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Land Surveying in Early Pennsylvania: A Case Study in a Global Context

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A Case Study in a Global Context

Abstract

By the end of the seventeenth century, Anglo-Americans on both sides of the Atlantic accepted the importance of surveying to any system of land ownership. Most historians of colonial British have similarly taken colonial surveying practices as a given. This article complicates these assumptions through an examination of Pennsylvania in a wider context. In fact, land policy in colonial Anglo-America differed significantly from practices elsewhere in the early modern world. English colonizers embraced a model of settler colonialism that created a market for land, thus encouraging the proliferation of modern surveying practices.

Keywords

surveying – land distribution – Pennsylvania – settler colonialism – Anglo-America

Modern geometrical surveying practices emerged during the sixteenth century in Western Europe before spreading around the globe, allowing men with a modicum of mathematical skill to measure and record the dimensions of land-holdings accurately. Surveys appealed to governments and private landowners alike. By using comprehensive registers of surveys known as cadasters, governmental officials assessed the state of land ownership at a glance. Plat maps of individual surveys and cadastral maps of a region offered outside investors a tangible grasp for land purchases that was previously only enjoyed by locals. Over time, through public and private intervention, surveys helped break up and reduce the bewildering variety of medieval land tenures, so that individual landholders with clear ownership were more easily counted for taxation purposes. As a result, James C. Scott has argued that surveys principally served

“the tax official and the land speculator;” while local landholders tended to resist surveys.¹

As surveying developed into a tool of the state during the early modern era, a variety of empires expanded into sparsely settled territories in the Americas, Central Asia and elsewhere. In some cases, these newly conquered regions became better surveyed than the mother country. In Scott’s words:

As a rule of thumb, cadastral mapping was earlier and more comprehensive where a powerful central state could impose itself on a relatively weak civil society ... It followed from the same logic that conquered colonies ruled by fiat would often be cadastrally mapped before the metropolitan nation that ordered it ... Where the colony was a thinly populated settler-colony, as in North America or Australia, the obstacles to a thorough, uniform cadastral grid were minimal.

While Scott’s assertion holds true for Australia and much of North America, surveying did not take powerful hold in many newly claimed regions. For example, Spain, Portugal, Russia, and the Qing Dynasty managed to invade and occupy borderlands without recourse to surveying—although this began to change during the eighteenth century. So why did surveys become so important in Anglo-America and what caused the other empires of the early modern period to eventually emulate this system? After all, surveys added a layer of bureaucratic hassle to land distribution, and isolated backcountry surveyors had the opportunity and incentive to collude with speculators to deprive the government and its favorites of the best frontier lands. Why would governments bother with them?²

Using early Pennsylvania as a case study can demonstrate the differences in land policy between English-derived societies and the rest of the world. English colonists first settled Pennsylvania during the 1680s, long after the empire had established settler colonies elsewhere in America. Critically, Pennsylvania’s first settlements took place after the Down Survey of Ireland, a comprehensive effort that surveyed and mapped Ireland during the 1650s. As a result,

1 James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, Ct.: Yale University Press, 1999), 11–52, quotation at 39; see also Roger J. P. Kain and Elizabeth Baigent, *The Cadastral Map in the Service of the State: A History of Property Mapping* (Chicago, Ill.: University of Chicago Press, 1992). On surveying in colonial America, see Sarah S. Hughes, *Surveyors and Statesmen: Land Measuring in Colonial Virginia* (Richmond, Va.: Virginia Surveyors Foundation, 1979); J. Barry Love, *The Colonial Surveyor in Pennsylvania* (Harrisburg, Pa.: Pennsylvania Society of Land Surveyors, 2000).

2 Scott, *Seeing Like a State*, 49.

William Penn considered surveys and maps as the centerpieces of his original colonization plan. After Penn's death, the province's colonial and early national governments continued to use surveys to regulate frontier land distribution throughout the eighteenth century.

Several related factors drove Pennsylvania's reliance on surveys. By the time Pennsylvania developed, the English had already embraced a culture of quantification when it came to property ownership. Extended peace and good environmental conditions in the Mid-Atlantic drove an active land market for selling land to non-locals. Finally, rather than using its powerful central state to micro-manage affairs in the colonies, the English Empire decentralized authority overseas. In the case of Pennsylvania, the decentralization of the English state allowed local elites to institute a well-regulated surveying regime.

