ABSTRACT

Nicotiana tabacum, the species from which all commercial tobacco is derived, was central to the success of early English settlements in the Chesapeake region. Their success would require and accelerate the displacement of Indigenous people from their homelands and the establishment of commercial slavery in North America on a massive scale. During the peak growth of tobacco in the Chesapeake, two strains dominated the market: Sweet-Scented and Oronoco. Current research on Sweet-Scented and Oronoco tobacco has focused on delineating the regions in which each strain could grow based on soil type; however, the research so far ignores the dynamic, evolving nature of *N. tabacum* as a species. Originating in South America, *N. tabacum* spread across the colonial world, and its relocation would expose the plant to new selective pressures in each locale. Different populations of tobacco could and would have come in contact with each other depending on how and where seeds were purchased and introduced to the Chesapeake. Therefore, it is also important to consider the evidence that genetic differences between Sweet-Scented and Oronoco tobacco were a major factor in their differentiation. I have used a combination of historiography, primary source analysis, sediment mapping, and a modern biological perspective to create a better understanding of genetic influences on colonial tobacco strains. This work contributes to our collective understanding of what factors enabled specific planters to amass the economic and political power to displace Indigenous populations and institute commercial slavery on a large scale.

What's In a Seed: Considering the Importance of Seedstock and Land Quality in Securing Power in The Colonial Chesapeake Region

by
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TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Tobacco is so tied to the history of the Chesapeake Bay region (Figure 1) that it is hard to imagine one without the other. It is hard to remember that the original plans of the Virginia Company in 1607 were focused on precious metals, timber, and other goods that could be extracted quickly from the area. The plantations and tobacco boom that unfolded were based on a stroke of luck that saved a failing colony.[1] Initially there was only one type of tobacco in the Chesapeake: *Nicotiana rustica* (Figure 2b). *N. rustica* was grown by Indigenous peoples in the Chesapeake and had a "byting tast" that made it unsuitable for sale to English smokers.[2] In 1610 a man named John Rolfe would arrive at a colony in disarray after the shipwreck of the *Sea Venture* on Bermuda delayed the arrival of vital supplies and leadership to the colony.[3] Rolfe would introduce a new variety of tobacco, grown in South America by Spanish colonists, *Nicotiana tabacum* (Figure 2a). His experiments with *N. tabacum* would at last produce a product that could spark the dying embers of the colony into a bonfire focused on one thing: tobacco exports.[4]

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[1] Russo, Jean B. and Russo, J. Elliott, *Planting an Empire: The Early Chesapeake in British North America.* (Johns Hopkins University Press, 2012), 38; Walsh, L.S., (2010) *Motives of Honor, Pleasure, and Profit: Plantation Management in the Colonial Chesapeake, 1607-1763* (The University of North Carolina Press, 2010), Ch. 1.

[2] Strachey, William, *The Historie of Travaile into Virginia Britannia: Expressing the Cosmographie and Comodities of the Country, Together with the Manners and Customs of the People* (Accessed via the Library of Congress, 1619), 121-122.

[3] Doherty, Kieran, *Sea Venture: Shipwreck, Survival, and the Salvation of Jamestown.* (St. Martin's Press, 2007), Ch.7 and Ch.14.

[4] Russo and Russo, *Planting an Empire*, 7-22, 40-43, 55; Hardin, D.S. (2006). "'The same sort of seed in different earths.': Tobacco types and their regional variation in colonial Virginia." (*Historical Geography 34,* 2006), 138-139.

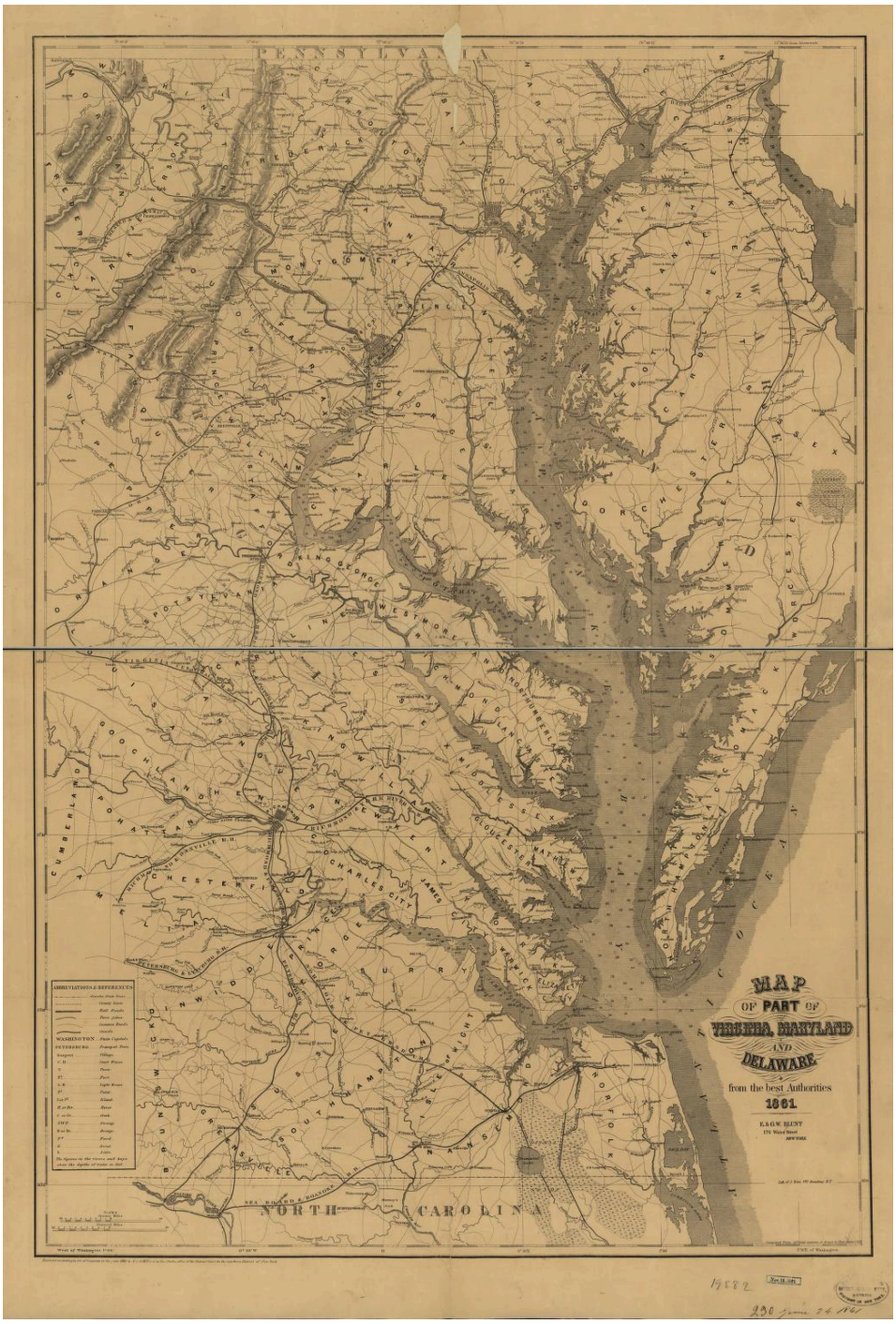

Figure 1: 19th-century Map of the Chesapeake Bay Area. The map shows the entire Chesapeake Bay Area, including parts of Virginia, Maryland, and Delaware. There are five major rivers on the western shore: the James (the southernmost), the York, the Rappahannock, the Potomac (forming the border between Virginia and Maryland), and the Patuxent River. Also shown are the three "necks" of Tidewater Virginia: The Lower Neck (between the James and the York), the Middle Neck (between the York and the Rappahannock) and the Northern Neck (between the Rappahannock and the Potomac) Heyne *et al*. 1861. "Map of part of Virginia, Maryland, and Delaware : from the best authorities" E. & G.W. Blunt. Accessed via the Library of Congress.

Virginia colonists ran with the new product. In 1616, 1,250 pounds of tobacco were exported to England, and only a year later that number increased to 10,000 pounds.[5] That same year, Samuel Argall, then governor of Virginia, saw tobacco plants in "the Store-house they used for the Church, the market-place, and streets, and all other spare places."[6] Tobacco exports increased rapidly from 20,000-25,000 pounds in 1619 to 1.3 million pounds in 1640.[7]

Figure 2: 18th-Century Botanical Illustrations of *Nicotiana tabacum* and *Nicotiana rustica*. *Nicotiana tabacum* (left) grew 6 to 9 feet tall in colonial times, and had pointed leaves and pink flowers. In contrast, *N. rustica* (right) was a much shorter plant, with yellow flowers and more rounded leaves.[8] Engravings from Martellio et al. 1772 "Hortus Romanus a Nicolao Martellio" accessed from the New York Public Library.

Producing hundreds of thousands to millions of pounds of tobacco quickly wore out the soil it was planted on.[9] Ravenous for more land to plant on, colonists had no regard for the numerous Indigenous peoples already living there (Figure 3). In the first year of contact

[5] Bailyn, Bernard, *The Barbarous Years: The Peopling of British North America: The Conflict of Civilizations, 1600-1675* (Alfred K. Knopf, 2012), 79-80.
[6] Russo and Russo, *Planting an Empire*, 41.
[7] Garner, W. W., *The Production of Tobacco* (The Blakiston Company, 1946), 26; Bailyn *The Barbarous Years* p. 79-80.
[8] Descriptions from Strachey, *The Historie of Travaile into Virginia Britannia*, 121-122.
[9] Russo and Russo, *Planting an Empire,* 7.

with the English colonists there were relatively peaceful relations between the settlers of Jamestown and the Powhatan chiefdom they had settled into.[10] This brief period of peace ended in 1608 when the colonists resorted to violence and deception when the Powhatan people were unwilling to trade with them for provisions. In response, Powhatan ordered his people and his allies to prevent the colonists from leaving Jamestown through the winter of

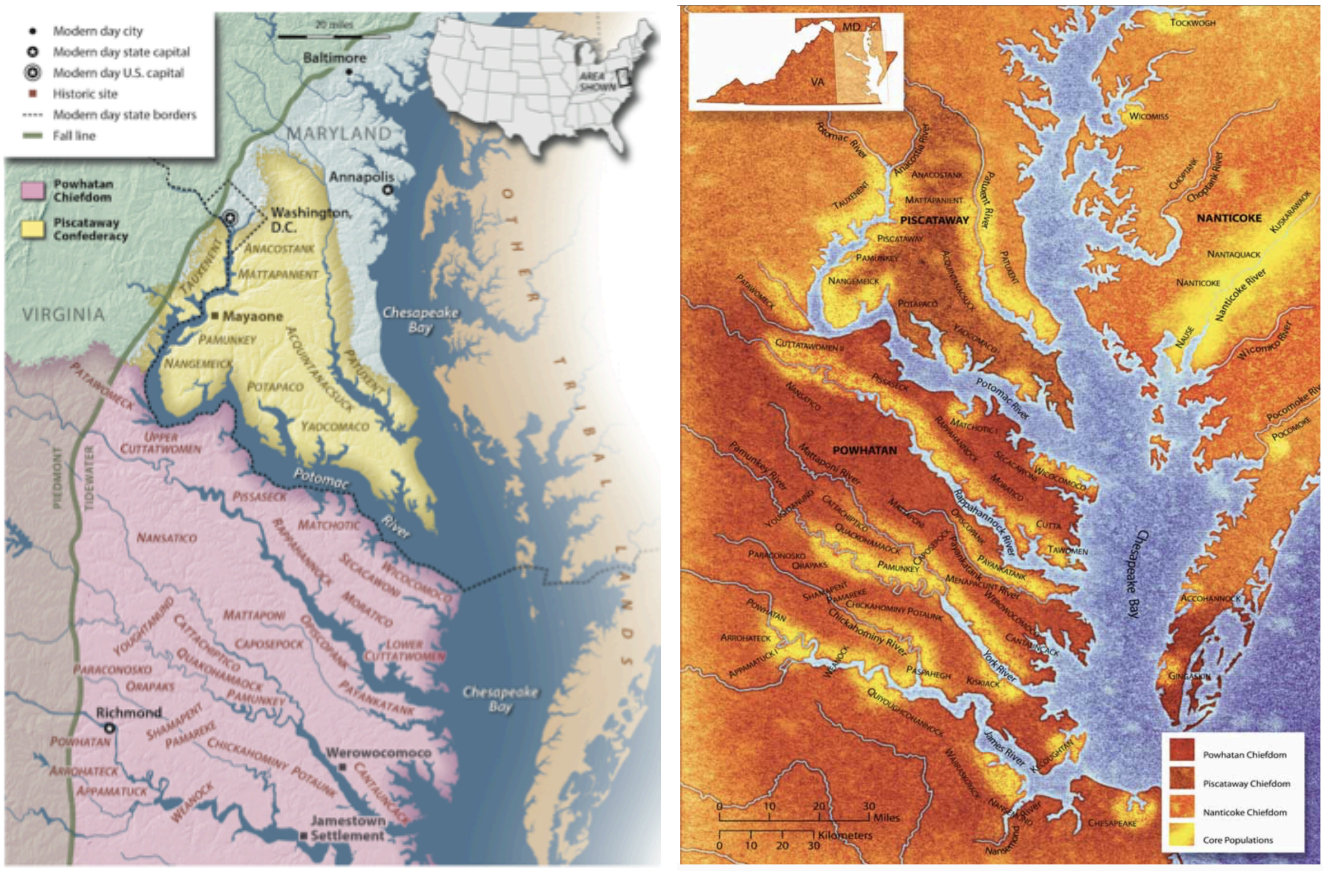

Figure 3: The Distribution of Indigenous People in the Chesapeake, 1610. These two maps show the political organization (left) and population density (right) of Indigenous people in Tidewater Virginia (below the fall line) and Maryland when *N. tabacum* was introduced to the Chesapeake Bay. Both maps were produced by the National Museum of the American Indian, the map on the left as part of the "Native Knowledge 360°" Education Initiative, and the map on the right as part of "We Have a Story to Tell: Native Peoples of the Chesapeake Region." The core population of each group was found along the river banks, making them targets for the English planters that desired the fertile farmland found there.

