

## 1 Prologue

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An article now cultivated in each of the four quarters of the globe: this is silk! The work of that little worm which clothes mankind with the leaves of trees digested in its entrails. Silk! That double prodigy of nature and of art.

Abbé Raynal, 1770<sup>1</sup>

### Spontaneous Generation and Marvellous Transformations

Under magnification, the fibres of cotton, linen, and wool appear twisted, hatched, knobbly or scaled. In contrast, silk strands were described in 1665 by the first English micrographer as ‘small, round, hard, transparent, and to their bigness proportionably stiff, so as each filament preserves its proper Figure, and consequently its vivid reflection intire’. So Robert Hooke, a man hardly renowned for his emotional or descriptive eloquence, could not help marvelling at the fibres of silk, which ‘above those of hairy Stuffs, or Linnen’, appeared as if translucent cylinders of coloured gemstones. The same year, across the English Channel, French agronomist Christophle Isnard determined ‘that nature worked to make silkworms incomparably more admirable than all the other animals on the earth’, going so far as to compare the silkworm and its output to the glorious transformations and resurrection of Jesus Christ. His fascination was mirrored by that of a gifted teenage artist and naturalist in Frankfurt, Maria Sibylla Merian, for whom the life cycle of the silkworm had already inspired the beginning of a long and distinguished transatlantic career in entomology and the study of metamorphoses.<sup>2</sup> These observations,

<sup>1</sup> Abbé Raynal, *A Philosophical and Political History of the British Settlements and Trade in North America, from the French of Abbé Raynal, in Two Volumes* (Aberdeen: J. Boyle, 1779), 1: 282–3.

<sup>2</sup> Robert Hooke, *Micrographia: Or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses. With Observations and Inquiries Thereupon* (London: Printed by J. Martyn and J. Allestry, 1665), 6, 7, 159; Christophle Isnard, *Mémoires et instructions pour le plant des meuriers, nourriture des vers à soye & l’art de filer . . .* (Paris: Chez l’auteur et

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bouncing around northern Europe in the 1660s, reflected the growing reach of the humble silkworm into European societies, publications, and imaginations – and above all, into European materiality. By the end of the seventeenth century, silkworms and their prized product were positioned at the cutting edge of fashion, and increasingly at the cutting edge of science and technology. They were already instrumental to Europe's burgeoning transoceanic commercial activity in Asia, and were becoming the subjects of increasing literary attention at home, since first finding their mouthpiece in the Latin poetry of Italian humanist Marco Girolamo Vida in 1527. Vida had begun his tribute by bemoaning how, for the earliest silkworms, 'No honours to their fruitless works were paid', their threads hanging unused and unnoticed.<sup>3</sup>

This book sets out to show that silkworms were also at the cutting edge of Atlantic imperialism between the sixteenth and nineteenth centuries. Though their traces often hang unnoticed, they are meaningful not because raw silk became a successful American commercial product, but because, in spite of almost every conceivable encouragement across different European powers and within the fledgling United States, it ultimately did not. It is fitting, of course, that the fields of commodity history and Atlantic trade have concentrated on the 'winners': the long list of transformative raw materials extracted and exported from the Americas – the silver, sugar, tobacco, rice, and cotton. The object of this work is not to repackage silk as a successful Atlantic product, but rather to offer a deep and wide-ranging interrogation of its failure.

The history of failure is something of an inbuilt blind spot for historians, whose eyes naturally gravitate to development-oriented narratives. Economic history, no less than political history, has been written by the winners – and the Atlantic world in particular has tended to succumb to the tyranny of supply and demand. But by taking the commercial failure of silk seriously, historicising it, and examining the numerous experiments (large and small) across New Spain, New France, many small corners of northern Europe, and especially British North America and the early United States, we can locate new insights into the determinative matrix of aspiration, labour, environment, and economy in these societies. Each devised its own dreams and plans of cultivation, framed by the compound particularities of cultures and landscapes. Writ large, these dreams would unravel one by one: the attempts to introduce silkworms to new regions around the Atlantic world – powered by

chez Georges Soly, 1665), 284, 287, 292, 300; Elisabeth Rücker and William T. Stearn, *Maria Sibylla Merian in Surinam* (London: Pion, 1982), xi, 8, 10, 85.

