19 July 1877 that imposed preferential tariffs on *guinée* produced in the French Empire specified the size of the cloth: at least 15 metres in length, 0.85 metres in width and 1.8 kilograms in weight.
[29] Several authors mention that the inhabitants of the Sahel purportedly believed that when indigo stains the skin, it acts as a protective coating against both the strong rays of the sun and dry air. Lydon, *On Trans-Saharan Trails,* 60; Raymond Vacquier, *Au temps des factoreries, 1900-1950* (Paris, 1986), 172.

point, Jenny Balfour-Paul (1997) explained that indigo in the Arab world serves as a cosmetic and even the characteristic in which, on a surface, indigo rubs off so readily, a property considered a disadvantage in the eyes of the West, has been considered a positive assets.[30] According to her, the indigo dye was thought to protect against temperature extremes and act as an insect repellent.[31] Women used it as an item for facial bleaching or as incense to attract their husbands.[32] In deserts where water is scarce, it seems that there is also an aspect where it is more convenient to use indigo-dyed cloth that does not show dirt easily. Based on the discussion above, the Maures were likely more particular about the indigo dyeing than the cloth. Pondicherry could provide the indigo-dyed cotton cloth that the Maures appreciated. However, France did not immediately decide to produce indigo-dyed cotton cloth in Pondicherry for the Senegalese market just after France acquired territories in Senegal and India in 1817.

III. The transition from vernacular methods to capital-intensive mass production to manufacture indigo dyes

Indigo dyeing requires a complex knowledge of chemistry. Nevertheless, people worldwide have acquired this technique empirically since ancient times and adapted their own ways to their respective environments. On the earth, more than 750 species of the genus Indigofera exist. The leaves of these plants contain colourless indican, which forms indoxyl through fermentation in an alkali solution. People initially used urine, lye, and shell ashes to make the alkali solution. After the eighteenth century, industrial products such as lime, calcium hydroxide, and, recently, sodium hydrosulphite were often used because of their easy availability

[30] Jenny Balfour-Paul, *Indigo in the Arab World* (London and NY, 2012), reprint version.
[31] *Ibid*.
[32] *Ibid*.

and handling despite their harm to both the human body and the environment.[33] Through oxidisation by contact with air, the indoxyl turns into indigo, a blue dye. However, since indigo is not water-soluble, dying fibres require a reduction process, transforming indigo into leucoindigo. At this stage, when fabrics are soaked in the solution, leucoindigo attaches itself to the fibre. By taking fibres from the indigo vat, leucoindigo combines with oxygen in the air to turn indigo and fixes itself to the fibres.

This way, cloth can be dyed directly with a solution fermented with indigo leaves. However, since the harvesting season for indigo leaves is limited, processing these leaves is necessary to make dye available at any time of the year. Various methods have emerged for the geographical condition of each region. These methods can be classified mainly into composting and soaking methods, and each has techniques that use fresh or dried leaves. For example, Japanese *sukumo* is made by composting dried leaves; water is sprinkled on them, allowing them to ferment for several months; and leaves are then pounded to make a solid paste or rolled into a dumpling shape to ship. A similar indigo processing method has also been used in West Africa. Kazuyo Iseki, a Japanese dyer and specialist in West African studies, reported that when she visited Bele, a Hausa village in Nigeria, in 1984, the harvested indigo plants (*Indigofera arrecta*) were cut into 5–6 cm lengths, dried thoroughly, packed in jute bags, put in an unused indigo jar, and stored for two to three years.[34] According to her, these dried leaves absorb moisture from the soil and ferment into a compost-like substance similar to Japanese *sukumo*.[35] In contrast, in the

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[33] Prakash Kumar pointed out that the use of limewater increased in the late eighteenth century. See Prakash Kumar, *Indigo Plantation and Science in Colonial India* (New York, 2012).
[34] Kazuyo Iseki（井関和代）, 'A Comparative Study of Ethno-Technology for "The Process of Making Indigo"', *Journal of Osaka University of Arts* （「藍植物による染料加工―「製藍」技術の民族誌的比較研究」『大阪芸術大学紀要』）, no. 23 (2000).
[35] *Ibid*.

traditional European method, the fresh leaves of the woad plant have been employed, crushed, rolled into balls (*coque* in French), and subsequently dried. Mary Terrall (2023) reported that a similar method was applied in Senegal, although it is uncertain whether Europe or Senegal first developed this method and influenced the other.[36]

The soaking method is more common than composting worldwide. In the soaking method, indigo plants are precipitated in water and placed for fermentation to transform indican into indoxyl, which generates indigo through oxidisation by stirring. Indigo dyes are obtained after draining the excess water, collecting the indigo at the bottom of the vat, and drying it. Indigo made using the compost method contains plant residue, whereas indigo made using this method has a higher pigment content. In general, dyes with a high indigo content are considered to be high-quality products. A prototype of this soaking method is found in generating 'Indigo Lauro' from Bayana in the Agra region of northern India, which was transported in significant quantities by land to Mediterranean regions by non-European merchants during the sixteenth century.[37] On the Indian subcontinent, Bayana, Sarkhej, and Coromandel regions have long been famous as producers of indigo dyes, which were exported to the Middle East and Europe through Levant trade. At the beginning of the seventeenth century, VOC (Dutch East India Company) and EIC (East Indian Company) became the leading players in this trade.[38] All three regions

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[36] Colleen E. Kriger, '"Our Indico Designe" Planting & Processing Indigo for Export, Upper Guinea Coast, 1684–1702', in Robin Law, Suzanne Schwarz, and Silke Strickrodt (eds.), *Commercial Agriculture, the Slave Trade & Slavery in Atlantic Africa* (Suffolk, 2013). Mary Terrall, 'African Indigo in the French Atlantic: Michel Adanson's Encounter with Senegal', *Isis: A Journal of the History of Science Society,* 114, no. 1 (2023).
[37] Hans W. Van Santen, 'De Verenigde Oost-Indische Compagnie in Gujarat en Hindustan, 1620-1660 (The Dutch East India Company in Gujarat and Hindustan, 1620-1660)' (Leiden University, Ph.D. Dissertation, 1982):133–69, translation in Japanese by Hiroshi Nagashima (長島弘) 「(資料)クジャラートとヒンドゥスターンにおけるオランダ東インド会社 1620－1660 年(I)」『長崎県立国際経済大学論集』第 21 号第 4 巻（1988）.
[38] Ghulam A. Nadri, 'Indigo in Precolonial South Asia', in *Oxford Research Encyclopedia of Asian History* (Oxford, 2020).

adopted this soaking method to make indigo dyes, but while the Bayana used fresh leaves, Sarkhej and Coromandel used dried leaves.[39]

There is much debate about whether fresh or dried leaves are preferable for the soaking method. Generally, fresh leaves can produce more indigo dyes, whereas dried leaves allow for more flexible production with small amounts of capital. The amount of indican increases with the growth of leaves but moves from leaves to flowers after blooming. Therefore, harvesting the leaves just before flowering within a short period is necessary to obtain as much indigo as possible. Furthermore, the indican in the leaves changes into indigo, which is not soluble in water, over time. Therefore, it is preferable to soak fresh leaves in a vat immediately after they are harvested to release indican into the water and efficiently produce indigo dyes. Matsui Toru, a Japanese historian and expert on Indian indigo dye production, noted that, as a result, the production of indigo dyes from fresh leaves tends to be on a large scale.[40] In contrast, dried leaves are convenient for busy farmers because they can be stored for a long time and processed at any time on a small scale, which is convenient for these farmers.[41]

In the mid-seventeenth century, European merchants were obliged to look for alternatives in other regions because the Mughal Empire interfered in the indigo trade.[42] The indigo dyes manufactured via three large vats with water or animal power and forced labour, which Spaniards established in the Americas, surpassed Indian dyes in terms of quality, homogeneity, and price and became the main substitute. It seems that this modern indigo production was the

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[39] *Ibid*.
[40] Toru Matsui (松井透), 'On the Indigo-Producing Technology in the Nineteenth Century India', *The Aoyama Journal of Economics* (「19 世紀インドのアイ産技術について」『青山経済論集』) 10, no. 1-2 (1958).
[41] Ibid.
[42] Nadri, 'Indigo in Precolonial South Asia.'

