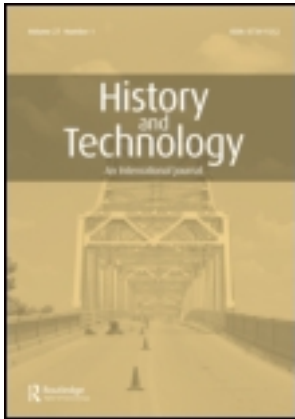


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Inventing ingenios: experimental philosophy and the secret sugar-makers of the seventeenth-century Atlantic

Eric Otremba*

This article examines how the Barbadian sugar industry was interpreted by the English scientific community in the latter seventeenth century. In particular it focuses upon the spread of *ingenios* (sugar mills) to Barbados from Brazil, and how this process was understood and chronicled by England's early scientific community of experimental philosophers. It then contrasts these narratives against archived plantation documents from this period, demonstrating how these writers, despite explicit claims to the contrary, were relatively unconcerned with creating an objective account of sugar-making. Rather, they highlighted specific elements of the industry in order to make the 'invention' of sugar appear congruent with their new experimental methodology. These scientific narratives thus ignore a host of factors within the early Barbadian industry, particularly the critical sugar-making knowledge embodied within the plantation's servile workforce. Rather than illuminating this facet of the industry, experimental philosophers efface these workers and portray ingenios as the laudable product of a few ingenious, experimenting white planters.

Keywords: slavery; plantations; Royal Society; Francis Bacon; experimental philosophy; Barbados; sugar; embodied knowledge; distributed cognition; immutable mobiles

In 1702 the author, compiler, and natural philosopher Thomas Snow published his *Apoptoscopy: Or, a Compleat and Faithful History of Experiments and Observations*. Snow's work was an attempt to create a comprehensive 'experimental history,' meaning a compendium of recent important experiments and discoveries related to early modern natural science, and their relevance to contemporary artisanal and mercantile industries. As such the work lists and details a diverse array of innovations from recent decades, with entries ranging from iron-making improvements, to new ballistics theorems, to horticultural tools, to perpetual motion machines. Like most natural philosophy compendiums of this time, Snow's work pays special attention (and homage) to the evolving connections between scientific innovation and the progress of English trade. To this end he at one point lectures on the positive effects specific innovations can have on creating new jobs and employments, giving four examples: (1) The amalgamation of mercury with gold, which created the gilders trade; (2) the invention of the metal coil or spring, which allowed for the clockmaker's trade; (3) experiments with *aquafortis* on precious metals, which advanced the refining industry; and (4) innovations regarding *lixivium* (potash and other alkaline additives) within the colonial sugar industry, which allowed the mass-production of sugar within Britain's expanding empire. To Snow, this last item was of particular importance because it created more jobs than most. He claimed that sugar

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engendered a variety of recent sugar-making and confectionery trades, greatly augmented the apothecary profession, and was a venerable example of the 'transplanting of arts and manufactures,' which can be achieved through experiment and innovation. He continued his encomium on sugar by lauding the planters of Barbados and their intrepid forbearers who, about 50 years prior, possessed an admirable 'curiosity' which drove them to invent and develop this 'useful industry.' Finally, he extols the virtues of current Barbadians who have made their tiny island a paragon of advanced husbandry, calculating that the tiny island now produces over 20 million pounds of sugar per year.¹

The idea of an experimental or natural history text was conceived almost a century earlier by Francis Bacon, and in publishing the *Apopiroscopy* Snow was consciously participating in an early modern intellectual tradition known to his contemporaries as Baconian or experimental philosophy.² As seen in Snow's writing and examples, experimental philosophers were novel insofar as they found ways to link the distinct concepts of observation, invention, medieval trades, and linear accumulation into a single network of progressive national development.³ Though the Baconian program is well known to historians of science and technology, it is less known that this program included a solid endorsement of chattel slavery sugar production. Indeed, unlike later British philosophers, scientists, and political economists, the Baconian adherents of the seventeenth century were able to seamlessly incorporate the practices of slave societies like Jamaica and Barbados into their broader vision of experiment, innovation, and national improvement. In particular they were enamored with the ingenios (sugar mills) of Barbados and other West Indian colonies, the seemingly novel technologies of which allowed for the sale and consumption of sugar in England at heretofore unthinkable levels. While experimental philosophers endorsed all forms of invention, they reserved special praise for new machines and methods which increased English trade and plenty. Coincidentally, during this same time sugar was the most rapidly expanding sector of the English economy, and this combination led to a number of natural histories which chronicled the sugar industry's development as a paragon of Baconian experiment and innovation.⁴

The following article will discuss two items. First, it will explore the extent to which experimental philosophers employed the category of sugar within their arguments, and what this says about sugar's role within seventeenth-century science and thought. In particular it will focus upon the 'invention' of English ingenios around 1650, and how this development was subsequently framed by England's Baconian advocates.⁵ Though today we rarely associate sugar with ideologies of technological progress, these thinkers understood sugar in a radically different context, one which allowed them to compare it to wonders like gunpowder or the lodestone. Second, it will compare these philosophers' accounts against plantation records from this period, showing the discrepancies between these narratives and the material reality of an ingenio's day-to-day operation. Contrasting these sources illuminates the extent to which Barbadian planters depended upon the embodied knowledges of their servile labor force, and the extent to which this is effaced within experimental philosophy narratives on the new sugar industry. As will be shown, successfully operating a Caribbean ingenio required the simultaneous application of a number of artisanal epistemologies and craft skills, many of which were unknown outside of the routine tasks and 'rules of thumb' employed by a few of the mill's workers. Thus, inventing or transplanting a sugar industry to a new locale had less to do with circulating texts or ideas amongst inventive planter elites, and instead relied on literally transferring artisan slaves and workers from one locale to another. These migrations, which were often

forced and which are so central to early modern Atlantic history, are thus inseparable from the ideas which allowed the novel 'wonder' of sugar-making to grow and evolve.

Controlling both the movements and knowledges of these workers and coercing them to contribute towards the larger ingenio project presented a central challenge to plantation owners, and is a theme that frequently appears within plantation records. Yet experimental philosophy accounts efface this facet of plantation life, creating a narrative which posits the ingenio as the direct product of gentlemen planter discovery and ingenuity. Beyond promoting English trade and industry, Baconian philosophers championed a novel, empirical methodology, and their natural histories claimed to be compendiums of what that methodology could and did produce when utilized within English society. Importantly, this new approach was informed by an elite English cultural belief that inventions and discoveries proceed from the minds of diligent gentlemen individuals, who produce knowledge through isolated observation and experiment. Baconian natural histories reflect this paradigm, and as these histories were also promotional tracts, the discoveries presented within them are frequently altered and framed so as to validate their new methodology. Such was the case for sugar, where the actions of myriad free and unfree workers were stripped away so as to make the invention of sugar-making appear as the result of a few experimenting Caribbean gentlemen.⁶ By portraying sugar in this fashion, experimental philosophers reshaped the nascent Caribbean industry into yet another polemic on the social benefits of their Baconian method.⁷ As such, this transcription of Caribbean practices into English natural science texts constitutes an example of the 'black boxing' process common to this period's scientific expansion. When European natural philosophers read, recorded, and published scientific accounts, they transformed the foreign knowledge they encountered into stable objects which could be incorporated into new taxonomic systems of their own design. Moreover, the objects created through this process were not neutral additions to new scientific canons, but were consciously shaped in ways which allowed these objects to actively reinforce the epistemologies of those very canons. This black-boxing could be applied to foreign objects, foreign peoples, a variety of non-European knowledges, or in this case, an entire system of colonial agriculture.

I. Experiment

Today, sugar's ubiquitous usage has acculturated us into considering it a mundane, commonplace material. Furthermore, historians who have described sugar's past reliance on bondage, forced labor, and corporal punishment have made it difficult for us to imagine how sugar-making could be viewed as a progressive force. Yet to the seventeenth-century English, sugar was a modern wonder. Most of this appreciation for sugar stemmed from its sudden introduction into English life in massive quantities during the seventeenth and eighteenth centuries, transforming the substance from an exotic material used sparingly by elites to a commonplace consumable of all social classes.⁸ The beginnings of this change occurred in the mid-seventeenth century when English colonists in Barbados transformed the island's economy into a sugar monoculture, developing a business platform of large landholdings and a heavy commitment to African slave labor. This so-called 'sugar revolution' of Barbadian history enabled a massive upsurge in English sugar usage, and what was a trickle of sugar imports in 1600 passed above 5000 annual tons by 1650, and was five times that by 1700.⁹ As consumption increased, the uses for sugar shifted and diversified, and the cultural meanings inscribed onto this heretofore rare material were radically altered. Previously thought of as a trifle and only interesting to apothecaries and elite bakers, sugar suddenly had important ramifications on areas as diverse as



Figure 1. Condensed portrayal of a Brazilian ingenio complex, showing all of the stages of a sugar-making operation. Notes: Grinding mills are left and center, and are powered by water and animal power. Meanwhile the boiling, striking, and curing aspects are portrayed on the right. Question: What is the diagonal box for in the picture? Another pair of mills are portrayed in the distant background. Source: Image initially from Simon De Vries, *Curieuse aenmerckingen der bysonderste Oost en West-Indische verwonderens-waerdige dingen . . .* (Utrecht, 1682); used with permission from the James Ford Bell Library, at the University of Minnesota.

diet, trade, health, industry, leisure, and politics. These changes did not go unnoticed by natural philosophers and other English elites, who consequently saw sugar production as a bona fide seventeenth-century invention.

Aside from sugar's increased visibility and social importance, the process of sugar-making itself was interesting to experimental philosophers. In turning the pith of the sugar cane plant into white crystalline sucrose, the ingenios of the Atlantic basin relied upon a series of mechanical and chemical processes which were highly sophisticated for their day (see Figure. 1).¹⁰

After cutting, sugar canes were hauled to a large vertical press for grinding. The press consisted of three massive, iron-plated rollers spun by a system of overhead gears, which were in turn powered by wind, water, or animal power. Slaves would force canes between the rollers, crushing them, while the extracted cane juice accumulated in a pan below. The press was built on a hill and a pipe connected the accumulation pan to the boiling house at the hill's bottom. Once there, other slaves would boil the cane juice in a series of copper cisterns. Each kettle would be hotter than the previous, and 'tempering' additives such as lye, lime juice, or ox blood were added to alter its alkaline content. Eventually the concoction would begin to granulize and at the precise moment of this

transformation the juice would be 'struck' from the fire, strained, put into clay jars, and sent to cure in the climate-controlled purging house. There it could either be left alone to form into muscovado (brown sugar), or it could be 'clayed' into white sugar. Claying involved placing the sugar in large pots and sealing the top with a damp claying compound, another 'invention' eulogized within Snow's work. Slaves poured measured amounts of water atop the clay at regular intervals, keeping it moist. The water then would filter through the clay, percolate through the sugar, and finally drain out through a small hole in the pot's bottom. This process, continued over a couple weeks, would purge the sugar of any residual elements, creating a pure white sugar. Of course, throughout the entire process there were many variables involving speed, temperature, duration, moisture, additives, etc. which had to be closely monitored if the sugar was to be refined correctly. While sugar had been created from canes since ancient times, it was never done so to this extent or complexity, making sugar production seem a mechanical and chemical wonder.

