Giorgio Riello, "The Colour of Empire: Cochineal and Indigo in the Pre-modern World", in *A Revolution in Colour: Natural Dyes and Dress in Late Medieval and Early Modern Europe*, edited by Maria Hayward, Giorgio Riello and Ulinka Rublack (London: Bloomsbury Academic, 2024), pp. 64-84. ISBN: HB: 978-1-3504-0562-2; ePDF: 978-1-3504-0563-9; eBook: 978-1-3504-0564-6.

Cochineal and Indigo: Environment and the Making of Global Commodities

Today, as in the early modern period, red and blue are two widespread colours used in textile and clothing production. Both colours were achieved in the pre-modern period using a variety of dye substances of animal and vegetable origin. Before the early sixteenth century, most European cloth was dyed in red or blue by using natural dyes local to Europe or sourced in the Middle East. Notwithstanding the fact that dyes were expensive, their trade remained confined mainly to the Mediterranean and to Levantine routes. In the sixteenth century, indigo produced in India and Central America, and cochineal from Mexico revised the global geography of dye production and trade. Historians have pointed to a 'globalisation' of dyes in the early modern period: American cochineal became a major product on European markets; and indigo became synonymous with blue, though its adoption was slower than for cochineal. A series of academic and popular studies have chartered the global success of these dyeing substances; yet their stories remain separate and mostly explained by referring to different chronologies and geographies.[1]

This chapter brings the stories of indigo and cochineal together to reassess the global dynamics that made them the two most important dyes in Europe. Beyond the simple narrative of their success in Europe (and globally), it considers the geo-political and environmental conditions that shaped markets and influenced the trajectory of both dyes. It focuses first on the Spanish Empire in Latin America and its role in producing and commercialising cochineal and indigo in the sixteenth and seventeenth centuries. It points, in particular, to the different types of 'imperial globalisation' that these dyes embodied. The chapter proceeds by assessing the opportunities, as well as the limits, faced by cochineal and indigo. Both dyes encountered serious opposition in Europe as practical knowledge of them remained limited, sometimes purposely so. The chapter concludes by considering the rising interest of the British empire in promoting indigo and cochineal production in the eighteenth and early nineteenth centuries. Circulation of knowledge and expertise were key in a changing geography of dye production that would privilege India rather than Latin America as a supplier of dyes for the expanding British industry. This was only partly achieved, showing the limits not just of the globalisation of dye production but also of imperial projects at play.

While the focus of this chapter is the European maritime empires and European cloth production and dyeing, it considers global processes that touch upon issues of labour, knowledge, environmental exploitation and political ambition. But what were the common features and differences between indigo and cochineal? Like other natural dyes imported into Europe in the early modern period such as logwood and brazilwood, indigo and cochineal were produced by the exploitation of natural resources, often without considering issues of sustainability.[2] Cultivated dyes – similar to other 'tropical' produce – could subvert established environments as they often required the introduction of intensive agriculture systems leading to soil depletion. Yet, cochineal and indigo's different natural, agrarian and chemical properties produced diverse economic and social consequences. Vegetable dyes such as indigo often led to the creation of new agrarian structures among which were slave economies. Indigo production could not be carried out on a small scale and needed infrastructural investment.[3] Visual representations of indigo works show not just the large-scale production but also the substantial manufacturing involved in the processing indigo shoots (Figure 3.1). Similar to sugar, a great deal of processing had to be undertaken before the final product – standardised and highly tradable indigo cakes - was shipped out.[4] As more indigo could be extracted from fresh leaves, the processing increasingly took place next to cultivation. The *xiquilite* (Indigofera local to Central America) cuttings were loaded into large vats to be submerged in water and subjected to steeping for up to 24 hours. This allowed for fermentation, turning the water blue. The water was then moved to a second vat where, through constant beating with wooden poles, the compound was made to oxidise. The beating poles could be turned by water wheels. Once skilled labourers decided that the process was complete – and much of the quality depended on this decision – the water was drained, and the sediment poured onto cloth to strain it out. After drying, the indigo was cut into bars that were packed in boxes.

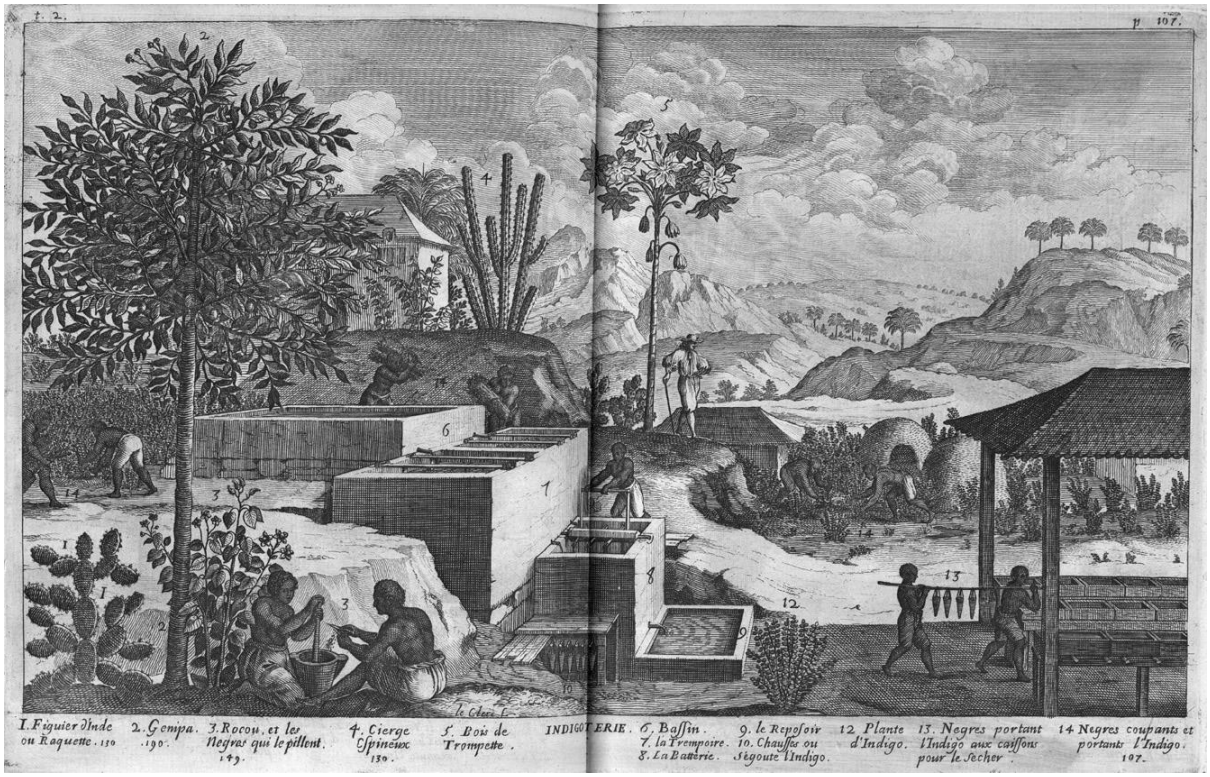

Figure 3.1 Indigoterie, from Jean Baptiste Du Tertre's *Histoire générale des Antilles habitéespar les François* (Paris, 1667–71), vol. 1, plate at 106–107. Courtesy of the Beinecke Rare Book and Manuscript Library, Yale University.