[10] Russo and Russo, *Planting an Empire,* 33-34.

1609-1610, resulting in the death of a majority of the colonists there.[11] This action prompted Lord De La Warr, the next leader of Virginia to enact a harsh military campaign of village burnings, crop destruction, and killing of Indigenous women and children alongside warriors.[12] As the 17th century wore on, English settlers pushed Indigenous peoples out of their homelands. First, Indigenous peoples were pushed from the prime fertile land along the rivers of the Lower Neck, and then as far north as the Potomac River by the end of the century. Some groups, like the Accomacs and the Rappahannocks, gifted or sold portions of their homeland to colonists before retreating into other parts of their homeland less suited for plantations. The Piscataway Confederacy attempted to protect themselves by aligning themselves with the colonial government of Maryland. No matter the position they took, Indigenous peoples of the Chesapeake were uprooted from their traditional territories and forced either to assimilate into colonial society, move onto reservations, or migrate to join other Indigenous groups in less settled areas. Colonists were relentless, using legal loopholes and outright violence to cement their control of the Chesapeake terrain.[13]

The back-breaking pace of production was only possible through the introduction of forced labor, which involved both indentured servitude and slavery from the beginning. Slavery became the dominant form of forced labor as enslaved people became available to larger and larger swathes of the colonial population.[14] John Rolfe himself notes the first documented arrival of captive laborers from Africa in August of 1619. One of his accounts of the sale of "twenty Negars" comes casually after his detailed report of the quality and value of Virginian tobacco; but the two together, along with the displacement of Indigenous people,

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[11] Russo and Russo, *Planting an Empire,* 35-38.
[12] Russo and Russo, *Planting an Empire,* 39.
[13] Russo and Russo, *Planting an Empire,* 7, 84-88.
[14] Coombs, John C., "Phases of Conversion: Conversion: A New Chronology for the Rise of Slavery in Early Virginia," (*William & Mary Quarterly* 68(3), 2011), 360.

were required to transform the Chesapeake into the Tobacco Coast.[15] Their bodies, along with those of Indigenous people captured by settlers and slavers alike, provided the labor needed to make tobacco profitable, a task that required each laborer to tend thousands of plants for nearly a third of the year.[16]

In the early days, however, slave-holding was limited to the most profitable regions of Virginia, where only the wealthiest planters could afford captive laborers.[17] This was because not all tobacco grown looked or smoked the same. By the 1650s two distinct colonial varieties were recognized.[18] One variety of tobacco had a large oval leaf with a pointed tip and thick central vein. The other variety had thicker leaves, with a rounder shape and thinner central vein. The first type became known as Oronoco, and was grown throughout Virginia and Maryland, while the latter was called Sweet-Scented and grown only in certain parts of the Virginia colony. Sweet-Scented, named for its milder taste, was more popular with English smokers than Oronoco. Oronoco tobacco was preferred by smokers on the continent of Europe.[19] This English preference helped make the Sweet-Scented tobacco planters the wealthiest in the Chesapeake during the first half of the 1600s, allowing them to amass economic and political power in the young colony.[20] Thus, the difference between being able to grow Sweet-Scented tobacco or not gave planters immense power over the lives of others and the course of this continent's history.[21]

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[15] Rolfe, John (1619), *Narratives of Early Virginia, 1606-1625* ed. Tyles, L.G. (Charles Scribner's Sons, 1907), particularly the section from 336-337.
[16] Russo and Russo, *Planting an Empire,* 55-56, 59-60; Morgan, Edmund, *American Slavery, American Freedom* (WW Norton & Co. Inc., 1975), 329.
[17] Russo and Russo *Planting an Empire* p. 65-70; Walsh *Motives of Honor, Pleasure, and Profit* p. 433.
[18] Hardin, "'The same sort of seed in different earths.'", 139.
[19] Detailed descriptions of the two strains, as described by Hugh Jones (among others) can be found in Hardin, "'The same sort of seed in different earths.'", 139.
[20] Walsh, L.S., "Summing the Parts: Implications for Estimating Chesapeake Income and Output subregionally" (William & Mary Quarterly 3(56):1, 1999), 60.
[21] Walsh, *Motives of Honor, Pleasure, and Profit,* 433.

In light of the importance of Sweet-Scented tobacco to our shared history on this continent, I think it is necessary to reconsider what factors differentiate Sweet-Scented and Oronoco tobacco strains. In particular, it is necessary to determine if there were two genetically distinct strains or, if, as Drs. David Hardin and Lorena Walsh suggest in their historical works on regional variations of tobacco in the colonial Chesapeake, there was one population that exhibited dramatic changes in traits when grown in different environmental conditions.[22] The latter option requires examining tobacco's plasticity—how plants with the same genotype, or genetic material, can display different phenotypes (physical traits).[23] In a purely scientific study of living plants, these questions could be answered through genomic sequencing of plant tissue, which would allow us to count the differences in the genetic sequences of these two strains. Another experiment could be carried out by planting seeds from Sweet-Scented plants in Oronoco soils, and vice versa with Oronoco seeds in Sweet-Scented soils in order to test the influence of environment vs. parentage directly. However, these studies are not feasible because in the intervening two centuries the Oronoco strain has been continuously modified both intentionally and unintentionally by planters and plant scientists to create the modern varieties of tobacco. The Sweet-Scented strain is now considered extinct.[24] As part of this study I tried to locate preserved specimens of the colonial strains at a range of institutions (including herbariums and the Nicotiana Germplasm

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[22] Hardin, D.S. "'Alterations they have made at this day': Environment, Agriculture, and Landscape Change in Essex County, Virginia, 1600-1782" (unpublished dissertation, 1995); Hardin,"'The Same sort of Seed in Different Earths'"; Walsh, *Motives of Honor, Pleasure, and Profit*. Environmental conditions here could include several things. One, variations in soil type between different places (e.g. the silty loams found along river banks vs less fertile soils found on ridges). Another source of variation is changing conditions in the same place, such as soil quality decreasing as a result of consecutive years of farming on the same land, known as soil exhaustion.

[23] For a detailed review of the ways organisms can express plasticity see Forsman, A., "Rethinking phenotypic plasticity and its consequences for individuals, populations and species." (*Heredity* 115, 2015), 276-284.

[24] Garner, W.W., Allard, H.A., and Clayton, E.F. (1936). "Superior Germ Plasm in Tobacco," in USDA Yearbook: Yearbook Separate No. 1580 (Washington, DC: GPO, 1937): 785–830. See p. 808.

Collection at North Carolina State University), but no viable samples were found for sampling.

Instead, I have used a multi-pronged approach to determine the possible genetic contributions to colonial tobacco strain phenotypes, integrating published scientific studies with historical data. This process began with a thorough review of the existing literature on colonial tobacco strains, discussed in the historiography section. I then attempted to clarify how and when *Nicotiana tabacum* was introduced to the Chesapeake region in order to establish if multiple genetically distinct strains could have coexisted in the colonial Chesapeake. Then I examined accounts of planters and travelers in the 17th to early 18th century in order to consider whether Sweet-Scented and Oronoco tobacco were two strains or just one exhibiting extensive plasticity. Finally, I used a combination of geological maps and county soil surveys to further the current understanding of what soils produced the highly valued Sweet-Scented tobacco strain. By examining each of these areas of inquiry in turn, I am able to contribute a new perspective as to what allowed the Sweet-Scented planters of colonial Virginia to shape history so profoundly.

HISTORIOGRAPHY AND PREVIOUS TOBACCO STUDIES

The possible reasons for the geographic distribution of these two colonial tobacco strains have been primarily studied by two historians, Dr. David Hardin and Dr. Lorena Walsh.[25] Using reports on the quality of tobacco issued by Governor Drysdale of Virginia in the 1720s, Hardin delineated subregions in Virginia based upon the proportion of Sweet-Scented tobacco they produced (Figure 4a).[26] He refined his analysis by seeking to understand where within these counties there were soils that could grow Sweet-Scented tobacco. Working from an agroecological perspective, Hardin defined sweet-scented soils as dark soils, most likely silty loams, which are rich in organic matter, based on analysis of historical accounts and 20th-century soil surveys of a famous Sweet-Scented tobacco plantation (Figure 4b). Hardin proposed that the key factor in this soil's formation was the frequency of alluvial (flood) sediment deposition as sea levels rose and fell during the Pleistocene, shaping the Chesapeake Bay. These alluvial sediments are finely textured and high in organic matter, which Hardin viewed as essential to their ability to support Sweet-Scented tobacco.[27]

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[25]Works by Hardin and Walsh on this topic include Hardin, "'Alterations they have made at this day'"; Hardin, "'The same sort of seed in different earths,'"; and Walsh, *Motives of Honor, Pleasure, and Profit*. Early 19th-century strains and beyond have been studied by historians such as Barbara Hahn, who has worked on the emergence of Bright tobacco as tobacco expanded out of the Tidewater in Hahn, B., "Paradox of precision: Bright tobacco as technology transfer, 1880-1937" (*Agricultural History* 82 (2), 2008), 220-235; and Hahn, B. *Making Tobacco Bright: Creating an American Commodity, 1617–1937* (Johns Hopkins University Press, 2011)

[26] Hardin, "'The same sort of seed in different earths.'", 140-141.

[27] Hardin, "'The same sort of seed in different earths.'", 143.