Thus sugar was viewed as a novelty in both its consumption and production aspects. Because of this, experimental philosophers would often employ sugar within polemics on their new methodology's social utility. Importantly, experimental philosophers would often articulate this utility by favorably comparing the achievements of their current age to those of classical antiquity – the so-called 'ancient versus moderns' debate – and argue that experimental philosophy was responsible for these recent, positive changes. Thus a frequent tactic in these authors' writings would be to (1) enumerate the recent marvels of invention and science, (2) argue that these inventions resulted from individuals applying Baconian science to the wider world, specifically through a healthy spirit of skeptical inquiry and earnest desire to collect knowledge, and (3) to implore others to break free from old adulations of church and ancients, and to likewise commit to their new empirical philosophy for mankind's benefit. While other historians have previously detailed the many particulars and significances of this paradigm and polemic, for our purposes it is important to note the frequency with which sugar-making was included within these enumerations of modern wonders.

This admiration of sugar's novelty is evident within even the earliest experimental philosophy works. Francis Bacon's *Preparative Toward a Natural and Experimental History* (1620) is one such text which lays out his design for what a natural history should encompass and how it should be organized. In its preface, Bacon proclaims that were all the world 'composed of nothing else but Academies, Colledges, and Schools of Learned Men; Yet, without such a Natural and Experimental History, as we shall now prescribe, we deny that there could be, or can be any progress in Philosophy, and other Sciences, worthy of Man-kind.'¹¹ This proto-positivist stance is followed by a series of aphorisms regarding this new knowledge system, and in the fifth he outlines the importance of 'mechanick' arts for the accumulation of knowledge, they being 'of the most use.' He then outlines the most important examples of these, being 'Husbandry, Cookery, Chymistry, Deying, the Workings of Glass, Esmalta, Sugar, Gunpowder, Artificial Fires, Paper, and the like.'¹² His other works reinforce this interest. Bacon's *Novum Organum* (1620), outlines a series of recent 'noble inventions' and their relation to the new experimental philosophy, they being gunpowder, silk, magnets, and sugar.¹³ In the *Sylva Sylvarum* (1626), he conducted experiments comparing honey and sugar in their roles as a sweetener. This was prompted by his assertion that sugar, although 'to the Ancients it was scarce knowne, and little used,' had recently replaced honey as the sweetener of choice because of its increasing abundance and declining price.¹⁴ These experiments were matched by others scattered in his works, including ones for preserving different fruits in

sugar, dissolving sugar and salt within various liquid solutions, striking sugar loaves to produce sparks, and attempting to make a sugared wine that prevents drunkenness.¹⁵

Later in the century others echoed Bacon's works. In his 1664 book entitled *Experimental Philosophy, in Three Books Containing New Experiments Microscopical, Mercurial, Magnetical*, prominent Royal Society member Henry Power includes a synopsis of what experimental philosophy has recently accomplished for modern society. He also admonishes his contemporaries outside the Royal Society for failing to embrace experimental philosophy more thoroughly, and speculates on what the present age would lack were it not for those few intrepid individuals who had embraced the new Baconic paradigm:

Had the winged Souls of our modern Hero's been lime-twig'd with such ignoble conceptions as these they had never flown up to those rare Inventions with which they have so enrich'd our latter dayes; we had wanted the useful Inventions of Guns, Printing, Navigation, Paper, and *Sugar*; we had wanted Decimal and Symbolical Arithmetick, the Analytical Algebra, the Magnetical Philosophy, the Logarithms, the Hydrargyral Experiments, the glorious Inventions of Dioptrick Glasses, Wind-guns, and the Noble Boyle's Pneumatick Engine.¹⁶

Others concurred. In 1697, prominent Royal Society member John Evelyn wrote a treatise on metals wherein he advocated that English coins be re-minted so that, like Dutch Guilders, they bear the likeness of individuals who have contributed to the nation's glory via inventions or explorations. He adds that this series of coins include one for those involved in 'Refining, and indeed inventing Sugar.'¹⁷ In another work, a 1700 medical treatise, the author remarks how the modern world possesses 'a great many sorts of Medicines...all of which were unknown in Hippocrates time.' He then compares the ancient medical knowledge to the present by presenting the past as a period where 'Rhubarb had not yet purged bitter Choler, nor Senna the sower juice of the Milt, nor Agarick the sweet Phlegm, nor had Cassia, Sugar or Manna filled the Apothecaries boxes....'¹⁸

Perhaps the best comment of this type comes from Charles De Rochefort's immensely popular *Historie Naturelle et Morale des Antilles* (1658), translated in English as *The History of the Caribby-islands* (1666). Rochefort was a Parisian lawyer and scholar, and though he never visited the West Indies himself his massive and long-anticipated work was a collaboration between him and several other French chroniclers, including a host of eye-witnesses from whom Rochefort gained his information.¹⁹ Like others involved in the ancient versus moderns debate, Rochefort's style differs from earlier travelogues insofar as he frequently adds a level of historical meaning by juxtaposing the Caribbean's features and developments with the ancient Mediterranean, judging that older time against his own. Such is the case with his account of sugar-making, which he prefaces by stating:

Though it may be granted, that the Plant of the Sugar-Cane was known to the Ancients, yet is the invention of making the Sugar but of late years: The Ancients knew no more of it then they did of Sena, Cassia, Ambergreece, Musk, Civet, and Benjamin: They made no other use of this precious Reed, then in order to drink and Physick. And therefore we may well oppose all these things, with much advantage, as also our Clocks, the Sea-Compass, the Art of Navigation, Prospective-glasses, Printing. Artillery, and several other excellent Inventions of the last Ages, against their right way of dying Purple, their malleable Glass, the subtle Machines of their Archimedes, and some such like.²⁰

Though Rochefort was neither English nor a member of the Royal Society, his work was nevertheless popular with both. It went through several English editions, was cited or copied on many occasions, and even drew the attention and praise of eminent chemist and Royal Society member Robert Boyle. Sugar was never the main focus of any of

Boyle's works, yet the commodity was featured in many of his arguments due to its seemingly unusual chemical properties. Scattered within his essays are notes on comparing tropical sugar with New England maple farming, how to use sugar as a corrosive, and how to use alchemical components for creating a sweet-tasting sugar substitute for flavoring food.²¹ In his 1669 *Certain Physiological Essays* Boyle engages in an argument with other chemists over the issue of salts, and whether or not salt as a rule had a 'hardening' effect on objects. In the course of his argument Boyle turns to sugar production, mentioning that 'ingenious French Publisher' Rochefort, who demonstrates that, though sugar was thought to be a form of salt and thus should coagulate easily, yet the Atlantic sugar-making process relied on a complex mixture of heat, lye, and acids for the transformation to occur.²² Boyle corroborates Rochefort's testimony by mentioning other sugar-making experts with whom Boyle had 'purposely inquir'd' regarding the issue, adding that Rochefort's work is also 'not to be distrusted.'²³ Based upon these transatlantic informational sources, Boyle concludes that sugar may not in fact be a variety of salt.

II. Ingenios

These examples show how ingenios and sugar-making were incorporated into experimental philosophy's paradigm of empiric experiment, technological innovation, and social progress. By 1700, increasing sugar production and consumption patterns had reached a point where the 'invention' of sugar mills could be seen as a powerful agent of social change, cutting across areas such as trade, health, industry, politics, physics, chemistry, and philosophy. However, there is another part of this story worth telling, and it is important to note the discrepancies between these scientific narratives and the material reality of a working slave plantation. When describing the ingenio and its effects, these philosophers were less interested in detailing this reality than with creating a manageable representation of a distant object which could be used to further their new methodology. Baconian natural histories contended to be compilations of neutral facts and inventions which had been gained through individual observation and experiment, and in creating such compilations these early natural scientists hoped to promote the value of experimental philosophy. However an important consequence of this latter motive was that the facts and inventions presented inside these works had to appear as the direct result of their new empiric process. Thus, experimental philosophy's larger promotional program worked by framing the history of technological progress as a series of discreet and major inventions, often created by elites, instead of as a concatenation of tiny developments involving a host of human and non-human actors and events. Through this paradigm, a technological development which may have been the result of myriad discursive choices involving a wide spectrum of socially distributed cognitions is winnowed into a single subject-object relationship between an inventor and the physical material he or she is manipulating – in this case the planter and his cane.

However, in the case of ingenios there was no 'inventor' of the forms and technologies which comprised the sugar mill. Historians of slavery have long documented how ingenios evolved from a centuries-long collaborative process, moving across four continents and involving field hands, landlords, artisans, environmental factors, mass-migration, production and transportation innovations, credit institutions, and consumer demand patterns.²⁴ Initially cultivated in ancient Asia, sugar slowly migrated westward through the medieval Middle East and was being grown on Mediterranean islands such as Cyprus and Sicily by the fourteenth century. Over next four centuries it moved from this region to Madeira and the Canaries in the Atlantic, to São Tomé in Africa, to Brazil, and finally

to Barbados and the Leeward (after which it moved on to Jamaica and Surinam, and then elsewhere). At each stop forms of land cultivation and labor organization and exploitation grew in size and complexity, increasing the plantation's output. Thus, while the Barbados industry was only one link in this global migratory chain, seventeenth-century natural histories rarely place it into this larger context. Instead, like with other recent 'inventions' such as gunpowder and the compass, experimental philosophers envisioned ingenios as examples of recent experimental advancements in the arts and manufactures, and attributed its novelty to specific 'inventive' Barbadian planters.²⁵

Experimental philosophy's effacement of these complexities can be further seen through a closed analysis of a single step within this larger chain: the transfer of ingenios from Brazil to Barbados and the tiny island's subsequent 'sugar revolution' in the mid-seventeenth century. The general timeline of the Barbadian sugar revolution is as follows: English settlers arrived at Barbados in 1627 and focused on tobacco and cotton planting throughout the 1630s. It is unclear when the first Barbadians began planting sugar, but it is assumed to be around 1640, when a global glut in tobacco prices caused Atlantic planters to search for a more profitable cash crop.²⁶ The transition to sugar remained slow during the early 1640s, and the first recorded shipment of Barbados sugar to England did not occur until 1643.²⁷ However things accelerated quickly after 1645, in part because of a large number of wealthy Royalist émigrés who fled the English Civil War and arrived with plenty of capital to invest in new plantations.²⁸ By 1650 the transition to sugar was occurring rapidly throughout the island, and was generally complete by 1660. Indeed, the change occurred so quickly that while in 1645 canes were still a rarity, within a decade a visitor would report that 'the wealth of this island consists in sugar. Sugar cane or reed is planted in the countryside as far as the eye can see.'²⁹