The proprietors of Pennsylvania, the Penn family, derived their income primarily from selling land to the rapidly expanding settler population and a steady stream of newcomers from Europe. Their finances depended upon the price of Pennsylvanian land, which derived its value primarily from settlers' improvements and from an owner's ability to sell to newcomers and investors. Surveys gave landholders documents that made land claims legal and enticed sales to non-local speculators. While nobles in Europe resisted nationally mandated surveys and English officials overseeing other American colonies tolerated disorganized surveying regimes, the aristocratic William Penn and his descendants embraced a highly centralized surveying bureaucracy.

This article will compare and contrast Pennsylvania's centralized surveying system with that of earlier English colonies in Virginia and New England. Lacking individual proprietors, these areas decentralized surveying authority, resulting in the practices of indiscriminate location and strict townships, respectively. This essay will also consider the surveying and land distribution policies of a number of other early modern empires, including the American colonies of Spain and Portugal, the land-based empires of Russia and the Qing Dynasty, and islands under the control of the English and Dutch. With the exception of the Dutch, who were fellow early adopters of geometric surveying, the English used surveying technology as a tool for directing settlement far earlier and more extensively than other early modern empires. When combined with allowing considerable autonomy for its colonies to distribute profits from land sales, the English emphasis on creating a colonial land market made surveying a key technology.

The timing of Pennsylvania's settlement allowed Penn and his successors to capitalize on the newly developed technology of geometric surveying. During the late Middle Ages, what the English called "surveys" emphasized land valuation not measurement. These surveys found and marked the internal and

external boundaries of the land, noting distinctions between improved and unimproved lands. Medieval “surveyors” often specialized in other agricultural or managerial duties. Surveyors recorded improvements such as buildings, wood lots, pastures, or arable fields, describing each improved tract in terms of specific crop patterns or general potential (inferior, mediocre, or superior land) and by giving it a concrete monetary value. Surveyors used an estate’s tenants as guides, because tenants knew both the best uses for certain lands and where the traditional boundaries between parcels lay. When perambulating the outside of a tract, surveyors took with them those tenants with the best memories of the land’s ancient uses, as well as young people, so that the memory of the land’s precise bounds stayed in the locals’ collective memory. Until the sixteenth century, surveyors considered measurements less important and often left them to their assistants.³

During the sixteenth and seventeenth centuries, following the development of modern surveying techniques based on geometry and trigonometry, surveyors evolved from legal experts into land measurers, a process completed throughout the English empire by the last half of the seventeenth century. Surveys still described and evaluated lands, but added accurate measurements of area. In place of descriptions of a variety of legal holdings, surveyors typically added plat maps to their surveys, which situated a graphical display of a landholding within its neighboring tracts. Over time, as English lords began to force peasants off of their lands as part of the enclosure movement, they found the new surveys useful to efficiently reapportion their property while erasing any reference to the rights of the previous tenants. While the English were relatively early adopters of surveying technology, they were not alone. The earliest Norwegian attempts at cadastral mapping began in 1514. Dutch officials began commissioning surveys and recording cadastral maps as registers during the 1530s. The Habsburgs surveyed their Milanese holdings in

3 E. G. R. Taylor, “The Surveyor,” *Economic History Review* 17, no. 2 (1947): 121–133; D. Chilton, “Land Measurement in the Sixteenth Century,” *Transactions of the Newcomen Society*, 31, no. 1 (1957–58 and 1958–59): 111–129 at 112; Carol Rawcliffe and Susan Flower, “English Noblemen and Their Advisers: Consultation and Collaboration in the Later Middle Ages,” *Journal of British Studies* 25, no. 2 (April 1986): 157–177 at 160. On perambulation, see E. P. Thompson, *Customs in Common: Studies in Traditional Popular Culture* (New York: New York Press, 1993), 99; John R. Stilgoe, “Jack-o’-lanterns to Surveyors: The Secularization of Landscape Boundaries,” *Environmental Review* 1, no. 1 (1976): 14–30; Silvio A. Bedini, *Thinkers and Tinkers: Early American Men of Science* (New York: Charles Scribner’s Sons, 1975), 56. For perambulation in colonial Brazil, see Stuart B. Schwartz, *Sugar Plantations in the Formation of Brazilian Society: Bahia, 1550–1835* (New York: Cambridge University Press, 1985), 291.