culmination of the knowledge of Native Americans, Indians, and enslaved Africans.[43] Prakash Kumar referred to the phenomenon in which knowledge of indigo production in multiple regions has evolved while influencing each other as 'transnational knowledge of indigo'.[44]

As the world has become more connected, the vernacular technologies practised in various regions have influenced each other and evolved into even better technologies. In this process, technologies that can produce products that are more competitive in terms of quality or price have been selected, and less competitive products are generally eliminated from the global market, even if they encounter temporary resistance. The 'Indigo Lauro', which Europeans imported merely to complement the woad dyes used for woollen fabrics, became a significant threat to European woad industries, and some European countries banned Indian indigo from the late sixteenth century to the early seventeenth century.[45] However, from the middle of the seventeenth century onwards, Indigo Lauro also faced competition from indigo produced in large-scale modern factories established by Europeans in the Americas and, subsequently, the West Indies, and exports of Indian indigo to Europe declined significantly.[46] However, Bengal indigo, produced by combining indigenous Indian technology with those introduced from the West Indies via the French and British Empires in the second half of the eighteenth century, became the most sought-after indigo dye in the world market in the nineteenth century. This Bengal indigo was also a major threat to the indigo industry in Japan, which opened its doors to the world in 1853 after ending its isolation policy. However, it was only a matter of time before it was replaced by the chemical indigo, which began to be produced in Germany in the 1880s. In

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[43] About the African enslaved labour's impact, see Frederick C. Knight, *Working the Diaspora: The Impact of African Labor on the Anglo-American World, 1650-1850* (New York and London, 2012).
[44] Kumar, 'Planters and Naturalists.'
[45] Catherine Legrand, *Indigo: Périple bleu d'une crétrice textile* (Paris, 2012).
[46] Nadri, 'Indigo in Precolonial South Asia.'

this way, indigo dyes transitioned from handcrafted products made by farmers during the off-season with their vernacular technologies suited to their geographical conditions to commodities manufactured by large-scale capital. As a result, Indigo producers have also changed from being independent farmers working on a small scale to cheap labour that requires constant supervision in a production system based on capital equipment, and large quantities of homogeneous indigo came to be produced in specific regions and supplied at low prices for the global market. On the other hand, this transition made indigo-dyed products available to a broader range of people at lower prices.

IV. Hidden relations regarding indigo dye production within the French colonial empire: Senegal, France, and Pondicherry

Pondicherry in French India and Saint-Louis in Senegal had almost the same status within the French colonial empire. In 1673, Pondicherry and Saint-Louis became the principal cities of their respective French colonies and experienced British rule together during the French Revolution. Both towns became the capitals of French colonies again due to the Treaty of Paris (1814-15). Although the bonds they formed with Metropolitan France were not as solid as those that the French *Ancient Colonies* had developed, both were granted various privileges, such as French citizenship, representative councils, and voting rights to elect their deputies to the French National Assembly.

The project to modernise guinée cloth production in Pondicherry occurred when France struggled to obtain indigo dyes while trying to catch up with Britain, which was ahead in industrialisation. In the early nineteenth century, France lost Saint Domingue, its leading supplier of indigo dyes, and was far behind England in terms of cotton cloth production. Around that

time, Bengal indigo was gaining popularity in Europe, including France. However, Napoleon's blockade of the continent made it challenging to obtain the indigo dyes the growing French textile industry needed. Consequently, with the imperial decree of 25 March 1811, the French government set about modernising the woad industry, which had been on the verge of extinction since 1737, when the embargo on tropical indigo was lifted.[47] Curiously, the method promoted to make indigo dyes at this time was the soaking method, which uses hot water instead of water.[48] Devices were also invented to stir the bath with a minimal workforce, as shown in Fig. 2.

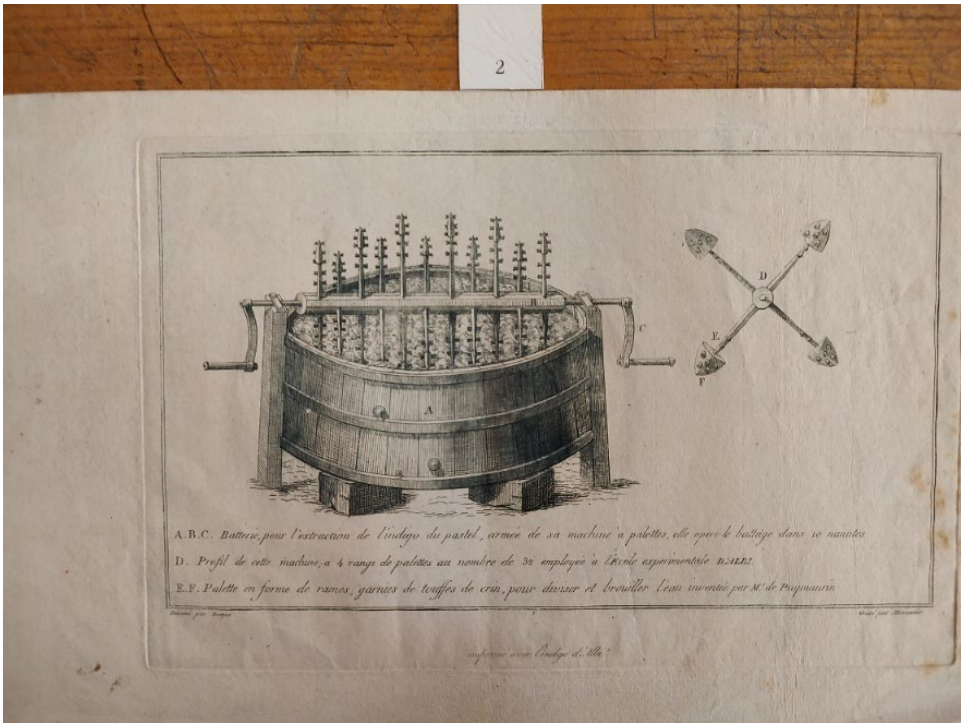

Fig. 2. A stirring machine to obtain indigo from woad plants (France), circa 1811

ANOM, Senegal.

[47] Décret imperial, au Palais des Tuileries, 2 March 1811. Claude Fohlen, 'À propos du blocus continental: Le pastel toulousain', *Annales du Midi: Revue Archéologique, Historique et Philologique de la France Méridionale* 61, no. 7–8 (1949): 413–21.
[48] Gioanni Antonio Giobert. *Traité sur le pastel et l'extraction de son indigo* (Paris: Impr. impériale, 1813).