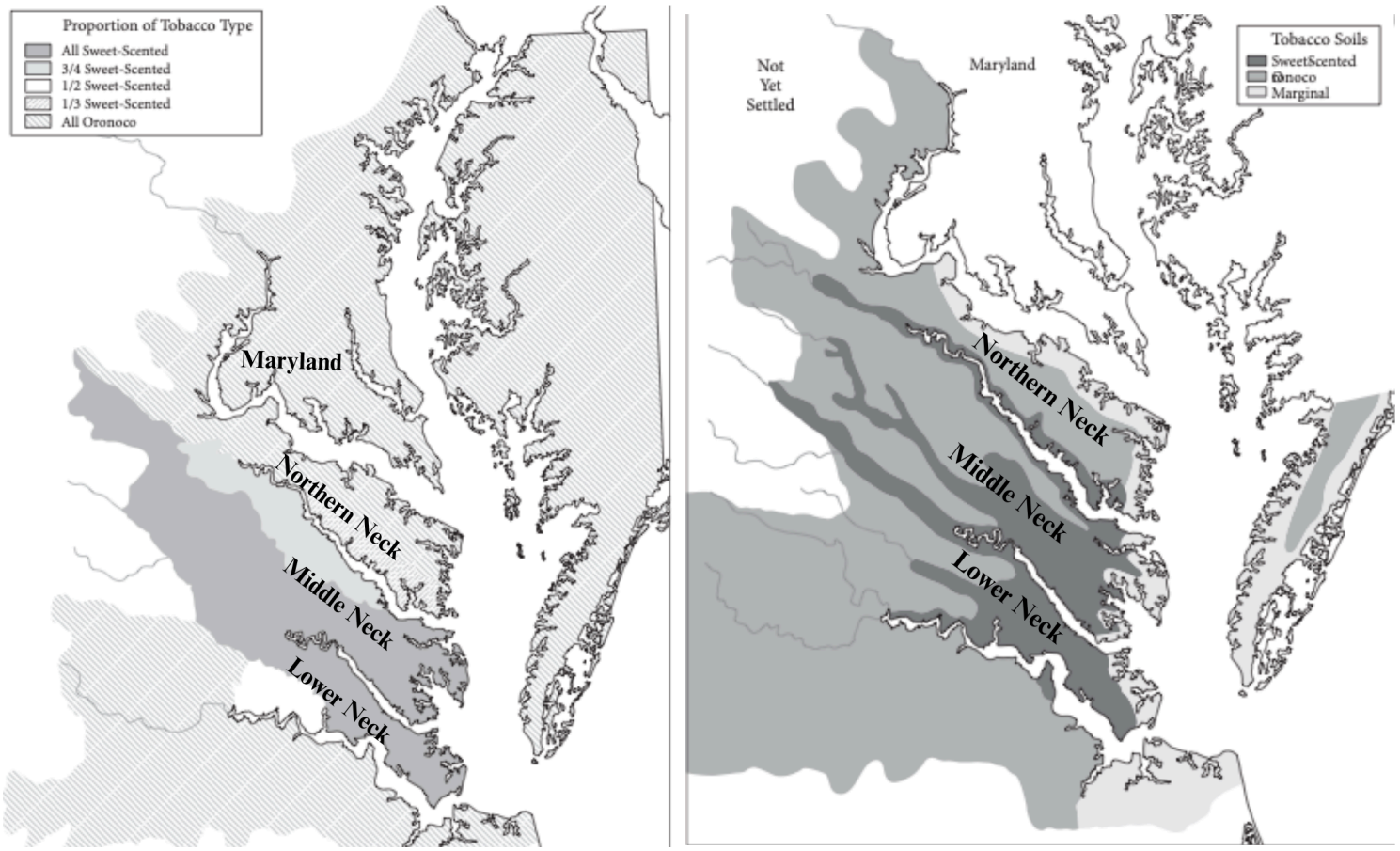

Figure 4: Distribution of Tobacco Types and Tobacco Soils in the Chesapeake. Sweet-Scented tobacco was mainly produced in the Lower and Middle Necks, whereas the Northern Neck produced almost entirely Oronoco tobacco (left). Hardin refined this analysis by mapping where sweet-scented soils occurred within those regions, revealing that the soils suitable for Sweet-Scented tobacco occurred mainly along the banks of the James, York, and Rappahannock Rivers, and was especially limited along the Rappahannock and the southern bank of the James. Maps modified from Walsh (2010) *Motives of Honor, Pleasure, and Profit* after Hardin (2006) "The Same Sort of Seeds in Different Earths."

By incorporating the analysis of soil surveys into his historical research, Hardin was better able to analyze geographic patterns of tobacco production and income in colonial Virginia. Lorena Walsh built on his work in her book, *Motives of Honor, Pleasure, and Profit*, substantiating Hardin's distinctions using primary records from planters throughout the Chesapeake. Her work also illustrates how the greater wealth of the Sweet-Scented planters

was tied to their crop and enabled them to purchase enslaved people as captive laborers before other planters.[28]

While the delineation of tobacco subregions by environmental conditions has been an invaluable lens for analyzing the development of the colonial Chesapeake, other possible factors in the differentiation of Sweet-Scented tobacco from Oronoco tobacco have been overlooked. As a result, sources of genetic difference between Sweet-Scented tobacco and Oronoco tobacco have often been downplayed.[29] In fact, most of the historical literature treats all strains of tobacco descended from Rolfe's initial planting in the Chesapeake as genetically indistinct, despite there being no conclusive evidence that they are, and good reason to believe they may not be.[30] This claim originates in Hardin's dissertation, and the article he later published based on it. In his works, he cites a letter written by John Clayton, an English clergyman who visited Jamestown in the 1680s, who wrote "the same sort of seed in different earth…" was "much different, as to goodness."[31] Clayton's quote seems to foreshadow the biological concept of plasticity, suggesting that individual organisms can develop different traits depending on the environment in which they develop. However, the full sentence from Clayton seems to contradict Hardin's literal interpretation that each variety was produced from the same seed in different environmental conditions:

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[28] Walsh, *Motives of Honor, Pleasure, and Profit*. For passages substantiating Hardin's claims 47-149, how Sweet-Scented tobacco planters were able to gain early access to enslaved people as a labor source, 433.
[29] This includes Hardin, "'Alterations they have made at this day'"; Hardin, " 'The same sort of seed in different earths.'"; and Walsh, *Motives of Honor, Pleasure, and Profit*, as well as other sources such as Hahn, "Paradox of Precision"; Hahn, *Making Tobacco Bright*; and Percy, D.O., "The Production of Tobacco Along the Colonial Potomac," (The Accokeek Foundation, 1973). The reasons for believing they may not be are discussed at the end of this section, as well as within the following two sections.
[30] Hahn,"Paradox of Precision", 222.
[31] Hardin, "'The same sort of seed in different earths.'", 137; Hardin,"'Alterations they have made at this day'", Ch. 4.

> The Soil in general is sandy: I had designed, and I think it might be worth a critical Remark, to observe, the difference of Soils seem appropriated to the several Sorts of Tobacco: For there is not only the two distinct Sorts of sweetscented, and Aranoko Tobacco, but of each of these be several Sorts much different, the Seeds whereof are known by distinct Names, they having given them the Names of those Gentlemen most famed for such Sort of Tobacco, as of *Prior Seed,&c*. Nay, the same Sort of Seed in different Earths, will produce Tobacco much different, as to Goodness.[32]

Clayton notes "there is not only the two distinct Sorts of sweetscented, and Aranoko Tobacco, but of each of these be several Sorts much different, the Seeds whereof are known by distinct Names…"[33] His observations suggest that, at the time (1680s), Sweet-Scented and Oronoco were seen as two distinct strains, each with several related sorts depending on where they were grown. It is also possible, based on the wording, that Clayton means the name "sweet scented" referred to two distinct strains, and "Aranoko" (Oronoco) referred to another strain, and then each of the three had different related sorts depending on environmental conditions. In either interpretation, Clayton's writing indicates that Sweet-Scented and Oronoco tobaccos came from different seed stocks, suggesting what today would be considered a genetic difference between them. This directly contrasts the most commonly accepted view in the historical literature, that there were little to no genetic differences between the colonial strains of tobacco.

Walsh agrees with Hardin's assessment that soil and climate were the dominant factors in the formation of colonial tobacco strains, and cites Barbara Hahn's "Paradox of Precision"[34] as further support for the theory. Walsh takes Hahn's work to say all tobacco

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[32] Clayton, J., "A Letter from Mr. John Clayton Rector of Crofton at Wakefield in Yorkshire, to the Royal Society, May 12. 1688. Giving an Account of several Observables in Virginia, and in his Voyage thither, more particularly concerning the Air." (Accessed via the Library of Congress, 1688), 15.
[33] Clayton, "A Letter from Mr. John Clayton…", 15.
[34] Hahn, "Paradox of Precision" Bright Tobacco as Technology Transfer, 1880-1937."

varieties "are not genetically distinct and do not reliably reproduce from seed."[35] However, this claim seems to be a slight misinterpretation of Hahn's work, which may not be directly applicable to colonial tobacco strains. Hahn's article focuses on bright tobacco, a type of tobacco which originated in the late 19th century near the border of North Carolina and Virginia and fueled the creation of cigarettes.[36] Hahn's work draws heavily on an article in the 1936 U.S. Department of Agriculture Yearbook, a research summary intended for the public which was published annually between 1849-1992.

The article, written by three senior researchers at the USDA Bureau of Plant Industry, Dr. Wightman W. Garner, Dr. Henry Allard, and Dr. E. F. Clayton, reviews the challenges in breeding superior tobacco strains as well as the origins of the varieties available in the early 20th century. In it the authors consider Virginia Oronoco varieties grown at that time to be genetically "almost indistinguishable" from the original (Oronoco) strain.[37] This wording supports Hahn's claims about bright cigarette tobacco, a descendant of Oronoco, but cannot be applied broadly to colonial varieties as Walsh does. Garner et al. did distinguish genetic differences between some strains—notably Virginia Oronoco and Maryland Broadleaf, which the botanical literature at the time considered to be distinct strains and even separate species, indicating they did not believe all tobacco varieties were genetically homogenous.[38] The distinction between Virginia Oronoco and Maryland Broadleaf is particularly interesting because the authors hypothesized that Maryland Broadleaf is descended from the Sweet-Scented colonial strain.[39] If this link can be corroborated, it lends support to there

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[35] Walsh, *Motives of Honor, Pleasure, and Profit,* 149 note 34.
[36] Hahn, *Paradox of Precision*; Hahn, "Making Tobacco Bright.".
[37] Hahn, "Making Tobacco Bright", 222.
[38] Garner et al., "Superior Germ Plasm in Tobacco", 809.
[39] Garner et al., "Superior Germ Plasm in Tobacco", 813; Also reported in Gage, C. E., "Historical Factors Affecting American Tobacco Types and Uses and the Evolution of the Auction Market." (*Agricultural History* 11(1), 1937), 47.

having been a significant genetic difference between the colonial strains, though it is still possible the two strains diverged sometime after the colonial period and before the USDA study.[40]

Another reason to be cautious when applying Garner et al.'s conclusion broadly is the date of the article. While theoretical foundations of modern genetics were laid out in the 1930s, the techniques used to explore genetic sequences at a molecular level were still decades away. The structure of DNA, which made the sequencing of an organism's genomes possible, would not be discovered until 1953, almost fifteen years later. Without the molecular tools commonly used in genetic analysis today, scientists in the 1930s were forced to rely on morphological traits and the results of cross-breeding experiments, both of which have pitfalls compared to directly comparing genetic data.[41] Now, over sixty years since the discovery of DNA, we can compare genetic sequences at high resolutions. Modern phylogenetic analyses use algorithms to find the most likely relationship between organisms based on the differences and similarities between genetic sequences, and what series of mutations likely led to the sequences in the data collected.[42] Therefore the type of data used by Garner et al. would be considered insufficient today for Hahn's claim that Bright tobacco is genetically indistinguishable from Oronoco, and would similarly be insufficient for any claims about other tobacco varieties made on the same basis.

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[40] There is good reason to maintain the possibility of the strains diverging after the colonial period, particularly because the article does not include information on the age or origin of the samples used in the study.
[41] Garner et al., "Superior Germ Plasm in Tobacco.".
[42] There are several different types of algorithms used which prioritize different traits in a phylogenetic tree, such as parsimony (constructing a tree that requires the least mutations to arrive at the collected sequences) and maximum likelihood (constructing a tree using a model of molecular mutation that considers if some changes in the sequence were more likely than others and chooses the most probable). Today, multiple models are often considered in a study. For further discussion on the different types of computational phylogenetic methods and their advantages and disadvantages see Munjal, G., M. Hanmandlu, and S. Srivastava, "Phylogenetics Algorithms and Applications" (Ambient Communications and Computer Systems 904, 2018), 187-194.

INTRODUCTION(S) OF TOBACCO TO THE CHESAPEAKE

The introduction of *Nicotiana tabacum* to the colony of Virginia is underexplored, despite its vital importance to any attempts to understand the genetic diversity of colonial tobacco strains. The consensus among historians is that John Rolfe grew the first commercially successful crop of tobacco in Virginia, using seeds he brought with him when he arrived at the colony in 1610.[43] The origin of these seeds, on the other hand, is less certain. Walsh says he "probably" obtained the seeds on Bermuda, on account of the time he spent shipwrecked there from 1609-1610.[44] This echoes the findings of historian Michael Jarvis in his book *In the Eye of All Trade*, which notes that Rolfe "could have easily collected seeds" from the tobacco growing wild on Bermuda.[45] Hardin names the Spanish colonies in northern South America as another possible source of Rolfe's tobacco.[46] If the seeds did in fact come from Bermuda and not South America, there remains the question of how the seeds arrived in Bermuda and what variety they were. Walsh, Jarvis, and other scholars such as Jean Russo and J. Elliot Russo agree that tobacco was growing wild on Bermuda, brought by earlier

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[43] Accounts that agree that Rolfe had the seeds with him when he arrived in the colony include Jarvis, M, *In the Eye of All Trade: Bermuda, Bermudians, and the Maritime Atlantic World, 1680-1783*, (The University of North Carolina Press, 2010), 18-19; Walsh, *Motives of Honor, Pleasure, and Profit*, 36; Russo & Russo, *Planting an Empire,* 40. Journalist Kiernan Doherty offers an opposing view that Rolfe bought the seeds from a sailor in Jamestown who had visited the Spanish colonies in the Caribbean in Doherty, *Sea Venture: Shipwreck, Survival, and the Salvation of Jamestown*, 220, but does not offer a source for this claim. Hardin, "'Alterations they have made at this day'", 100 suggests Rolfe's seeds came from Trinidad or Tobago by way of Dutch traders or raiders.

[44] Walsh, *Motives of Honor, Pleasure, and Profit,* 36.

[45] Jarvis, *In the Eye of All Trade*, 18-19.