1568. German private landholders contracted surveys for their own properties during the sixteenth century.⁴

While modern surveying technology became well known during the early modern period, some expanding empires chose not to employ geometric surveying as the foundation of their early land distribution systems. For example, the Portuguese first settled Brazil using a policy known as *capitanias hereditárias*, which divided the country into fourteen fifty-league sections of coastline. In contrast to English practices, the boundaries between provinces extended along lines of latitude, without regarding the natural features of the interior. The government granted authority over each province to a captain, but a lack of apparent sources of revenue in the colony attracted few immigrants, and six of the captains never bothered to take control of their regions. The Portuguese abandoned this system in 1548, replacing it with grants of large tracts of land known as *sesmarias*. These grants to settlers were conditional upon the owner actually cultivating the land claimed, but few colonists had any interest in securing formal rights to land when it was plentiful and easy to occupy. The government made no attempts to monitor land claims. The *sesmarias* failed to attract many new immigrants and Brazil's colonial population remained small for centuries, only reaching three hundred thousand people by 1700.⁵

Similarly, most early colonists in Spanish America had little interest in securing permanent land tenures. To gain vast fortunes, ambitious conquistadors needed access to labor, not just land. Spanish elites came to control plantations through the *encomienda* system, a grant of control over local Indians that produced the side effect of giving the *encomendero* a large plantation on which to employ his labor. Spanish law prevented these men from fencing in their estates or preventing free passage through their lands. Private ownership to one's own land extended only to ground put to agricultural use. Forests and

4 For examples of plat maps, see *Draughts of the Proprietary Manors in the Province of Pennsylvania, as Preserved in the Land Department of the Commonwealth*, ed. William Henry Egle, (Harrisburg, Pa, 1895); J. A. Yelling, *Common Field and Enclosure in England, 1450-1850* (Hamden, Ct.: Archon Books, 1977), 3-21; Robert C. Allen, *Enclosure and the Yeoman* (New York: Oxford University Press, 1992), 14-71; Kain and Baigent, *The Cadastral Map in the Service of the State*, 11-24, 98, 123-125, 180-187.

5 Lee J. Alston, Gary D. Libecap, and Bernardo Mueller, *Titles, Conflict, and Land Use: The Development of Property Rights and Land Reform on the Brazilian Amazon Frontier* (Ann Arbor, Mich.: University of Michigan Press, 1999), 33-34; Patricia Seed, *Ceremonies of Possession in Europe's Conquest of the New World, 1492-1640* (New York: Cambridge University Press, 1995), 140-148.

waterways remained commons, while the crown reserved the right to mine the earth. This allowed the government to dominate the important silver trade.⁶

In contrast to the frontier-focused settlement patterns of Anglo-America, Spanish settlers preferred to move to a handful of well-developed cities. In a pattern established early in the sixteenth century and codified in 1573, the Spanish used surveyors to lay out their towns along rectilinear grids. At this time, Philip II distributed a comprehensive series of questions to colonial officials to establish basic facts about his overseas possessions. Included in their answers, the crown wanted city maps, with thick descriptions of the topography and quality of the local land. In recognition of the lack of a reliable population of Spanish settlers in rural areas, the government promised large land grants to Spaniards willing to establish villages of thirty people or more. In return, the organizers would receive seven square miles of land (a fourth of the amount reserved for new villages).⁷

Despite this edict, centralized surveying regimes had little use in the Spanish American countryside. While the Spanish abandoned the *encomienda* system in Central America during the sixteenth century, the government made no attempt to monitor landholding in rural areas until 1591, when the crown reasserted its rights to settlement fees throughout the Americas. Large landholders in Mexico who had encroached illegally upon the surrounding countryside could legitimate their unauthorized land holdings by paying the government a fine. This became known as *composición*. Government interest in land remained sporadic, but between 1642 and 1645, the Spanish made another concerted effort to collect money from Mexican towns. Rather than paying for surveying fees on top of the penalties for assessments, most communities opted to settle with the state before surveys began.

Landholders behaved similarly outside of Mexico. In the highlands of Guatemala, Spanish settlers encroached on Indian lands to establish ranches for sheep grazing during the seventeenth and early eighteenth centuries. Rather

6 J. H. Elliott, *Empires of the Atlantic World: Britain and Spain in America, 1492–1830* (New Haven: Yale University Press, 2006), 35–41.