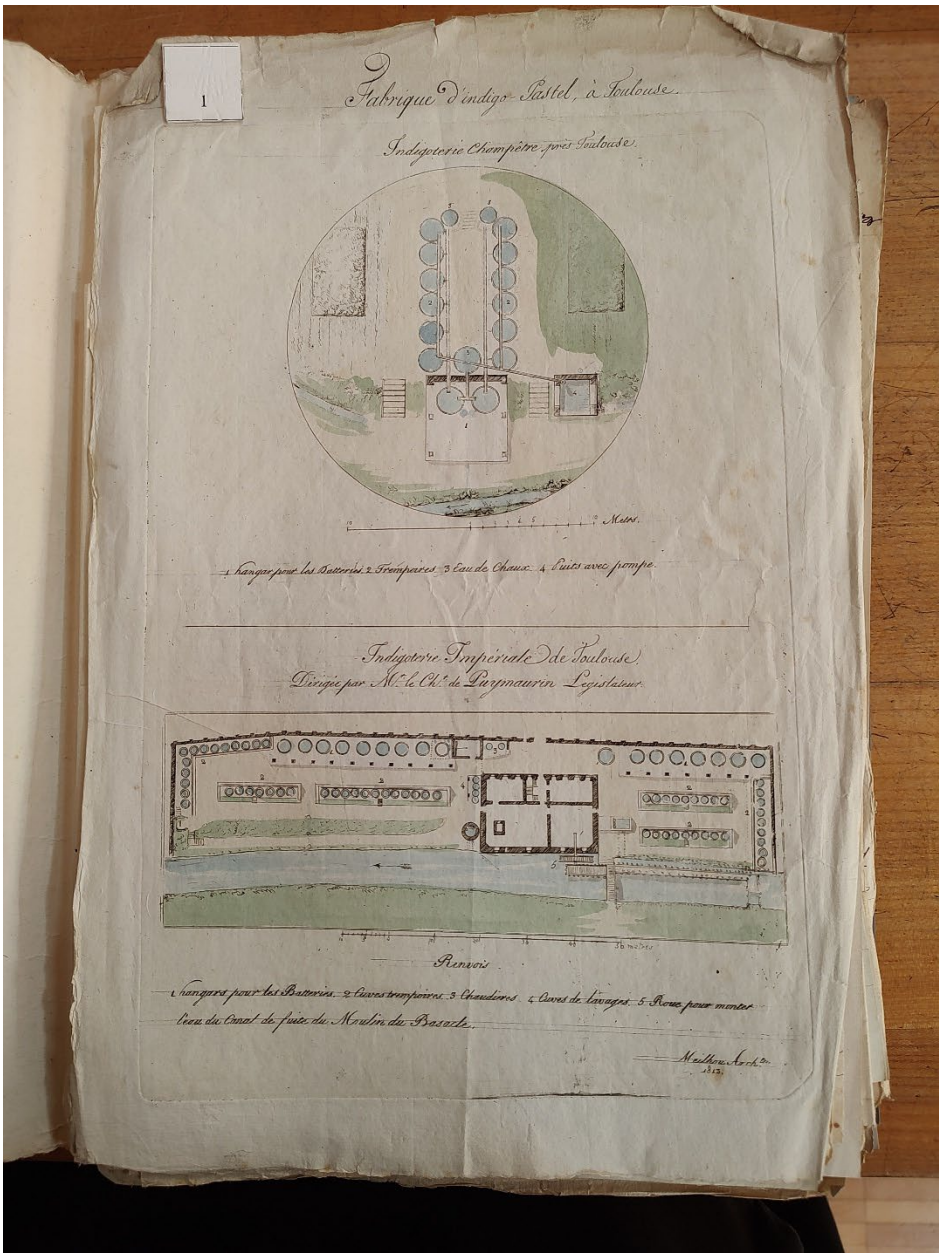

Fig. 3. A plan to establish the Imperial Indigo plant of Toulouse (1813).

ANOM, Senegal.

France made various efforts to catch up with its rival, Great Britain. Napoleon I was keen to boost national industries to combat the economic hegemony of Great Britain. In November 1800, he appointed Jean-Antoine Chaptal, a distinguished chemist, physician, agronomist, and industrialist, to be Minister of the Interior. The following year, he created the *Société*

d'encouragement pour l'industrie nationale (Society for the Development of National Industry), an organisation meant to support the development of French industries, and appointed Chaptal as its president. Ironically, as Richard Barker puts it, this newly formed national organisation in France was modelled on the London Society for the Encouragement of Arts, Manufactures and Commerce.[49] In 1801, this organisation began granting medals to distinguished industrialists at the Industrial Expositions for National Products held intermittently from 1798 to 1849. Although Chaptal resigned as Minister in 1804, on 27 June 1810, Napoleon I created the *Conseil général des fabriques et des Manufactures* (General Council of Factories and Manufactures) under the Ministry of the Interior by imperial decree.[50] Bertin Gilles explains that its establishment intended to support industrialists, who were less present than merchants, in combating England's economic hegemony.[51]

Nevertheless, the political turmoil in Metropolitan France in the first half of the nineteenth century also affected indigo production strategies at the national level. By the end of the First Empire, plans to promote the woad industry had disappeared. In place of woad, the restoration monarchy turned its attention to indigo from Senegal, which became a French colony due to the Treaty of Paris (1814-15). Under the initiative of Jacques-François Roger (Baron Roger), who arrived in Senegal in June 1819 and became a colony representative in July 1821, France started a project to produce indigo dyes in Senegal.

There was also a plan to establish a factory in Senegal to manufacture guinée cloth. M. Biard, a mechanic and manufacturer, submitted the plan with some samples on 1 April 1816 to

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[49] Richard J. Barker, 'The Conseil General des Manufactures under Napoleon (1810-1814)', *French Historical Studies,* 6, no. 2 (1969):185–213.
[50] Bertrand Gille, *Le conseil général des manufactures 1810-1829* (Paris, 1961).
[51] *Ibid.*, II.

the director of the colonies in the Ministry of Navy.[52] This plan suggested that the colony could expect to produce 20,000 pieces of guinée cloth annually. M. Biard proposed that instead of requiring an advance of 40,000 francs from the government to cover the initial costs, a piece of guinée cloth, which the British had previously supplied at 60 francs per piece, would be supplied at 40 francs per piece.[53] This proposal seems to have been considered but never realised. Richard Roberts wrote that the request was probably premature, as the colonial government had yet to be established.[54]

The French attempt to make Senegal a base for indigo and guinée production in the early nineteenth century should not be detached from the practices of indigo dyeing in West Africa for a long time. Colleen E. Kriger suggests that *Indigofera tinctoria* was likely introduced into Africa during the early Muslim trade.[55] Mary Terrall also shares this view, stating that the indigo used in Senegambia in the early modern period probably originated from Indian seeds traded via the Middle East to North Africa and eventually southwards across the Sahara.[56]

For the project of cultivating Indian indigo plants and manufacturing indigo dyes in Senegal, Roger invited Bernard Plagne, a naval pharmacist who stayed in Pondicherry during the late 1810s, to this new colony in West Africa.[57] Plage was the person who discovered that the high aluminium content of the water in Pondicherry is what makes the dyeing in this region so superior.[58] In addition Plagne, an expert on indigo known as Degoutin from Chandannagar, a

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[52] A note from Picard to Baron, April 1816, ANOM Senegal.
[53] *Ibid*.
[54] Roberts, 'Guinée Cloth'.
[55] Kriger, '"Our Indico Designe"', 102; Colleen E. Kriger, 'Mapping the History of Cotton Textile Production in Precolonial West Africa', *African Economic History*, no. 33 (2005), 87–116.
[56] Terrall, 'African Indigo', 6–7.
[57] ANOM, Senegal.
[58] Lobligeois, 'Ateliers publics et filatures privées', 7. Analyse par M. Plagne, Pharmacien, de l'indigo provenant du Nerium Tinctorium, 1818-1819. ANOM, India.

French territory in Bengal, was invited in 1824 to work in Senegal for a four-year term.[59] Finally, in 1826, the indigo dyes that Plagne manufactured in Senegal were presented through the Ministry of Navy to Charles X, who approved the insertion of a note appreciating the high quality of Senegalese indigo in its national gazette, *le Moniteur universel*, on 20 June 1826.[60] This note aimed to attract investors' attention to indigo production in Senegal.[61] In September 1829, Auguste de Bergevin, the Chief Superintendent of the Navy (Principal Commissaire de la Marine) in Bordeaux, proudly wrote to his colleague, 'Indigo production in Senegal is expected to bring enormous benefits to the French by making it possible to break French dependence on indigo from the British colony, Bengal'.

[62] Nevertheless, the project was suspended in 1830 owing to its high cost.[63] It is hard to believe that the increase in Indian indigo exports to France after this decision in 1830 was just a coincidence.[64]

When France re-obtained French India in 1817, Pondicherry was devastated after 25 years of British occupation, and many beggars were found in the streets. Therefore, by the Order

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[59] Degoutin was paid 7500 francs every month for four years. An agreement between Degoutin and M. Pellisir, Commissaire of Navy responsible for the services of French establishments in Bengal, Dépêche du 5 Juin 1824 delivered by the Ministry of Navy, ANOM Senegal; ANOM India.