By contrast, the scarcer visual representations of cochineal production show a different 'agro-manufacturing' system. The harvesting of cochineal was relatively simple: it did require a great deal of labour, but it was not capital intensive and therefore did not need large-scale infrastructural investment (Figure 3.2). The peculiarity of cochineal was its environmental limitation: for the most part in the early modern period it was grown in a specific ecologic niche, the small region of Oaxaca in southern Mexico.[5] This happened because the vegetable world of the nopal tree had to align with the animal world of the cochineal insect. This meant that the areas where production could be carried out efficiently – with good nopal cultivation but also the right conditions for cochineal rearing – were restricted, when compared with those of vegetable dye cultivation. As in the case of animal fibres (wool and silk), animal dyes are generated by a double chain of transformation (fauna that feed on vegetable materials) that makes them not just more complex and fragile, but also more energy intensive (inside the case the beetle acts as a supplementary converter of energy) and therefore more expensive.[6] Cochineal required instead great dexterity and skill in collecting the insects by local populations. Because newcomers could not easily learn these processes, the bounded nature of cochineal production was both natural and human-made.[7]

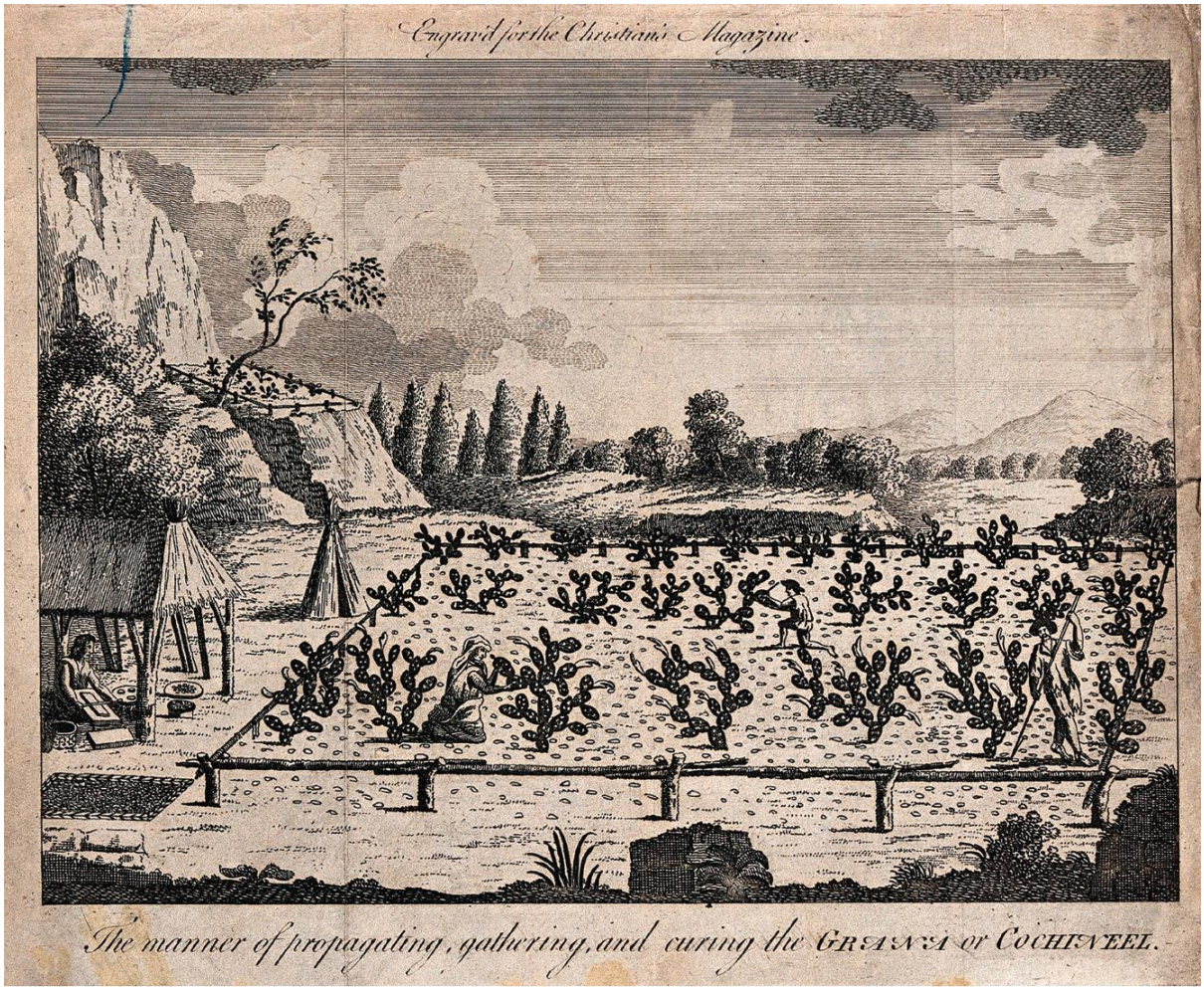

Figure 3.2 'The manner of propagating, gathering and curing the grana or cochineel', engraved for the *Christian's Magazine*, *c*. 1760. Wellcome Library, London, no. 25317i.

Commodities of Empire: Spanish America

The histories of cochineal and indigo in the sixteenth and seventeenth centuries can only be partially explained within the framework of what Alfred Crosby called the Columbian exchange: the exchange of crops, animals and illnesses from the Americas to Afro-Eurasia and vice versa.[8] The Columbian exchange is often presented as the transfer of foodstuffs (famously the potato and the tomato) that came to be cultivated in Europe. Similarly, sugar (a crop originally from Southeast Asia but cultivated in Mediterranean Europe in the Middle Ages) and coffee (originally from East Africa) became staples of Latin American agricultural production. Yet not all plants were easily cultivated across the world. Cocoa continued to be cultivated in the Americas and traded to Europe. Even the potato – that found a suitable climate in parts of Europe – did not enter Europe's consumer basket or European fields as easily as for instance maize.[9] Cochineal and indigo set themselves apart from other 'tropical' goods belonging to the Columbian exchange: their story

highlights the role of politics and knowledge in shaping production, trade and consumption. Cochineal became an item of trade but was not transplanted for at least two centuries. Indigo instead was present in the Americas and, while there might have been a transplantation of Asian indigo (Old World *Indigofera* varieties) to the Americas, what was central was the transfer of technical knowledge, a topic that is still little understood.

If the Columbian exchange sets the framework for the cultivation of, and attempts to, transfer cochineal and indigo globally over the sixteenth and seventeenth centuries. their cultivation, commercialisation and success were shaped by the action of the empire. Both dyes are 'commodities of empire' with the Spanish empire playing a prominent role in their global trajectories. Yet, a mismatch is immediately visible between a narrative of empire and one of trade. In the case of cochineal, whilst the former frames it to be a commodity whose potential was not apparent to Spanish colonial administrators, the latter underlines instead its success on European markets within a matter of decades.[10] Cochineal was first 'discovered' by Europeans in 1523 and became a tradeable commodity twenty years later in the early 1540s.[11] However, its success in Europe was immediate: already in 1550 the trade in cochineal on the Puebla market was worth 200,000 pesos.[12] By 1575 Mexico produced 175,000 pounds of cochineal a year, doubling in the following quarter of a century.[13] In 1600 cochineal had achieved the rank of a major commodity and was, with silver, one of the most important items of trade from New Spain.[14] During the seventeenth century it retained such status, with the import of cochineal into Spain ranging between 250 and 300,000 pounds a year at two pesos per pound.[15]

The peak of cochineal production coincided with the expansion of indigo production in central America. The Spanish Crown showed an interest in the indigo plant as early as the 1550s, but it was in the period between the 1570s and the 1620s that production expanded markedly. In 1609 nearly 300,000 pounds of indigo were shipped from the Mexican region of Yucatán where production had been established in the early 1560s. By this date indigo production was also being developed in Honduras, Nicaragua and most especially Guatemala.[16] If in 1575 Nicaragua produced just 5 tons of indigo a year, by the 1610s its production reached 110 tons per year, briefly surpassing cochineal in value.[17] The rise of indigo was related to the Colonial search for a 'dynamic product' to be cultivated in Central America. Indigo promised good returns because of the high price and small quantities of the dye supplied from other world producing regions. Moreover, failed attempts at cultivating woad in New Spain meant that indigo was considered a viable alternative.[18]

From its early start, indigo cultivation relied on plantation production and slave labour. Yet labour remained a major bottleneck in the labour-intensive production of the dye in Spanish America.[19] The majority of the enslaved workforce was involved in heavy but unskilled tasks. The crop could be grown relatively easily and whilst for most of the time it required little tending, its harvesting occupied a couple of months a year. This meant that the recourse to slave labour was not always economically viable. Indigo production

would have employed them for only a few months of the year and the local economy did not allow the cultivation of other crops to be integrated with indigo.[20] At the same time, Spanish royal orders forbade Indigenous populations from working in textile factories and *obrajes*. Over the first half of the seventeenth century a system of official *visitas* (inspections) was organised for the *obrajes* on the Guatemalan coast to fine entrepreneurs who employed the Indigenous workforce illegally. Yet the need for labour was such that before the removal of this prohibition in 1738, regulations were circumvented by bribing officials into reporting only minor infractions.