7 Elliott, *Empires of the Atlantic World*, 42–48. Robert C. Smith, “Colonial Towns of Spanish and Portuguese America,” *Journal of the Society of Architectural Historians* 14, no. 4 (December 1955): 3–12 at 3. On the 1573 order, see Karl W. Butzer, “From Columbus to Acosta: Science, Geography, and the New World,” *Annals of the Association of American Geographers* 82, no. 3 (September 1992): 543–565 at 554–557. On Philip’s questions, see Howard F. Cline, “The Relaciones Geográficas of the Spanish Indies, 1577–1586,” *Hispanic American Historical Review* 44, no. 3 (August 1964): 341–374. On land grants, see Thomas R. Ford, *Man and Land in Peru* (Gainesville, Fla.: University Press of Florida, 1955), 35–36.

than secure grants for these lands, they seized much of the land in the region through *composición*. Taken as a whole, surveying played a marginal role in determining land distribution in Latin America.⁸

While the central government directly controlled land distribution systems in Portuguese and Spanish America, this was not always the case in the English Empire, where individual colonies retained greater autonomy. Despite the availability of the technology, geometric surveys did not regulate land distribution in England's earliest colonies. In Virginia, England's first permanent American colony, colonists initially held the land in common, under the management of the Virginia Company. Ignorant about the local climate and geography, they searched in vain for precious metals and attempted to establish various inappropriate industries, such as silk harvesting and winemaking. The colony failed to flourish until happening upon some lucky experimentation with Caribbean tobacco, which became the colony's major export by 1616. In the years that followed, this sparked a brief yet intense mania, in which settlers planted Jamestown's public spaces with tobacco and spread out into the backcountry to clear land for more plantations.⁹

The economic windfall came too late for the Virginia Company, which chose to give up control over its landholdings in 1616. The company issued dividends to its investors in the form of undeveloped land. For the price of hiring a surveyor (£12 10s), investors could receive fifty acres of land around Jamestown, with the promise of 150 more acres once the colony became larger. At the time, few investors had any interest in purchasing land in a colony with no clear revenue stream, especially as Virginia had no surveyor at the time. By 1618, the Virginia government changed its policy, so that immigrants who came before 1616 would receive one hundred acres and later immigrants would receive fifty acres. Purchasers of Virginia Company stock would receive one hundred acres, plus fifty acres for each migrant shipped to Virginia.¹⁰

For fair and accurate land allocation, the colonists needed a surveying bureaucracy, but no surveyor arrived until 1621. Because settlement predated

8 Francois Chevalier, trans. Alvin Eustis, *Land and Society in Colonial Mexico: The Great Hacienda* (Berkeley, Cal.: University of California Press, 1963), 218, 266–273; W. George Lovell, "Landholding in Spanish Central America: Patterns of Ownership and Activity in the Cuchumatán Highlands of Guatemala, 1563–1821," *Transactions of the Institute of British Geographers* 8, n.s., no. 2 (1983): 214–230. For Peruvian *encomiendas*, see Ford, *Man and Land in Peru*, 31–33.

9 Lorena S. Walsh, *Motives of Honor, Pleasure & Profit: Plantation Management in the Colonial Chesapeake, 1607–1763* (Chapel Hill, N.C.: University of North Carolina Press, 2010), 1, 25–39.

10 *Ibid.*, 30–39.

surveying by nearly fifteen years, surveys needed to account for development that had already taken place on the ground. Years of expansion into the backcountry made establishing a regular grid pattern and laying out towns impossible, so Virginians adopted the policy of indiscriminate location, in which settlers chose their own sites and the surveyor located the appropriate amount of acreage on the site of their choice.¹¹

Indiscriminate location became traditional in Anglo-America's southern colonies. This had the long-term effect of privileging plantation development and stunting the growth of towns and cities. Because settlers purchased plots of their own choosing, regardless of where they lay in relation to prior land holdings, they could avoid marginal regions and claim fertile lands along rivers and streams. In contrast to a township system that would force settlers to live on marginal lands, settlement sprawled quickly toward the frontiers. The first entrants to a newly opened frontier area enjoyed a considerable advantage over latecomers, because they could select the best lands in whatever configuration they chose, without regard to the development of towns. Indiscriminate location therefore fostered inequalities in wealth, enriching those men lucky enough to enter a frontier region first, or already rich enough to pay local agents to reserve the best lands on their behalf.¹²

Unlike Virginia, the earliest colonists in New England initially intended to establish farming settlements. Like Virginia, settlers initially had little use for surveys. Prior to allowing individuals to settle in a locale, colonists in New England formed corporations that established townships by negotiating land purchases with Indians and setting aside lots. This system created tightly knit towns where residents supported churches and schools. Close neighbors could more easily engage in local politics and commerce, so settlers often chose to improve marginal lands within the township. This tended to limit disparities in wealth. All towns, however, hosted sizable minorities of landless settlers. In many towns a handful of prestigious families controlled the best plots of land, often while residing elsewhere.¹³

11 Sarah S. Hughes, *Surveyors and Statesmen: Land Measuring in Colonial Virginia* (Richmond, Va.: The Virginia Surveyors Foundation and the Virginia Association of Surveyors, 1979), 4–5.