Seventeenth-century histories which describe the sugar revolution follow three general paths: some claim ingenios were invented in Barbados; others claim that they were invented in Brazil but perfected by English planters; while others claim that the mills of Brazil and Barbados are essentially the same, yet Barbadians should nevertheless be lauded for their individual curiosity and methodic, trial-and-error adaptation of an existing technology into a new environment. In all these narratives, the planter was presented as the one singularly responsible for bringing mills into the English empire, and for the subsequent benefits they brought to Britannia writ large. Returning to Thomas Snow's *Apopiroscopy*, he gives the following account of how Barbadians came to grow sugar:

I am informed by very credible Relations, there are not many Years effix'd, since in our Memory, a Forreigner accidentally bringing some *Sugar-Canes*, as Rarities, from *Brasil* into *Europe*, and happened to touch at *Barbados*, an *English Planter* that was curious, obtained from him a few of them, together with some hints of the way of Cultivating them, and using them; by which *Observations*, and the curiosity of the *English Colony*; they in a short time, well improved them, that that small island became, and is still, the Chief *Store-House*....³⁰

This account of the curious planter is similar to (and likely an embellished version of) one found in Sir Dalby Thomas's 1690 publication *An Historical Account of the Rise and Growth of the West-India Colonies*.³¹ Thomas was an influential merchant who sold slaves and provisions to West Indian colonies, and frequently lobbied planters' interests to Crown and Parliament. His book, originally a proposal brought before Parliament regarding West Indian finance reform, contains a long testimony to the industriousness of planters and why they are the nation's greatest spur to economic growth. Thomas begins his narrative with a brief sketch of the pre-history of sugar in medieval Europe, after

which he continues by claiming: 'But no Nation made so considerable a progress therein as the *Portugalls*, who having with some Success, Improv'd the Art of Planting it in their *African Colonies* and Islands, did at last make it their main Business in *Brasile*.'³² Next, he narrates the transfer of mills to Barbados, claiming that in the 1640s:

A *Hollander* happen'd to arrive from thence upon our Island of *Barbados*, where though there were good *Sugar-Canes*, the English knew no other use of them then to make refreshing Drink for that hot Climate....But this *Hollander*, understanding sugar, was by one Mr. *Drax*, and some other inhabitants, there drawn in to make Discovery of the Art he had to make it.

This development was followed by the arrival of many 'ingenious men' who immigrated to Barbados during the English Civil War, and improved sugar-making to the point where 'we at present exceed all the Nations in the world in the true improvement of that Noble Juice of the Cane...And as our Nation has been ever famous for Meliorating Inventions of all Kinds, so in this we have gone so far, that [English planters]...set the price of it in all *Europe*, to the Kingdom's Pleasure, Glory, and Grandure.'³³

As a West Indian merchant, it is likely that Sir Dalby Thomas heard many first-hand stories about the arrival of mills to Barbados. He would also have been familiar with an even earlier narrative about this technology transfer, Richard Ligon's very popular *The True and Exact History of the Island of Barbados* (1657).³⁴ Ligon, a Royalist who fled to Barbados during the Civil War, lived and worked there from 1647 to 1651. His work is a collection of careful observations about the island during that critical period when its economy was rapidly transforming into a sugar monoculture, and it remained the definitive work on Barbados for the rest of the century.³⁵ Ligon's account repeats the theme of curious English planters, referring to 'industrious men' who had gotten some canes from Brazil in an attempt to make sugar, deciding it 'worth the while to set up a very small Ingenio, and so make tryall what Sugar could be made upon that soyl.' However the early efforts of these planters were not fruitful, 'the secrets of the work being not well understood.' Nevertheless they persevered according to Ligon, and were helped by 'new directions from Brasil, sometimes from strangers, and now and then by their own people, who being covetous of the knowledge...were content sometimes to make a voyage thither.' Ligon states that during his arrival in 1647 the planters had improved their works but were 'still ignorant' on several key points, but that by his departure in 1650 their techniques were 'much better'd' and he doubted that further improvement would be needed or made.³⁶

It is interesting to note how in each of these narratives, the tale of sugar-making becomes more packaged and refined with each retelling. The messy particulars of the complex process are increasingly omitted, the contributions of foreigners and other actors are reduced, and the emphasis is slowly placed upon the sole ingenuity of the English planter/inventor. Ligon's planters, while ultimately successful in the end, were frustrated for years in their attempts, needing to make several trips back to Brazil.³⁷ Dalby Thomas's protagonist needed only a single sojourning Dutchmen to stay with him a bit, learning the art from his teachings. Snow's planter does even better, starting out with only some bits of souvenir cane accidentally left behind by a foreigner, and a few 'hints' as to how to grow them. In each instance the story undergoes a translation away from a complex web of details which comprised the event as it happened, and towards a packaged object suitable for easy incorporation into the new narratives of science and progress. Moreover, each of these latter experimental philosophers would have had access to Ligon's original work which remained popular throughout this period, and Dalby Thomas

himself had numerous correspondence connections to plantations through his position as a West Indian factor and lobbyist. Thus their choices in framing the invention of sugar had less to do with any lack of knowledge than with carefully emphasizing certain facts while effacing others.

The extent of this transformation appears even larger if we examine documents prior to and outside of Ligon's narrative, where we find more evidence of outside assistance and other messy particulars which the natural history accounts strip away. In all three of the above reports, sugar-making is portrayed as a trade easily learned and replicated by unskilled observers. A simple analysis of the collective tasks required to operate an ingenio can easily dispel this. As mentioned above, ingenios relied upon a complex process of grinding, boiling, tempering, striking, curing, and packaging, and at each stage there was little room for error in regards to a number of variables. Moreover, because cut sugar-canes rot within 24 hours if not processed, all of the mill's activities occurred in tandem, meaning that failure in any one of these stages could bottleneck the system and spoil the remaining crop. In sum, running an ingenio required a concatenation of tasks and skills which were too numerous to master quickly. Nor could a single set of memorized instructions prepare a planter for the array of variables regarding weather, disease, supply fluctuations, and irregular shipping schedules. Nor could they be learned from a book, even if instruction manuals and literacy were widely available during this time (and they were not).³⁸ Training would also require at least one full crop season in order to learn the process from start to finish, and given that the typical cane maturation cycle is 12–14 months, this learning process would thus last up to a year or longer. Together these factors meant it would take months of hands-on experience before one could acquire even basic levels of competency in managing all the components of a successful ingenio.

Other factors contributed to preclude the independent invention or development of an ingenio. First, creating a sugar plantation required a substantial amount of start-up capital. Unlike other Atlantic cash crops, sugar production required an economy of scale that necessitated both a large labor force and a costly sugar works, meaning it was rarely produced in small quantities for individual sustenance or domestic markets. Thus, planters were typically not afforded the luxury of being able to slowly learn the craft through small experimental batches. While Ligon mentions a few Barbadians who set up a small mill to 'make tryall,' this experimental procedure was only one component of a larger strategy which involved both multiple trips to Brazil and (as shall be seen below) the importation of foreign sugar-making specialists onto Barbados. Moreover only a few of the island's wealthiest planters would have been in a position to experiment in this manner, as most had neither the time nor money for this strategy. Indeed, during the 1639–1640 tobacco glut, Caribbean planters were commanded by crown decree to convert to cotton growing; few, however, responded. Things got to the point where the island's governor was granted a warrant to 'go from plantation to plantation and inquire into the excessive quantities of tobacco grown.'³⁹ Peter Hay, a Barbadian agent writing to England at the time, explained planter reluctance towards conversion as 'a thing planters can hardly doe, because they are indebted, that if they leave planting of tobacco they shall never be able to pay.'⁴⁰ Sugar was sufficiently more labor and capital-intensive than cotton, which meant that those who did make the transformation were either wealthy newcomers who 'plunged' into sugar-making with immediate massive capital outlays, or local elites who combined resources in joint partnerships, going substantially into debt purchasing the necessary labor and equipment.⁴¹ Such individuals would likely wince at

the prospect of investing so heavily only to sacrifice the first few crops to the process of trial and experimentation.

Such factors meant it was imperative to have someone on hand who was experienced in sugar-making, and that would mean more than a visiting foreigner and some hints on how to get started. In the case of Barbados, these skills would initially have to be learned via Portuguese or Dutch sugar-makers from Brazil, who would need to live on Barbados for an extended period and be available for daily consultation. Prior to the 1640s Brazil was the world's largest producer of sugar and dominated the nascent European sugar market. Brazilian mills were originally established in the sixteenth century by Portuguese in the provinces of Bahia and Pernambuco, who transported the ingenio technology from their older colony of São Tomé.⁴² By 1600 Dutch merchants had engrossed most of the Brazilian sugar trade, making the Netherlands a chief sugar entrepôt during the early part of the century.⁴³ Of particular importance to this trade was a community of Sephardic Jews, *converses*, who, while originally from Portugal, had grown accustomed to doing business beyond national borders and oversaw trading networks throughout Spain, Peru, Mexico, Brazil, and the Netherlands.⁴⁴ Thus, a thriving trade of slaves, sugar, and plantation provisions operated between Portugal, Africa, Brazil, and Amsterdam, and by the 1620s Brazil had an estimated 350 ingenios while Amsterdam had over 20 sugar refineries.⁴⁵ These connections were intensified after 1630 when the northern province of Pernambuco was conquered by the Dutch West India Company, who assumed control of the sugar exports until 1645, when an insurrection of the province's Portuguese citizens destroyed most of the industry. Faced with this destruction, many of these international merchants sought new areas to develop a profitable sugar industry, and Pernambuco's Jewish population was particularly active in creating new colonies and colonial trading enclaves throughout the Atlantic world after this date.⁴⁶

It was these Brazilian émigrés who initially brought the knowledge of sugar-making to Barbados, providing a niche from which it could be disseminated into the rest of the colony. It should be noted that amongst Caribbean historians there is currently a debate about the extent of Dutch and/or Brazilian involvement within Barbados' developing sugar industry. While older sources have taken the words of Ligon and others at face value, newer quantitative evidence suggests that, statistically, the number of actual Dutch and/or Brazilian migrants to Barbados was quite small.⁴⁷ Yet, while these more recent works portray an island with relatively few non-English settlers, this need not invalidate the method of knowledge transmission I am about to describe. What was important was not the number of Brazilian émigrés to Barbados, but the positions these few Brazilians held when coming to the colony. As will be shown, the vast majority of Barbados's initial sugar magnates had documentable connections to Brazilian sugar-making knowledge. Once in possession of this knowledge, it quickly spread to other English elites via networks of business, kinship, and personal friendship.