<sup>3</sup> Marcus Hieronymus Vida and Samuel Pullein, *The Silkworm: A Poem, in Two Books*, trans. Samuel Pullein (Dublin, 1750), 17.

Europeans' consuming appetite for their fibre – ultimately constituted a step too far, marking out the limits of Europeans' seemingly unbounded power. That they were bewildered by this failure, and for over 300 years sought to counter environmental and demographic odds stacked against them, turning from one site to another, and mobilising every theory and workforce that they could muster, was a profoundly energising force. It opened up creative models of colonialism, exchange, domestic production, and regional interconnection – some of which would disappear altogether, some fall into myths that would be recycled, and others which would become spurs to more commercially successful projects as people, policies, and ideas were recycled from silk to other more competitive and achievable products. Raw silk was the nearly cochineal in New Spain, the nearly tobacco in Virginia, the nearly rice, the nearly indigo, the nearly cotton; it left as its tombstones neglected non-native mulberry trees scattered across multiple continents.

To pause and assess how they got there is firstly to recognise that the Atlantic world had some defining features – its vast distance, its spread, its cultural hybridisation, and in large parts of the post-contact Americas, its societies' existential fragility and manufacturing deficits. Yet at the same time, the mulberries, transplanted by dreams of silk production, bear witness to how the Atlantic world and its evolution was always bound up inescapably with global developments. That raw silk did not become one of the iconic products of the Americas had global implications. Whether the dying of this 'butterfly' in the New World had the power to help generate floods of trade around the Indian Ocean, to consolidate silk production around the Mediterranean, or to cause the revisiting of European beliefs and technologies, is impossible to prove empirically. But even without far-flung counterfactuals, this chaotic history of successive episodes in the Americas underscores how each of them was enmeshed in transnational and extra-Atlantic circuits: Native American uptake was compromised by Eurasian disease, Spanish attempts were interrupted by Pacific supplies, French efforts were trumped by domestic production, English opportunities were undercut by East Indian trade, American hopes were compromised by international manufactures.

The unravelling dreams of silk therefore help us to see the Atlantic past as fractal – even if its history tends towards the linear, or triangular. Fractals, such as snowflakes or crystals, are objects in which the same patterns occur over and again at different scales and sizes. In the Atlantic world patterns repeated themselves, with subtle variations, defined above all by questions of environment, labour, and imperial demand. Commodity projection and successful production appeared natural and

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progressive, a fixed feature which served from the earliest encounters as a foundation stone for claims to European sovereignty. But beneath the appearance were variables of huge complexity and dynamism, which helped shape the particularities of the Atlantic world itself, and instructed its tendency to be self-similar across different scales. My larger hope is that this exposition of one commodity's prolonged transoceanic ordeals will encourage others to do likewise: to root around the middens of the past, the archives of failed endeavours, and use them to get closer to the sense of contingency that contemporaries felt about the places, people, clothes, creatures, and forests around them.<sup>4</sup>

Published works proposing the introduction of sericulture (silk cultivation) in the Spanish, French, and British empires would often stress the miraculous effect that silk raising promised to have on the political economy of states that were dependent on imports. Authors and poets naturally enjoyed the opportunity to play on the silkworms' personal metamorphoses (from larvae to caterpillars to cocoons to moths) and to compare them to the hoped-for metamorphosis of the state, through domestication or colonialism. Silkworms were an influential entomological analogy invoked in the service of European national promotion and self-critique, especially in the century after 1650, as naturalists came to better understand and share their insights about the functioning of the insect world.<sup>5</sup>

To take one example, silkworms were directly involved in the debunking of the archaic theory of spontaneous generation (the long-standing idea that organisms could emerge from non-living matter), when the Italian naturalist and court physician to the Medici grand dukes of Tuscany, Francesco Redi, spent a heroic amount of time watching flies lay eggs and observing caterpillars' activities on trees. Redi's 1668 work explicitly repudiated the claim that 'the mulberry tree produces the silkworm, on being impregnated with the seed of any chance animal', which had been advanced by the eccentric German Jesuit scholar Athanasius Kircher amongst others (and had featured in many publications trying to