[46] Hardin, "'The same sort of seed in different earths.'", 139.

Spanish explorers. However, Walsh and Russo & Russo state the seeds were Oronoco, while Jarvis claims the seeds were of a different variety called Varinas.[47]

Figure 5: 17th-Century Map of Venezuela and the southern part of New Andalucia. This map by Henrik Hondius depicts Venezuela and New Andalucia, two provinces of the Spanish Empire in the 17th century that make up the modern state of Venezuela. Note the close proximity between the mouth of the Orinoco, Trinidad, and the settlement of Comana in the lower right quadrant of the map. Each of these locations is associated with a highly prized variety of tobacco that Rolfe's Oronoco tobacco was compared to, suggesting his seeds originated somewhere in the vicinity. Hondius, H., 1612-1699, "Venezuela with the Southern Part of New Andalusia." Accessed via the Library of Congress.

[47] Walsh, *Motives of Honor, Pleasure, and Profit* , 36; Russo & Russo, *Planting of an Empire,* 40; Jarvis, *In the Eyes of All Trade,* 18-19.

Contemporaries of Rolfe shed some light on the source(s) of his tobacco seeds. Ralph Hamor, an early secretary of Virginia, wrote in 1615 that the "goodnesse " Rolfe's tobacco was comparable to that of "west-Indie Trinidado or Cracus," pointing to an origin in the Spanish colonies near Venezuela.[48] The mouth of the Orinoco River in what is now Venezuela is not far from Trinidad, and both were under Spanish control at the time (Figure 5). Furthermore, Varinas tobacco, the variety mentioned by the historian Jarvis, was a highly prized Spanish tobacco grown in Venezuela.[49] Rolfe's plantation was even named Varinas or Varina because of how similar his tobacco was to the variety Varina, named after a small settlement on the Venezuelan coast near Comana.[50] It seems likely, given the noted similarity in product and the similar names, that Rolfe's tobacco originated from Venezuela near the Orinoco River, possibly by way of Bermuda.

Another odd feature of this tobacco origin story is that it is the only widely reported story of *Nicotiana tabacum's* introduction to the Chesapeake. In most works, only John Rolfe's arrival (with seeds in hand) is recorded, and then a couple decades of "experimenting" are skipped over.[51] Yet, it seems improbable that tobacco seeds were introduced only once to Virginia, or that it all stemmed from one source or even one geographic area. The reasons why become clear when you consider how rapidly production increased even within the first decade tobacco was exported from Virginia (Figure 6). The cultivation of tobacco plants involves a process called "topping" where the buds are removed

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[48] Hamor, R., "A True Discourse of the Present Estate of Virginia, and the successe of the affaires there till the 18 of June, 1614 . . ." (Accessed via the Library of Congress, 1615), p. 24.
[49] Gray, S. and Wyckoff, V. J., "The International Tobacco Trade in the Seventeenth Century." (*Southern Economic Journal* 7 (1), 1940), 3, 5 note 4.
[50]Varina Plantation National Register of Historic Places Inventory Nomination Form (1974). National Park Service. Available at https://www.dhr.virginia.gov/VLR_to_transfer/PDFNoms/043-0020_Varina_Plantation_1977_Final_Nomination.pdf; Comes, O. 1900. "Histoire , géographie, statistique du tabac.", 9.
[51] Hardin, "'The same sort of seed in different earths.'", 139; Walsh, *Motives of Honor, Pleasure, and Profit*; Russo & Russo, *Planting an Empire,* 40.

from the plant so it will devote more resources towards leaf production, thereby increasing yield.[52] However, this means that plants grown for market cannot produce seeds for the next season. This means planters likely had to either purchase new seeds from within the colony or abroad, or grow plants specifically for seed production, or do some combination of the two. While a domestic market may well have sprung up later, it seems odd to suggest Rolfe or other planters shared their carefully cultivated seeds, especially as plantations transitioned from direct Virginia Company control to smaller joint-stock investment groups to individual owners.[53] As the groups controlling plantations became increasingly numerous between 1620-1640, there would have been more value in keeping your seed to yourself—or selling it for profit—than sharing freely with your competitors. Therefore, it would have been hard to produce the number of seeds necessary to support the rapid expansion of the cultivation of tobacco in the early 17th century without additional seed imports.

Despite the need for seeds to grow tobacco, I have found no discussion of seed markets or exchanges in my research, and only one distinct shipment. Expanding our understanding of the early tobacco seed market could be used to track possible sources of genetic diversity in the colonial Chesapeake market. After all, it only takes one mutant specimen, carefully bred by an observant planter, to produce a new strain, as seen in the example of modern White Burley tobacco.[54]

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[52] Russo & Russo, *Planting an Empire*, 56.
[53] Walsh, *Motives of Honor, Pleasure, and Profit*, Ch.1, particularly 28-46, 83-87.
[54] Gage, "Historical Factors Affecting American Tobacco Types… ", 48.

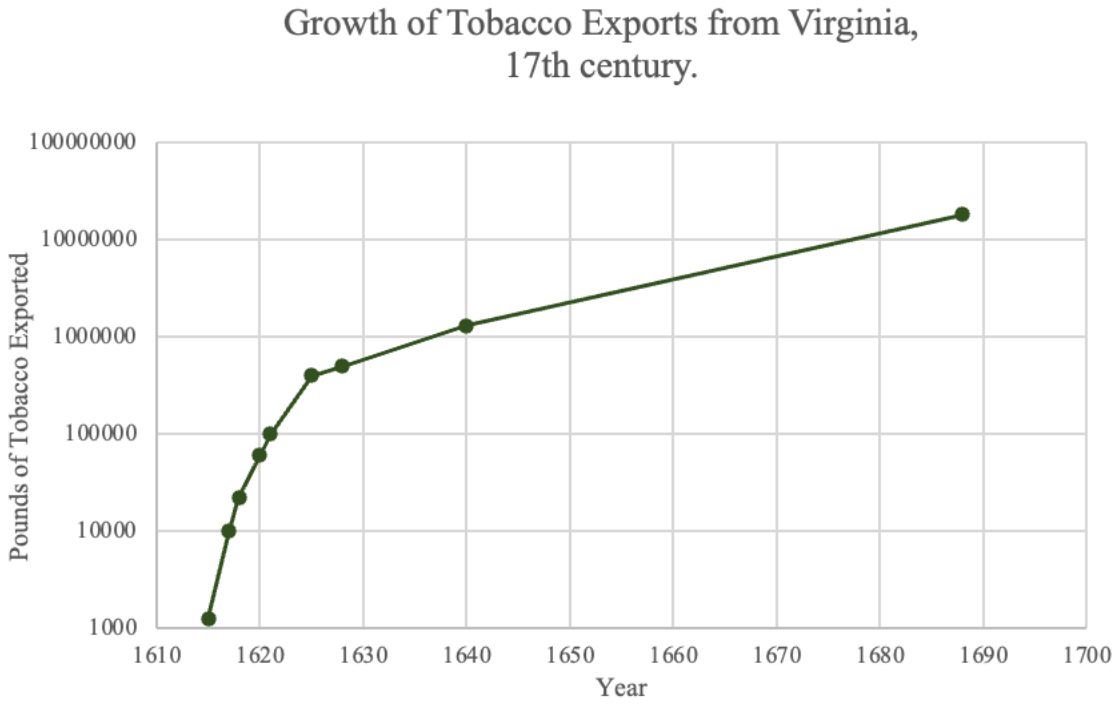

Figure 6: Growth of Tobacco Exports from Virginia, 17th Century. Exports of tobacco increased exponentially after its introduction, hitting 100,000 pounds within ten years and over 1,000,000 pounds before midcentury. Data drawn from Garner, W. 1946, *The Production of Tobacco*, The Blakiston Company. p.46 and Bailyn, B., 2012, *The Barbarous Years*, Alfred A. Knopf, p.79-80. Garner and Bailyn cite slightly different export numbers for 1618 and 1619 (25,000 lbs vs 20,000) so for the purposes of this figure 22,000 lbs was used for the year of 1618.

Given that the key period of tobacco strain development corresponds with Virginia's transition from a company colony to a royal colony, it seems possible that individual planters could have introduced genetically distinct lineages of tobacco that contributed to the development of the Sweet-Scented and Oronoco tobacco strains between 1620-1650.[55]

In order to track seed movement through colonial Virginia, I investigated records from the British Board of Trade and the records of Middlesex, Essex, and York counties from the 17th century to determine if there are any existing import records from the early colonial period. I also surveyed individual planter's records for evidence of exchanges of seeds

[55] Walsh, *Motives of Honor, Pleasure, and Profit,* Ch.1, particularly 28-46, 83-87

between plantations (e.g., The Diaries of George Washington and Colonel Landon Carter of Sabine Hall, as well as the Frederick Hall Plantation Books, and the Robert Beverly Letterbook). Additionally, accounts from The Custis Papers in the Colonial Williamsburg Library provided valuable insight into the management of the Custis Plantation in York County.[56] These accounts and accounts like them can provide key information on where tobacco seeds were coming from and how they grew, both of which are needed to assess how genetics played a role in differentiating tobacco strains. This work could take years to complete through the careful examination of records from the British, Dutch, and Spanish empires, as well as colonial records, which span numerous languages and locations. It would be impossible to capture them all in this study; however, my early work has shown the importance of turning to sources outside the English language for missing perspectives.

Jerome Brooks, a rare books expert and author, suggested that there were at least two or three introductions of tobacco between 1611 and 1620 from distinct locations based on writings and ephemera on tobacco in the collection of George Arents.[57] The Arents Collection is housed at the New York Public Library and constitutes the "largest and most comprehensive library in the world devoted to the history, literature, and lore of tobacco."[58] Brooks believed Rolfe's original tobacco seeds came from the Orinoco River region, based on Hamor's 1615 account (quoted above). In 1619 William Strachey, secretary of the

[56] These planters are known to have left papers and documents about their plantations and business dealings, and have been referenced by other Chesapeake scholars, particularly Lorena Walsh.
[57] "J. E. Brooks, Author, Rare Books Authority" (New York Times, 1983); Brooks, J. E., *Tobacco: Its History Illustrated by the Books, Manuscripts, and Engravings in the Library of George Arents Jr.* Volume I. (The Rosenbach Company, 1937).
[58] "George Arents Collection: Rare Book Collection," nypl.org, New York Public Library, Accessed April 15th, 2025, https://www.nypl.org/locations/schwarzman/rare-books-division/arents-collection.

Virginia colony, notes in an import list "tobacco-seed from Trindado," which Brooks interprets as a second, distinct importation of tobacco from Trinidad.[59]

Brooks then draws on the work of Orazio Comes, a 19th- to early 20th-century Italian botanist, to explain how the importation of tobacco from separate locations may have contributed to the development of Sweet-Scented and Oronoco tobacco. Comes claims that

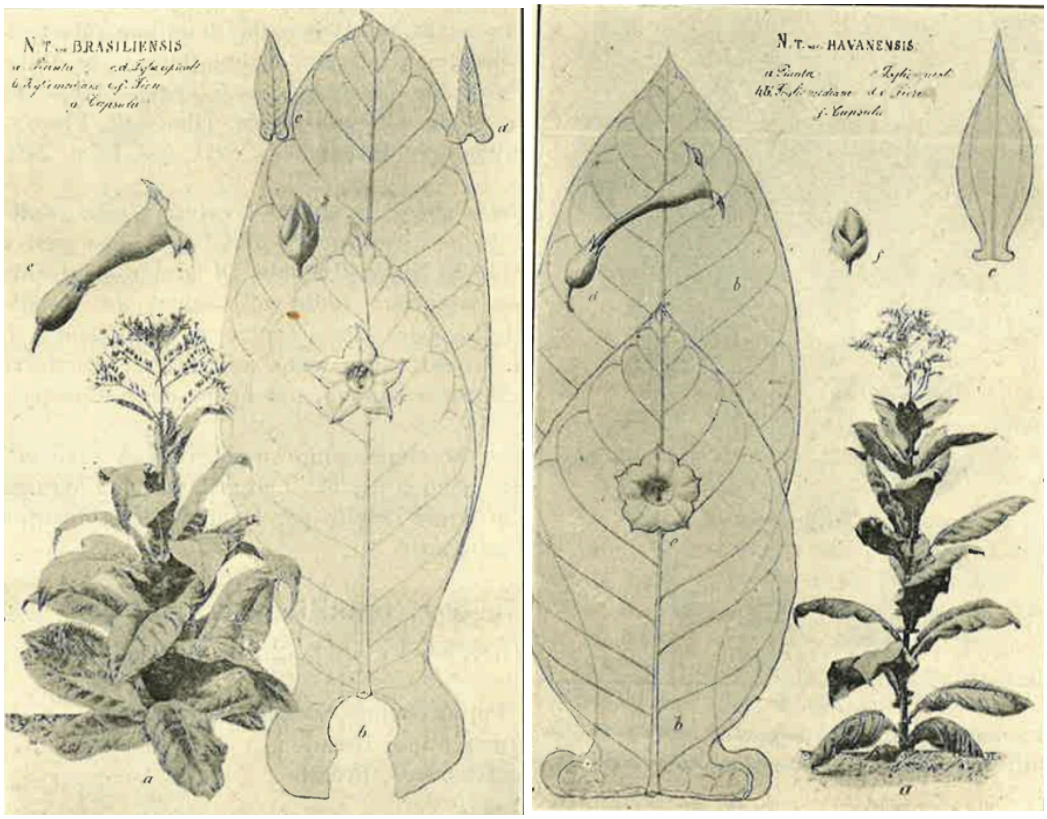

Figure 7: Botanical Illustrations of *N. tabacum var. brasiliensis* and *N. tabacum var. havanensis* by Orazio Comes. Comes believed the Oronoco tobacco arose from *var. brasiliensis* (left), which grew around the Orinoco River in the early 17th century and had sharp leaves and a strong taste. Similarly he believed Sweet-Scented tobacco arose from *var. havanensis* (right) due to their similarity in leaf shape and taste. Taken from Comes, Orazio, *Delle Razze dei Tabacchi: Filogenesi, Qualità, ed Uso* (Società Cooperativa Tipografica, 1905), 19-20, 22-23, 122

the Oronoco variety resulted from the adaptation of *N. tabacum var. brasiliensis*, a variety that grew near the Orinoco and Amazon Rivers in South America, to the local climate (Figure 7a).[60] Sweet-Scented tobacco, according to Comes, arose from a third introduction of