The various primary and secondary narratives which describe the initial import of sugar technology into Barbados typically credit one of three Barbadian planters: James Drax, Richard Holdip, or Constant Sylvester. While Holdip, who will be discussed later, was an English war veteran and agent of the powerful Company of Merchants Trading to France, both Drax and Sylvester were Anglo-Dutch merchants with connections to Pernambuco. Sylvester was from a Sephardic Jewish family and the son of Gyles Sylvester, a prominent Amsterdam trader.⁴⁸ Barbados's early archival records show that Constant Sylvester, initially residing in Amsterdam, was importing Barbadian produce to Holland as early as 1641. He became a Barbadian landowner in 1645 and had accumulated a sizeable fortune in slaves and sugar estates by his death in 1671.⁴⁹ He had also made strong

connections with many of the island's more powerful English planters, including Samuel Farmer and Francis Raynes, who were executors of his will.⁵⁰ Samuel Farmer, originally a Bristol merchant, was a Barbados assembly member who was also one of the first to invest heavily in sugar, undertaking a plantation partnership with English Barbadian William Hilliard in 1645.⁵¹ Hilliard, in turn, was the owner of over a dozen estates on the island, a member of the governor's council by the early 1640s, and is mentioned in Ligon's *History* as the 'eminent planter' who initially partnered with Sir Thomas Modyford when Modyford first came to Barbados in 1647.⁵² Modyford himself would later become governor of Barbados and after that, Jamaica.

In fact, the presence of Anglo-Dutch transatlantic mercantile partnerships in Barbados pre-dates Sylvester and goes back to the colony's original founding. Barbados was initially discovered by a group of mariners returning to England from Pernambuco in 1624. The ship was financed by Sir William Courteen, a prominent Flemish merchant in the Stuart court who was living in Protestant exile from Hapsburg-occupied Flanders. Upon hearing stories of the island's vacancy and abundance from his ship's captain, Courteen funded a subsequent expedition in 1627 which founded Barbados's first permanent settlement. Moreover, this was not Courteen's first colonial project within the region, as he was already involved in a series of attempts to settle the 'wild coast' area of present-day Guiana with fellow Dutchman Jan De Moor. These Dutch settlements, some of which were producing substantial crops by the 1620s, were initially peopled by migrants from Vlissingen, a Dutch coastal city that had been garrisoned by the English in the early seventeenth century and contained a substantial English population.⁵³ When Courteen's settlers landed at Barbados, they immediately sent emissaries to these mainland colonies for assistance.⁵⁴

This story is important because one of the settlers from this initial 1627 settlement was James Drax, another Anglo-Dutch merchant who eventually became the richest Barbadian planter and the individual most frequently associated with bringing sugar to Barbados.⁵⁵ Like the other early settlers, he initially worked plantations of cotton and tobacco before moving into sugar sometime around 1640. He also possessed numerous Amsterdam connections including several business dealings with the Sylvester family, at one point arbitrating a transatlantic dispute between Constant and his father Giles.⁵⁶ Like Sylvester, Drax was also close to other early English elites such as Hilliard and Farmer, and he oversaw their 1645 partnership for creating an ingenio, mentioned above. Indeed, these three planters, along with other close associates of Drax, were all entrenched at the top of the Barbados oligarchy from an early date, most holding positions on the island's assembly or governor's council by the late 1630s.⁵⁷ By 1654 Drax had earned enough money to relocate to London, leaving his plantations to his son Henry. After his departure his son Henry continued to expand their Barbadian holdings while James became one of England's more successful West Indian merchants, earning a spot on Whitehall's Committee of Trade and Plantations.⁵⁸

These types of linkages were essential for the English to initially learn the complex workings of a sugar plantation. While these foreign planters were never a majority within the island's plantocracy their importance lay in their introduction of sugar-making techniques via their role as intermediaries between Pernambuco merchants and Barbados's rising sugar plantocracy. Through such networks, these migrants could transfer a working knowledge of ingenios into the ranks of the top English planters, providing a node from which the technology could disseminate into the rest of the colony. Yet beyond this initial infusion of foreign knowledge, it takes more than a few newly briefed planters to replicate the complex distributed cognition which

guided a working ingenio. As mentioned above, sugar mills required the simultaneous application of a number of tacit and formal knowledges in order to keep their various facilities operating as a single machine. Thus it would be imperative for one or more individuals, preferably with lots of experience in these matters, to be present within the mill at all times. Planters like Hilliard and Farmer would need more than occasional visits to Sylvester or Drax's estates for this kind of know-how. To complicate matters, planters often managed multiple estates, in addition to dealing with a host of other planter obligations (council duty, deed disputes, militia service, warehousing negotiations, etc.), which would have made constant attention to the mill impossible even if they did possess such knowledge. Thus, maintaining a plantation required the employment of a number of subordinate, skilled workers.

Of all positions within the ingenio, that of chief overseer was the most important as it was he who saw to the mill's overall operation, in particular its grinding, boiling, and curing processes. Under the Brazilian system, these employees were known as *mestres De acucar* (sugar masters), and were middling artisans who nevertheless commanded high wages for their work. While this position was usually held by a white freeperson, there is at least one example from Brazil where a larger mill employed a skilled African slave.⁵⁹ When ingenios were transferred to Barbados, most of the basic workflow routines and labor divisions were retained, including this top position. In his *History of Barbados*, Ligon gives a description of the various types of hands needed to run an ingenio. He stresses the importance of a 'Prime Overseer' in several places, stating at one point that without one the planter alone will 'have too much to do.'⁶⁰ This 'supreme overseer' was to be the intermediary between the planter and the 'subordinate overseers' (meaning the boilers, watchmen, and drivers), receiving general instructions from the plantation owner and translating them into more specific directions further down the chain of command. While Ligon insisted that the subordinate overseers and all other positions on the plantation could be staffed with slaves or servants, he maintained that this head overseer must be free, eat at the planter's table, and earn an annual salary of £50.⁶¹

The importance of a head overseer can also be seen in a 24-page set of instructions made by Henry Drax for his chief overseer Richard Harwood in 1679.⁶² Like his father 25 years earlier, Henry Drax was now leaving to become an English absentee planter and his instructions itemize an extensive list of responsibilities which would require Harwood's daily attention. Most telling in these instructions is that Drax explicitly forbids Harwood from *ever* leaving the plantation, as Drax found absent overseers 'very pernicious to all proceedings.' Instead, Drax arranged for multiple attorneys to handle his business matters outside the estate, allowing for Harwood's constant surveillance of the ingenio and its discrete tasks.⁶³ Next, out of all the plantation's activities, Drax commands Harwood to focus the majority of his time and energy within the boiling house itself, 'the place where your cheife skille will be required.'⁶⁴ It is important to note here that while Drax's instructions for the ingenio seem quite detailed, he nevertheless admits that they are but 'general rules' and that much of the daily activities will be left up to Harwood's own experience and judgment. Indeed, at one point Drax tells Harwood that he gave him the job because of Harwood's excellent reputation for sugar-making, of which Drax was 'very well Satisfied.'⁶⁵ Harwood also had a reputation for being an effective manager of slaves, and Drax likewise deferred to Harwood's judgment in matters regarding slave treatment. 'For the government of family both Whites and Blacks,' writes Drax, 'I need leave no Directions welle knowing the good Command you have and the delight you take in a Sober and welle ordered family.'⁶⁶ Finally Drax requests

that Harwood invite one Christopher Loader to stay at the plantation so that Harwood can educate him how to be a better plantation owner. Christopher Loader was a young neighboring landowner and Drax hoped that Harwood's influence would 'keep him Sober and make him to better mind his Business.'⁶⁷ In sum, Drax's instructions demonstrate the importance of having an overseer on hand at all times, the high amount of artisanal knowledge and individual judgment employed by overseers, and how overseers could transfer their skills onto other planters and landowners.

Charting the movement of these chief overseers through early Barbadian society is difficult. The two main types of records for this early period, wills and land deeds, are forms which usually do not give references to individuals in wage-paying positions. The issue is compounded because verbs like 'oversee' and 'manage' are frequently used in varying and non-specific settings in these documents, and can refer to people as diverse as plantation owners, attorneys, chief overseers or sugar masters, field overseers or drivers, commissioned agents, or even a friend or relative sent to execute a specific task. The general consensus amongst historians is that by the late seventeenth century, the head overseers in Barbados were mostly of English decent, were likely former indentured servants who had accumulated ingenio experience, and who now worked for wages.⁶⁸ How early English overseers initially learned their trade is uncertain, but like planters, it would need to have come directly from foreign mill workers, likely imported by the earliest Barbadian sugar magnates.

One interesting set of documents from the Barbados archives offers some suggestions into not only the role and importance of these overseers, but also their incorporation into the above-described kinship and business networks which operated to disseminate sugar-making knowledge and technology. Like the Sylvesters, the Lucies were another cosmopolitan merchant family, likely Sephardic, operating out of London, Amsterdam, and other Atlantic ports during this time. Luke Lucie (aka Lucas), a London merchant, got into the Barbadian sugar boom by purchasing an undeveloped plantation there in 1645.⁶⁹ This purchase was witnessed by one Seger De Hem, an employee of Lucie and presumably of either Portuguese or Sephardic descent. Fourteen years later, Lucie was back in London and filed a document with the London Aldermen, granting a Charles Jennens power of attorney over this same Barbadian estate.⁷⁰ The document also contains powers and instructions for Seger De Hem, who had recently returned to work as an overseer at Lucie's plantation. De Hem was put in charge of all of the plantation's daily affairs, including 'to rule, oversee, direct, and command' all of the plantation's servants.⁷¹ The document states that Charles Jennens is to travel to Barbados, live on the Lucie plantation, and jointly manage its affairs with De Hem. Together their powers included everything from taking and managing plantation supply stocks, to the 'sale and disposal' of finished crops, to pursuing Lucie's debtors within local courts.⁷² It is unclear how much experience De Hem possessed as a sugar master, but the document states that Lucie was bringing De Hem back to his estate to replace the previous overseer, Englishman Thomas Moore, whom Lucie judged to be either incompetent or fraudulent.⁷³

Seger De Hem remained on the estate until his death in 1680. By this time the plantation had been transferred to Jacob Lucie, a relative of Luke who was similarly residing in London for business reasons.⁷⁴ De Hem's will demonstrates both his modest but important role within the Lucie plantation, and also his foreign character.⁷⁵ In it he mentions a brother Jacob De Hem, the overseer of a neighboring plantation run by the English Andrew's family, who died in 1677 and was buried in the Andrew family cemetery.⁷⁶ Seger requests that he be buried 'in the ground where my kinsman was lately

interred,' demonstrating his lack of immediate family on either the Lucie plantations or elsewhere in Barbados. He also mentions a sister, to whom Jacob Lucie should repay a debt owed to her by De Hem, out of wages owed to De Hem by Lucie.⁷⁷ There are no other relatives or children. Seger De Hem also bequeathed some small monetary amounts to a few friends on the island, and concludes that 'All the rest of my estete except my funeral expenses I do give to the said Jacob of Lucy and his heirs for ever in manifestation of my real gratitude for the great kindness he hath at all times shown to me.' Finally he leaves instructions for the management of Jacob Lucie's plantation after his death, appointing Henry Gallop, John Holder, and the above-mentioned Richard Harwood to manage the estate 'till the said Lucy shall otherwise order and direct.' Witnesses to his will include Luke Lucie and Jonathan Cox, another English planter whose lands neighbored Jacob Lucie's plantation.