[60] Note of the Ministry of the Navy and Colonies, 20 Jun 1826, ANOM Senegal. The gazette presents the comments of the Commission, shown as follows: *It is greatly to be desired that the Department of the Navy should encourage the cultivation of indigo in Senegal by all the means at its disposal, and we have reason to hope, from the first attempts which have just been made in this colony by Mr. Plagne, with a few further improvements, Senegal will be able to supply, in a few years' time, products of this kind comparable to the finest varieties from Bengal*(translated by the author) *Gazette nationale ou le Moniteur universel, 20 June 1826*.

[61] Note dated 20 Jun 1826 by Direction des colonies Administration. ANOM Senegal.

[62] A letter from Bergevin to his colleague, 5 Sept 1829. ANOM Senegal.

[63] In 1845, Charles Cottu wrote, '*The anxiously awaited harvest initially surpassed everyone's expectations: indigo from Saint-Louis equalled, if not surpassed, that from Bengal; but soon (as this fatal restriction recurs again and again in the history of the industrial development of our colonies) the cost price of the commodity wiped out the general joy. The sale rate remained so high that, after five years of trials of all kinds, the colony had to give up hope of delivering indigo from Senegal to European markets at the same price as Indian products* (translated by the author).'Charles Cottu, 'Le Sénégal: Histoire et situation actuel de la colonie', *Revue des Deux Mondes*, 9 (1845), 279.

[64] Nadri, *The Political Economy of Indigo*, 113.

of 13 November 1823, Compte Dupuy, the governor-general of French India between 1816 and 1825, created the Charitable Office, which was meant to support poor and needy people in Pondicherry.[65] Following his predecessor, Eugène Panon Desbassyns de Richemont, who was appointed the governor of Pondicherry in 1826 after Depuy, introduced a series of policies to rebuild Pondicherry and create jobs for the poor by modernising the *guinée* cloth industry.[66] His plan was executed on two fronts: creating a workshop (*atelier de charité*) with dyeing and weaving experts from Rouen and inviting private investors from France to build modern spinning and weaving enterprises with steam engines. On the first front, Desbassayns de Richemont reorganised the Charitable Office that his predecessor launched and created arts and crafts workshops for those in need.[67] Notably, those who were eligible were white (European) vagrants, not locals, as the first article of this ordinance stated the establishment of a charity workshop for white people in Pondicherry.[68] Desbassayns intended to provide opportunities for these disadvantaged white people to earn money. In response to his request dated 26 July 1826, the Minister of the Navy and Colonies sent experts to Pondicherry. One of them was Michel Dennis Gonfreville (M.D. Gonfreville), a chemist and dyer from Déville near Rouen in French Normandy.

Although this project in French India was performed while the Senegalese colonial government worked diligently to produce indigo dyes, these two projects were not implemented in isolation. Instead, the promotion of interlinkages was also considered within the colonial

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[65] Lobligeois, 'Ateliers publics', 9.
[66] *Ibid*., 3–6.
[67] *Ibid*., 8. Two ordinances creating charity workshops for the city of Pondicherry were announced on 24 Jul 1826. See I. Français, *Archives administratives des etablissements Français de l'Inde contenant les lois, ordonnances, réglements et toutes autres publications faites par ordre du gouvernement* (Pondichéry, 1826).
[68] Ordonnance portant creation d'ateliers de charité pour la ville de Pondichéry. 24 Jul 1826. Lobligeois, 'Ateliers publics', 9.

government. Notably, on 1 May 1827, when discussing the dispatch of Gonfreville to Pondicherry, an official of the Personnel Division of the Ministry of Naval Colonies wrote that it would be worthwhile to train Gonfreville in an Indian indigo factory and use the knowledge that he gained there to train indigo workers and to send them to Senegal and Cayenne (French Guiana) to develop the industry, for which they decided to pay 500 francs from the treasury of French India.[69]

M.D. Gonfreville was born around Rouen in France circa 1793 as the first son of Michel François Gonfreville (1767-1836) and Madeleine Marie Boucachard (1769-1848).[70] His father, M.F. Gonfreville, was known as a distinguished industrialist involved in dyeing and bleaching cloth, and he opened a factory at Déville, a small industrial village two kilometres from Rouen, in 1791.[71] He was one of the dyers who attempted to extract indigo from the woad plant during the Continental Blockade.[72] Following in his father's footsteps, M.D. Gonfreville studied the chemistry of dyeing in Rouen.[73] Then, he learned of the dyeing techniques in Gobelins, a distinguished establishment for woven tapestries and dyeing in Paris, and the Conservatoire National des Arts et Métiers.[74] Before he was sent to India, M.D. Gonfreville had been awarded a silver medal for dyed cotton in 1819 and a gold medal in 1823 at the Industrial Expositions for National Products.[75]

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[69] Rapport du Ministère de la Marine et de Colonies, 1 May 1827, ANOM, India.
[70] Jules Garçon calculates Michel Dennis Gonfreville's birth year as potentially 1793 by his father's certificate of death. Jules Garçon, 'Gonfreville, Teinturier, à Déville; Sa vie-ses œuvres', *Bulletin de la Société Industrielle de Rouen* (1901), 827–8.
[71] Unknown Author, 'Bibliographie des industriels, M. Gonfreville (Michel-Francois)', *Recueil Industriel, Manufacturier et Commercial, de la Salubrité Publique,* (1837); M. Bertran, 'Rapport sur les travaux de la societé pendant l'anneé', *Recueil Industriel Manufacturier et Commercial* (1833).
[72] Unknown Author, 'Bibliographie des industriels, M. Gonfreville (Michel-Francois).'
[73] Garçon, 'Gonfreville, Teinturier, à Déville'.
[74] *Ibid*.
[75] Jean G. V. Moléon, A. Cochaud, and A. O. Paulin-Desormeaux, *Musée industriel. Description complète de l'exposition des produits de l'industrie française faite en 1834* (Paris, 1836).

Gonfreville departed France on 29 May 1827, arrived at Pondicherry in September, spent approximately three and a half years there, and completed his mission on 31 December 1830.[76] His mission in Pondicherry was, first, to record in detail how to manufacture Madras handkerchiefs and acquire by all means the process of blue dyeing for guinée cloth and, second, to identify Indian red dye and other substances used to produce the primary colour and procure several hundred kilograms of these substances.[77] In addition to these instructions, M.D. Gonfreville noted in his report, which described in detail the indigo dyeing of guinée cloth in Pondicherry, published in 1845 that he was urged to succeed, if possible, in simplifying, improving and perfecting this production in the common interest of the dyers and traders of Pondicherry and the factories of Metropolitan France.[78] To fulfil his mission, M.D. Gonfreville requested an establishment to dye and weave cotton and silk in Montrepaleum, near Pondicherry, and an order on 29 March 1828 granted this request.[79]

V. *Guinée* cloth production before the French reform

Little is known about how guinée cloth was traditionally produced before the French reforms in the 1820s. As of the late 1820s, Pondicherry cloth was classified by the local *conjon* or *kal* measurement units. A *conjon*, which was used in the northern part of Pondicherry, referred

[76] Regarding the day of departure, see Minutes of the *Séance publique de la Société libre d'émulation de Rouen, Tenue le 6 Juin 1833* (1834). Regarding the month of arrival, see Frédéric Preisser, 'Mémoire sur le Chaya-ver', *Bulletins de la Société Libre d'Émulation de Rouen* (1838).
[77] Lobligeois, 'Ateliers publics'. Unknown Author, 'Rapport du comité consultatif des arts et manufactures pres le ministre de l'interieur, sur la mission remplie dans l'Inde par M. Gonfreville, teinturier-chimiste du gouvernement, pendant les annees 1828, 1829, et 1830, Seance du 24 mars 1831', *Annales Maritimes et Coloniales,* 16 (1831).
[78] Michel D. Gonfreville, 'Mémoire sur la teinture en bleu des toiles dites guinées.'
[79] Specifically, this is known as an arrété relatif à la creation d'un établissement pour le tissage et la teinture du coton et de la soie, sous les auspices et la surveillance du gouvernement. See, *Bulletin des actes administratifs des établissements français de l'Inde. Tome Premier* (1828), 17–20.