<sup>4</sup> For selected considerations: Bethany Aram and Bartolomé Yun Casalilla, *Global Goods and the Spanish Empire, 1492–1824: Circulation, Resistance and Diversity* (London: Palgrave Macmillan, 2014); E. D. Melillo, 'Global Entomologies: Insects, Empires, and the 'Synthetic Age' in World History', *Past & Present* 223, no. 1 (1 May 2014): 233–70; Scott A. Sandage, *Born Losers: A History of Failure in America* (Cambridge, MA: Harvard University Press, 2005). For an excellent review essay on approaches to Atlantic history and its distinctive features: Cécile Vidal, 'Pour une histoire globale du monde atlantique ou des histoires connectées dans et au-delà du monde atlantique?' *Annales. Histoire, Sciences Sociales* 67, no. 2 (2012): 279–300.

<sup>5</sup> Janice Neri, *The Insect and the Image: Visualizing Nature in Early Modern Europe, 1500–1700* (Minneapolis: University of Minnesota Press, 2011).

advance silk cultivation). Redi described the suggestion that silkworms could spontaneously emerge from the decayed carcasses of mules or calves as a ‘fabulous belief’ ascribable to an elegant passage in Girolamo Vida’s poem, but with no foundation in fact. Redi proved by experiment that his mulberry-crammed rotting flesh produced nothing but maggots, which became flies!<sup>6</sup> ‘Do not marvel at all these strange births and transformations’, he warned in a moment of existential relativity amidst the Medici and the maggots, ‘for we ourselves, are nothing more than caterpillars and worms’.<sup>7</sup> But between 1500 and 1840, political economists and consumers showed little of the humility that he advocated, as silk became an increasingly visible part of how states and individuals dressed themselves up.

No experienced silk raisers can have lent credence to the theory of spontaneous generation, for it can never have worked, but it was nonetheless recirculated and repurposed. A New Spanish planter, Gonzalo de Las Casas, in late-sixteenth-century Oaxaca (Mexico) cast doubt on the theory, but used it to make a point by suggesting it may have been propounded by ignorant or devious Moors.<sup>8</sup> For their part, the French in the early eighteenth century attributed the suggestion to the Spanish.<sup>9</sup> Indeed, such theories of spontaneous generation or directions for ‘abiogenesis’ had surprising longevity, with the method of overfeeding a young cow mulberry leaves being recommended in Pennsylvania as late as 1770.<sup>10</sup> Only with the nineteenth-century experiments of microbiologist Louis Pasteur did those remaining believers in spontaneous generation relent (by which stage nobody was slaughtering leaf-satiated calves).<sup>11</sup>

The early spread of international scientific research into the organism was actually intimately connected to wider ambitions of growing silk around the Atlantic basin – of spontaneously generating strange births

<sup>6</sup> Francesco Redi, *Experiments on the Generation of Insects*, ed. Mab Bigelow (Chicago: Open Court, 1909), 109, 123. The original was published as *Esperienze intorno alla generazione degl’insetti* (Florence, 1668).

<sup>7</sup> Redi, *Experiments*, 103.

<sup>8</sup> Gonzalo De las Casas, *Arte nuevo para criar seda*, ed. Antonio Garrido Aranda (Granada: Servicio de Publicaciones de la Universidad de Granada, 1996), 210, 229v–230.

<sup>9</sup> Noël Chomel, *Dictionnaire oeconomique* (Lyons: Printed by the author & Pierre Thened, 1709), 71. Spanish culpability was repeated by the English author Henry Barham in 1719 but with the theory dismissed with the phrase ‘Credat Judaeus’. Henry Barham, *An Essay upon the Silk-Worm: Containing Many Improvements upon This Curious Subject; Together with Large Collections from the Most Approved Authors* (London: Printed for J. Betterham and T. Bickerton, 1719), 161.

<sup>10</sup> *Pennsylvania Gazette*, 12 April 1770, p. 1.

<sup>11</sup> Agnes Ullmann, ‘Pasteur-Koch: Distinctive Ways of Thinking about Infectious Diseases’, *Microbe (American Society for Microbiology)* 2, no. 8 (2007): 383–7.