Such connections demonstrate the role of family and mercantile linkages in bringing foreign expertise to bear on the daily management of a sugar plantation. Moreover, these links between overseer and planter, while superficially a simple wage-earning relationship, also demonstrate the deep degree to which these overseers were enmeshed into the maintenance, reproduction, and spread of the complex machine that was the sugar plantation. Despite their low social position, the De Hems were crucial contributors to the development of the Lucie and Andrew estates, and trusted components of the Lucie mercantile network. By bringing Seger De Hem to Barbados, the Lucies not only imported foreign knowledge to their Anglo-Dutch plantations, but that knowledge then flowed out onto the neighboring Andrew and Cox estates.

De Hem's life also shows how day-to-day knowledge required to operate an ingenio was transmitted and maintained through personal relationships. For example John Holder, one of the overseers appointed by De Hem, remained deeply involved with the Lucie family, appearing as witness to the will of Jacob Lucie's father Elias in 1686 and presenting it to the local magistrate for verification. Richard Harwood, a friend of De Hem and an executor of his will, was also intimately connected with the Barbadian plantocracy, previously serving under Henry Drax as mentioned above. After De Hem's death Harwood left the Drax plantation to work for Lucie, as per De Hem's instructions.⁷⁸ Lucie must have favored Harwood, for the absentee planter attempted to influence the Barbadian Council into accepting Harwood as a member in 1686. The result of this political episode shows that despite the mutual dependence between overseers and planters when operating an ingenio, class-based differences nevertheless prevented the latter from judging overseers as true partners, either in knowledge or politics. In this case, the Barbadian councilmen issued a remonstrance against Harwood's appointment, claiming him unfit because of his 'servile condition.'⁷⁹ After the affair, Harwood continued in Jacob Lucie's employ as overseer until his own death in 1690. By this time he had also become the father-in-law of a Daniel Richardson, yet another friend of Seger De Hem mentioned in De Hem's will.⁸⁰

Connections to Brazil were the most likely source for importing foreign sugar-making expertise; however, overseers and sugar masters from other areas were also represented. In 1654 a visitor to the Drax estate reported that one of Drax's overseers was a Frenchman named Monsieur Raince, who had previously worked at a sugar refinery in Rouen.⁸¹ The connection is interesting, as in the early seventeenth century Rouen was both the leading city in France's nascent refining industry and also home to a number of English international merchants.⁸² In 1611 James I issued a charter for the Company of Merchants Trading to France, a large association of cloth merchants that were incorporated for legal protection. The company maintained a headquarters in Rouen, staffed by

commissioners jointly appointed by the company and the French king, for settling trade disputes.⁸³ While Drax was not a member of this company, it did contain a few notables who were also highly active in early Barbadian plantations. One was William Speight, who was an assistant director of the company and who in 1635 established a coastal settlement in northern Barbados which later became Speightstown, the island's second largest city. A second important member was Sir Marmaduke Rawdon, a wealthy merchant with enterprises in multiple French cities and who was granted extensive landholdings in Barbados in 1629. These holdings were subsequently managed by his employee and sugar-making pioneer James Holdip, the story of which is detailed below.

Despite the overseer's importance, all of the ingenio's multiple activities occurred in concert and one individual cannot look to all the mill's aspects at once. Records almost never show more than one head overseer per plantation, and thus the mill relied upon a variety of other skilled positions, notably the head boilers, kettlemen, curers, distillers, and watchmen. While the head overseer was typically a free, white person, these other positions were usually manned by servants and slaves. As with the tradition of head overseer, the use of skilled slaves within these roles can be traced to Brazil. After trying unsuccessfully to create a slave labor force from Native Americans, Portuguese planters slowly began to transition to African labor in the 1580s. During that time the first Africans to arrive in Brazil were a variety of skilled ingenio workers from São Tomé, and the logic behind this decision was that Brazilian planters felt these individuals could be better trusted to operate the ingenio correctly.⁸⁴ Portuguese plantation records also differentiate these workers from unskilled field slaves, both by appraising them above regular field hands within plantation estate appraisals and also by granting these workers extra provisions.⁸⁵ This trend continued in Barbados, where evidence suggests that the first slaves to work in Barbadian sugar were similarly of the skilled variety. Richard Ligon's *History* mentions a group of slaves 'who have been bred up amongst the Portugalls' that were residing upon James Drax's plantation during his stay in the late 1640s.⁸⁶ These Creole slaves, presumably from Brazil, possessed European skills that the African slaves did not, including fencing whereby they 'play[ed] at Rapier and Dagger very skillfully.' A similar comment was made by Father Antonie Biet, the French Catholic missionary who visited Barbados in 1654. Biet commented on the lack of religious instruction given to the African slaves by their English masters, concluding that 'if any of them have any tinge of the Catholic religion, which they received among the Portuguese, they keep it best they can, going their prayers and worshipping God in their hearts.'⁸⁷

This use of skilled Portuguese slaves occurred elsewhere in the Caribbean, particularly after the destruction of Pernambuco. A noteworthy example of this knowledge dissemination via the African diaspora occurred in Jamaica in 1655. That year the English conquered Jamaica from the Spanish, and when they arrived they found an incipient sugar industry headed by two Sephardic brothers, Don and Gaspar Accosta. Gaspar had recently immigrated to Jamaica from Pernambuco while Don was a wealthy landowner and Sargento Mayor within Jamaica's Spanish government.⁸⁸ After the English landing the Spanish community fled from the larger English force into the mountains, from where they hoped to wage guerilla war against the English. These efforts were impeded by the Accostas who suddenly switched sides and joined the English, giving them valuable information about the island, in particular the interior valleys where the Spanish had driven their herds of cattle.⁸⁹ According to a first-hand Spanish account of the English conquest, Don Accosta's treason was because of the death of one of his favorite slaves. Don had been sent by the Spanish governor to negotiate with the English generals and was an official hostage in the English camp. While there, he was using a slave of his to

send parlaying messages back and forth to the Spanish encampment, and in particular to his brother Gaspar. After a few days of negotiations, a member of the Spanish camp grew suspicious that this slave was leaking intelligence to the English, and killed him. The Spanish author of this account remarks that 'although an Angola black, this negro was clever. He could read and write, knew the movable feasts, conjunctions, moons and tides, as well as though he had thoroughly studied them; he was a good sugar-master, and could give an excellent account of himself when necessary.'⁹⁰

By the 1670s this initial generation of Portuguese slaves would have likely either passed or been acculturated into their new colonial societies, yet the tradition of elite skilled slaves within the ingenio persisted. In Henry Drax's instructions to Richard Harwood, Drax makes numerous references to such artisan slaves, mentioning for example his negro 'owerSeers and head Boylers,' who should be given double the rations of regular slaves as a form of extra payment for their unique role within the complex.⁹¹ He also lays out a special set of responsibilities for these head boilers, in particular that they closely oversee the subordinate boilers during the clarifying process. These head boilers are to be 'Soberly Punished' if they neglect this supervision, as an entire season's crop could be ruined but for 'want of skill in the Boiling-House.'⁹² These head boilers were also responsible for overseeing the potting of sugar once the solution had been 'struck' and transferred from the final kettle. Drax demands that these boilers ensure that the potted sugar is neither too hot nor too cold, and that it is 'in its due firme.'⁹³ Elsewhere, when discussing the process of tempering the sugar by adding lixivium or other alkaline additives, Drax commands that only Harwood or these head boilers be allowed to do this as they are the only ones with the knowledge to do so properly.⁹⁴

As mentioned above, boiling sugar required a careful attention to temperature, duration, and amount of alkaline contents, knowledge which was not accessible through formalized knowledge channels and could only be taught via experience. Some early modern authors commented on this feature of sugar-making, and like with other 'secrets' of early modern trades, the skill occupied a tenuous and ambiguous position within the evolving metrologies of early modern science.⁹⁵ In 1698 Royal Society member John Houghton published a lengthy treatise on Caribbean sugar-making as part of his ongoing serial *Letters for the Improvement of Husbandry and Trade*. When describing the processes of the boiling house to his readers he states that:

The principal knack, without which all their labour were in vain, is in making the juice, when sufficiently boil'd, to kern or granulate. Which is done by adding to it a small proportion of lee made with (vegetable) *ashes*; without which, it would never come to anything by boiling, but a syrup or an extract.⁹⁶

Celebrating an embodied artisanal technique as a 'knack' was a common technique of experimental philosophy writings during this time, and was a method of emphasizing the technique's importance to both trade and natural science while simultaneously denying it legitimacy as a formal form of knowledge. By categorizing sugar boiling this way Houghton was, perhaps unwittingly, placing the activities of slave sugar boilers on par with other artisanal occupations in England. Houghton was not alone in categorizing sugar boiling this way, and this trope of experience dominated the thinking of planters and natural scientists alike for much of the next century. Several decades later a Caribbean planter published a treatise on sugar-making wherein, when discussing how slaves manage to master the proper striking technique, he exclaims that 'the Negroe-

Boilers have no Rule at all, and guess by the Appearance of the Liquor; and indeed it is wonderful, what Long Experience will do.⁹⁷

III. Transmission

These examples of Brazilian transplants, wage-earning sugar masters, and slave boilers are only a few of the chief labor components necessary to construct and operate a successful plantation. Beyond the millhouse itself, sugar estates required a host of auxiliary artisans including millwrights, blacksmiths, coopers, masons, carters, potters, drivers, carters, watchmen – professions too numerous to detail here. This array of requirements proves the invalidity of the experimental philosopher polemics which maintained that the mill was the direct product of individual planter ingenuity. Not only did the knowledge of how to create an ingenio come from outside the curious mind of the planter, but he was rarely aware or in control of the multiple tasks which allowed the mill to function as a single unit.