12 On early American property distribution, see Edward T. Price, *Dividing the Land: Early American Beginnings of Our Private Property Mosaic* (Chicago: University of Chicago Press, 1995).

13 John Frederick Martin, *Profits in the Wilderness: Entrepreneurship and the Founding of New England Towns in the Seventeenth Century* (Chapel Hill: University of North Carolina Press, 1991), especially 294–304. Over time, the pre-allocation of townships broke down in New England.

In New England, land distribution devolved onto the local community. Locally elected selectmen perambulated township bounds, distributed new tracts of land as they saw fit, and mediated disputes. The town of Scituate in Plymouth Colony provides an example of how a small community could eschew surveying. Selectmen divvied up lands based on local reputations, so that the best quality lands went to the foremost men in the town. By dividing tracts along easily recognizable natural boundary markers and estimating the amount of acreage in each tract, the town could avoid the need for geometric surveys. During the 1630s, when a dispute over township lines with the neighboring town of Hingham in Massachusetts Bay arose, the governors of the two colonies found natural landmarks to divide the towns: the aptly named Accord Pond and Bound Brook. As the town grew, the need occasionally arose to run straight lines through the woods as property boundaries, which the people did themselves. Only once during the seventeenth century, in 1649, did the townspeople hire a mathematically trained surveyor to mediate intractable disputes over township lots. Beginning in 1683, townspeople again debated whether to hire a trained surveyor, but made no action to hire one until 1710.¹⁴

Both Virginia and New England evolved with extensive population pressures and many examples of land speculation, but neither developed centralized land surveying schemes. In Europe, the English first implemented modern surveying techniques on a grand scale after the foundation of these colonies, following the conquest of Ireland in the second half of the seventeenth century. To assure the responsible redistribution of the devastated Irish lands, the government commissioned surveys to measure the whole island. During the 1650s, beginning with the Gross and Civil Surveys and ending with William Petty's comprehensive Down Survey, the English conducted the first effort that surveyed and mapped the whole of a European country. No other surveys before or after rivaled the Down Survey for its impact on England's later imperial development. The surveys of Ireland created a useful map for the military in case of another war, and marked Catholic areas for later redistribution to Protestants. The government intended to use eleven million acres of Irish land to pay bounties to thirty-five thousand soldiers and fifteen hundred adventurers who had financed their own expeditions.¹⁵

The Down Survey simultaneously measured and mapped Ireland while transforming the meaning of the land with technology. Surveyors not only

14 Stilgoe, "Jack-o'-lanterns to Surveyors," 23–29.

15 William J. Smyth, *Map-making, Landscapes, and Memory: A Geography of Colonial and Early Modern Ireland, c. 1530–1750* (Notre Dame, Ind.: University of Notre Dame Press, 2006), 165–188.

noted a tract's improvements, or whether it included mountains, bogs, forests, and fertile land, but also measured value in acres. This rendered varying topographies equivalent, even if their former owners had operated under distinct legal rights. With standard calculations, single lots could include both forests and meadows, or combine various tracts that natives had owned, leased, or held in common. Surveyors erased the medieval Irish emphasis on traditional legal rights. In their place came maps and thick descriptions of property values. Among Europeans influenced by the Scientific Revolution, surveyors' emphasis on mathematical accuracy made this new, abstract vision of land legitimate. In Petty's words, the country became "a white paper." This view suited Ireland's new English lords: expunging the land's past strengthened the claims of its current conquerors.¹⁶

Ireland provided a model for effective surveying in North America, because soldiers controlled and redistributed native lands. Their efforts imbued colonists with conceptions of land use and ownership informed by surveys and maps, leading to the introduction of a market economy that transformed the environment. In American colonies that began after the Down Survey, such as Pennsylvania, the settlement of Ireland affected both the organization and personnel for colonial surveying. Even in Maryland, a proprietary colony founded before the Down Survey, the Irish precedent affected land distribution policy. Maryland first appointed a surveyor general in 1634, but he left within a year, replaced by a man without formal training in surveying. Subsequent surveying in the colony was of mixed quality, but by 1683, the province reorganized its system to emulate the rigor of Ireland's effective surveyors general, establishing a central office with a surveyor general who made no surveys in the field and held clear lines of authority over deputy surveyors.¹⁷

Prior to establishing his colony, William Penn had already internalized the importance of surveys: as a landholder in Ireland, he had seen the benefit of the Down Survey firsthand. As an adult, he became friends with William Petty, and would have had access to Petty's records and maps when visiting his house in 1667. While he never settled in America, Petty expressed early interest in Penn's colony by purchasing a five thousand-acre share in Pennsylvania. With characteristic enthusiasm and exactness, he devised a plan to settle one thousand people on his acreage. Petty also concocted a similar scheme for the forty million acres he imagined Pennsylvania to contain. While neither of

16 *The Economic Writings of Sir William Petty*, ed. Charles Henry Hull, 2 vols. (Cambridge, U.K., 1899), 1:9.