[59] Strachey, *The Historie of Travaile into Virginia Britannia,* 31; Brooks, *Tobacco* Vol. 1, 526; Billings, E. R., *Tobacco; Its History, Varieties, Culture, Manufacture and Commerce* (American Publishing Company, 1875), Ch. 14.
[60] Brooks, *Tobacco* Vol. 1, 526.

tobacco from Cuba, that he refers to as *N. tabacum var. havanensis* (Figure 7b).[61] If correct, Comes's theory means that there were diverse genetic populations present in Virginia from almost the very beginning of colonial tobacco production there, contributing to the emergence of new strains along with soil and climate factors. Aside from Comes and Brooks's accounts, I was able to find only one other account of seed importation into Virginia, coming from a Maryland law book after the colonial period.[62] Discussions of seed exchange within the Chesapeake were limited to accounts in the 1760s linking the decline of Sweet-Scented tobacco to its decline in quality.[63]

[61] Comes, O.,*Histoire, Géographie, Statistique du Tabac* (Typographie Coopérative, 1900), 50; Comes, *Delle Razze dei Tabacchi,* 122-123.
[62] "An Additional Supplement to an Act, entitled. An act to regulate the inspection of tobacco," *Maryland Law Book*. (1820).
[63] Walsh (2010) *Motives of Honor, Pleasure, and Profit* p. 597-598. The details of these accounts are discussed at the end of the next section.

LINKING COLONIAL ACCOUNTS TO BIOLOGICAL TRAITS

Orazio Comes's theory about the origins of Sweet-Scented and Oronoco tobacco provides a possible explanation for how the two varieties could belong to genetically distinct lineages. Comes's theory is supported by comparisons of their traits with other tobacco varieties and each other. Hugh Jones gives the most cited colonial account of the appearance of each strain, writing (in 1724) that Oronoco tobacco had "a sharper leaf like a Fox's Ear" while Sweet-Scented tobacco were "rounder and with finer fibers."[64] His description of Oronoco tobacco is similar to Stratchey's account of tobacco from Orinoco and Trinidad as "large, sharpe and growing two or three yardes from the ground."[65] The similarity between Stratchey and Jones's accounts lends support to Comes's theory that Oronoco tobacco arose from tobacco sourced around the Orinoco river. However, these arguments rely on a particular vision of what makes organisms different from each other, called the morphological species concept. The morphological species concept groups organisms together based on their physical traits, assuming shared traits reflect a shared lineage. While intuitive, this idea can be misleading, causing organisms that are not closely (genetically) related at all to be grouped together.[66] The opposite is also possible. Despite appearing different in form, the two varieties of tobacco could be a single genetic lineage exhibiting a

[64] Jones, H. (1724). *The Present State of Virginia* p. 40.
[65]Strachey (1619) *The Historie of Travaile into Virginia Britannia* p. 122-123.
[66] A famous example of this is the recurrent evolution of crabs. Many organisms we recognize and call crabs today evolved separately from different lineages within the decapod order.

broad range of plasticity—the ability to express different traits in response to environmental conditions while having the same genotype.[67]

In order to test Comes's theory further I have searched for descriptions of tobacco planted both within the Sweet-Scented tobacco region identified by Hardin and in the surrounding tidewater region. In particular, I was most interested in instances where Oronoco was planted in soils suitable for Sweet-Scented strains, and the opposite—that is, attempts to plant Sweet-Scented strains in soil more suitable for Oronoco. To find these accounts I searched planters' ledgers and day books, many of which have been digitized by organizations such as the Virginia Museum of History and Culture, the University of Virginia, and the Library of Virginia. In addition, the Royal Society of London solicited accounts from travelers who spent time in colonial Virginia, such as John Clayton, which have proven useful in my search due to their descriptions of plantations they visited.

By comparing these descriptions I attempted to discern if a) Sweet-Scented and Oronoco tobaccos might be the same species responding to different types of soil; b) Sweet-Scented is a separate species from Oronoco that can only survive in the specific conditions as identified by Hardin, with Oronoco exhibiting plasticity depending on the soil it is planted in; or, c) Oronoco and Sweet-Scented are separate species both of which exhibit significant plasticity based on the environment in which they are planted. Each possibility could be confirmed by a unique set of observations. Either a) Oronoco tobacco seeds and Sweet-Scented tobacco seeds grow into plants that appear the same when planted in the same conditions; b) Sweet-Scented tobacco seeds only grow in Sweet-Scented regions, but seeds believed to be Oronoco tobacco can be grown in either region, with varying traits depending

[67] e.g. Forsman, "Rethinking phenotypic plasticity…", 276-284.

on the environment; or c) Sweet-Scented tobacco seeds and Oronoco tobacco seeds are able to grow in both regions, varying in traits depending on the region, but do *not* appear identical to each other.

Two contemporary accounts from the late 17th century illustrate cases of each variety being grown outside of its usual environment. The first account comes from John Clayton, an English rector traveling through Virginia, who wrote to the Royal Society of London about the colony of Virginia in 1688. He noted that when Sweet-Scented tobacco was grown on "Pine-wood land," which was considered poor tobacco land because of its low fertility and increased acidity, was "large and porous" and "smoked as coarsely as Aranoko (Oronoco)."[68] Clayton's account shows a clear decline in Sweet-Scented tobacco quality when grown on other soil to an extent that he called it "agreeable" to Oronoco tobacco. Unfortunately, Clayton did not offer a description of the Sweet-Scented tobacco's leaf shape when grown on Pine-wood land, which could have shed light on whether the tobacco looked like Oronoco tobacco or was just of a similar quality. Taken alone, Clayton's account suggests that soil conditions are truly a key differentiating factor between Sweet-Scented and Oronoco tobacco.

However, the second account, from the letters of William Fitzhugh, offers a conflicting piece of evidence. Fitzhugh was an affluent 17th-century planter who owned extensive land in the periphery of the Sweet-Scented region between the upper reaches of the Rappahannock and the southern bank of the Potomac rivers (Figure 4).[69] In a 1698 letter to John Cooper, a London merchant who sold Fitzhugh's tobacco for him, Fitzhugh apologizes

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[68] Hardin, "Alteration They Have Made at this Day", 137-143; Clayton, "A Letter from Mr. John Clayton …", 17.

[69] Breen, T., *Tobacco Culture: The Mentality of the Great Tidewater Planters on the Eve of the Revolution.* (Princeton University Press, 1985), 44.; See also "Fitzhugh Family Plantations" https://ravensworthstory.org/people/owners/fitzhugh-family/fitzhugh-family-plantations/

for not consigning any tobacco to him because Oronoco tobacco had been "generally sorry" and he had not grown "anything but sweet for some years."[70] This is particularly interesting because John Clayton claimed "the richer the land the better" for Oronoco tobacco, an observation supported by the differentiation of Oronoco tobacco into two subvarieties: Brightleaf Oronoco, which was considered superior, and Dull Leaf Oronoco.[71] Following this logic, sweet-scented soils, considered the best soils in the Chesapeake region for tobacco, should have produced excellent Oronoco tobacco.[72] Instead, this letter suggests that there were cases when Oronoco tobacco could not grow on sweet-scented land, which could mean Oronoco and Sweet-Scented tobacco had distinct nutrient requirements or habitats. Without more contemporary accounts, it is impossible to say for certain if this is true; but possible distinctions between Sweet-Scented tobacco land and prime Oronoco tobacco land are explored in the next section.

In order to attempt to corroborate these historical descriptions of tobacco traits, I have searched the scientific literature for more recent genetic studies of different strains of tobacco, to see if any significant differences have been established between modern commercial tobacco strains or if any studies have been conducted that include historical strains. Genetic sequencing has been remarkably successful in differentiating other species that are morphologically similar throughout their life cycle because they rely on another species concept: the phylogenetic species concept.[73] The phylogenetic species concept

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[70] Richard Beale Davis, ed., *William Fitzhugh and His Chesapeake World, 1676-1701* (Chapel Hill, University of North Carolina Press, 1963), 357-358.
[71] Clayton, "A Letter from Mr. John Clayton…", 15-16 ; Hardin, "'The same sort of seed in different earths.'", 139; Schweitzer, M. M., "Economic Regulation and the Colonial Economy: The Maryland Tobacco Inspection Act of 1747." (*The Journal of Economic History* 40 (3), 1980), 558.
[72] Hardin, "Alteration They Have Made at this Day", 144.
[73] For an example see Bickford, D., Lohman, D.J., Sodhi, N.S., Ng, P.K.L., Meier, R., Winker, K., Ingram, K.K., & Das, I., "Cryptic species as a window on diversity and conservation." (*Trends in Ecology and Evolution.* 22 (3), 2007), 148-155.

defines a species as the smallest possible group of organisms that have a common ancestor and traits that distinguish them from other individuals.[74] This concept avoids some of the pitfalls of the morphological species concept by accounting for differences in traits that cannot be observed with our eyes or microscopes. Constructing phylogenies based on genetic data also accounts for evolutionary relationships more directly than morphology-based studies because they study the code of genetic inheritance directly, side-stepping the problem of plasticity.

For studies that include historical strains, results that show Sweet-Scented and Oronoco tobacco are not sister taxa (i.e., most closely related to each other) would support genetics as a significant factor in their differentiation. Another result that would suggest genetic differentiation is if the two strain phenotypes are sister taxa, but have been evolving separately for a long time (have many mutations separating them from their common ancestor and each other). For studies that do not include historical strains, results that show a separation between established descendants of each variety would suggest a genetic difference between Sweet-Scented and Oronoco tobacco, though that difference could have arisen after the colonial period (as discussed in the historiography).

The most recent analysis I have found that mentions colonial strains is from 1987, which examines the relationship between 131 cultivars of tobacco.[75] Researchers found a tight cluster between three strains: Maryland Broadleaf, Sweet-Scented, and White Burley.[76] This cluster was found to have a within-group r, or relatedness value, of 0.62 (higher than the r value between full siblings), while r-value between that group and other strain was

[74] Genetic differences can count as distinguishing traits under this species concept, but there is an ongoing debate on what the threshold of genetic difference should be to qualify individuals as a species.
[75] Cultivar is another word for variety that emphasizes the role of human cultivation techniques in the creation of particular traits as opposed to other factors
[76] Murphy, J. P., Cox T. S., Rufty R. C., and Rodgers D. M., "A representation of the pedigree relationships between flue-cured tobacco cultivars." (*Tobacco Science* 31, 1987), 70-75.

extremely low (0.03-0.04).[77] These findings seem to corroborate the ancestral link suggested by Garner et al.[78] White Burley is a mutant variety of Burley tobacco, which was a form of Maryland Broadleaf.[79] Therefore it makes sense that the two varieties are clustered together. However, Murphy et al. do not disclose how they sampled Sweet-Scented tobacco, which was considered extinct by the 1930s.[80] This discrepancy casts some doubt on how Sweet-Scented tobacco was placed in the cluster with Maryland Broadleaf and White Burley. Without establishing a definitive link between Sweet-Scented tobacco and a modern tobacco strain, it is not possible to use more recent phylogenetic analyses of tobacco varieties to examine the relationship between Sweet-Scented and Oronoco tobacco. Without living samples of the tobacco strain genotypes to sequence, it is impossible to fully apply the phylogenetic species concept in this case. Therefore I find that using a morphological species concept, with considerations for plasticity, is the best option for differentiating Oronoco and Sweet-Scented tobacco strain phenotypes.