As stated above, the sugar plantation was an evolutionary object which moved across the Atlantic in a series of stages. Some of the above examples give glimpses of this process at work, as the knowledge of how to build and operate an ingenio was distributed from person to person during the Barbadian sugar revolution. Moreover, transmitting this knowledge was a task which went beyond simple sets of verbal or written instructions due to the embodied nature of much of an ingenio's work. The plantation required both the continuous presence and input from a variety of skilled workers and slaves, and without the contributions of *all* the workers described above, the ingenio would fail and its reproduction in a new locale would be impossible. Thus, creating a new sugar plantation had as much to do with importing the right kinds of labor as it did with sharing the right texts or ideas, as much of the required knowledge literally travelled upon the backs of the ingenio's workforce. In Barbados, this material reality explains why planters almost never started from scratch when constructing new plantations but rather assembled them through components brought wholesale from a prior space, transferred and reassembled as a single prefabricated unit. This in turn explains why the ingenio moved across the Atlantic in distinct, traceable stages rather than spontaneously appearing in random locales.

A few final examples should make this point clear. To do this, we return to one of those three Barbadian planters eulogized in English sugar narratives as a prime figure in bringing canes to Barbados: Captain James Holdip. Holdip was initially an agent for the wealthy London cloth merchant Sir Marmaduke Rawdon, and spent several years in French port cities under Rawdon's employ. In 1627, at the very beginning of Barbadian settlement, the island's proprietor granted 10,000 acres of the island's best land to a constituency of London merchants, Rawdon being the chief member. Holdip was then assigned by Rawdon to be the governor and chief rents collector for this corporate fiefdom.⁹⁸ He arrived in Barbados in 1629, and by 1631 had assembled a massive plantation named Locust Hall. That same year he was described by a visitor as 'the beauty, hands, eyes, feet of all the other planters; he hath in one year that which any other hath, and also more than any other hath, yet not so perfect. Next year he will be worth looking on.'⁹⁹ Holdip was also highly corrupt and fraudulent, as much of Locust Hall was embezzled from the 10,000 acres he was employed to manage. Furthermore, over the course of the 1640s he used the chaos of the English Civil War to swindle his Royalist merchant employers out of almost the entire remainder of their Barbadian claim.¹⁰⁰ Indeed, prior to the 1660 Restoration he was involved in no less than 27 Barbadian land deals, and was

the seller in each case.¹⁰¹ Holdip was also one of the earliest planters to grow sugar, converting his plantation sometime around 1641.¹⁰² While there is no evidence to suggest how he initially created his ingenio, archival records show how he introduced many other planters to the practice. Often, when selling off his newly stolen lands, he would include stipulations within the mortgage that allowed the new owner to begin sugar-making with a minimum of effort. It is no coincidence that most of these sales occurred in the late 1640s, when the Barbadian sugar revolution was at its peak, and many of Holdip's customers were wealthy English newcomers eager to buy large plots for immediate sugar production. Holdip's arrangements for assisting new planters in sugar-making became more complex and comprehensive over time as the sugar revolution progressed, and provide an excellent window into how a planter with no prior sugar-making knowledge could come to operate an ingenio.

The first of these examples is from 1644 when Holdip sold 200 acres of his enormous Locust Hall plantation to Thomas Applewaite, another London cloth merchant.¹⁰³ The deed stipulates that Holdip will provide to Applewaite 'so many sugar canes to plant upon his premises sold as shall be needful.' The land deal was also contingent on Applewaite receiving a batch of servants from an incoming English ship, and would have been void had the ship not arrived.¹⁰⁴ This early record demonstrates how Applewaite, a Londoner with presumably little planting experience, was dependent upon both the expertise of an existing planter and upon an external supply of laborers, without which his plans for sugar-making would have been impossible. There is no mention of an ingenio in the brief contract between the two men. It is likely, though, that, as the land was adjacent to Holdip's plantation, some type of sharecropping arrangement would have been made until Applewaite could build his own mill.¹⁰⁵ Other contracts followed. In 1648 he and planter partner John Wadlos drafted a deed with James White.¹⁰⁶ White was to purchase another 300 acre section of the Locust Hall plantation, directly adjacent to the new Applewaite estate. The contract also stipulated that Holdip and his partner will 'at their own proper arts and charges plant...as many sugar canes at each distance as is usuall' upon that land, and to do so in time for them to be ready by the next year's harvest. They furthermore agree that if any canes should 'fail' that Holdip and Wodlos will resupply them. Finally White paid for the plantation via a series of London exchange bills, and should any of them prove to be invalid or insufficient Holdip and Wadlos have the right to commandeer and work White's plantation and seize its profits until the debts are paid.

This kind of technology transfer can be best seen through a rental agreement made by Holdip the following year. Because this type of contract involves the creation of a plantation which is to be leased to a third party, it contains many details that are not mentioned in traditional sale deeds. Holdip and Wodlos made an agreement for yet another section of the Locust Hall estate, this time granting Richard Campbell 350 acres adjacent to the new White plantation. Campbell was to lease the land for the next 11 years, with Holdip and Wadlos agreeing to provide everything required to establish a working plantation. To wit: Holdip and Wodlos will first supply Campbell with 50 slaves, 20 indentured servants, and 30 cattle from their own plantation stock. Next they agree to plant, with the help of those 70 slaves and servants, enough canes to cover 190 acres of the plantation and in time to be ready for cutting by the next harvest. Between each 24th row of cane they will also plant cassava for the sustenance of Campbell and the 70 workers. Next they agree to 'provide and erect sufficient coppers, stills, and all other utensils and materials...necessary and convenient for ye employment, maintaining, and perfecting of a sugar ingenio.' The contract includes stipulations for a mill, boiling house, distillery, cur-

ing house, home for Campbell himself, slave quarters, and all other tools and objects needed to run a plantation.¹⁰⁷ Some of the dimensions of these planned buildings are given within the contract, while others such as the boiling house ‘shall be edified according to the directions agreed upon by them with ye workmen (meaning the hired overseers).’ Also, during the first year of the lease they agree to supply a carpenter, smith, mason, and cooper, and agree to pay the wages of the head overseer. Finally upon harvest time they will provide additional cattle for use in the plantation mill and 10 donkeys for delivering the sugar to port. The 70 servants and slaves are to stay on the plantation for the duration of the lease and to assist Campbell with sugar-making, although Holdip has the right to recall any of them for his own use if needed. Campbell also has the right to ask for additional assistants from Holdip as he needs, but must pay for them on his own account. For all of these things, Campbell must replace any servants or slaves who die or any servants whose time expires, must return the plantation ‘clean and well-ordered’ after 11 years, and offer up the vast majority of the plantation’s annual sugar crop as rent.

Holdip of course was not alone in these types of dealings, and many contracts from this period involved sharing skilled servants, oral knowledge between planters and workers, and most importantly the embodied knowledge within skilled servants when reproducing a new ingenio.¹⁰⁸ Through the above business arrangements we can see all the occupational components of a plantation at work, operating jointly to sustain the ingenio as a cohesive unit. Furthermore the crucial importance of each of these components explains why successful mills in new Atlantic settlements were transferred wholesale from a prior space, rather than assembled from scratch. Indeed, instead of starting with an individual planter who crafts his skill through isolated observation and experiment, building an ingenio was a collaborative process of distributed cognition, involving not only family, neighbors, and business partners, but also employees, servants, and slaves. While the mill externally appeared as a single innovative unit, the inside contained a complex gradation of interconnected tasks, workers, and knowledges – the secret sugar-makers of the Atlantic.

All of this puts the polemic narratives of Snow and other experimental philosophers in a new light. In the opening lines of the *Apopiroscopy*, Snow makes a public appeal to all who have ‘received any Lights, either from *Nature, Education, Observation, or Experience.*’ He extols society’s Enlightened individuals who pursue discovery and invention, beseeching them ‘offer it to the World,’ so that others may benefit from these recent discoveries.¹⁰⁹ Yet despite such calls for illumination and transparency, philosophers like Snow actually shrouded the true workings of things by highlighting the select actions of individual Europeans over broader migrations of socio-technological knowledge. When these authors appropriated ingenios to promote their Baconic methodology within progressive narratives, they invented stories about sugar’s development and role within society. In doing so, sugar’s true makers were kept secret.

Notes

1. Snow, *Apopiroscopy: Or, a Compleat and Faithful History of Experiments and Observations: Not Only Chymical and Curious, but Mechanical; and in Several Arts, Sciences and Professions. Being Pleasant, Useful and Profitable. Extracted from the Most Authentick Writers, Manuscripts, and the Author’s Experience.* By T. Snow (London, 1702). Accessed through Eighteenth Century Collections Online, Gale, September 7, 2011. http://find.galegroup.com/floyd.lib.umn.edu/ecco/infomark.do?&contentSet=ECCOArticles&type=multipage&tabID=001&prodId=ECCO&docId=CW3307099976&source=gale&userGroupName=umn_wilson&ver-

- sion =1.0&docLevel=FASCIMILE. Thomas Snow was a pseudonym for Richard Neve. It is unclear how proficient Snow was himself in producing scientific experiments. His work is mainly compiled through an incredibly thorough canon of seventeenth-century natural science works, although he does insist that these readings were augmented by many of his own personal experiments and observations.
2. Bacon's idea of a 'Natural History,' including what it should consist of and what its social utility should be, is most clearly detailed in a series of works he published in 1620 under the collective title of *Instauratio Magna*. Baconian science, the English Scientific Revolution, and the English Enlightenment all have extensive historiographies. For the best overviews see for example Hunter, *Establishing the New Science*. Other notable works include Porter, *Creation of the Modern World*; and Stewart, *The Rise of Public Science*; and Jacob, *The Cultural Meaning of the Scientific Revolution*. On the history of science more generally see Cohen, *The Scientific Revolution*; Shapin and Scheffer, *Leviathan and the Air-Pump*; and Golinski, *Making Natural Knowledge*.
 3. Seventeenth-century experimental philosophers were not the first in Europe, or even England, to conceive of these now distinct ideas in this fashion, as many proto-forms of experimental philosophy can be found in the previous Tudor period. Nevertheless, the concept became more concrete within the minds of its practitioners after Bacon's publications in the 1620s. See Eamon, *Science and the Secrets of Nature* and Shapiro, *Culture of Fact*.
 4. On the crucial importance of sugar to seventeenth-century English trade, see Drayton, 'The Collaboration of Labor,' 107–8.
 5. *Ingenio* is a Spanish term which means the cluster of core buildings or 'works' of a sugar estate: primarily the mill, boiling house, and curing house, as well as any other auxiliary structures. Portuguese colonies used the similar term *engenho*, and both terms translate loosely into 'engine' or 'device.' When the English in Barbados first developed their sugar industry they referred to their mills as ingenios, but after the 1660s the term fell out of use in favor of 'sugar works.' See Schwartz, *Tropical Babels*, 2. Notably, however, some experimental philosophers continued to use the term ingenio to refer to various agricultural processing machines well into the late seventeenth century, both in England and the larger English empire. See for example John Beale's article on cider presses in the *Philosophical Transactions* 11 (1676), 583–4.
 6. 'Unfree' refers to a wide spectrum of coercive labor conditions which were prominent in the West Indies during this period. I prefer this word over slavery, as this broader category includes chattel slavery, European indentured servitude, and a litany of contracts which bonded nominally 'free' persons to plantation regimes for extended periods. While many of the white overseers mentioned in this article may have been free, there were a host of other structural constraints which had been created to retain them within the mill during this time. For more information on white 'bond slaves' during this period, see Donoghue, "'Out of the Land of Bondage': The English Revolution and the Atlantic Origins of Abolition"; and Beckles, 'A "Riotous and Unruly Lot."'
 7. This article draws upon a number of recent works from the history of science and technology when framing its narrative of effacement of Caribbean sugar workers. Pamela Smith's idea of 'artisanal epistemology' is invoked to describe the collection of tasks and knowledges assembled inside the plantation to create a properly functioning sugar estate, and to help describe the transmission of ideas about sugar-making from Caribbean workers to English natural scientists. See Smith, *Body of the Artisan*. More recently, see Roberts et al., *The Mindful Hand*. Steve Shapin's idea of the invisible technician is also invoked to describe how the knowledges of these artisanal sugar-makers were effaced in favor of an emphasis on a gentleman planter, who creates and manages his ingenio through diligent observation and careful experiment. Shapin, *A Social History of Truth*, ch. 8. Both of these concepts have recently been explored in more depth in Mukerji, *Impossible Engineering*. Finally, on the role of movement and migration within recent science studies, in particular as it relates to knowledge construction in the early modern Atlantic, see Smith, 'Science on the Move.' Finally, for information on concepts of technoscience networks, combinable and mutable objects, and centers of calculation, see Latour, *Science in Action*.
 8. The classic work on this transformation is Mintz, *Sweetness and Power*.
 9. For more historiographical information on the sugar revolution see Menard, *Sweet Negotiations*; and also Higman, 'The Sugar Revolution.' For statistics on English imports see