17 Mary Catherine Wilheit, "Colonial Surveyors in Southern Maryland" (Ph.D. diss., Texas A&M University, 2003), 19–57.

these designs came to fruition, some of his proposals no doubt made their way to his friend Penn. Among Petty's concerns for the colony, he warned against "Stragling plantations" like the ones that stretched inefficiently over Virginia's landscape.¹⁸

While Penn had a grand vision for the civic and religious benefits that his colony might provide, he also needed the colony to yield a profit. In 1681, shortly after acquiring his colony, he quipped, "Though I desire to extend religious freedom, yet I want some recompense for my trouble." In contrast to the original Virginian colonists, he knew not to expect a sudden windfall from tropical crops or the discovery of precious metals. Instead, Penn planned to hold a monopoly on the colony's lands and attract settlers that would buy or rent those lands, thereby providing his family with a long-term revenue stream. Like Petty, Penn imagined the New World as a tabula rasa with fungible acreage. Without ever stepping foot in the New World, he mapped out a rectilinear capital for his province, intending to sell land to adventurers at standard rates, sight unseen.¹⁹

To avoid leaving gaps of unsold land in the backcountry, Penn desired a township system like New England's. For financing, he sought out investors to pay £10 for five hundred-acre shares in a village, with annual quitrents of one shilling per hundred acres. Individuals would receive fifty-acre lots inside the village and four hundred fifty acres outside the village. Penn stipulated that investors needed to settle their lands within three years. However, his need for funds compelled him to make exceptions to these land policies. To shore up his finances, Penn sold forty thousand acres to the Barbadian merchant Ralph Fretwell at a discounted rate. Many other settlers convinced surveyors to avoid marginal lands and apportion them dispersed lands of better quality. Wary of scaring away future revenues, Penn chose not to punish settlers who failed to settle their lands within the required time. His plans for Philadelphia also went awry: he had originally intended to enclose ten thousand acres

18 *The Papers of William Penn*, ed. Mary Maples Dunn and Richard S. Dunn, 4 vols. (Philadelphia, Pa.: University of Pennsylvania Press, 1981), 1:47, 101–107, 333–334; 2:130–131, 278–280, 394–397, 651; 3:620–622; *The Petty Papers: Some Unpublished Writings of Sir William Petty*, 2 vols., ed. Marquis of Lansdowne (1927; New York: Augustus M. Kelley Publishers, 1967), 2:95–121; *Annals of Pennsylvania, from the Discovery of the Delaware, 1609–1682*, ed. Samuel Hazard (Philadelphia, 1850), 643. Pennsylvania now contains almost thirty million acres, much of it mountainous.

19 Quoted in William Robert Shepherd, *History of Proprietary Government in Pennsylvania* (New York: Columbia University Press, 1896), 175. For examples of Penn's promotional material, e.g., *Coleman's Reprint of William Penn's Original Proposal and Plan for the Founding & Building of Philadelphia in Pennsylvania, America in 1683* (London, 1881).

within Philadelphia, and grant ten acres of bonus land within the city to each of the first purchasers. He could not do so because settlers from the defunct colony of New Sweden already held farms along much of the best land on the Delaware. Instead, Penn's commissioners laid out a two-mile square rectangle between the Delaware and the Schuylkill, approximately one-eighth the size Penn had intended.²⁰

By 1685, Penn had sold over seven hundred thousand acres of the countryside surrounding Philadelphia. However, no laws dictated that frontier territory needed to follow a regular township grid, so the township system languished when the province expanded. During the eighteenth century, instead of laying out township grids prior to settlement in the backcountry, surveyors left township bounds open-ended, stretching toward the province's purchase lines, to allow for future sales. In theory, the Land Office required surveyors to sell land in these new townships in rectangular tracts, to ensure that townships filled up evenly, without gaps of empty land between straggling plantations. However, because of the enormous frontier, squatting abounded and legitimate buyers often avoided undesirable land, creating a checkerboard arrangement on the ground that resembled indiscriminate location. In lieu of numerous close-knit townships, the province laid out a few county towns as centers for trade and political activity. Even after centralizing and standardizing the surveying process, Pennsylvania's wilderness spaces and the Penns' financial need for quick land sales prevented the transformation of the colony into a tabula rasa with a regular grid of townships. In effect, Pennsylvania blended the Virginian and New England approaches to land distribution.²¹