to 120 warp threads within a fixed width.[80] A *kal* used in the southern part of Pondicherry equals two *conjons*. For example, a piece that was 12 *conjons* (6 kals) contained 12 multiplied by 120 or 1440 warp threads across the width of a loom, which was approximately one metre. According to M.D. Gonfreville, in the late 1820s, *guinée* cloth was most commonly made with 14 *conjons* (1680 threads) across a width of 1.05 metres.[81] This implies that the cloth was woven with approximately eight warp and eight weft threads in a 5-mm square. Duchon-Doris, Jr., a Bordelaise merchant committed to establishing a modern guinée cloth industry in Pondicherry, also noted that even the highest quality of guinée cloth had only 8-9 *kals* or 16-18 *conjons* per metre.[82] An annual report on French India published in 1843 revealed at least nine categories of cloths according to the number of *conjons*: 12, 14, 16, 19, 23, 26, 30, 36 and 40. Generally, cotton cloth with a higher thread count is considered finer and more expensive.[83] Therefore, we can conclude that cotton cloth with only 16-18 *conjons* was relatively coarse. Gonfreville reported that *guinée* cloth was made with the lowest quality and most inconsistent thread counts.[84]

Like indigo production methods, indigo dyeing methods also differ across regions. People devise techniques that best fit their geographic, environmental and climatic conditions. Ghulam Nadri explained that many small earthen vessels were used to dye textiles along the Coromandel Coast; Southern India's hot and humid climate made it infeasible to use the large open vats used in the Agra and Gujarat regions.[85] Unlike Bengal, which did not have competitive

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[80] Pierre-Constant Sicé, *Annuaire statistique des établissements français dans l'Inde pour l'année 1842* (India, 1842).
[81] Gonfreville, 'Mémoire sur la teinture'.
[82] J. P. Duchon-Doris, *Commerce des toiles bleues dites guinées de l'industrie française de Pondichérie et de la métropole dans ses rapports avec le Sénégal. l'île de Bourbon et l'étranger* (Paris, 1842).
[83] Sicé, *Annuaire statistique des établissements français*.
[84] Gonfreville, 'Mémoire sur la teinture.'
[85] Nadri, *The Political Economy of Indigo in India*, 24–5.

indigo industries until the late eighteenth century, the Coromandel region already had a well-established indigo industry. However, this does not necessarily mean that its indigo was as good as Bengal's. In fact, until the late 19th century, when synthetic dyes replaced indigo dyes, France mainly sourced indigo not from French India but from British India or other European countries.[86]According to Gonfreville, two types of processed indigo were used in Pondicherry in the 1820s: *indigo terré* (soiled indigo) and *indigo fin* (fine indigo).[87] According to Gonfreville, '*indigo terré*' was sold all along the Coromandel Coast in the form of a 480-pound (240 kilograms) block comprising 5–10% pure indigo with a large amount of soil.[88] To understand this unfamiliar mass, the description of Pierre Sonnera (1745-1814), a French naturalist, colonial administrator and writer who lived in India from the late eighteenth century to the early nineteenth century, is helpful: in this region, muddy water, instead of lime water, was used to precipitate indigo substances that floated just after oxidisation.[89] In other words, the indigo precipitates with the mud, drying to become Indigo *terré*. In contrast, *indigo fin* refers to indigo of high purity. In the sense that no lime is used in the production of Indigo *terré*, it can be said that this method causes little harm to the human body and the environment, but because of its low purity, it cannot be said to be high-quality indigo.

Both types of indigo require some preparations before dyeing. *Indigo terré* was left to soak in water for approximately six hours. All the liquid was decanted, and the indigo—at that point in a slurry—was put on a finely woven cloth placed on a hemispherical dish called Saal; it

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[86] Direction générale des douanes, *Tableau général du commerce de la France avec ses colonies et les puissances étrangères*. 1825-1895, Paris.
[87] Gonfreville, 'Mémoire sur la teinture.'
[88] *Ibid*.
[89] Pierre Sonnerat, Jean Deloche, and Madeleine Lyo-Ty-Fane, *Nouveau voyage aux Indes orientales (1786-1813)* (Pondichéry, 2010).

was crushed using a wooden pestle and hands (Fig. 2 in Fig. 3). In contrast, *indigo fin* was prepared simply by soaking it for a few hours in cold water and crushing it roughly, first by hand and then with a stick in a pan and a bowl.

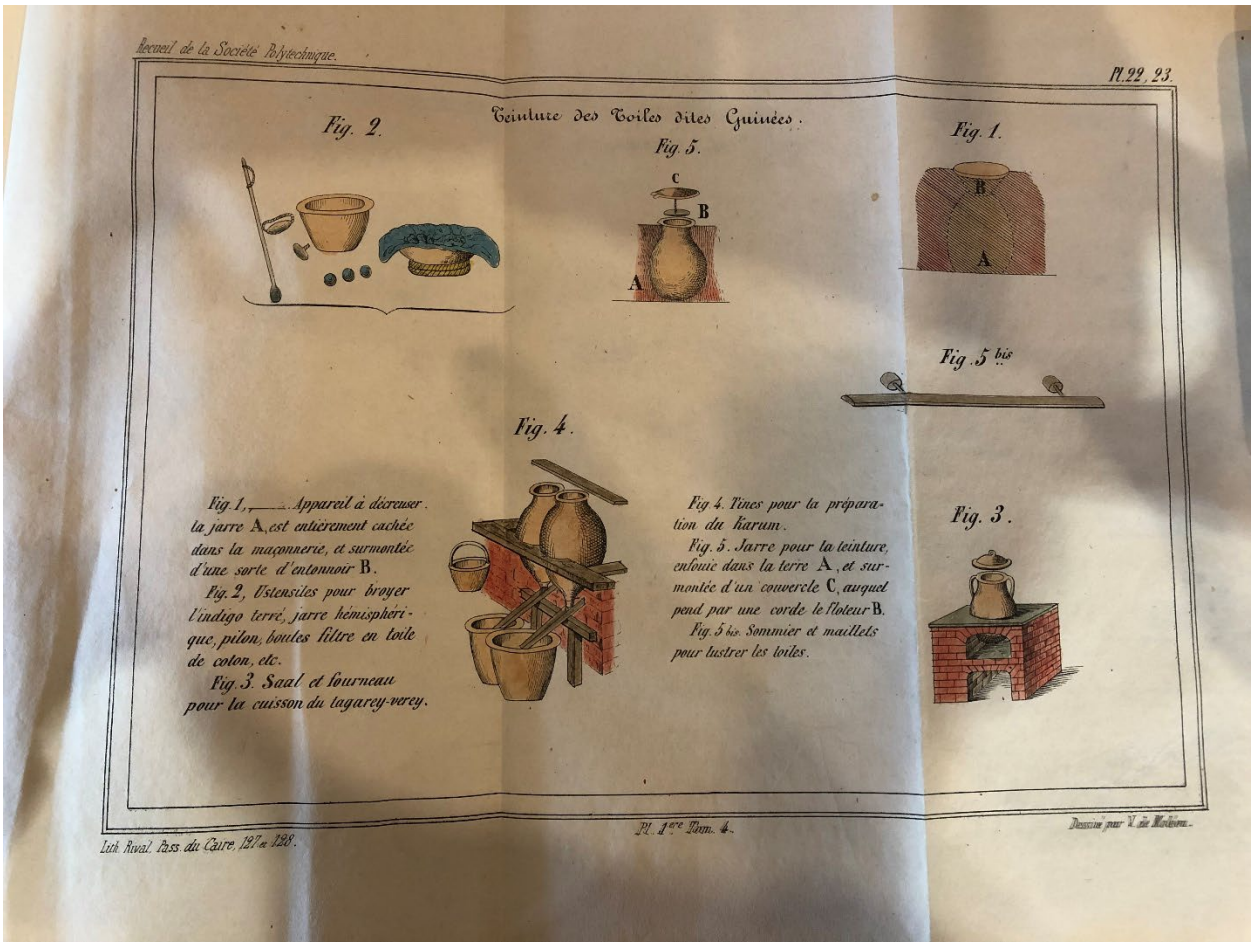

Fig. 3. Equipment used to dye *guinée* cloth.

Source: ANF.