- McCusker and Menard, *The Economy of British America*, 151–8, and Menard, *Sweet Negotiations*, 68.
10. Several works contain detailed descriptions of the sugar-making process. One of the most detailed, which also stresses the novelty and complexity of English sugar-making in the seventeenth century is Barrett, 'Caribbean Sugar-production Standards in the Seventeenth and Eighteenth Centuries.' See also Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, 114–22.
 11. Bacon's *Preparative* was initially published in 1620 as the third part of his *Great Instauration*, which also contained an introductory work on the *Instauration*, the *Novum Organum*, and the *Preparative*. The above quotes are from a 1670 English-language edition which was released as a stand-alone version of the *Preparative* and included a collection of sundry letters and articles from the late Bacon. See *A Preparatory to the History Natural & Experimental Written Originally in Latine, by the Right Honourable Francis, Lord Verulam, Lord High Chancellour of England ; and Now Faithfully Rendred into English, by a Well-wisher to his Lordships Writings* (1670), introductory material. Accessed through Early English Books Online Database, Text Creation Partnership (EEBO), <http://eebo.chadwyck.com>.
 12. *Ibid.*, 4.
 13. Bacon, 'New Organon,' digitized by the Internet Archive. <http://archive.org/details/works-francisco08bacoiala> (accessed March 26, 2012).
 14. Bacon, *Sylva Sylvarum or A Naturall Historie In Ten Centuries*, 156. Accessed through EEBO.
 15. Most of these experiments can be found in *Ibid.*
 16. My emphasis on sugar. By 'ignoble conceptions' Power means: 'A diffidence and desperation of most men (nay even of those of more discerning faculties) of ever reaching to any eminent Invention; and an inveterate conceit they are possess'd with of the old Maxim, That Nil dictum, quod non prius dictum.' Power, *Experimental Philosophy, in Three Books Containing New Experiments Microscopical, Mercurial, Magnetical*, 190. Accessed through EEBO.
 17. Evelyn, *Numismata, a Discourse of Medals*, 280. Accessed through EEBO.
 18. Herwig, *The Art of Curing Sympathetically, or Magnetically*, 3. Accessed through EEBO.
 19. See Preface from the English version of De Rochefort, *The History of the Caribby-islands*. Accessed through EEBO. See also Sandiford, *The Cultural Politics of Sugar*, 41.
 20. Rochefort, *The History of the Caribby-islands*, 194.
 21. Boyle's works also contain many references to *Saccharum Saturni*, or Sugar of Saturn, which is a separate entity. Sugar of Saturn, known today as Acetic acid, is an element found in vinegar and was often boiled in lead to create a sweet tasting substance (which if consumed repeatedly resulted in lead poisoning). The above-mentioned essay was an attempt by Boyle to create a sweet-tasting, non-sugar substitute that was not Sugar of Saturn. For examples of sugar within Boyle's works see *Some Considerations Touching the Usefulness of Experimental Naturall Philosophy* (1664); *Experimental Notes of the Mechanical Origine or Production of Fixtness..s*(1675); *The Origine of Formes and Qualities...* (1666); and *Certain Physiological Essays* (1669). Each accessed through EEBO.
 22. Boyle, *Certain Physiological Essays*, 270.
 23. *Ibid.*, 272. Boyle also corresponded with Rochefort during this time; however, the letters have been lost. See Hunter, *The Correspondence of Robert Boyle*, vol. IV, 127.
 24. A good summary of these developments can be found in Galloway, *The Sugar Cane Industry*; Curtin, *The Rise and Fall of the Plantation Complex*; and Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, chs 1–3.
 25. Within experimental philosophy works, the wonders which they emphasized were all products which were seen to have had a recent, significant impact on English society, such as the ones listed by Bacon and Power above. Other, older inventions, such as windmills and watermills, were not mentioned in experimental philosophy accounts as they were not seen to be recent innovations. While a sugar mill was in fact as old as these other mills, experimental philosophers overlooked this, as sugar had hitherto been a rare commodity within England, and sugar mills little known. Thus sugar was not unlike gunpowder or paper in this regard, which had long histories by the sixteenth and seventeenth centuries, but appeared 'new' to the English during this time.
 26. Klooster, 'Anglo-Dutch Trade in the Seventeenth Century.'

27. Batie, 'Why Sugar?,' 18.
28. On these émigrés see Menard, *Sweet Negotiations*, ch. 3.
29. Handler, 'Father Antoine Biet's Visit to Barbados in 1654,' 66.
30. Snow, *Apopiroscopy*, 18.
31. Thomas, *An Historical Account of the Rise and Growth of the West-India Colonies*.
32. *Ibid.*, 13.
33. *Ibid.*, 14.
34. Ligon, *The A True & Exact History of the Island of Barbados*. Accessed through EEBO.
35. In the latter seventeenth century, famous experimental philosophers such as Henry Pope Blunt, John Houghton, and Robert Boyle all reference Ligon within their natural history works. Boyle at one point refers to him as 'the Ingenious Mr. Lygon.' See Boyle, *The Origine of Formes and Qualities*, 136. Accessed through EEBO.
36. *Ibid.*, 85.
37. Another publication from Ligon's period confirms his statements about Barbadian sugar in the 1640s, saying that it was 'of the worst sort.' See Gardyner, *A Description of the New World, or, America Islands and Continent*, 51. Accessed through EEBO.
38. Even as late as the eighteenth century the few manuals that did exist on sugar-making were only general primers. They refrained from giving specific figures on many important items, claiming such things had to be addressed in person and on a case by case basis. See for example Belgrove, *A Treatise upon Husbandry of Planting*, 24–7.
39. Sainsbury, *Calendar of State Papers, Colonial Series, 1574–1660*, Vol. I, 292.
40. Bennett, 'Peter Hay, Proprietary Agent in Barbados, 1636–1641,' 16.
41. Menard, *Sweet Negotiations*, ch. 3, 21.
42. An island near West Africa, which along with Madeira and the Canary Islands, was perhaps the first European colony to produce a single cash crop for European consumption using primarily African slave labor. See Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, ch. 1.
43. Israel, *Empires and Entrepots: The Dutch, the Spanish Monarchy, and the Jews, 1585–1713*, 417–48.
44. Klooster, 'Communities of Port Jews and their Contacts in the Dutch Atlantic World.'
45. Schreuder, 'The Influence of the Dutch Colonial Trade on Barbados in the Seventeenth Century,' 47; see also Wiznitzer, *Jews in Colonial Brazil*, ch. 3.
46. Klooster, 'Networks of Colonial Empires.'
47. The most popular of these early historical works being Dunn, *Sugar and Slaves*, 60–2; however, several other works repeat these claims. This line of argument is originally based upon Ligon's testimony and another anonymous manuscript created around 1670 entitled 'Some Observations on the Island of Barbados' (PRO, C.O. 1/21, no. 170). The manuscript was transcribed and published by Jerome Handler in *The Journal of the Barbados Museum and Historical Society* 34, no. 3 (1973). See also Harlow, *A History of Barbados, 1625–1685*, 40. More recently, Russ Menard's *Sweet Negotiations* argues against a large Dutch presence in regards to the financing of the new ingenios, and in supplying the colony with black slaves. These arguments for limiting the Dutch presence can also be found in Schwartz, *Tropical Babels*, esp. ch. 9. Conversely, Yda Schreuder has published a series of articles in *The Journal of the Barbados Museum and Historical Society* emphasizing the Dutch role in Barbados. See in particular Schreuder, 'The Influence of the Dutch Colonial Trade on Barbados in the Seventeenth Century'; Schreuder, 'Evidence from the Notarial Protocols'; and Schreuder, 'A True Global Community.' Of particular note here is Schreuder's discovery that many Sephardic Jews relied upon English aliases when conducting business in Barbados, hence making them invisible in the island's early record books. See Schreuder, 'Evidence from the Notarial Protocols,' 69–70. Finally, on the contribution of Jewish merchants to English trade more generally, including their ability to evade the Navigation Acts, see Snyder, 'English Markets, Jewish Merchants, and Atlantic Endeavors.'
48. Schreuder, 'Evidence from the Notarial Protocols,' 63.
49. Smith, 'Disturbing the Peace in Barbados,' 40–1. He may have had business and property transactions in Barbados prior to these years, as this is merely the earliest recorded dates within the deed books at the Barbados National Archive. Records are not extant before 1640, and are scant for most of the subsequent decade.