Penn was aware that he would base his fortune off of selling land that Indians already occupied. When he founded his province, bloody wars that pitted whites against Indians had recently convulsed both New England and Virginia. Unlike earlier English officials who had operated at the beginning of

20 For Penn's early land sales, see ed. Jean R. Soderlund, *William Penn and the Founding of Pennsylvania: a Documentary History* (Philadelphia: University of Pennsylvania Press, 1983), 58–91. For Penn's early township plans, see ed. Albert Cook Myers, *Narratives of Early Pennsylvania, West New Jersey, and Delaware: 1630–1707* (New York: Barnes & Noble, 1912), 263, 274–275. On early land speculation, see Gary B. Nash, *Quakers and Politics: Pennsylvania, 1681–1726* (1968; Boston: Northeastern UP, 1993), 90–94. On the first site of Philadelphia, see Dunn and Dunn, *Papers of William Penn*, 2: 334, 358–360.

21 Soderlund, *William Penn*, 72; Price, *Dividing the Land*, 257–283; Irma Corcoran, *Thomas Holme, 1624–1695: Surveyor General of Pennsylvania* (Philadelphia, Pa.: Memoirs of the American Philosophical Society, 1992), 89–282; Love, *Colonial Surveyor in Pennsylvania*, 114.

the seventeenth century, Penn incorporated local Indians as early partners in his colonial enterprise, negotiating with them to purchase the land that he would sell to settlers. As time passed, the Penn family's demands for Indian land became increasingly predatory. However, Pennsylvania benefitted from the English Empire's Indian policies, which fostered close ties with the powerful Iroquois through the alliance known as the "Covenant Chain." Despite living in the hinterlands of New York, the Iroquois pressured Pennsylvanian Indians into selling large tracts of land through treaties. As a result, Pennsylvania gained lands, but experienced little violence until the mid-eighteenth century, when imperial crises with France became more pressing.²²

Because provincial-level decision-makers determined surveying policies in the English empire, contrasting surveying systems developed on the American mainland. Elsewhere, surveying could be of less importance, depending on economic conditions. For example, despite its initial colonization having taken place after the completion of the Down Survey, English Jamaica had no proprietor, and therefore little incentive to establish complicated procedures for patenting land that might discourage immigration. Initially, no officials recorded land patents and islanders could take free possession of land. After 1661, the royal governor limited land holdings to thirty acres of improvable land for every immigrant, charging quitrents to farms over one hundred acres worked by servants. This policy did not last long. By the 1670s, large plantations stretched across many parts of the island.²³

Economic realities in other empires dictated differing levels of interest in surveys. In contrast to Jamaica, on the island of Ceylon, first settled by the Dutch East India Company during the 1630s, surveyors became integral to the

22 Ned C. Landsman, *Crossroads of Empire: The Middle Colonies in British North America* (Baltimore, Md.: The Johns Hopkins University Press, 2010), 41–44, 71–72. Penn communicated with the Lenapes (later known as Delawares) prior to arriving in America in order to shore up his land claims against Maryland. Daniel Richter, however, points out Penn's belief that "divine and civil authority alike made Pennsylvania legitimately his to enjoy," Richter, *Trade, Land, Power: The Struggle for Eastern North America* (Philadelphia: University of Pennsylvania Press, 2013), 136–154 at 141. On peace with the Indian nations, see David L. Preston, *The Texture of Contact: European and Indian Settler Communities on the Frontiers of Iroquoia, 1667–1783* (Lincoln, Neb.: University of Nebraska Press, 2009), 117–146; James H. Merrell, *Into the American Woods: Negotiators on the Pennsylvania Frontier* (New York: W. W. Norton & Company, 1999), 19–224.