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and transformations in silk industries themselves. In the late 1660s, the secretary of the Royal Society (comprising leading intellectual figures in England) reached out to Italian specialists to ask them to contribute to the frontiers of biological and colonial knowledge, inviting them to reflect on new or notable features of ‘especially the *silkworm* and its productions’. The upshot was Marcello Malpighi’s remarkable 60,000 word treatise, *Dissertatio epistolica de bombyce*, the first systematic dissection of an insect, which offered a foundation for many of the descriptive and illustrative conventions of modern biology and scientific illustration (see Plate 1). Upon its production, the Royal Society immediately conferred the status of Fellow upon Malpighi, while rivals such as Jan Swammerdam (another debunker of spontaneous generation) queried several of the specific claims. While such pioneering and celebrated moments in European scientific production have rightly been judged significant, seldom has their timing or content been linked to the plantation of mulberries in the American colony of Virginia or to bizarre questions about the impact of feeding silkworms on lettuce (that had been thrown up by English experimentation).<sup>12</sup> Yet contemporaries such as the diarist and horticulturist John Evelyn had little doubt about the interconnections: he had drawn on Virginian insights for the chapter on mulberry trees in his major survey of forestry, had welcomed Malpighi’s ‘incomparable History of the Silkworme’ in 1669, and went on to record in February 1672 (as a member of the Council of Foreign Plantations) that ‘we enter’d on enquiries about improving the Plantations by silks’.<sup>13</sup> His comments reflected a wider appreciation that timeworn theories, like decaying old silk centres, stood ready to be eclipsed in the dynamic crucible of a New World.

In the long run of course, silkworms failed to effect a marvellous transformation upon the Atlantic economy. But they paid testament to the experimental spirit, profound adaptability, and indomitable conviction of early American communities. By placing transatlantic efforts to generate silk under the microscope, we see how they were differently constructed as the Atlantic world evolved, and begin to understand why

<sup>12</sup> Matthew Cobb, ‘Malpighi, Swammerdam and the Colourful Silkworm: Replication and Visual Representation in Early Modern Science’, *Annals of Science* 59, no. 2 (January 2002): 111–47; Marcello Malpighi, *Dissertatio epistolica de bombyce* (London: Martyn & Allestry, 1669).

<sup>13</sup> John Evelyn, *Diary and Correspondence of John Evelyn, F. R. S.*, ed. William Bray, 4 vols. (London: Henry Colburn, 1882), 309, 357; John Evelyn, *Sylva: Or a Discourse of Forest Trees*, 4th ed. (London: Arthur Doubleday & Co., 1706). For a consideration of Evelyn’s own mulberry trees at Sayes Court Park in Deptford, Karen Liljenberg, ‘In Search of John Evelyn’s Mulberry’, 3 August 2016 at [www.moruslondinium.org/research/john-evelyns-mulberry](http://www.moruslondinium.org/research/john-evelyns-mulberry).

they were so frequently flawed and yet frequently resurrected. Attempts to generate raw silk in the face of environmental and logistical handicaps revealed features common to Spanish, French, British, and early US efforts, with their distinctive triangulation of race, space, and empire, and their intensive drawing on Atlantic networks of knowledge, materials, and people. Yet they also exposed a gap between the Atlantic powers with Mediterranean borders, who had longer familiarity with sericulture and nearby access to supplies, and those in northern Europe (including Britain) farther removed from sources, for whom the challenge was more pronounced for reasons of deficits in both their climate and their human capital. These equations would change somewhat as developments occurred that reoriented East Indies trade and European manufacturing centres, and as commercial conflicts ebbed and flowed. Silkworms and their trials, in macro terms, therefore exposed both the extent and the limits of commodity projection in the Early Modern Atlantic.