The trajectory of indigo was therefore shaped not only by environmental but also political factors. The size and organisation of its production made it impossible to rely on a peasant system. This is one of the main differences with cochineal whose production was instead strongly linked to small-scale Indigenous peasant units. The Spanish administration was once again fundamental in shaping the production of cochineal though the so-called *repartimientos* system that remained in place until 1787. This was based on advances made by merchants of 12 reales (1.5 pesos) per pound of cochineal delivered. Merchants in Mexico City advanced funds to Oaxaca merchants, who in turn provided funds to the *Alcades mayores* (local bureaucrats), who in their turn lent to peasants.[21] Local peasant families worked on the production of the dye that they had to 'sell' to the *Alcande Mayor* or his delegates who in turn relied on local merchants in Oaxaca and exporters to ship the dye to Veracruz where Spanish merchants would buy it to be shipped to Cádiz or Seville. This was not a market system: the price at which cochineal was purchased was fixed and the dye was sold in exchange for a variety of commodities such as textiles, beaver hats, mirrors, paper and playing cards.[22]

Empire was heavily involved also in the commercialisation of cochineal in Europe. This was a lucrative business in the hands of Spanish and Italian merchant bankers with close links to the Habsburg monarchy. Cochineal travelled with much valued merino wool from the ports of Seville and Cadiz to Genoa, Leghorn and Florence.[23] High demand (because cochineal alone could produce vivid shades of red) and concentrated supplies (well guarded by the Spanish authorities) meant that cochineal increased in value over time. Soon after its introduction on European markets, the cost of cochineal skyrocketed. Between 1547 and 1554 the price of a pound of cochineal on the Seville market increased threefold while in Florence in the same years it increased from 8 to 18 lire.[24] At 4 to 6 pesos a pound it cost between 30 and 60 times the price of sugar. Such high prices were maintained by avoiding gluts in the market and by controlling supply.[25] Yet, there were implicit risks as well: famous is the attempt by the Florentine Capponi family in alliance with the Maluenda bankers of Burgos to monopolise the European cochineal market in 1585. Their plan was to buy all the cochineal in European markets to control its price. The experiment failed, but it shows the dangers of a restricted supply via one entry point.[26]

While the history of cochineal can be read as one of success in keeping production closely monitored, localised, and in the hands of one imperial power, Spain, that of indigo can be read as the reverse. Labour restrictions, frequent locust invasions that spoiled crops, the forbidding of direct trade by non-Spanish vessels, and the depressed state of the textile industry in Spain are all seen as part of the relatively poor performance of indigo production in Central America in the seventeenth century. At 400,000 pounds a year in 1700, Guatemala remained an important world region of indigo production; yet over the eighteenth century the primacy of Spain in the production and trade of indigo was challenged. This was due both to inter-imperial competition and to environmental opportunities. As demand for indigo boomed in Europe from the second half of the seventeenth and throughout the eighteenth century because of the increase in printing on cotton, reliance on Spanish supplies was perceived – most especially by France and England who were leaders in calico printing and painting – as an impediment to the development of their national textile industries. The relative easiness of the transfer of indigo cultivation accounts for the rise of competitors. Already by the late seventeenth century the French-controlled island of Saint Domingue, where indigo cultivation had been brought from Martinique, had become the most important producer in the Americas.[27]

In 1655 the English captured Jamaica and secured a small, but important centre of indigo production, estimated in 1672 at 50,000 pounds weight per year. England, however, also looked towards Asia for indigo. Already in the sixteenth century large supplies were procured by the Portuguese in the South Asian regions of Surat and Cambay and commercialised via Lisbon to Spain, France, and the Low Countries.[28] Both the English and Dutch East India Companies valued the trade in indigo from Gujarat.[29] In 1620 when cotton textiles were yet to become the staple of Indian trade for the European companies, as much as 200,000 pounds of indigo was imported into Europe annually by the English company.[30] As we will see, South Asian indigo turned out to be a low-profit commodity and by 1700 the European trade in indigo was overwhelmingly an American affair. Notwithstanding the small Javanese production put in place by the Dutch (probably smaller than 10,000 pounds a year), and the more substantial 30-40,000 pounds from Gujarat traded by the English company, in the eighteenth century the vast majority of the dye entering Europe was produced in Guatemala, the West Indies and from the mid-century also in Louisiana where 80,000 pounds of indigo were produced in 1754. In the 1770s and 1780s Venezuela also became an important producer with 137,000 pounds of indigo sent to Spain in 1788.

Bounded and Unbounded Commodities

One of the risks of narrating the trajectory of commodities on a global canvas is that of unwittingly supporting a narrative of globalisation, in which local conditions, circumstances, and responses are side-lined. Cochineal and indigo can however be considered through the notions of the 'bounded' and the 'unbounded' to observe what might have been the real and perceived opportunities brought about by these dyes and the natural

and human-made barriers to their expansion. I focus on Europe as I consider first the creation of markets for both dyes, before moving to examining the knowledge concerning the nature, properties and cultivation of both dyeing substances.

Neither cochineal, nor indigo were instantly accepted in Europe. The arrival of cochineal in Italy for instance was welcomed differently according to the interests of local merchants dealing in other red dyes such as grain (*grana*) and kermes.[31] Whilst it was quickly adopted in Milan (an important textile manufacturing centre), cochineal was opposed in Genoa (a key Italian trading centre). It was supported in Florence by the city's ruler, Cosimo I de Medici, while in Venice grain merchants wished to limit or ban the use of cochineal.[32] Yet, the adoption of cochineal was not just a matter of trade: concerns were raised about its manufacturing properties and in particular whether its red colour would be as resistant as the kermes used for the dyeing of silks and grain used in the production of crimson woollens. Opposition to indigo was even stronger than for cochineal: many countries that produced woad banned the use of indigo outright. The dye was labelled as the 'devil's colour' and dismissed as a 'pernicious drug' to be forbidden, as was the case in France already during the Reign of Henri IV (1399-1412) when a ban was enacted that remained in place until 1737. Indigo was also forbidden in England during the Reign of Elizabeth I (1558-1603), while in 1577 the Frankfurt authorities called indigo a 'harmful, and balefully devouring corrosive dye'.[33]

Vested interests in the production and trade of existing dyes such as grain, kermes, madder and woad were undeniably significant. Yet, as for all new commodities, a further problem was how to assess the quality of the new dye and ensure that it would not spoil precious silk yarn or expensive wool. The capacity for assessing the imported dye was thus paramount. Indigo was often mixed with impurities created from the complex production process and sometimes purposely added to increase its weight. Indicators on which to assess the 'goodness' of a product were important: 'The chief signs of the goodness of the indigo are, its lightness and feeling dry betwixt the fingers, its swimming upon water, and, if thrown upon burning Coals, its emitting a violet-colour'd smoke, and leaving but little ashes behind' reported Baldaeus in his description of Indian indigo.[34] Yet adulteration of both indigo and cochineal remained rife. By 1572 the quality of cochineal had become such a problem for the Spanish authorities that the Viceroy of Mexico instituted a *Juez de la Grana Cochinilla* in Puebla, a body designed to check the pureness of the dye exported.[35] Instructions were given for the production of good quality cochineal: for instance, killing the insects by other methods, such as tan drying in the sun, was forbidden. The regulation stipulated a fine of twenty pesos for infringements on the part of Spaniards and a hundred lashes as well as banishment from the town for a year for mulattos, Indians and persons of colour found guilty of adulterating cochineal.[36]