Furthermore, two additional materials were used to dye *guinée* cloth: *tagarey-verey* and *karum. Tagarey-verey* refers to the brown seeds of Cassia tora, an herbaceous shrub native to Asia and Africa. In 1921, Gilbert Fowler and M. Srinivasiah reported that this seed effectively

reduced indigo.[90] According to Gonfreville, the seeds were put in a pot containing 25–30 litres of pond water; they were boiled for three to four hours and left in hot ashes until the afternoon (Fig. 3 in Fig. 3)[91] The seeds were subsequently swollen and boiled well, forming a very thick, mucilaginous bath that was more or less like water with a large quantity of gum.[92] Approximately five kilograms of *tagarey-verey* could dye ten pieces of cloth.[93]

Gonfreville discovered that *tagarey-verey* contributed to creating a specific smell that the Maures in the Sahel appreciated and succeeded in growing and harvesting in Rouen.[94] However, the amount produced was still insufficient for dyeing guinée in France, and large quantities of *tagarey-verey* had to be imported from India, increasing production costs.[95] As a result, as of the mid-1870s, M.J. Clouet, a professor at Rouen, concluded that it was difficult to dye *guinée* cloth using *tagarey-verey* in Rouen.[96] This may be why guinée cloth was still being produced in Pondicherry, even in the second half of the 19th century, when France came to produce cotton cloth. Therefore, French merchants even created a new type of guinée known as GP, woven in Europe but dyed in Pondicherry.[97]

The second material, *karum*, was made with alkaline soil known as *olla munnoo*; it was found abundantly near Pondicherry and collected only in May and Jun before the rains would wash out the salt from the earth.[98] As shown in Fig. 4 in Fig. 3, *karum* was made with 100

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[90] Gilbert J. Fowler and M. Srinivasiah, 'The Bio Chemistry of the Indigenous Indigo Dye Vat', *Journal of the Indian Institute of Science* (1921).
[91] Gonfreville, 'Mémoire sur la teinture.'
[92] *Ibid*.
[93] *Ibid*.
[94] *Ibid*, J. Cloüet, 'Note sur le Cassia tora, L., et la possibilité de son emploi industriel', *Bulletin de la Société Industrielle de Rouen, Juillet-Aôut* (1876).
[95] *Ibid*.
[96] *Ibid*.
[97] Roberts, 'West Africa and the Pondicherry Textile Industry'; 165. Note pour Monsieur le sous-secrétaire d'Etat, Paris, dated 8 November 1885. ANOM, Senegal.
[98] Gonfreville, 'Mémoire sur la teinture.'

kilograms of *olla munnoo* and five kilograms of lime or calcined shell powder mixed well with pond water in jars.[99] After three or four hours, the plugged hole on the bottom of the jar was opened, and the remaining was transferred to another bowl.[100] *Karum* seems to have been used to adjust the pH of the solution in dyeing jars.

The dye baths used by Gonfreville in the village of Pachnampett in Coromandel were prepared as follows: an old (used) bath was used as a leaven and poured in equal parts into nine jars.[101] The prepared *indigo terré* was added to each jar in different amounts depending on the desired strength of the fermentation mixture.[102] On the next day, the *Paniken* (chief dyer) regulated the colour, odour, and taste of the bath in jars by adding *karum*, continuing the fermentation, adding a decoction of *tagarey-verey* or filling them with water in different proportions.[103]

Fig. 4 shows the interior of a dyeing facility at Pachnampett. The centre of the workshop was occupied by a massive masonry structure in which pottery jars containing dye baths were embedded. These jars were made of clay and sandstone; they were reinforced with a small rim at the top and tapered from the middle to each end (Fig. 5 in Fig. 3).[104] Each piece of *guinée* cloth was generally soaked ten times, and approximately 40–60 jars were required to dye twenty pieces of cloth.[105] This workshop included a series of 65 jars placed in 5 rows of 13 jars each. Gonfreville reported that the most extensive dyeing facilities had 3 or 4 series of 150 to 200 jars.[106]

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[99] *Ibid*.
[100] *Ibid*.
[101] *Ibid*.
[102] *Ibid*.
[103] *Ibid*
[104] *Ibid.*
[105] *Ibid.*
[106] *Ibid.*

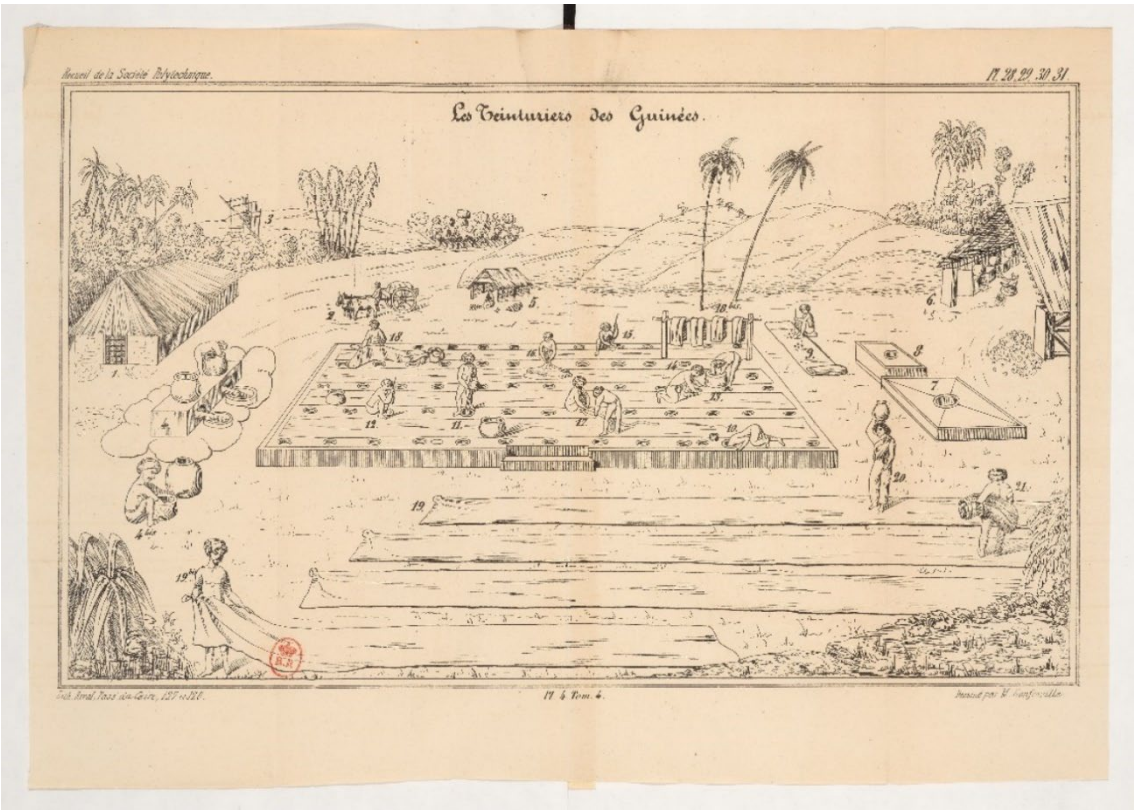

Fig. 4 A scenery of dyeing guineé cloth.

Source BNF.

The refined cotton cloth was soaked in jars when the dye was ready. After being soaked, the cloth was twisted by two workers and immediately placed outside to dry. This process was repeated multiple times. The number of immersions varied depending on the depth of the desired colour. In this process, Gonfreville reported that Indian dyers attempted to economise their dyes so that the cloth was unevenly dyed, while the cloth appeared to be a uniform colour at a glance.[107] In this respect, it is very hard to say that *guinée* cloth was a quality textile.