One possible explanation for the disappearance of Sweet-Scented tobacco is that it lost the genetic differences that differentiated it from Oronoco tobacco. In the 1750-1760s there was a noted decline in the quality of Sweet-Scented that, combined with the increasing quality of Oronoco tobacco, caused the prices of Sweet-Scented and Oronoco tobacco to converge.[81] Planters noted decreasing yields as the Sweet-Scented crop lost its characteristic dense leaves and other traits of "true sweet scented" tobacco. Walsh maintains that the change in quality is due to loss of soil fertility, but acknowledges that genetic modifications could also have played a role as Sweet-Scented seeds were "ever more widely" exchanged

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[77] Murphy et al., "A representation of the pedigree relationships…", 70-75.
[78] Garner et al., "Superior Germ Plasm in Tobacco", 813.
[79] Garner et al., "Superior Germ Plasm in Tobacco", 820
[80] Garner et al., "Superior Germ Plasm in Tobacco" 808.
[81] Walsh, *Motives of Honor, Pleasure, and Profit,* 431.

throughout Virginia. This theory is supported by a 1764 letter from Joseph Valentine, the manager of George Washington's in the Sweet-Scented region. Washington accused Valentine of planting Oronoco tobacco on his plantations because of the quality of the tobacco produced, and Valentine defended himself saying Sweet-Scented would "alter and ware (wear) out" if it was not exchanged between plantations.[82] The fact that the struggle for quality seed was blamed for the decline in Sweet-Scented tobacco quality even in the longest cultivated area of the Sweet-Scented region underscores how important seedstock was considered as a factor in tobacco quality.

Therefore, it seems important to consider more seriously the possibility that Sweet-Scented and Oronoco tobacco hybridized over time, and as genetic differences (stemming from different populations of origin) became homogenized, Sweet-Scented tobacco was no longer a distinct variety. This theory was considered seriously by Comes, who dubbed the hybridized variety *Nicotiana tabacum var. virginica* (Figure 8), an intermediate type of tobacco that would sometimes appear like Sweet-Scented and sometimes as Oronoco, fitting the details of Valentine's account.[83] In order to further support this claim, more work would need to be done to verify Comes's initial theories about the origins of Sweet-Scented and Oronoco tobacco, as well as to find more contemporary accounts that consider or illustrate the importance of seedstock in declining Sweet-Scented tobacco quality.

[82]Walsh, *Motives of Honor, Pleasure, and Profit*, 597-598.
[83] Comes, *Delle Razzi dei Tabacchi,* 122-123.

Figure 8: Botanical Illustration of *N. tabacum var. virginica* by Orazio Comes. Comes believed *var. virginica* to be an intermediate type of tobacco that developed from the hybridization of Sweet-Scented and Oronoco tobacco in Virginia over time. Image taken from Comes, 1905, p. 21.

EXAMINING SOIL CONDITIONS AND PARENT MATERIAL

In order to discern the role soil conditions and parent material played in shaping colonial tobacco strains, the environments in which each strain of tobacco grew must be documented. Considering the approximately 200-year gap between the study period and the oldest available soil surveys, it is difficult to assess what the soil was like during the colonial period. However, evidence suggests that when tobacco soil was "exhausted," it was probably due to a temporary depletion of nitrogen, rather than a long term damage to the soil.[84] More important was the increased erosion caused by the removal of trees to make way for tobacco fields. [85] However, county soil surveys and surficial geology remain the best data we have available to study the soil conditions in particular areas, and can still be useful in combination with historical accounts.

Hardin used county soil records for Digges Neck (Figure 9 site 2), a known Sweet-Scented tobacco plantation along the York River, to identify the types of soils in which Sweet-Scented tobacco was grown. The soil on Digges Neck was a mix of fine textured soils with high organic matter content, which aligned with contemporary accounts from colonial planters and travelers passing through Sweet-Scented tobacco lands.[86] Using the soils found on Digges Neck as a guide, Hardin examined Virginia soil maps to find similar soils in the coastal plain and map them (Figure 4b).

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[84] Walsh, *Motives of Honor, Pleasure, and Profit,* 358; Hardin, " The Same Sort of Seed in Different Earth", 148, 153; Percy, "The Production of Tobacco Along the Colonial Potomac", 50-53.
[85] Percy, "The Production of Tobacco Along the Colonial Potomac", 51-52.
[86] Hardin, "The Same Sort of Seed in Different Earths", 143-146.

To investigate these associations further, I have examined soils and their sediment sources at three additional sites where Sweet-Scented tobacco was grown in Tidewater Virginia (Figure 8). These sites, along with Hardin's, have experienced significant change since the colonial period, particularly in regards to sea level. Today, the Chesapeake Bay region is experiencing sea-level rise at twice the global rate of sea-level rise.[87] The reasons behind the Chesapeake's rapid sea-level rise can be traced back to the last glacial maximum, when the Laurentide Ice Sheet sat heavily to the north of the Chesapeake Bay region. Though the glacier never covered the Chesapeake region itself, its heavy weight pressed down on the continental crust, displacing the mantle beneath. The displaced mantle then pooled beneath the nearby, unburdened Chesapeake region, uplifting the continental crust. As the ice sheet began to retreat, the bulge began to subside, allowing the land to sink down. The subsiding Earth only compounds the effects of ice sheets and glaciers melting globally, causing sea level to rise at a rate of 3.4 millimeters per year on average in the Chesapeake region.[88] Using this rate as an estimate, sea level could have risen as much as 935 millimeters, or around three feet, since the mid-18th century, and perhaps as much as four-and-a-half feet since John Rolfe began growing tobacco in Virginia. Therefore, it is likely that there were significant areas of land available to colonial planters along the river banks that are underwater today, whose quality and parent material we cannot assess. Secondly, the lower sea level would have reduced the influence of saline or brackish water on areas that today are too saline for agricultural use. Due to these factors, this study is limited in its ability to assess the full extent of sweet-scented land that would have been available to planters during the colonial

[87] The global rate accounts only for sea level rise driven by the melting of glaciers worldwide, which increases the total amount of water in the oceans, and not for other local conditions that contribute to local or regional rates of sea level rise.

[88] DeJong, B.D., P.R., Bierman, W.L., Newell, T.M., Rittenour, S.A., Mahan, G., Balco, and D.H. Hood, "Pleistocene relative sea levels in the Chesapeake Bay region and their implications for the next century" (*GSA Today 25(8)*, 2015), 4-10.

period. However, there is still value in analyzing remaining plantation sites for any patterns in soil conditions and parent material that could clarify the relationship between tobacco strain phenotypes and environmental factors.

The first site I have considered is Varinas, the plantation where John Rolfe grew the first successful crops of *N. tabacum* in 1612. Varinas lies in the upper reaches of the Coastal Plain along the James River in what is now known as Henrico County, Virginia (Figure 9 site 1).[89] Along the York River (and its tributaries, the Mattaponi and Pamunkey Rivers), I examined the soils and underlying sedimentary deposits at Digges Neck, the site used by Hardin as a model for Sweet-Scented tobacco soil because the tobacco grown there was called the best in colonial Virginia (Figure 9 site 2).[90] The next site I examined was the White House Plantation along the Pamunkey River, which was part of Martha Custis Washington's dowry lands managed by George Washington in the heart of the sweet-scented subregion during the mid-late 18thth century (Figure 9 sites 3 and Figure 4).[91] Finally, I considered Mount Pleasant in Essex County, part of the Garnett family lands lying along the Rappahannock River's south bank (Figure 9 site 4) in the periphery of the sweet-scented subregion (Figure 4).[92]

The southernmost site considered in this study, Varinas on the north bank of the James River, lies on Wickham fine sandy loam,[93] similar to the soils found at Digges Neck,

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[89] Varina Plantation National Register of Historic Places Inventory Nomination Form (1974). National Park Service. Available at https://www.dhr.virginia.gov/VLR_to_transfer/PDFNoms/043-0020_Varina_Plantation_1977_Final_Nomination.pdf

[90] Hardin, "The Same Sort of Seed in Different Earths", 144.

[91] Walsh, *Motives of Honor, Pleasure, and Profit,* 598.

[92] Essex County as a whole is considered in detail in Hardin, "Alterations They Have Made at this Day", which I will reference when discussing Mount Pleasant.

[93] United States Department of Agriculture, *Soil Survey of Henrico County, Virginia* (1914), https://archive.org/details/usda-soil-survey-of-henrico-county-virginia-1914/mode/2up.

which included Norfolk fine sandy loam, Norfolk sandy loam, and Portsmouth sandy loam.[94] Wickham fine sandy loam is most developed in the area around Varinas, and is a fine sandy loam. It is considered good for agriculture, but inferior to the Wickham silt loam found on neighboring necks.[95]

The White House Plantation, along the Pamunkey River in New Kent County, lies on two soil units: Nawney-Lanexa-Matten and Altavista-Dogue-Pamunkey. The Nawney-Lanexa-Matten unit is mostly considered unsuitable for agriculture because it has very poor drainage, making the soils anoxic and waterlogged. The Altavista-Dogue-Pamunkey unit, on the other hand, is much like the soils at Digges Neck and Varinas. The soils have a fine sandy loam or loam texture and are well-drained, and the parts along the Pamunkey River are well suited for farming.[96]

The third site, Mount Pleasant, is near Loretto, by the south bank of the Rappahannock River. This is part of the Garnett family's land, which extended west and north along the southern banks of the river. Hardin's dissertation notes that the soil in the lowlands of Essex County, where the Garnett's land was located, was a combination of silts

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[94] United States Department of Agriculture, *Soil Survey of the Yorktown Area, Virginia*, (1905), https://archive.org/details/usda-soil-survey-of-the-yorktown-area-virginia-1905 ; Summarized in Hardin, "The Same Sort of Seed in Different Earths.".

[95] United States Department of Agriculture, *Soil Survey of Henrico County, Virginia* (1914), https://archive.org/details/usda-soil-survey-of-henrico-county-virginia-1914/mode/2up.

[96] United States Department of Agriculture, *New Kent County Survey, Virginia* (1989), https://archive.org/details/usda-soil-survey-of-new-kent-county-virginia-1989 .

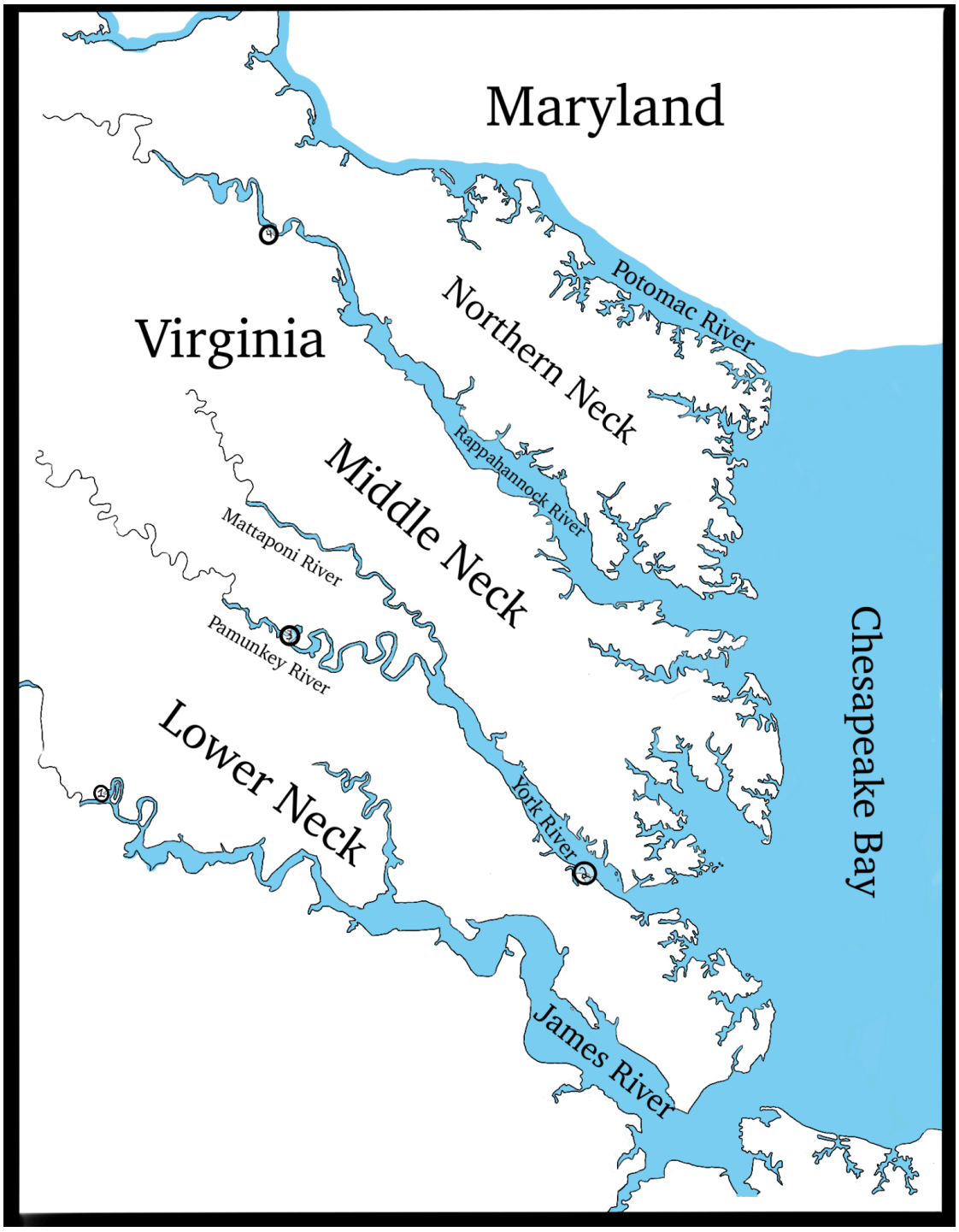

Figure 9: Location of Virginia Sediment-Soil Study Sites. The four sites within the sweet-scented region are labeled 1-4 from south to north. 1) Varinas Plantation (on the James River), 2) Digges Neck (York River), 3) White House Plantation (Pamunkey River, a tributary of the York), and 4) Mount Pleasant (Rappahannock River).