Environmental constraints were also important. In the case of cochineal, as early as 1617 attempts were made at growing nopal tree-like cacti on the Pacific coast of Guatemala, a fertile area with higher agricultural potential than the internal valleys where cochineal

originated. Within four years this state-supported venture had folded. It has been hypothesized that locusts might have destroyed the plants; that the heavier rain climate of Guatemala might have not been conducive to the vulnerable cochineal insects; or that cochineal - very sensitive to temperature change - might have not found a suitable environment. Yet this was the first of a series of failed attempts at acclimatizing cochineal to other environments.[37] Attempts at producing cochineal in Europe failed when in 1536 the nopal cactus was introduced in the areas of Spain where grain was produced.[38] This might have to do both with the suitability of the chosen environments and the availability of workers skilled in the harvesting of the insects, drying them and transforming them into a pulverised substance.

Human capital and knowledge have been considered in recent scholarship as two key conditions for botanical and economic transplantation of plants and crops. Knowledge on how to rear cochineal was not just in short supply – confined as it was to a specific area of the Spanish empire – but also treated as 'a tightly-guarded Spanish monopoly'.[39] From its early appearance in Europe in the 1540s, there was much speculation as to whether cochineal was an animal or a vegetable material. This is surprising since cochineal had similarities with both grain and kermes. Yet, the Florentine merchant Matteo Botti queried with his business partners in Lyon in 1543 as to what cochineal might be: 'we would be very grateful, if possible, to let us know whether you know the country where it is produced and if this is a material from a tree or bush, or if it is from an insect or other, how it is considered, whether there are large quantities and how it is produced'.[40] Botti had seen cochineal but in its finished pulverised state, and was unable to make up his mind about what this dye might have been.

Although guarded, some information about cochineal circulated in the sixteenth and seventeenth centuries. Fray Bernardino de Sahagún (1499-1590) described in his 'Historia General de las Cosas de Nueva España' (also known as the Florentine Codex, 1576-77) cochineal in the form of loaves formed by a compact mass of insects, which was prepared and dried, in order to guarantee the conservation of the product and facilitate its transport.[41] The loaves had predetermined sizes and weights and could be divided into halves or quarters for sale, thanks to some indentations made on the surface. He provided an analysis of the prickly pear as well as the cochineal insects and illustrated them, though the impact of his report remained confined and his descriptions generic.[42] In 1599 the Viceroy of New Spain commissioned a survey of the methods of cultivation and drying of cochineal, what is now the Codex entitled 'Memorial de Gonzalo Gomez de Cervantes para el Doctor Eugenio Salazar, oidor del Real consejo de las Indias' (Figure 3.3).[43] This report clearly relied on Indigenous knowledge, what Marcy Norton calls 'subaltern technologies'.[44] Yet, it remains unclear how widespread the knowledge codified in the report became.

Figure 3.3 'Memorial de Gonzalo Gomez de Cervantes para el Doctor Eugenio Salazar, oidor del Real consejo de las Indias'. The British Museum Am2006, Drg.210.

Descriptions and visual representations did contribute to the accumulation of knowledge on cochineal but did not further much the understanding of its nature or production methods. There were contrasting opinions: Francisco López de Gómara (c. 1511 - c. 1566) believed cochineal to be an excrescence of the nopal cactus, a notion that was upheld during the seventeenth century. Yet, when in 1604 the Florentine merchant Roberto Pepi saw the arrival of the Spanish fleet carrying 'cermini' (cochineal), he had no doubt that 'it is – something that I did not know – an American insect that lives on trees that we call *fichi d'india* (cacti), and they are harvested with much care by locals with pork bristle in order not to kill them as they would be damaged, and once dried without force, they are taken to markets to be sold'.[45]

The controversy about the nature of cochineal was resolved only in the following century. In the 1670s microscopic observations by Jan Swammerdam (1637-80) and by Antony van Leeuwenhoek (1632-1723) revealed that cochineal was indeed an insect, but they thought it of a metamorphosing kind.[46] The definitive answer came only with Melchior

de Ruusscher's *Natuerlyke historie van de couchenille* (1729), the result of a wager between the botanist and a friend: de Ruusscher believed cochineal to be an insect while his friend believed it to be a seed. De Ruusscher's publication in Dutch and French reproduced original documents from an enquiry held in Mexico that showed that cochineal was neither a seed nor a fruit but an insect and that it did not undergo metamorphosis. It appears that the judicial hearing of 1728 on cochineal was the first use of the microscope in a court of law to support written evidence.[47]

Knowledge about indigo cultivation and the plant's properties was widespread in the early modern period; yet it is difficult to trace how knowledge of the complex production process was acquired and circulated not just in Central America but also between Afro-Eurasia and the Americas. Different explanations have been considered. According to Prakash Kumar, indigo cultivation 'was undoubtedly created by drawing on local knowledge(s) of different stripes. In a sense, the English and French planters in the Caribbean were direct legatees to native practices circulating in the Spanish greater Caribbean'.[48] Yet, it is still uncertain the extent to which pre-colonial and Indigenous practices might have affected the organization of indigo production in Central America. Other scholars have underlined the legacy of Asia: it is said that samples of the best indigo produced in India made their way to the New World in the sixteenth century.[49] This is a point that still needs clarification, including the role of Europeans as knowledge brokers. For sure, we know that Augustinians and Jesuits brought improved methods of indigo cultivation to Colonial Spanish America. Later in the eighteenth century, engineers were sent by the French government to increase the efficiency of production of indigo vats in the West Indies.[50] Codification also helped the spread of indigo cultivation across the Caribbean and into continental North America. Important works such as Jean-Baptiste Du Tertre's *Histoire générale des Antilles habitées par les François*, first published in 1667-71 was followed by Jean-Baptiste Labat's *Nouveau Voyage aux isles Françoises de l'Amérique* (1722) which focused on the natural history of the French West Indies and was translated into Dutch and English within years from its first publication.[51] Labat wrote about his stay in the Antilles between 1693 and 1706 in a book that was influential in instructing cultivators in South Carolina to start indigo production in the 1740s.[52] Similarly, Élie Monnereau, a planter with several years' experience, published a book detailing his knowledge of indigo cultivation in Saint Domingue in 1736.[53]

Yet, it was not just a matter of knowledge. Practice and experience were equally valuable as the case of Richard and William Bridgman shows. The two brothers had extensive experience in cultivating indigo in Jamaica and were employed by the Royal African Company to establish indigo cultivation on the Guinea Coast in 1691. What they carried with them was not just seeds (a box from the Leeward Islands) and abundant expertise, but also equipment and labourers. What they were asked to do was no easy task: Colleen Kriger observes that the transfer of the West Indian technology of indigo manufacturing might have been hampered by the fact that local practices in the Guinea Coast were quite

different as they were not based on the putrefaction of the whole plant but just the processing of leaves. After several attempts at planting indigo, the enterprise ultimately failed; yet this story tells of a culture in which botanical knowledge and colonial enterprise converged.[54] It is also telling of the pressure that British traders, textile producers and ultimately the British state were under in securing cheaper and more reliable supplies of dyes.