The intertwining of the international and the local was no less pronounced when it came to the people involved in forwarding silk production across the Atlantic. Several illustrious names lent their patronage and capital to ventures – from Hernán Cortes to James I and later British monarchs, to a range of American luminaries (such as Benjamin Franklin), who were keen initially to impress imperial patrons, and subsequently to secure a New World of textile independence after the American Revolution, as silk raising took a nationalistic and republican turn. Less familiar names, but arguably more important people to sericulture's prospects, were the regional entrepreneurs, botanists, planters, and a host of opportunistic or desperate workers at the local and household levels. These were the men and women (whether of European, Indian, or African origin) who laid out thousands of mulberry orchards, who reconfigured their domestic spaces to accommodate the peculiarities of the seasonal hatchings of helpless caterpillars, and who demonstrated innovation and developed expertise in spite of the profound difficulties of colonial environments, and the shortcomings of much of their advice literature. This history serves to expose this array of often nameless actors, who sought to put in motion the grander ambitions at the heart of colonial projects, responding to the assortments of bounties, land grants, rewards and assistance framed by imperial bodies and institutions. One of its central and recurring claims is that the shadowy gaps left around the successful commodity flows – through which American colonialism has been understood – help us to expose how much labour adaptation, improvisation, and creative agency derived from marginalised groups, especially women.

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The nature of efforts at silk production in the Americas – episodic, opportunistic, and dependent upon the intermittent provision of materials and expertise – does not naturally lend itself to a systematic overview. Failure, after all, is typically something we look to downplay or forget. As in the process of reeling raw silk from cocoons (outlined below), threads need to be teased out, often break, and require attention to detail, so this account offers an interpretation based on a regional dissection of the attempts at sericulture. Its chapters are clustered within three parts, following this prologue which is designed to offer a global assessment of the spread of sericulture (up to the Atlantic barrier in 1500), and to explain the general processes and practices of production, which may be as unfamiliar to readers as they were to denizens of northern Europe and America. Part I addresses the ‘Emergence’ of sericulture (for the fibre under Hooke’s microscope was unknown in the Americas prior to Columbian contact), and considers various European initiatives to transplant mulberries and silkworms with varying degrees of success. The regions treated in this part are New Spain in the sixteenth century, English Virginia in the seventeenth, and French possessions around the Caribbean (particularly Louisiana).

Part II, ‘Persistence’, begins with a survey of the changing patterns and ambitions of silk production in Europe, before looking closely at the particularities of Britain and its colonial ambitions in North America. The competition between nations, merchants, and manufacturers in Europe and Asia, driven by high consumption of silk goods, prompted a host of efforts to domesticate silkworms – even in unlikely places. While first Spain and then France had largely retreated from transatlantic projects in sericulture, relying instead on deepening their domestic output, Britain’s distinctive circumstances encouraged it to persist in new ways. These chapters go on to explain how proponents generated significant investment and activity in the Lower South (South Carolina and Georgia) and New England, each region manifesting its own peculiar features and facing its own drawbacks during the eighteenth century. Although several of the early challenges had now been overcome, and metropolitan support was better coordinated, organisational and environmental factors continued to compromise sustainability. Individual colonies, townships, and households made extraordinary adjustments to try to accommodate silkworms into their regimens, though there was little sense of synchronicity.

Part III, ‘Convergence’, explores the ways that attempts to grow American silk became increasingly integrated, mutually informed, and developmental in the final third of the eighteenth century. The efforts in Pennsylvania were taken forward even as the British American imperial



crisis threw into question many long-standing ideas about silk and its worth. Ultimately, the onset of the American Revolution forced a reconfiguration of the arguments in favour of raw silk production, and the areas in which it was pursued. The commercial and political fallout of the revolutions at the end of the eighteenth century disrupted silk's place, closing off some productive possibilities and opening or reopening others. In the United States, silk was eventually repackaged to assume a nationalistic bent: making American silk now depended upon making silk American, which was accomplished by some sleight of argumentation and a growing interest in textile manufacturing. The epilogue explores the last great fling with American sericulture in the United States – the mulberry mania of the 1820s and 1830s – noting the common resonances with earlier Atlantic colonialism, and the distinctive twists provided by new methods, materials, and media in the early nineteenth century.