and loams.[97] According to the 1989 Essex County Soil Survey, there are two soil units within the site: Tetotum-Tomotley-State and Rappahannock-Molena-Pamunkey. The first unit's fertility is due to the mix of State and Tetotum soils, which are both well-drained, deep and finely textured silty loams, while the Tomotley soil is considered much less fertile. The second unit, closer to the river bank, was likely less suitable for farming. While the Pamunkey soil, also present at White House Plantation, is well-drained and finely-textured, the Rappahannock and Molena soils suffer from too little and too much drainage respectively.[98] While the soils are more mixed than at the other sites, the continued pattern of well-drained loam soils across the sweet-scented region supports Hardin's observations that Sweet-Scented tobacco is associated with finely textured, organic soils.

The lithology of the underlying sediments (parent material of soils) is a major factor in soil formation.[99] However, parent material is also known to affect the levels of trace nutrients, including plant nutrients like zinc, as well chemical and physical properties.[100] The relationship between specific formations and sweet-scented soils has not been well documented in other studies. Hardin noted the association between the deep alluvial deposits of the Quaternary Shirley and Tabb formations and Sweet-Scented tobacco soils in Essex County, crediting the fine-grained texture of the deposits for the soil's fertility, along with the lessened threat of erosion because of their position in the lowlands.[101] To expand on his

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[97] Hardin, "Alteration They Have Made At This Day", 67.
[98] United States Department of Agriculture, *Soil Survey of Essex County, Virginia* (1989), https://archive.org/details/usda-soil-survey-of-essex-county-virginia-1989 .
[99] Navarro-Hasse, E., Yáñez, C., Neaman, A., and Pinochet, D., "The effects of parent rock on soil clay mineralogy and soil physicochemical properties: A review." (*Idesia (Arica)* 41(4), 2023), 125-139.
[100] Hasse et al., "The effects of parent rock on soil clay mineralogy…"; Novoselov, A. A., Hodson, M. E., Tapia-Gatica, J., Dovletyarova, E. A., Yáñez, C., and Neaman, A., "The effect of rock lithology on the background concentrations of trace elements in alluvial soils: Implications for environmental regulation." (*Applied Geochemistry,* 2022), 146.

[101] Hardin, "Alterations They Have Made at this Day", 65-66.

observations, I have documented the underlying sediments along the major rivers throughout Tidewater Virginia, focusing on the four sites discussed above (Figure 9 and Figure 10).

The most striking result of my observations is the close association between peat-bearing sedimentary deposits and prime Sweet-Scented tobacco land. Each study site lies partially or entirely on the Quaternary Shirley Formation (Qsh) or the Chuckatuck Formation (Qc) (Figure 10). The Shirley Formation was deposited ~184,000 years ago during the middle late Pleistocene under the influence of river, marsh, and estuarine conditions. In areas along the coast of Chesapeake Bay, Shirley deposits include bay, barrier island, nearshore marine, and eolian deposits.[102] The exact age of the Chuckatuck Formation is not known, but it is older than the Shirley Formation, having been deposited somewhere between the early Pleistocene and the middle late Pleistocene. The upper portion of the Chuckatuck was deposited under tidal bay and estuarine conditions, while the older parts of the deposit were deposited under river and marsh conditions.[103]

The Shirley and Chuckatuck Formations are unique among the sedimentary deposits of the Coastal Plain because they contain not just sand, silt, and clay, but also notable amounts of peat.[104] Peat is an organic material formed from the incomplete or partial decomposition of terrestrial plant materials in waterlogged (oxygen-deficient or dysaerobic) conditions. The change in the environment of deposition of the Chuckatuck Formation reflects the fluctuating sea levels of the Pleistocene, which would have created the waterlogged conditions necessary for peat formation.[105] These conditions continued during

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[102] Johnson, G.H, and Berquist, C.R. Jr., "Geology and Mineral Resources of the Brandon and Norge quadrangles, Virginia" (Virginia Division of Mineral Resources, 1988), https://ngmdb.usgs.gov/Prodesc/proddesc_39837.htm .

[103] Johnson, G.H, and Berquist, C.R. Jr., *Geology and Mineral Resources of the Brandon and Norge quadrangles, Virginia*, https://ngmdb.usgs.gov/Prodesc/proddesc_39837.htm .

[104] *Geologic map of Virginia* (Virginia Department of Mineral Resources, 1973)

[105] Johnson, G.H, and Berquist, C.R. Jr., *Geology and Mineral Resources of the Brandon and Norge quadrangles, Virginia*, https://ngmdb.usgs.gov/Prodesc/proddesc_39837.htm .

the deposition of the Shirley Formation with sea levels fluctuating as glaciers receded from a glacial maximum towards an interglacial period.[106]

Soil organic matter is vital to soil fertility; its presence increases nutrient availability, water holding capacity, and porosity.[107] Having a readily available source of soil organic matter in the parent material of sweet-scented soils may explain why they are particularly fertile. This association is strong enough to warrant further study into how the Shirley and Chuckatuck Formations could have played a role in forming sweet-scented soils.

The association between these deposits and the sweet-scented soils identified by Hardin is reinforced by their similar distribution patterns. sweet-scented soils were not seen on the southern bank of the James River, except for one prominent point where a large deposit of Qsh occurs (Figure 10 and Figure 4b). Additionally, the long stretch of sweet-scented soils on the upper reaches of the Rappahannock River's south bank (Figure 4b) makes sense in light of the high concentration of Qsh deposits there (Figure 10). Additionally, Hardin notes that the southeastern portion of Essex County (including the area southeast of Mount Pleasant) had less sweet-scented tobacco soil, limiting production.[108] This observation aligns with the decrease in peat-bearing deposits south of site 4 on the banks of the Rappahannock (Figure 10).

The presence or absence of peat deposits alone does not explain why several counties on the banks of the Rappahannock produced significantly less Sweet-Scented tobacco, according to Drysdale's reports on tobacco quality from 1724 and 1726 (Figure 4a). Another key difference between the sediments adjacent to the Rappahannock River and those adjacent

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[106] Lauer, T. and M., Weiss, "Timing of the Saalian- and Elsterian glacial cycles and the implications for Middle – Pleistocene hominin presence in central Europe" (Scientific Reports 8:5111, 2018).
[107] Gerke, J., "The Central Role of Soil Organic Matter in Soil Fertility and Carbon Storage." (*Soils Systems,* 2022); Johnston, A.E. (1986). "Soil organic matter, effects on soils and crops." (*Soil Use Management* 2(3), 1986), 97-105.
[108] Hardin, "Alterations They Have Made at this Day", 240.

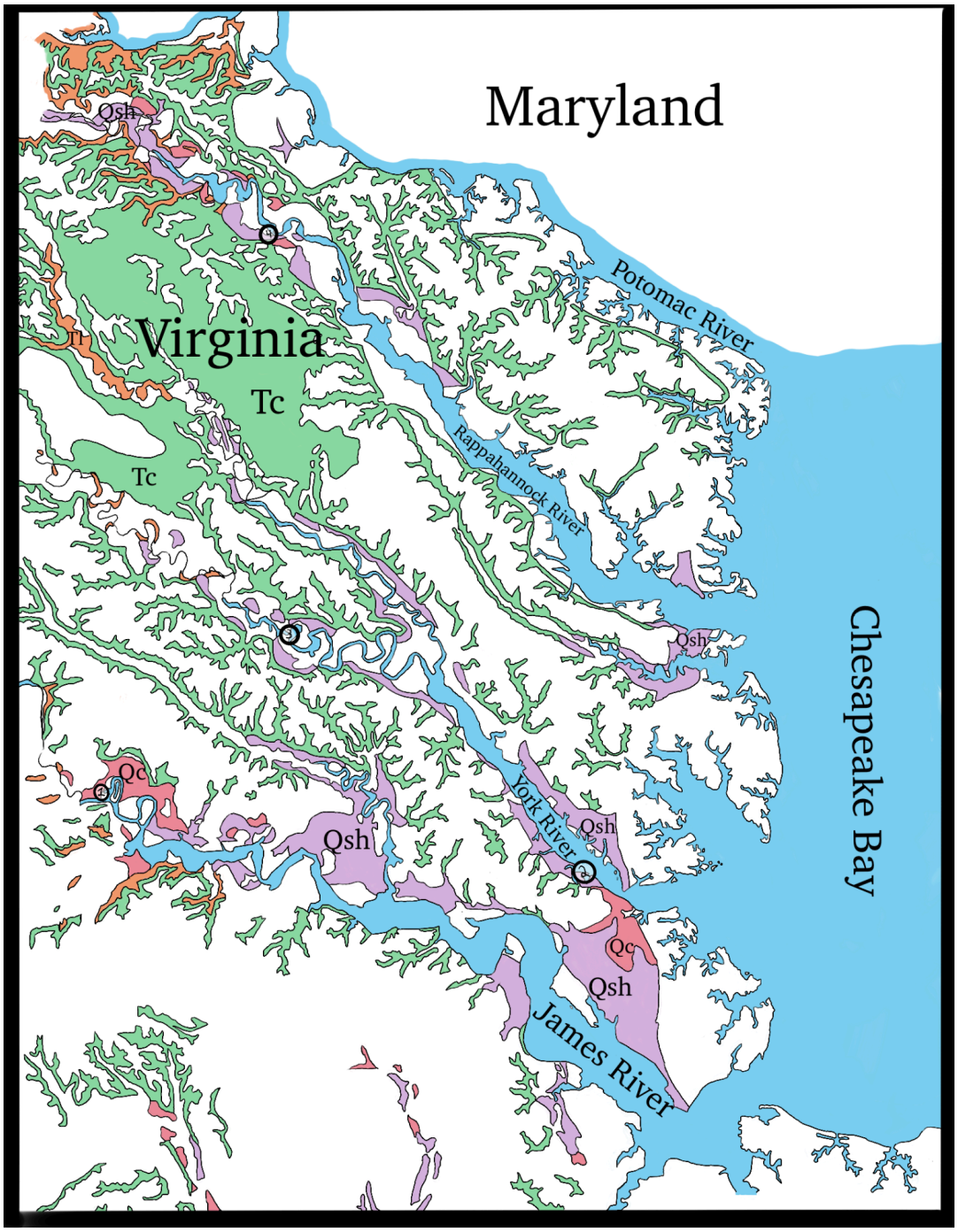

Figure 10: Distribution of Sediments in the Chesapeake. This map shows the location of the Shirley (Qsh) and Chuckatuck (Qc) Formations, as well as their underlying strata, the Chesapeake Group (Tc) and Lower Tertiary Deposits (Tl). Based on the Virginia Department of Mineral Resources "Geologic Map of Virginia" (1993). There is a strong association between the Shirley and Chuckatuck Formations and the study sites.

to the James and York Rivers is in the strata that lie directly below the Shirley and Chuckatuck Formations. On the James and York Rivers, the Chesapeake Group (Tc) underlies the Shirley and/or Chuckatuck Formations (Figure 10). The Rappahannock River deposits are underlain by older deposits from the Tertiary Period (Figure 10). The older Tertiary deposits (Tl) tend to lack a key mineral described in the Chesapeake Group: glauconite.[109] Soils formed on top of glauconitic deposits tend to be more fertile because levels of potassium, magnesium, and phosphorus—key plant nutrients—are elevated.[110] Therefore, the absence of the Chesapeake Group beneath the peat-bearing formations could be a possible factor in the changing conditions that make the Rappahannock basin less suitable for Sweet-Scented tobacco. This correlation should also be studied further in order to clarify the relative effect of different deposits on the formation of Sweet-Scented tobacco soils.