Commodities of Empire (II): British India

Cochineal and indigo are intimately connected with inter-imperial competition, most especially between Spain, France and England. In the first half of the seventeenth century, the English had looked to India – rather than the Americas - as a source of indigo supply. The hinterland of Biana, Sarkhej and Baroda in Gujarat produced indigo of differing quality. The Dutch too were supplied with Gujarati indigo. In the 1620s and 1630s it was a commodity of choice for both the Dutch and English companies and together they managed to fend off an attempt by the Mughal Emperor Shah Jahan to create an imperial monopoly on indigo.[55] Yet a couple of decades later the English East India Company faced severe competition on European markets from indigo imported from the Americas. As K.N. Chaudhuri observed, indigo was characterised by both supply and demand elasticity: higher prices quickly attracted more abundant supplies especially from the West Indies.[56] The correspondence sent by the English East India Company to their trading hub (factory) in Surat in 1660 explained that 'Wee shall bee very well content if you send us a small quantity of indicoe by our next expected shipping, the greatest part of what wee received in the last yeare … remaining still in our warehouse unsold, and there is in towne aboundance of the commoditie, which came from the plantations in the Barbadoes and West Indies'.[57] Part of the problem was that Gujarati indigo suffered from a generally low reputation: cheaper varieties were mixed with sand, something that decreased the overall quality of the product.[58] Notwithstanding a recovery of trade in the 1690s, by the early eighteenth century the export of indigo from India had all but stopped.[59]

British imperial discourse on indigo is not as easily definable as the discourse on other commodities.[60] In the Americas it was clearly shaped by competition with Spain and France, in which Britain played a modest role. While Spain increased its production in Guatemala, France developed production in Saint Domingue.[61] The early eighteenth century was one dominated by France: as R. C. Nash has shown, between 60 and 90 percent of all indigo traded in the Atlantic in the period 1725-75 was produced in French-controlled territories.[62] By comparison, the rising British empire in the Americas did less well: indigo cultivation was established in the British West Indies but by 1750 the crop was superseded by the more profitable cultivation of sugar.[63] The same happened when indigo was introduced in the 1670s in the British-controlled Carolinas where - after some encouraging results - cultivation was discontinued to concentrate on more profitable commodities. Eventually, indigo was reintroduced in South Carolina in the 1740s at a

time when Britain's supply of indigo from the French West Indies was severely curtailed by King George's War (1739-48). Between the early 1740s and the early 1770s the indigo production of South Carolina increased a hundred fold.[64] By the eve of the American independence, South Carolina produced more than one million pounds of indigo a year worth a quarter of million pounds sterling and it constituted a quarter of all indigo traded across the Atlantic.[65]

As for indigo, cochineal was the subject of intense competition on the part of Europe's imperial powers. Cochineal was first imported into England in 1569 and over the following decades its use became widely used in the production of high-quality woollen cloth.[66] In his 1648 *A New Survey of the West-Indies*, the friar Thomas Gage (c. 1597-1656) observed the intense competition between Spain and England: 'no nation is more warlike and high-spirited than the English, whose very clothes were fiery, wearing more scarlet than any nation in the world; as he might perceive by their coming so much with their ships to the Indian coasts to fight with the Spaniards', he opined, adding that 'as they [the English] delighted to go in red, and to be like the sun, so naturally they were brought to those seas to single our such ships as from America carried the rich commodity of cochineal, whereof they make more use than Spain itself to dye their clothes and coats withal'.[67] Pirating of the Spanish fleet was indeed one of the ways to secure abundant supplies of cochineal, though as we have seen, neither the French nor the English succeeded in developing alternative supplies. Between 1725 and 1780 France, for instance, imported on average more than 30 tons of cochineal a year.[68]

The third quarter of the eighteenth century was a period of abundant supplies of cochineal, as the dye started to be produced not just in Mexico but also in Guatemala. This expansion replaced indigo cultivations that had entered into a crisis due to competition from North America.[69] Yet this was a short-lived period of growth: from the 1780s to the 1820s cochineal production declined drastically due to the 1784-85 plague, and was followed by a botched reform of local administration, and by the Mexican wars of independence.[70] While in 1780-84 the Mexican production was nearly one million pounds in weight a year (accounting for a third of the country's export), in 1785-89 it had halved, and in 1800s it scarcely reached 300-400,000 pounds a year.[71]

The dominance and eventual decline of Spain's cochineal supplies presented a serious problem for France and England, the two major textile producing nations in Europe. Even before the crisis, cochineal must have been high among the commodities sought by the French state. The French devised one of the most daring acts of 'biopiracy': recounted in his 1777 *Traité de la culture du nopal, et de l'éducation de la cochenille dans les colonies-françaises de l'Amérique*, the naturalist Nicolas-Joseph Thiéry de Menonville (1739-80) wrote about not so much the story of cochineal in French America (as the title might suggest), but his attempt to steal the Spanish secret of this dye (Figure 3.4).[72] In 1776 he was sent from France to the French-controlled Saint Domingue and from there to the Spanish-controlled Veracruz where he entered under the pretence of carrying out research as a

noble physician and botanist. Notwithstanding the suspicion of the Spanish viceroy, he was able to reach Oaxaca and bring back to Saint Domingue both cacti and cochineal. The piracy was successful but his experimentations with nopal and cochineal were disappointing and cut short by de Menonville's death only a couple of years later at the age of forty-one.[73]

Figure 3.4 Page from Nicolas-Joseph Thiéry de Menonville's *Traité de la culture du nopal, et de l'éducation de la cochenille dans les colonies-françaises de l'Amérique* (1787). © John Carter Brown Library, Box 1894, Brown University, Providence, R.I. 02912.

While the French contemplated the best ways to produce cochineal in Saint Domingue, the English considered its transfer to North America and India. John Ellis's report published in the *Philosophical Transactions of the Royal Society* in 1761 and then reproduced for wider audiences two years later in the *Gentleman's Magazine* recounted the potential for producing cochineal in Georgia and South Carolina.[74] In India, as early as 1618 an English factor suggested that cochineal would be a good commodity for trade to Persia. By this time American cochineal was already traded to India, the Middle East and China, though the English company failed to get a hold on the trade of cochineal in Asia, most probably because supplies were reaching East Asia via the Spanish transpacific route. There was not yet a plan for cultivation, though by the 1780s the idea of transplanting cochineal from the Americas to India was seriously considered by the English East India Company. What turned out to be a risky and ultimately unsuccessful project involved two of the most famous botanists of their age, Joseph Banks and William Roxburgh, an East India Company doctor and the Company itself.

Arvind Sinha, James W. Frey, and Deirdre Moore have detailed the near farcical story of the attempt to produce cochineal in South Asia by the English company.[75] James Anderson (1738-1809) was a doctor serving the East India Company in Madras and an amateur naturalist. He was so convinced that the type of kermes to be found India was in fact cochineal that he convinced the famous English botanist and naturalist Joseph Banks (1743-1820). Eventually, experiments commissioned by the Court of Directors of the East India Company pointed out that the Indian variety was in fact 'entirely useless'. Yet this did not happen before Banks had conceived a plan to break the Spanish monopoly by transplanting cochineal from Brazil to India where Anderson would create a suitable cultivation of nopal plants. This plan was put in place in 1787 with instructions by Banks and £2,000 from the East India Company to acquire both the cactus and the cochineal insects in Rio de Janeiro. Plants and a wild variety of cochineal were smuggled by a Captain Nelson from Brazil in 1794-95. This was a complex transfer and whilst most of the insects died on the way to Madras, a few survived: in just two years substantial quantities of 'Madras cochineal' were shipped to England.[76] They also prospered in Calcutta where the Scottish botanist William Roxburgh (1751-1815) had set up a nopaltry and by Summer 1795 he had managed to produce the fifth generation of insects. The experiment was aided by the fact that it was soon realised that a variety of Opuntia already grew in Bengal. Yet the lack of knowledge on the precise characteristics of cochineal hindered the project: it was believed that there was no substantial difference between the wild and domesticated varieties of the insect and that different climatic conditions were unimportant (Oaxaca was more than 1,500 metres above the sea level). Roxburgh also believed that the wild variety of cochineal imported from Brazil would in due course become as productive as the Oaxaca by simple acclimatization.[77] Some results were achieved but, notwithstanding the mobilisation of what might be called 'the science of empire', Indian cochineal did not become a viable product.[78]