### Lighting the Globe

Since the most marvellous transformation in the silkworm's life cycle involved the moth's breaking out from its cocoon to the light, it is fitting for us to begin in the dark. Picture if you will, a map of the world, arrayed as if in deep shadow, the continents barely perceptible, edged against the blacker oceans. This imaginary shadow world represents the globe before human beings alighted on the possibility of unravelling the kilometre-long protein filament (composed of fibroin glued with gummy sericin) that the silkworm, *Bombyx mori*, secretes in constructing its cocoon. People had long twisted plant fibres to create rudimentary textiles, and domesticated many animals (amongst them sheep, pigs, and cattle) whose hides proved invaluable to clothing. But at some mythic moment of realisation, their attention alights upon the horned caterpillars that nestle amidst springtime forests, exclusively eating mulberry leaves from the *Morus* plant (which had originated around the Himalayas). Let us imagine at this juncture – perhaps the point at which a handful of the thin single filaments were first drawn off the cocoons, and plied with one another by twisting slightly to make a crude yarn (raw silk) of manageable texture and unparalleled fibrous strength – that a tiny light appears that punctures the darkness. This miniature LED represents the first time that humans intentionally usurp the silkworm's cocoon, ending its life prematurely, to steal the product of its labour. Raw silk first came to light in this way, sometime around 5000 BCE, amongst the wild mulberry trees of Neolithic eastern China, for by

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that date basic tools (such as spindle whorls and primitive backstrap looms) appear in the river valleys and lowlands.<sup>14</sup>

Chinese legend has long lent added cultural weight to this moment, attributing the discovery to Empress Leizu, the wife of the Yellow Emperor, Huángdì, who ruled in the twenty-seventh century BCE. Around the sixth century CE, in the Northern Chou dynasty, the mythic character of Leizu was elaborated to knit existing state ceremonies together with aspects of popular culture that had long personified silkworm goddesses. Leizu supposedly chanced on the idea of using silkworm cocoons when one dropped into her hot green tea, and the fibrous protein thread began to unravel as she looked on. Many legendary attributions to her have since followed, including the invention of the silk reel (a wooden device to pull off and intertwine the cocoon filaments), the invention of the loom (to form the yarns into textiles by cross-binding warp and weft), and the spiritual title of ‘Silkworm Mother’ (*Cangu nainai*) or ‘First Sericulturalist’. This famed origin story immortalised Leizu as a sericultural patron saint, emphasising her femininity, ingenuity, and maternalism, and proved not only to be important to the Chinese rituals and sacrifices that marked each silk-raising season, but to be culturally transmissible. The story had made its way by 1763, for instance, to a small house in the colonial town of Newport, Rhode Island, where one American family named individual silkworms after the legendary Yellow Emperor and his fellow founding sovereigns. As silkworm cultivation spread, so too would its core associations with female labour and prestige.<sup>15</sup>

If we tracked each cocoon unravelling as a light, then between the first-ever reeling of raw silk and the reign of the Yellow Emperor around 2750 BCE, when carbon-dated archaeological fragments from Huzhou (on the edge of Lake Tai, Zhejiang province – see Map 1) tell us that silk was being grown, we would witness raw silk’s luminosity expand across the Yangtze and Yellow River basins and their growing numbers of mulberry. The glow of sericulture was brightest around the strongholds of the Shang

<sup>14</sup> Peng Hao, ‘Sericulture and Silk Weaving from Antiquity to the Zhou Dynasty’, in *Chinese Silks*, ed. Dieter Kuhn (New Haven: Yale University Press, 2012), 66, 73; Dieter Kuhn, *Textile Technology: Spinning and Reeling, Science and Civilisation in China*, ed. Joseph Needham and Ling Wang (Cambridge: Cambridge University Press, 1988), 137–41. For the earliest evidence of non *Bombyx* sericulture outside of China, using the wild silk moth *Antheraea* in the Indus Civilisation (c.2500 BCE), see I. L. Good, J. M. Kenoyer, and R. H. Meadow, ‘New Evidence for Early Silk in the Indus Civilization’, *Archaeometry* 51 (2009): 457–66.

<sup>15</sup> Fan Lizhu, ‘The Cult of the Silkworm Mother as a Core of Local Community Religion in a North China Village: Field Study in Zhiwuying, Boading, Hebei’, *The China Quarterly* 174 (21 July 2003): 359–72; Dieter Kuhn, ‘Tracing a Chinese Legend: In Search of the Identity of the “First Sericulturalist”’, *T’oung Pao* 70, no. 4/5 (1984): 213–45.