[107] *Ibid.*

Fig. 5 shows a landscape and people finishing *guinée* cloth. To complete *guinée* cloth, a seed known as *keverou* was used.[108] Water made by boiling *keverou* imparted a certain amount of firmness to the fabric.[109] According to Gonfreville's observations, rice and millet were sometimes used instead of *keverou*.[110] The folded cloth was dipped in a bath of *keverou* and then dried on the grass; the pieces were subsequently folded four times along their length and once across their width and bundled together.[111] Next, the pieces were lightly moistened with water and left to sit for one day.[112] The cloth was then beaten with cylindrical mallets made of redwood or *shem-marum* in the local language; this action made the cloth firm and shiny.[113] This technique for making the cloth shiny has also been reported in West African and Arabian societies.[114] Finally, a small amount of moisture in the fabric penetrated everywhere, firming the fold lines of the cloth.[115] After five to six hours, the cloth was unfolded again, exposed to the sun for one or two hours to allow the remaining moisture to dissipate, and then refolded. Once they were ready for dispatch, the last upper folds were glued, pressed and dried, and the pieces of cloth were bound together.[116]

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[108] *Ibid.*
[109] *Ibid*.
[110] *Ibid.* Gonfreville uses the word *varagou*; this seems to refer to *varagou des Hindous*, which is *Paspalum miliaceum*, a species of millet.
[111] *Ibid*.
[112] *Ibid*.
[113] *Ibid*.
[114] Jenny Balfour-Paul Collection at the Pitt Rivers Museum, University of Oxford, Printable Exhibition Guide, 'Weaving Connections; Local Perspectives on Collections from the Middle East, North and West Africa' (Oxford, 2019).
[115] Gonfreville, 'Mémoire sur la teinture.'
[116] *Ibid.*, 97–8.

Fig. 5 Landscape and people finishing guinée cloth.
Source BNF.

VI. French reform of *guinée* cloth production and beyond

Since most of the cotton cloth dyed in Pondicherry was initially made in British India, France had to stop the influx of cotton yarn and cloth from British territories to protect its developed industries.[117] Under several protective measures, from the late 1820s onwards, yarn

[117] F. J. Joyau, *Notions préliminaires à l'étude des questions agitées en plusieurs ministères touchant la fabrication, la teinture et le commerce des toiles dites guinées bleues de Pondichery, par le delegué des établissements français de l'Inde* (Paris, 1842). Joyau was a delegate of the French establishments in Paris. This report provides information on not only the situation in Senegal but also guinée production in India in the early nineteenth century. He was critical of excessive protectionism of guinée, as these policies could raise prices and eventually allow British Indian guinée to dominate the market.

production using steam engines imported from Europe began.[118] The manufactured yarn was initially wholesaled to handloom weavers in Pondicherry, but it was only a matter of time before the cotton cloth was made by machine. Nevertheless, cotton cloth weaved with yarn produced in Pondicherry was thicker and heavier than in British India and Europe.[119]

To dye guinée, Gonfreville was in charge of simplifying and improving Indian methods. Therefore, he compared the dyeing costs for 100 pieces of cotton cloth using three different methods in three different places along the Coromandel Coast: first, the traditional Indian dyeing method using a mixture of *indigo terré* and *indigo fin* with local dyers in Packnampett from May to July 1828; second, the method using only *indigo fin*, akin to the French method, in Gonfreville's workshop in Montre-Paléom near Pondicherry from September to November 1828; and third, the method involving dipping the cloth into freshly extracted liquid from dried indigo leaves with a reduction in the number of other materials used, which was implemented at *La Forgue* (a French agent) in Ellapack from May to July 1829. The 100 pieces of cloth used for each experiment were woven in Salem, British India.[120]

To understand his cost calculation, it is necessary to understand the monetary system in French India at that time. Pondicherry used four local currencies in the early nineteenth century: *pagode*, *roupie*, *fanon* and *cache*. The conversion rate to French Franc for each is shown in Table 1. Although the exchange rates between local money and francs varied among towns,

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[118] Lobligeois, 'Ateliers publics'; Roberts, 'West Africa and the Pondichery Textile Industry.'
[119] Négociants Sénégalais, *Le Sénégal et les Guinées de Pondichéry: Note présentée à la commision supérieure des colonies* (Bordeaux, 1879).
[120] *Ibid.*and Rapport de M. Gonfreville, 17 Janvier 1830.

Gonfreville suggested that one *roupie* from Pondicherry was equal to eight fanons and 160 caches since one fanon was equal to seventeen caches.[121]

Table 1. Exchange rates between local currencies and francs in Pondicherry in 1829.

Pagode	Roupie	Fanon	Cache	French Franc
1	3.5	28	476	8 fr. 400
	1	8	136	2 fr. 400
		1	17 (20)*	0 fr. 300
			1	0 fr. 015

Note: In principle, one fanon was equal to 20 caches, but Gonfreville calculated the value as equal to 17 caches.

Source: Gonfreville, 'Mémoire sur la teinture.'

Gonfreville assumed that labour and general expenses were identical in all cases for simplicity when comparing costs. For example, the estimated cost of employing labourers to dye 100 pieces of *guinée* cloth was ten *roupie* per week, and that for other activities, such as applying glue, finishing, and beating cloth, was two *roupie*, seven fanons, and nine caches.[122] General costs, such as tools, commissions, and shipping, amounted to two *roupie* and four fanons, and the rent for the dyeing facilities was estimated to be only one *roupie*. In sum, the cost for these two segments was 15 *roupie*, 11 fanons, and nine caches (39.435 francs). Finally, Gonfreville reported the cost of dyeing twenty pieces of guinée cloth via each method, the results of which

[121] Sicé, *Annuaire statistique des établissements français*. Generally, at that time, one *fanon* converted to twenty caches, but the value of one fanon fluctuated between 16 and 20 caches, depending on the quantity of copper coins in circulation.

[122] For reference, the hiring costs for the supervisory clerk at the dye house and for the Paniken were seven roupies/month, those for *couli* were four roupies, and those for *tanigarchy* (female workers) were three roupies and four fanons for one person. Source; Gonfreville, 'Mémoire sur la teinture.'

are shown in Table 2. As shown, the transition from the first to the second method reduced costs by 9.7%, and that from the first to the third method reduced costs by 21.6%. Gonfreville was very proud of himself because he simplified the traditional Indian system of dyeing *guinée* as much as possible. According to his observations, the third method was more economical than that employed in British India because it could be carried out in the same vat that extracted indigo.[123] However, this method had a disadvantage: extracting indigo from leaves during the cold season was impossible.[124] The second method is the most common, and the author speculates that this method must have been applied, especially after the mid-19th century, when mass production of cloth in factories became possible.

Table 2. The cost of dyeing a piece of *guinée* cloth in Pondicherry from 1827-1829.

Indian traditional method used by local dyers in Packnampett from May to July 1827	A new method using *indigo fin* at Gonfreville's workshop (Montre-Paléom) near Pondicherry from September to November 1828	A new method using dried indigo leaves at a French Indigoterie, *La Forgu* (Ellapack), from May to July 1829
3 fr.24 (64 fr. 75)	2 fr.95 (59 fr. 00)	2 fr. 53 (50 fr. 75)

Note: The figures in brackets are the cost of dyeing 20 pieces in French francs based on those calculated in local currencies by Gonfreville.

Source: Gonfreville, 'Mémoire sur la teinture.'

[123] Gonfreville, 'Mémoire sur la teinture.' Rapport de M. Gonfreville, 17 Janvier 1830, ANF. M. D. Gonfreville, 'Mémoire sur un nouveau système de teinture et d'impression, avec 30 astringents et substances colorantes végétales de l'Inde, etc., et 80 mordants et substances colorantes minérales', *Bulletin du Musée de l'Industriel* (1846).

[124] F. J. Joyau, *Notions preliminaires a l'etude des questions agitées en plusieurs ministeres touchant la fabrication, la teinture et le commerce des toiles dites guinées bleues de Pondichery, par le deleguéé des etablissements francais de l'inde* (Cae, 1842). Rapport de M. Gonfreville, 17 Janvier 1830.

In fact, the Coromandel Coast produced *indigo fin* in the late nineteenth century. The method described in a contemporary document published in Rouen in 1877 shows that the fabrication method of indigo dyes in Coromandel was similar to the general three-vat method, except for the use of dried leaves.[125] Furthermore, this document also indicates that they used approximately 14 kilolitres of lime water for 50 kilograms of indigo leaves, which made inexpensive, inferior indigo dyes.[126] In this regard, a French official journal published in Indochina in 1869 criticised the excessive application of lime employed to produce indigo dyes in Coromandel because limewater can form an insoluble carbonate that precipitates and mixes with indigo to form a grey jelly-like paste that lacks cohesion, worsening the quality of the indigo.[127] Even today, there are still many indigo dyeing experts who are critical of the use of lime.