As Jordan Kellman has observed, the story of cochineal defies simple centre-periphery narratives of knowledge creation and dissemination. Its story points instead to a chain of epistemic spaces.[79] For instance it is unclear whether the choice of Brazil was influenced by the report on the cochineal varieties that in 1792 the members of the Macartney embassy had seen during their brief stay in Rio.[80] In turn the young Brazilian botanist Hipólito José da Costa (1774-1823) was unaware of Banks's project when a few years later, in 1799, he set sail for Philadelphia to find out information on tobacco, hemp, maple trees and most especially cochineal. Da Costa followed the instructions of José Mariano de Conceição Vellozo (or Veloso) (1743-1811) who had translated into Portuguese Menonville's treatise. It was in Philadelphia that da Costa was given by William Hamilton a copy of Anderson's published Letters to Sir Joseph Banks on cochineal (1788).[81] Eventually da Costa reached Mexico where he was able to get hold of both cacti and cochineal that alas did not survive the journey.[82]

The English East India Company might have approached Banks and Anderson's 'incredible folly' with a great deal of expectation.[83] A decade earlier, in 1777, the Company had successfully engaged in another 'transplantation venture' that had turned out to be extremely successful and consisted of planting indigo in Bengal.[84] The date is no coincidence: the American War of Independence had cut supplies from what used to be Britain's colonies at a time when both the Spanish and the French were producing large quantities of indigo in the West Indies. The importance of indigo was difficult to miss: it was half of the value of England's dye imports and 2-3 percent of the value of all imports. For Britain cochineal was of an item of great competition with Spain, in the same way that indigo was with France. Substantial quantities of the dye used by an expanding English textile industry came from French-controlled areas in the West Indies.[85]

The development of a new commodity in India was uncharacteristically welcomed by the English East India Company whose plan was to develop indigo as a means of remittance to England. The company employed Louis Bonnaurd, a Frenchman with prior experience of indigo planting in the island Reunion where he had set up two plantations in Hooghly.[86] Between 1779 and 1786 other contracts were signed by the Bengal government for the procurement of indigo. They established a purchase price for indigo well above market price with the result of a 28 percent loss in 1786. Similar to its engagement with silk production, the Company acted on the assumption that earlier losses would be made up by substantial gains once the activity was well established.[87] The main problems to overcome included the antiquated technologies used and the insufficient care in the processing of the dye that made the finished product of a lower standard than the West Indian product.[88]

Notwithstanding these limitations, the English Company was successful and by the 1830s the Bengal Presidency counted 878 firms that cultivated indigo on 320,000 acres of land.[89] Prakash Kumar warns us against giving 'a privileged position to a singular "Europe" in the making of modern indigo plantations' as well as assume that a more mature knowledge of indigo culture was introduced to South Asia by 'the West'. One needs to appreciate instead the 'multi-directionality of knowledge flows' that characterized the long history of indigo in particular.[90] Beyond knowledge, the transplantation of indigo to South Asia also showed the possibility of organizing production in ways that did not involve enslaved labour. Manufacturers did in fact grow indigo on estates that they purchased or leased from *zamindars* (local rulers) or signed contracts with peasants who grew the crop on lands for which they had tenant rights.[91]

Conclusion

This chapter has surveyed and entwined the stories of cochineal and indigo. While there is no lack of general and specialised studies on both dyes, they have rarely been considered together. Their comparative and combined story presents us with a wider picture of

the importance of these two dyes in early modern textile manufacturing in Europe and beyond. It also reveals the ways in which their stories intersected with those of empire. I highlighted here the role of the Spanish empire in the sixteenth and seventeenth centuries and of the British Empire and the English East India Company in the second half of the eighteenth century.

Political and economic competition represents only half of the story: environmental factors explain the different paths of indigo and cochineal. Whilst indigo found suitable environments across the globe, cochineal remained throughout its history confined to a small and secluded area of production. Yet, environmental and ecological factors are not sufficient to explain the stories of cochineal and indigo. This chapter has highlighted the importance of knowledge as a key factor in the transfer of dye production and of skills needed in the growing of plants and the rearing of insects. They allowed cochineal and indigo to become integral in the colour revolution of the early modern period, integrating local dyes and providing new hues to an ever-expanding colour palette.

FOOTNOTES

* Funded by the European Union (ERC, CAPASIA, GA n. 101054345). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Council Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

[1] See for instance A. Butler Greenfield (2006), A *Perfect Red: Empire, Espionage and the Quest for the Color of Desire*. New York: Harper Perennial; C. E. McKinley (2012), *Indigo: In Search of the Color that Seduced the World*. New York, Bloomsbury; C. Legrand (2013), *Indigo: The Color that Changed the World*. London: Thames & Hudson; C. Padilla and B. Anderson (eds) (2015), A *Red Like No Other: How Cochineal Colored the World*. Milan: Skira; J. Balfour-Paul (2016), *Indigo: Egyptian Mummies to Blue Jean*. London: British Museum; G. Roque (2021), *La cochenille, de la teinture à la peinture: une histoire matérielle de la couleur*. Paris: Gallimard; and D. Trichaud-Buti and G. Buti (2021), *Rouge Cochenille: historie d'un insecte qui colora le monde, XVIe-XXIe siècles*. Paris: CNRS Éditions.

[2] F. L. C. Baranyovits, (1978), 'Cochineal carmine: An ancient dye with a modern role', *Endeavour* 2 (2), 85.

[3] G. A. Nadri (1994), 'Indigo production and its organization in Sarkhej during the seventeenth century', *Proceedings of the Indian History Congress* 55, 338.

[4] On sugar see the classic S. Mintz (1985), *Sweetness and Power: The Place of Sugar in Modern History*. London: Penguin.

[5] A. Coll-Hurtado (1998), 'Oaxaca: geografía histórica de la grana cochinilla', *Investigaciones Geográficas* 36 (1), 73. For a map of production in the Americas see Roque, *La cochenille*, 15.

[6] For wool and silk vs. cotton and linen see G. Riello (2013), *Cotton: The Fibre that Made the Modern World*. Cambridge: Cambridge University Press, ch. 10.

[7] M. J. MacLeod ([or. ed. 1973] 2007), *Spanish Central America: A Socioeconomic History, 1520-1720*. Austin, TX: University of Texas Press, 171.

[8] A. W. Crosby (1972), *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Westport, Conn.: Greenwood.

[9] R. Earle (2020), *Feeding the People: The Politics of the Potato*. Cambridge: Cambridge University Press.

[10] On pre-Columbian cultivation and use of cochineal, see Trichaud-Buti and Buti, *Rouge Cochenille*, 17-19.

[11] C. Sánchez Silva and M. Suárez Bosa (2006), 'Evolución de la producción y el comercio mundial de la grana cochinilla, siglos XVI-XIX', *Revista de Indias* 66 (237), 478; R. L. Lee (1951), 'American cochineal in European commerce, 1526-1625', *Journal of Modern History* 23 (3), 206.

[12] Coll-Hurtado, 'Oaxaca', 72.

[13] MacLeod, *Spanish Central America*, 171.

[14] Lee, 'American cochineal in European commerce', 462.

[15] Lee, 'American cochineal in European commerce', 463; C. Marichal (2014), 'Mexican cochineal and European demand for a luxury dye, 1550–1850', in B. Aram and B. Yun-Casalilla (eds), *Global Goods and the Spanish Empire, 1492–1824: Circulation, Resistance and Diversity*. London: Palgrave Macmillan, 203.