50. Will of Constant Sylvester, Recopied Will Books, RB 6/8, 316–24, Barbados National Archive (BNA), Lazaretto, St. Michael, Barbados. Sylvester was also a member of the governor's council and had married the sister of Henry Walrond, once the island's acting governor and of a leading English family frequently mentioned in Ligon's *History*. Henry Walrond was the chief Justice of Common Pleas on the island and likely the son of Humphrey Walrond, one of the island's largest sugar planters during the time of Ligon's stay. See Will of Henry Walrond, Wills, RB 6/10, 333, BNA.
51. Recopied Deed Books, RB 3/2, 220, BNA. See also Menard, *Sweet Negotiations*, 62. The deed also mentions a Dutch merchant, John Berry, to whom Hilliard owed 1200 Dutch Guilders.
52. Between 1640 and 1660, Hilliard was involved in no less than 36 land deals on the island. See Deeds, Deeds Index and Counterdeeds Index, RB 3/43–44, BNA. On Hilliard as council member, see 'Extracts From the Council Books of Barbados,' October 13, 1641 to May 2, 1652. RB X10/33, BNA. Thomas Modyford was a Royalist émigré who quickly ascended the Barbados political ladder, becoming assemblyman, councilman, and even governor in due time. In 1664 he was assigned by King Charles II to be the governor of Jamaica, where he took a leading role in developing the plantation society of the nascent colony. See Dunn, *Sugar and Slaves*, chs 4–5, in particular pp. 81–2.
53. Mijers, 'A "Natural Partnership"'; Schreuder, 'Evidence from the Notarial Protocols,' 59; Ligon, *History*, 23.
54. When Courteen's men settled on Barbados in 1627, some went to the South American coast to procure Native American servants to help them establish their settlement. It is likely these Indians came from these colonies. See Harlow, *A History of Barbados, 1625–1685*, 5–6.
55. One Father Biet visited Drax on Barbados in 1651, who told him about the earliest days in 1627 when he and his fellow settlers lived in caves for shelter. See Handler, 'Father Antoine Biet's Visit to Barbados in 1654,' 69.
56. In 1647 James Drax was recruited by Gyles Sylvester (then in Amsterdam) to arbitrate a land dispute between he and his son Constant (then in Barbados). See Schreuder, 'Evidence from the Notarial Protocols,' 63. Also Constant's will stipulates that all products from his Barbadian plantations be consigned to Henry Drax of London, who was also the executor of Constant's estate there. See Wills, RB 6/8, 321, BNA. Furthermore, the first archival record of Sylvester in Barbados is from a sale between Drax and Thomas Middleton, which Sylvester oversaw. See Smith, 'Disturbing the Peace in Barbados,' 40.
57. Dunn, *Sugar and Slaves*, 58–9.
58. *Calendar of State Papers, Colonial Series*, Vol. II, 4 (item no. 12).
59. Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, 66.
60. Ligon, *History*, 113–14, 155.
61. *Ibid.*, 113–15. The point of having the overseer eat with the planter was to reinforce status-based differences between him and the rest of the workforce. This tactic was repeated in other planter instructions, including those of Henry Drax in 1679.
62. See Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation.' Drax's instructions were later amended and reprinted within William Belgrove, *A Treatise upon Husbandry or Planting*. Belgrove ascribed authorship of the instructions to Drax, subtitled them *Instructions for the Management of Drax-Hall* (1679). See Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 565–70, for a detailed description of the relationship between these three sources.
63. Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 601–2. Attorneys were usually neighboring planters who agreed to periodically monitor an absentee's planter for a fee. The attorneys would also act on the planter's behalf in local legal and business arrangements, and keep a steady correspondence with the absentee planter about the plantation's state of affairs. By the eighteenth century this position had grown into a full-time occupation for a class of managerial workers. The most complete account of plantation attorneys can be found in Barry Higman, *Plantation Jamaica 1750–1850*.
64. Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 601.
65. *Ibid.*, 592.

66. *Ibid.*, 587.
67. *Ibid.*, 600. Drax's commands are specifically that Loader 'eat at your table,' which would imply either staying with him or, at the very least, making frequent visits if Loader lived nearby.
68. Chief overseers were usually free, and almost exclusively white. There were a number of lesser overseer roles on plantations such as slave drivers, watchmen, and boiling house supervisors, which were often manned by black artisan slaves. This occurred more frequently in the late seventeenth and eighteenth century, after indentured servitude had dwindled in Barbados and the island's black population had risen to almost 80%. See Galenson, *White Servitude in Colonial America: An Economic Analysis*, esp. chs 8–9, for more specific information on this transformation.
69. Campbell, *Some Early Barbadian History*, 54. The Lucies all have names which signify a possible Jewish heritage. Jacob Lucie, the most famous Barbadian planter of the Lucie family, had siblings named Isaac, Elisha, Abraham, and Samuel. See Will of Elias Lucie, Wills, RB 6/40, 213, BNA.
70. Luke Lucie power of attorney document. Deeds, RB 3/2, 475–7, BNA.
71. Luke Lucie power of attorney document. Deeds, RB 3/2, 475, BNA.
72. Charles Jennens is also given permission to find and hire another manager, should De Hem die or 'depart from the island.' This departure clause is unusual amongst these documents, and is never mentioned within contracts that contain primarily English individuals.
73. The second half of Luke Lucie's document is a formal renunciation of the powers formerly granted to Thomas Moore, and both Jennens and De Hem are given power to 'eject and expel' Moore from the plantation. There is also an issue of a large outstanding debt owed to Lucie by Moore, which is likely damages suffered by Lucie through Moore's neglect, incompetence, or embezzlement.
74. Will of Elias Lucie, Wills, RB 6/40, 213, BNA. Jacob Lucie was the son of Elias Lucie, who lived in Barbados and possessed a large estate there. In his will, Elias stated his wish that Jacob 'come home' to Barbados, when his 'apprenticeship' was finished if not earlier, to help his newly widowed mother manage the estate. Jacob Lucy in time became a substantial London merchant, and was Assistant Director of the Royal African Company for several terms during the 1680s.
75. Will of Seger De Hem, Wills, RB 6/10, 187. BNA.
76. Anon, 'Historic Sites Re-Visited – I: Andrews Plantation, St. Joseph; Its Cemetery and History,' 93–4.
77. From the will it is unclear where in the Atlantic world De Hem's sister resides.
78. Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 570.
79. *Calendar of State Papers, Colonial Series*. Vol. VII, 224 (item no. 802.) The council also claimed 'personal inability, and other scandalous circumstances' as reasons to keep Harwood off the council. This is despite the fact that the lieutenant governor at the time called Harwood a 'loyal and honest man.' See Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 570.
80. Will of Richard Harwood, Wills, RB 6/41, 334. BNA.
81. Handler, 'Father Antoine Biet's Visit to Barbados in 1654,' 69. Many of the Jewish sugar-makers in Pernambuco had French sugar-making connections, although none to Rouen in particular are documented. See Wiznitzer, *Jews In Colonial Brazil*, 85, 111.
82. On Rouen's early leadership in refining see Stein, *The French Sugar Business in the Eighteenth Century*, 142–3.
83. Carr, *Select Charters of Trading Companies, 1503–1707*, 62–78, 70.
84. Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, 66. William Belgrove's account of how to operate a sugar mill also discusses this, allocating extra money for the purchasing of 'a Mill-Man, a Boiler, a Clayer, a Distiller, a Groom, two Carters, two Drivers, and a Watchman.' See Belgrove, *A Treatise upon Husbandry of Planting*, 41.
85. Schwartz, *Sugar Plantations in the Formation of Brazilian Society*, 67.
86. Ligon, *History*, 52.
87. Handler, 'Father Antoine Biet's Visit to Barbados in 1654,' 67.
88. Wiznitzer, *Jews in Colonial Brazil*, 60, 137; Firth, *The Narrative of General Venables*, 39, 47, 99, 124. See also Anon, 'The English Conquest of Jamaica, 1655–1656.' As conversos,

- these Accostas must have, at least publically, retained their Christian confession while in Jamaica.
89. Firth, *The Narrative of General Venables*, 39. Securing the cattle was essential if the English were to adequately provision their army.
 90. Anon, 'The English Conquest of Jamaica,' 11. By stating that the slave was 'Angolan' it would have meant that he was from either Brazil or Portuguese Angola.
 91. Thompson, 'Henry Drax's Instructions on the Management of a Seventeenth-Century Barbadian Sugar Plantation,' 586.
 92. *Ibid.*, 593.
 93. *Ibid.*, 593.
 94. *Ibid.*, 593.
 95. See for example Shapin, *Social History of Truth*, ch. 8; Roberts, 'The Death of the Sensous Chemist'; Schaffer, 'Experimenters' Techniques, Dyers' Hands, and the Electric Planetarium.'
 96. John Houghton, 'Letters for the Improvement of Husbandry and Trade,' June 17, 1698. Republished as *Letters for the Improvement of Husbandry and Trade* (1728) Vol. III, p. 303. Accessed through Eighteenth-Century Collections Online (ECCO). <http://gdc.gale.com/products/eighteenth-century-collections-online>. This treatise was largely based upon Ligon's *History of Barbados*.
 97. Quoted in Barrett, 'Caribbean Sugar-production Standards in the Seventeenth and Eighteenth Centuries,' 161.
 98. 'The Earl of Carlisle's Patent unto Capt. James Holdip sent him by Phoenix of London,' 1629/30. Hay Papers, Huntington Library. Reproduced in RB X10/15, BNA and in *The Journal of the Barbados Museum and Historical Society* 35, no. 4 (1978): 306–7.
 99. Anon, 'Diary of Henry Colt' (1631), reprinted in *Journal of the Barbados Museum and Historical Society* 21, no. 1 (1953): 12.
 100. Campbell, *Some Early Barbadian History*, 42.
 101. Deeds, Index and Counterindex, RB 3/43-44, BNA.
 102. Harlow, *A History of Barbados, 1625–1685*, 40.
 103. Deeds, RB 3/1, 536, BNA.
 104. Richard Dunn mentions this deed in *Sugar and Slaves*, stating that the 25 servants were to go to Holdip for payment of the land. Dunn's citation comes from a reprinted version of this deed found in Pares, *Merchants and Planters*, which is a paraphrase by Pares and is incorrect. The correct version can be found in Deeds, RB 3/1, 536-8, BNA, and is also reprinted in Anon, 'Applewaite of Barbados, Pt. II,' 11.
 105. This type of sharecropping arrangement was the norm in Brazil, and also existed to varying degrees in English sugar-making islands during this time. See for example Jeaffreson, *A Young Squire in the Seventeenth Century, Vol. 1, from the Papers of Christopher Jeaffreson*, 316. See also a case from early Jamaica, where one planter referred to the practice of grinding neighbors' canes as 'the custom here.' Letter from Jamaica, November 7, 1670. Heylar Manuscripts, 5.116, Somerset Record Office, Taunton, UK.
 106. Deeds, RB 3/3, 574-7, BNA.
 107. The original document also included a schedule which itemized all of the individual items (skimmers, sugar molds, ladles, etc.) needed to run the ingenio. This itinerary however has since been detached from the deed and is now missing.
 108. William Hiliard for example, arranged a similar contract for his nephew Richard that same year, loaning him skilled servants for a period of time for use on the land sold to his nephew. This loaning of slaves was reflected in Richard's repayment terms. See Deeds, RB 3/3, 617–20, BNA.
 109. Snow, *Apopiroscopy*, 2.

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