To further investigate if and how peat-bearing deposits contribute to the formation of sweet-scented tobacco soils, it is important to consider other places where prime tobacco was grown. Maryland lies completely outside the sweet-scented subregion; however, a type of prime tobacco called 'bright' or 'brightleaf oronoco' grew near the Patuxent River (Figure 11).[111] According to a French traveler in 1765, brightleaf tobacco was "as much esteemed as" Sweet-Scented tobacco (and drew higher prices than other kinds of Oronoco); yet it grew in Maryland around the Patuxent River in Anne Arundel and Prince George's counties, where

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[109] *Geologic map of Virginia* (Virginia Department of Mineral Resources, 1973).
[110] Van den Broek, J. M. M., & Van Der Marel, H. W., "Fertility and classification of Limburg soils (Netherlands) based on morphological, chemical and clay-mineral characteristics." (*Netherlands Journal of Agricultural Science* 11(3), 1963).
[111] Hardin, "The Same Sort of Seed in Different Earths", 139; ""Journal of a French Traveller in the Colonies, 1765," pt. I & II. (*American Historical Review*, 1921-1922)

Sweet-Scented tobacco could not.[112] Therefore, I also investigated a plantation called Mount Pleasant in Prince George's County, Maryland, which was seated between the main and the western branch of the Patuxent River (Figure 11).

The soils near Mount Pleasant, and in Prince George's County in general, have more deposits of gravel and sand than the sweet-scented soil regions farther south, but the uplands are dominated by Norfolk Loam. Based on soil surveys alone, there appears to be little difference between soils formed along the upper Patuxent River and the Virginia sites. Similar to the other loams studied, Norfolk Loam has a fine texture. The 1901 soil survey notes that this soil in particular has produced the best tobacco in Maryland since its beginnings as a royal colony in the 17th century, which likely refers to the brightleaf tobacco mentioned in the French traveler's account.[113]

Unfortunately, the geologic maps available for Maryland are not as detailed or updated as those available for Virginia. However, there is still much to be learned from examining the major sedimentary formations around the study site. The three main units underlying the study area are the Miocene Calvert Formation (Tc), and the Paleocene Nanjemoy (Tn) and Aquia (Ta) Formations (Figure 12). The Calvert Formation is underlain by the other two, which are exposed in incised rivers and streams (Figure 12). Unlike the Shirley and Chuckatuck Formations in Virginia, none of the three formations is mapped as containing peat.[114] The Aquia and Nanjemoy Formations belong to the Pamunkey Group.

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[112]"Journal of a French Traveller in the Colonies, 1765,"; Clayton, "A letter from John Clayton…"; Hardin, "The Same Sort of Seed in Different Earths", 139; Schweitzer, M. M., "Economic Regulation and the Colonial Economy", 558.

[113] United States Department of Agriculture, *Prince George's County Soil Survey, Maryland* (1901), https://archive.org/details/usda-soil-survey-of-prince-george-county-virginia-1985 .

[114] *Geologic Map of Maryland* (Maryland Geological Survey, 1968)

Figure 11: Location of Maryland Sediment-Soil Study Site. Mount Pleasant, a plantation in Prince George's County Maryland, produced Brightleaf Oronoco, a high quality variety of Oronoco tobacco. It was in central Maryland between the Main and Western Branches of the Patuxent River, just a few miles from Upper Marlboro, the county seat along the Western Branch of the Patuxent.

Like the Chesapeake Group, which underlies the Shirley and Chuckatuck formations in sweet-scented regions in Virginia, the sediments of the Pamunkey group are glauconitic.[115]

The presence of glauconite and absence of peat in the sediments underlying this area is interesting when considering the possibility that Sweet-Scented and Oronoco tobacco may have different nutrient requirements, as discussed in the above section. Glauconite seems to play a role in promoting the quality of tobacco in general, as seen in the brightleaf tobacco produced in Maryland, but it is unclear how significant a factor it is without further study. If Sweet-Scented and Oronoco tobacco phenotypes are instead differentiated primarily by environmental factors then this is still an important area of research to deepen our understanding.

[115] *Geologic Map of Maryland* (Maryland Geological Survey, 1968)

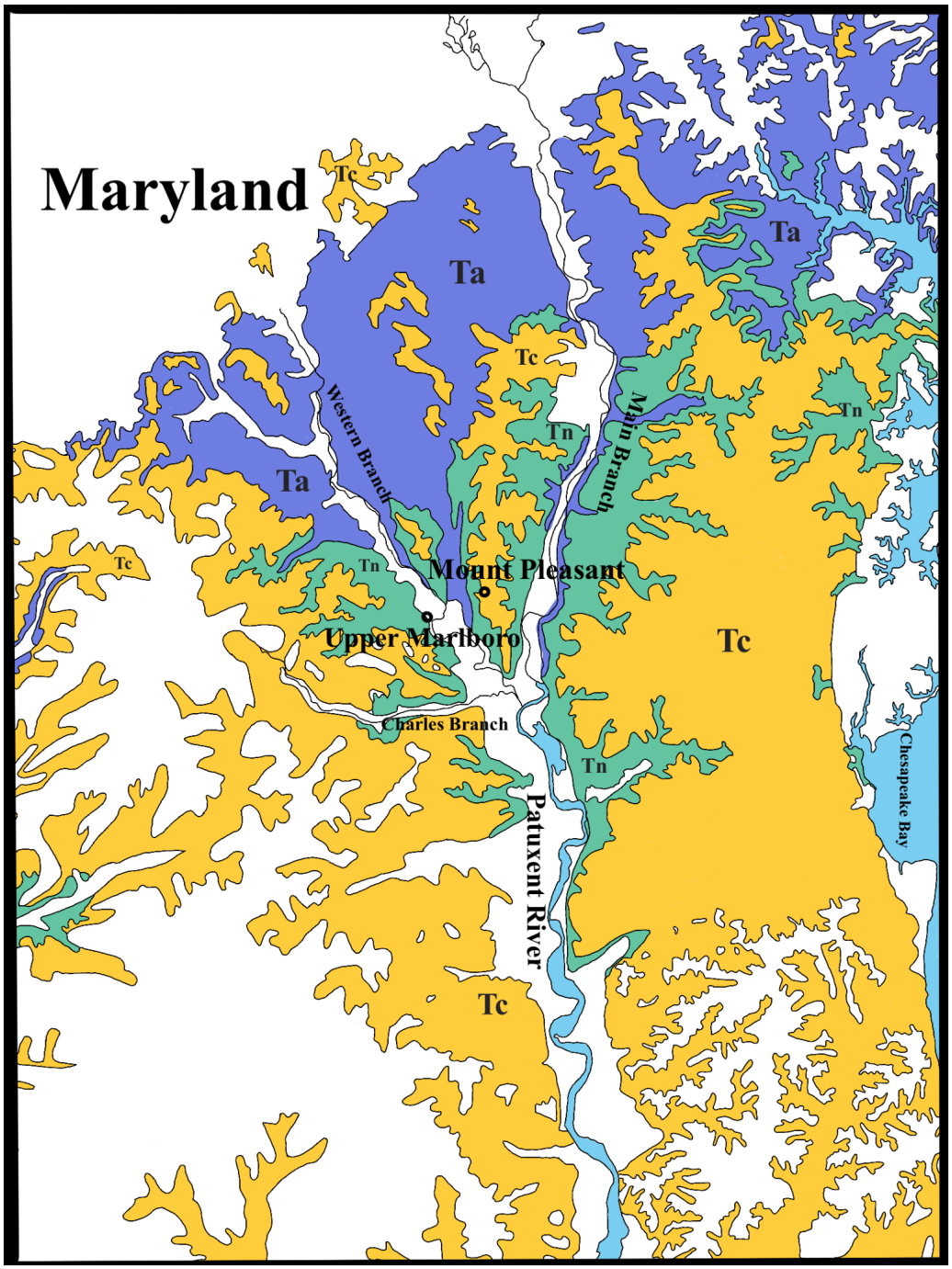

Figure 12: Distribution of Sediments near Upper Marlboro and Mount Pleasant, Maryland. This map shows the distribution of the Calvert (Tc), Nanjemoy (Tn), and Aquia (Ta) Formations. While none of these formations are peat-bearing, the Nanjemoy and Aquia Formations are glauconitic, similar to the Chesapeake Group in Virginia (Figure 10). Based on the Maryland Geological Society "Geologic Map of Maryland" (1968).

CONCLUSIONS

When considered altogether, the findings I have discussed here make a strong case that genetics should be reconsidered as an important factor in the differentiation of Sweet-Scented and Oronoco tobaccos. Ralph Hamor and William Strachey's 17th-century accounts provide evidence that multiple importations of tobacco seed from geographically distinct populations were made in the early period of tobacco production in the Chesapeake. Their accounts also provide strong support for Orazio Comes's theory that Oronoco tobacco arose from *var. brasiliensis*. Comes's observations about the similarities of Sweet-Scented tobacco to *var. havanensis* are also compelling, though more research needs to be done to pinpoint how or when seeds from Cuba would have entered colonial Virginia in order to solidify his theory. Regardless, it seems there is good reason to believe that Sweet-Scented and Oronoco tobaccos may have originated from genetically distinct lineages and, therefore, efforts should be made to clarify their possible origins and the effects these origins could have had on their distribution and quality.

One area of this research that should definitely be explored further is the behavior of Sweet-Scented and Oronoco tobacco when grown outside their subregions. The work I have done here is preliminary and could be strengthened by the addition of more colonial accounts from the 17th and 18th centuries. From the work done here, it seems that Sweet-Scented tobacco is a more specialized variety of tobacco, unable to thrive outside of its subregion. On the other hand, Oronoco tobacco seems to be a more generalist variety of tobacco, as shown by its multiple marketable subvarieties, Brightleaf and Dulleaf, depending on the fertility of

the soil on which it grows. Unfortunately, it seems unlikely that we will ever be able to apply phylogenetic analysis in a meaningful way to evaluate the genetic differences between Sweet-Scented and Oronoco tobacco directly. However, if further historical study establishes a firm relationship between Sweet-Scented tobacco and a modern variety, phylogenetic analysis could be used to study their relationships indirectly.

Since Clayton and Strachey's 17th-century accounts also clearly reinforce the importance of soil conditions in the differentiation of Sweet-Scented and Oronoco tobacco, future research should also continue to refine our understanding of the factors that created the soil conditions present in the colonial Chesapeake. As our understanding of the relationship between soil parent material and soil type grows, it will be interesting to see if the association between peat-bearing deposits and Sweet-Scented tobacco or the association between glauconite and prime tobacco land is significant.

The continued study of how Sweet-Scented and Oronoco tobacco were differentiated can only benefit us. If it is true that genetics was a key factor in their differentiation (and the eventual disappearance of Sweet-Scented tobacco altogether) then it represents a major gap in understanding what was required for Sweet-Scented planters to amass and maintain economic and political power in the colonial Chesapeake. Sweet-Scented planters would have needed not just access to sweet-scented land, but also connections to Sweet-Scented tobacco seedstock in order to grow the more profitable variety of tobacco. Therefore, being a Sweet-Scented planter would not just be a matter of the luck of surviving the early days of Virginia or inheriting the right land, but also of having the social, political, and economic connections to gain access to seedstock. If the reverse is true, and tobacco's plasticity is the dominant factor in its differentiation then the importance of early land ownership in the

colony of Virginia would be emphasized, since Sweet-Scented tobacco land was concentrated in the parts of Virginia seized first by colonists.

This gap can be filled by pursuing the research I have outlined above with particular attention to the early import and exchange of seeds in colonial Virginia. Through this work, we may better understand the characteristics of the plant that shaped the colonial Chesapeake by encouraging and enabling English colonists to displace Indigenous populations. The tobacco economy of colonial Virginia gave investors a reason to bankroll colonizers' displacement of Indigenous peoples from their homeland, rather than abandoning the colony of Virginia as a whole. Sweet-Scented tobacco had particular importance because of English smokers' preference for it, strengthening ties between England and its colony and making Sweet-Scented planters much wealthier than other planters in the colony. This facilitated Sweet-Scented planters prominence in the colony's government, as well as their access to the slave trade, allowing them to convert their workforce into enslaved laborers faster than other areas of the colony. By setting the standard of using enslaved people for labor in the early Virginia colony, the Sweet-Scented planters' took the first step to creating the racialized society we live in today.