[16] D. Alden (1965), 'The growth and decline of indigo production in colonial Brazil: a study in comparative economic history', *Journal of Economic History* 25 (1), 39-40.

[17] The increase in production is matched by data on indigo farms: an original nucleus of 48 farms in Yucatán listed in 1577 was supplemented by 1600 with a further 200 in El Salvador, 40 in Escuintepeque, Guazapán, and 60 in San Miguel, Tecpanatitlán, la Cholulteca, and Nicaragua. By 1620 there were in the jurisdiction on San Salvador in present-day central El Salvador more than 200 obrajes. MacLeod, *Spanish Central America*, 177-79, and 197; P. Pérez Herrero (1992), *Comercio y mercados en América Latina colonial*. Madrid: Editorial MAPFRE, 117.

[18] F. Zamora Rodríguez (2017), 'Central American Indigo. Globalization and Socioeconomic Effects (16th-17th Centuries)', *Análise Social* 52 (224), 589.

[19] Zamora Rodríguez, 'Central American Indigo', 596.

[20] MacLeod, *Spanish Central America*, 187-91.

[21] C. Marichal Salinas (2018), 'Mexican cochineal, local technologies and the rise of global trade from the sixteenth to the nineteenth centuries', in M. Perez Garcia and L. De Sousa (eds), *Global History and New Polycentric Approaches. Palgrave Studies in Comparative Global History*. Singapore: Palgrave Macmillan, 261.

[22] Sánchez Silva and Suárez Bosa, 'Evolución de la producción', 479; M. Salinas, 'Mexican cochineal and European demand', 209; J. Baskes (2005), 'Colonial institutions and cross-cultural trade: repartimiento credit and Indigenous production of cochineal in eighteenth-century Oaxaca, Mexico', *Journal of Economic History* 65 (1), esp. 186-87, 193-94; Trichaud-Buti and Buti, *Rouge Cochenille*, 99-100.

[23] Roque, *La cochenille*, 38-9 and 114-17.

[24] A. Orlandi (1998), 'Zucchero e cocciniglia dal Nuovo Mondo, due esempi di precoce diffusione', in S. Cavaciocchi (ed.), *Prodotti e tecniche d'Oltremare nelle economie europee. Secc. XIII-XVIII, Atti della "Ventinovesima Settimana di Studi" 14-19 aprile 1997*. Florence: Le Monnier, 486.

[25] Price of cochineal continued to increase. In 1630 in Amsterdam it was three times as high ast it had been in 1590. Lee, 'American cochineal in European commerce', 220-21.

[26] Marichal, 'Mexican cochineal and European demand', 201, 204, 205-6.

[27] M. Martin (2014), 'La reconfiguration des circuits d'approvionnement en indigo en France, 1789-1820', *Hypothèse* 1, 108-9; Alden, 'Growth and decline of indigo production', 40.

[28] Alden, 'Growth and decline of indigo production', 37-8.

[29] On the EEIC and VOC production and trade in indigo see in particular G. A. Nadri (2016), *The Political Economy of Indigo in India, 1580-1930: A Global Perspective*. Leiden and Boston: Brill; and Id. (2015), 'The indigo trade of the English East India Company in the seventeenth century: challenges and opportunities', in M. Berg, et. Alt (eds), *Goods from the East, 1600-1800: Trading Eurasia*. London: Palgrave, 61-76.

[30] B. Krishna (1924), *Commercial Relations between India and England (1601-1757)*. London: Routledge, 303, 94-97.

[31] See introduction; and L. Molà (2000), *The Silk Industry of Renaissance Venice*. Baltimore: The Johns Hopkins University Press, 108-12.

[32] D. Celetti (2018), 'Rouge cochenille: la diffusion d'un colorant de luxe à Venise (XVIe-XVIIe siècle)', in M. Martin and M. Villeret (eds), *La diffusion des produits ultramarins en Europe (XVIe-XVIIIe siècle)*. Rennes: Presses Universitaires de Rennes, 115-16; Orlandi, 'Zucchero e cocciniglia', 486.

[33] L. Capocaccia Orsini, G. Doria, and G. Doria (1992), *1492-1992: Animali e piante dalle Americhe all'Europa*. Genoa: Sagep Editrice, 240; F. A. Wood and G. A. F. Roberts (2005), 'Natural fibers and dyes', in Sir G. Prance and M. Nesbitt (eds), *The Cultural History of Plants*. London: Routledge, 303; S. Chassagne (2003), 'Calico

printing in Europe before 1780', in D. Jenkins (ed.), *The Cambridge History of Western Textiles*. Cambridge: Cambridge University Press, i: 515-16.

[34] P. Baldaeus ([or. Dutch ed. 1672] 1703), *A True and Exact Description of the Most Celebrated East-India Coasts of Malabar and Coromandel, as also of the Isle of Ceylon*. London: A. and J. Churchill, iii: 658.

[35] Molà, *The Silk Industry of Renaissance Venice*, 128.

[36] R. L. Lee (1948), 'Cochineal production and trade in New Spain to 1600', *The Americas* 4 (4), 470.

[37] MacLeod, *Spanish Central America*, 174.

[38] M. À. Herrero-Cortell (2019), 'Las colores de un imperio. Hispanic production and international trade of pigments and pictorial materials in the sixteenth century', *Journal for Art Market Studies* 3 (2), 12.

[39] Lee, 'Cochineal production', 450.

[40] 'aremo a ccaro molto v'informassi, se gliè a voj possibile, se nel paese che la si coglie voi intendete che sia materia che naschi in su erbe o piante, opure se è materia di bacherozzoli o quello sia, o come si raunj et se ve n'è gran quantità o come si facci, non ci mancate che ci viene a proposito'. Cit. In Orlandi, 'Zucchero e cocciniglia', 458.

[41] Fray B. de Sahagún (1576-77), 'The Florentine codex' (Historia general de las cosas de la Nueva España', Mexico, illustration ii: f. 368. Biblioteca Mediceo Laurenziana Mediceo Palatino, 218-220, Florence.

[42] See also B. C. Anderson (2015), 'Evidence of cochineal's use in painting', *Journal of Interdisciplinary History* 45 (3), 343-44.

[43] E. Phipps (2010), *Cochineal Red: The Art History of a Color*. New York: MET, 15-16.

[44] M. Norton (2017), 'Subaltern technologies and early modernity in the Atlantic World', *Colonial Latin American Review* 26 (1), 18-38. See also Trichaud-Buti and Buti, *Rouge Cochenille*, 73

[45] 'quale, per chi non havessi notizia, e' un vermine che al'Indie fa sopra certi alberi come fichi che noi chiamiamo del'Indie, e da quelli habitatori sono raccolti con diligenzia con setole di porco per non amazzarli, che se li torebbe la virtu', e seccati senza violenza, li portono ne luoghi habitati a vendere'. Cit. In R. Burr Litchfield and S. Bertelli (1999), 'Un mercante fiorentino alla corte dei Medici. Le "Memorie" di Roberto di Roberto Pepi (1572-1634)', *Archivio Storico Italiano* 157 (582), 763.

[46] J. Kellman (2010), 'Nature, networks, and expert testimony in the Colonial Atlantic: the case of cochineal', *Atlantic Studies* 7 (4), 377-78.

[47] M. J. Ratcliff (2009), *The Quest for the Invisible: Microscopy in the Enlightenment*. London: Routledge, 63-4.

[48] P. Kumar (2014), 'Planters and naturalists: transnational knowledge on colonial indigo plantations in South Asia', *Modern Asian Studies* 48 (3), 727.

[49] D. McCreery (2006), 'Indigo commodity chains in the Spanish and British Empires, 1560-1860', in S. Topik, C. Marichal, and Z. Frank (eds), *From Silver to Cocaine: Latin American Commodity Chains and the Building of the World Economy, 1500-2000*. Ithaca, NC: Duke University Press, 63.

[50] Phipps, *Global Colors*, 2.