Unlike cotton cloth production, which came to be carried out by a limited number of large manufacturers over time, dyeing was still left to many small local agents in the second half of the nineteenth century. According to Gonfreville, in 1827, there were 13 dyeing workshops around Pondicherry, which employed 193 dyers and contained 9531 dyeing jars.[128] The contemporary literature published in the mid-1850s also reports the same numbers.[129] However, this does not necessarily imply that indigenous people owned all of these dyeing workshops. Another report issued in 1883 informs us that immigrants from Bordeaux, Rouen, Great Britain,

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[125] J. Girardin, 'Emploi des matières tinctoriales et extraction de l'indigo chez les anciens orientaux', *Bulletin de la Société Libre d'Émulation du Commerce et de l'Industrie de la Seine-Inférieure* (1877).
[126] J. Girardin, 'Emploi des matières tinctoriales.'
[127] Brossard de Corbigny, 'Du l'indigo', *Courrier de Saigon: Journal Officiel de la Cochinchine* (1869). According to this report, in Coromandel, approximately 48 litres of limewater were used for 100 kilograms of dried leaves.
[128] Gonfreville, 'Mémoire sur la teinture.'
[129] Approximately 200 dyers and 8000-9000 jars. G. Burnét, 'Guinée', in *Dictionnaire universel théorique et pratique du commerce et de la navigation: A - G* (Paris, 1859).

and Belgium formed dyeing houses in Pondicherry.[130] The report says that installing one dyeing workshop in Pondicherry cost only 125 francs at that time, which allowed for indigo dyeing at a much lower cost than that in Europe, half of that in England and approximately one-third of that in Belgium.[131]

VII. Mass-produced items and the emergence of global capitalism: A case of the guinée cloth

Before the world became connected, everyday items such as clothes were produced locally using materials and techniques suited to geographical conditions. The two large books by Catherine Legrand in French and Jenny Balfour-Paul in English under the same title, *indigo*, show that people worldwide have independently developed similar techniques of indigo and cotton cultivation, indigo extraction, yarn spinning and weaving, and dyeing in parallel based on the wisdom and ingenuity of those living in each area.[132]

Since the Age of Exploration, the vernacular technologies of indigo production scattered around the world were refined into more modern technologies, such as the three-vat system, thanks to the development of transportation and communication methods that facilitated the transactions and transfer of knowledge between regions. At the same time, the divisions of labour and specialisation between regions at the global level developed. Those who could produce indigo dyes more efficiently became exporters, and others became importers, even if they knew how to produce them. Consequently, products have travelled longer distances, their

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[130] Unknown Author, *L'industrie de la teinture à Pondichéry menacé par la protection des guinées* (Bordeaux, 1883), ANOM, Sénégal.
[131] *Ibid*.
[132] Legrand, *Indigo*; Jenny Balfour-Paul, *Indigo* (London, 2006).

market has become more extensive, and the competition among producers to gain market share has intensified. In order to survive in this environment, it is necessary to adopt one or two of the following strategies: improving quality and decreasing production costs.

Nevertheless, the second strategy has often been adopted because the market for middle and lower-class consumers is much larger than that for those who can afford finer goods. For this purpose, a strategy of production rationalisation through the division of labour and expansion of scale has been adopted. Consequently, global capitalism for mass production targeting mass consumers who are even on the other side of the world emerged. In this way, the indigo dyes that farmers had been making during their off-season came to be efficiently produced in an extensive system that mobilised large amounts of capital and labourers who worked as cogs in an established system. As a result, the emergence of cheap indigo dyes also made it possible to produce affordable guinée cloth for West Africa at a low cost. France also must have been interested in producing cloth as cheaply as possible because it brought more seigniorage to the French agent since the cloth was used as money in the Western Sahel.

Standardised mass production technology, the inexpensive nature of indigo dyes, *tagarey-verey,* and aluminium-laden water made Pondicherry indigo dyeing competitive. Supported by cheap materials, the price of guinée cloth in the metropolitan franc in Pondicherry decreased markedly—40-45 francs per piece in 1817, 15-18 francs in the early 1840s, and 8.89 francs in 1882—although prices in the French mainland were almost identical between 1817 and

1882.[133] Mireille Lobligeois reported that, as of 1879, European guinées dyed with synthetic indigo were introduced into Senegal but were of poor quality and deteriorated quickly in the African climate. Although she wrote about this episode to illustrate the conflict of interests surrounding a measure introduced in 1877 to protect 'fine guinée cloth dyed in Pondicherry', from another perspective, this also illustrates the *commoditisation* of the Indian guinée cloth appreciated by consumers in the Sahel who could not afford a quality textile.

VIII. Conclusion

Since the eighteenth century, cotton fabrics with flower and tree designs exported from Coromandel have fascinated the world. However, as this research reveals, guinée cloth made in the same region was coarse and dyed simply with indigo from the beginning. With the start of mass production in the mid-nineteenth century, this item became an increasingly inexpensive commodity.

Indigo dyeing is a technique practised in many parts of the world since ancient times. Europeans integrated different knowledge and successfully sublimated it into the technology to produce standardised indigo dyes for mass production. The French attempted to transplant this modernised technology to Senegal, where many consumers of indigo-dyed cotton cloth inhabited. However, owing to cost considerations, this project was abandoned. Judging from the fact that Senegal temporarily became an essential source of indigo dyestuff for Metropolitan

[133] The prices in 1817 and the early 1840s are drawn from Duchon-Doris, *Commerce des toiles bleues*, 4 and those in 1882 are drawn from a document written by unknown author seeking removal of the protection of guinée. See Unknown author, *L'industrie de la teinture à Pondichéry menacé par la protection des guinées* (Bordeaux, 1883). The consumer price index in France in 1800-2020 is available from the website of a French public agent, L'inspection générale de l'environnement et du développement durable: IGEDD, https://www.igedd.developpement-durable.gouv.fr/IMG/xls/valeur-immobilier-1800-2020_cle2abd1f.xls.

France during the First World War and for some time afterwards,[134] it seems appropriate to conclude that Senegal could produce indigo dyes. However, it failed to be supplied for the global market in ordinary due to high costs.

The philosophy of producing cheap products in large quantities and supplying them to the global market can also be observed in the production of *guinée* cloth. This research shows that the French government and Gonfreville were interested in how to produce *guinée* cloth cost-effectively and fostered the modern *guinée* cloth industry in Pondicherry. Consequently, the Indian *guinée* became a mass commodity, and when similar cotton cloth began to be produced in Europe, the French government intermittently had to introduce some protection policies to favour Pondicherry's guinée cloth in the Senegalese market. Furthermore, French agents had strong incentives to bring as cheap cloth as possible because cloth was circulating as money in Western Sahel, which brought them more seigniorage profits.

The conclusion that the Africans accepted a large quantity of low-quality mass-produced goods may seem to contradict previous existing research, but it does not. The Africans must have selected the most preferable sample from those provided. The suppliers also offered the best products while assessing consumers' preferences and purchasing power under various constraints. Imported textiles were inferior to the high-quality hand-woven cotton cloth made on the continent but were similar to them and reasonable, which attract the emerging consumers. The fact that mass-produced goods attracted new mass consumers can be easily understood by looking at how cheap Asian products appeal to the masses in Africa today.

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[134] Direction générale des douanes, *Tableau général du commerce et de la navigation.* See volumes 1915 and 1916.

The important thing here is to consider why mass consumers were formed and why mediocre cotton cloth was demanded so rapidly in the nineteenth century. The reason for this is that the world market demanded the gum Arabic they provided due to the development of the mass production of cotton cloth in Europe. The increase in exports to outside the region promoted the monetisation of their economy. At first, this was in commodity money, which was the guinée cloth in this society since the French franc was not introduced until the beginning of the twentieth century. In that sense, it would be more accurate to say that Africans did not shape globalisation but that economic globalisation integrated Africans into the system without exception.