[51] R. P. Jean Baptiste Du Tertre (1667-71), *Histoire générale des Antilles habitées par les François*, 4 vols. Paris; J.-B. Labat (1722), *Nouveau voyage aux isles de l'Amérique*, 6 vols. Paris.

[52] Kumar, 'Planters and naturalists', 731.

[53] É. Monnereau ([First ed. 1745] 1765), *Le Parfait Indigotier, ou description de l'Indigo*… Amsterdam. See also A. Feeser (2021), *Red, White, and Black Make Blue: Indigo in the Fabric of Colonial South Carolina Life*. Athens, Georgia: The University of Georgia Press, 78-79; P. Kumar (2012), *Indigo Plantations and Science in Colonial India*. Cambridge: Cambridge University Press, 13-14.

[54] C. E. Kriger (2013), '"Our indico designe": planting and processing indigo for export, Upper Guinea Coast, 1684-1702', in R. Law, S. Schwarz, and S. Strickrodt (eds), *Commercial Agriculture, the Slave Trade and Slavery in Atlantic Africa*. Woodbridge: Boydell & Brewer, 102-3.

[55] I. Ray (2004), 'The indigo dye industry in Colonial Bengal: a re-examination', *Indian Economic & Social History Review* 41 (2), 200-1.

[56] K. N. Chaudhuri (1978), *Trading World Asia English East India Company, 1660-1760*. Cambridge: Cambridge University Press, 331.

[57] 'Letter from the court of directors to Surat Factory', 22 Feb. 1660, in W. Foster (ed.) (1921), *The English Factories in India 1655–1660*. Oxford: Clarendon Press, 322.

[58] Nadri, 'Indigo production', 339.

[59] Chaudhuri, *Trading World*, 333-34.
[60] W. Ashworth (2017), *The Industrial Revolution: State, Knowledge and Global Trade*. London: Bloomsbury, 162.
[61] Z. Lotut (2018), 'Blue in eighteenth-century England: pigments and usages', *XVII-XVIII. Revue de La Société d'études Anglo-Américaines Des XVIIe et XVIIIe Siècles* 75, 6.
[62] R. C. Nash (2010), 'South Carolina indigo, European textiles, and the British Atlantic economy in the eighteenth century', *Economic History Review* 63 (2), 365 table 1.
[63] Ray, 'Indigo dye', 202.
[64] Nash, 'South Carolina indigo', 365-66.
[65] R. Prasad (2018), 'Indigo: the crop that created history and then itself became history', *Indian Journal of History of Science* 53 (3), 298; Nash, 'South Carolina indigo', 363.
[66] Lee, 'American cochineal', 207.
[67] T. Gage (1928), *The English-American: A New Survey of the West Indies, 1648*. London: Routledge, 202. See also E. McLean, *Test Sacred Seeds: New World Plants in Early Modern English Literature*. Lincoln: University of Nebraska Press, 65.
[68] M. Perez Garcia (2016), 'Mercados globales de la América Española: el comercio de lana vicuña y "grana" cochinilla en el siglo XVIII', *América Latina en la Historia Económica* 23, 204.
[69] Sánchez Silva and Suárez Bosa, 'Evolución', 483, Still in 1830 the Guatemalan production was no more than 10 percent of that of Mexico. D. McCreevy (1994), *A History of Rural Guatemala, 1760-1940*. Stanford: Stanford University Press, 113.
[70] Marichal, 'Mexican cochineal and European demand', 210. See also J. Baskes (2012), 'Seeking red: the production and trade of cochineal in Oaxaca, Mexico, 1750-1821', in A. Feeser, M. Daly Goggin and B. Fowkes Tobin (eds), *The Materiality of Color: The Production, Circulation, and Application of Dyes and Pigments, 1400-1800.* Farnham: Ashgate, 101-17.
[71] Sánchez Silva and Suárez Bosa, 'Evolución', 482 and 485; Baskes, 'Colonial institutions and cross-cultural trade', 192-93.
[72] N.-J. Thiéry de Menonville (1787), *Traité de la culture du nopal et de l'éducation de la cochenille dans les colonies Françaises de l'Amérique.* Cap-Français, Haiti: Chez la veuve Herbault.
[73] L. L. Schiebinger (2004), *Plants and Empire: Colonial Bioprospecting in the Atlantic World*. Cambridge, MA: Harvard University Press, 39–45; R. Estrada Urroz (2019), 'Tabúes y pasiones. Ideas, afectos y prácticas en el cruce del Atlántico', *Artelogie* [online], 14: http://journals.openedition.org/artelogie/3718 [last consulted 28 March 2023].
[74] J. Ellis (1761), 'CVII. An account of the male and female cochineal insects, that breed on the cactus opuntia, or Indian fig, in South Carolina and Georgia: in a letter from John Ellis, Esq; to Peter Wych, Esq', *Philosophical Transactions*, 52 (31 December), 661-667; *The gentleman's magazine: and historical chronicle*. Volume XXXIII (1763). Plate.
[75] A. Sinha (1996), 'Introduction of cochineal culture in India: English plan to break Spanish Monopoly', *Proceedings of the Indian History Congress* 57, 575-80; and J. W. Frey (2012), 'Prickly pears and pagodas: the East India Company's failure to establish a cochineal industry in early Colonial India', *The Historian*, 74 (2), 241-66. For a wider analysis of Anderson's enterprise and personality, see: D. Moore (2021), 'The heart of red: cochineal in colonial Mexico and India'. Doctoral dissertation, Harvard University Graduate School of Arts and Sciences.
[76] A. Donkin (1977), 'Spanish red: an ethnogeographical study of cochineal and the opuntia cactus', *Transactions of the American Philosophical Society* 67 (5), 49.
[77] Frey, 'Prickly pears and pagodas', 253-56.
[78] On the botanical transfer from the Atlantic to South Asia see J. McAleer (2016), '"A Young Slip of Botany": botanical networks, the South Atlantic, and Britain's maritime worlds, c. 1790-1810', *Journal of Global History* 11 (1), 24-43, esp. 42 on Roxburgh and cochineal.
[79] Kellman, 'Nature, networks, and expert testimony', esp. 374-75.
[80] Eventually J. Barrow's (1764-1848) published account of the embassy (1796) included information about it. N. Safier (2009), 'Spies, dyes and leaves: agro-intermediaries, Luso-Brazilian couriers, and the worlds they sowed',

in S. Schaffer, L. Roberts, K. Raj, and J. Delbourgo (eds), *The Brokered World: Go-between and Global Intelligence, 1770-1820* (Sagamore Beach: Watson Publishing, 267. See also http://collections.vam.ac.uk/item/O723845/a-leaf-of-the-cactus-illustration-unknown/

[81] J. Anderson (1787), *Five Letters to Sir Joseph Banks ... on the Subject of Cochineal Insects, Discovered at Madras*. Madras: C. Ford. The letters caused a quarrel between Banks and Anderson, as Banks believed that the venture could have been successfully concluded only if kept totally secret, most especially from Spanish authorities. Yet Anderson thought of publishing the correspondence to create support in India for the project.

[82] Safier, 'Spies, dyes and leaves', 259.

[83] On the story see also Butler Greenfield, *A Perfect Red*.

[84] Prasad, 'Indigo', 297.

[85] Nash, 'South Carolina indigo', 363 and 365.

[86] Kumar, 'Planters and naturalists', 724.

[87] K. Hutková (2019), *The English East India Company's Silk Enterprise in Bengal, 1750-1850*. Woodbridge: Boydell and Brewer.

[88] McCreery, 'Indigo commodity chains', 63; Ray, 'The indigo dye industry', 203-4.

[89] Ray, 'The indigo dye industry', 211.

[90] Kumar, 'Planters and naturalists', 722-23.

[91] T. Roy (2011), 'Indigo and law in Colonial India', *Economic History Review* 64 - Supplement 1, 62.