23 Veront M. Satchell, *Hope Transformed: A Historical Sketch of the Hope Landscape, St. Andrew, Jamaica, 1660–1960* (Kingston, Jamaica: University of West Indies Press, 2012), 44–48.

local economy. They built roads and canals, made maps, and surveyed private plots of land in emulation of widespread practices in the Netherlands. By the mid-1700s, the Dutch employed ten surveyors in Ceylon, along with three in Java and one in the Cape Colony. In contrast, East Asian empires were happy to rely on old surveys rather than undergo the expense of producing new ones. The Tokugawa shogunate did not order new surveys to update those of the 1590s until the severe drought and famine conditions of the 1640s. Similarly, Qing Dynasty officials chose to use Ming Dynasty cadastral records for centuries rather than undergo the expense of a nationwide resurvey. As a result, Qing magistrates regularly ruled on “white contract” property disputes—properties held in technical violation of the law, lacking the official red seals of legally registered land.²⁴

As time passed and peace continued, the Penn family’s financial distress caused them to press the frontiers of the province further to the west, exacerbating the territorial pressures on local Native Americans. While William Penn lived, the province did not extend far past the lower Delaware River, and never expanded beyond the original three counties of Philadelphia, Bucks, and Chester. Beginning in 1718, a series of land purchases vastly expanded the size of the province. By 1754, Pennsylvania theoretically controlled close to ten million acres.²⁵

Among these purchases was one of the most infamous treaties in colonial history, the “Walking Purchase.” Beginning in the late 1720s, Pennsylvania had developed land in the far northern reaches of Bucks County, selling twenty-seven thousand acres to William Allen and other private investors and surveying one thousand acres at the forks of the Delaware River. By this time, Scots-Irish settlers had already squatted throughout much of the northern Delaware Valley, forcing the Penns to settle the frontier quickly, even if it meant

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- 24 Ian J. Barrow, *Surveying and Mapping in Colonial Sri Lanka* (Oxford: Oxford University Press, 2008), 24–28; Ian Jeffrey Barrow, “Surveying in Ceylon during the Nineteenth Century,” *Imago Mundi* 55, no. 1 (2003): 81–96 at 81–83; Geoffrey Parker, *Global Crisis: War, Climate and Catastrophe in the Seventeenth Century* (New Haven: Yale University Press, 2013), 489–499; Mary Elizabeth Berry, *Hideyoshi* (Cambridge, Mass.: Harvard University Press, 1982), 111–129; Jonathan K. Ocko and David Gilmartin, “State, Sovereignty, and the People: A Comparison of the “Rule of Law in China and India,” *Journal of Asian Studies* 68, no. 1 (February 2009): 55–100 at 75–76.
- 25 Donna Bingham Munger, *Pennsylvania Land Records: A History and Guide for Research* (Wilmington, Del.: Scholarly Resources, Inc., 1991), frontispiece; Richter, *Trade, Land, Power*, 155–169; Merrell, *Into the American Woods*.

selling thousands of acres to speculators and thereby foregoing greater long-term profits. Iroquois leaders based north of Pennsylvania agreed to cede both banks of the lower Susquehanna River and the area around the forks of the Delaware River in 1736. The land grab disturbed local Delaware and Shawnee Indians, but they lacked the military might to pose a threat to either the Pennsylvanians or the Iroquois.²⁶

In 1737, Penn coerced Delaware leaders into recognizing an unsigned copy of a supposed 1686 agreement in which the Delawares had sold land between the Delaware River and Neshaminy Creek. The Penns had never surveyed the tract, which should have extended as far as a man might walk in a day and a half. After Delaware leaders reluctantly accepted the validity of the 1686 document, Pennsylvanian officials made a farce of the agreement. Clearing a path through the woods, they sent three men to “walk” as quickly as possible over a day and a half, promising five hundred acres to the man who traveled farthest. The winner covered sixty miles by running in a northwesterly direction from the lower stretches of the Delaware. Rather than turning due east from the furthest point their “walker” had covered, the Pennsylvania surveyors Benjamin Eastburn and Nicholas Scull turned ninety degrees to the northeast to close the tract off nearer the headwaters of the Delaware. Thus, the Walking Purchase netted the province more than seven hundred thousand acres of land, far more than the Delawares could have imagined ceding.²⁷

Aggressively making purchases allowed the Penns to accelerate the tempo of land sales, capitalizing on immigrants’ desires for cheap backcountry lands. By 1730, most of the lands within fifty miles of Philadelphia had a population density of more than twenty people per square mile. Exacerbating this need for land, a steady flow of English, German, and Scots-Irish immigrants led to an increase in Pennsylvania’s population from forty-nine thousand to 108,000 in the years between 1730 and 1750.

Pennsylvania’s economic policy also encouraged land sales. Between 1724 and 1756, the Pennsylvania government issued more than three thousand low interest loans for those who had collateral in the form of prior landholdings and wished to buy more land. Intended to help the general population and

26 Jennings, *The Ambiguous Iroquois Empire* (New York: W. W. Norton & Co., 1984), 318–324; A. D. Chidsey, Jr., “Easton Before the French and Indian War,” *Pennsylvania History* 2, no. 3 (April 1935): 156–171 at 157–158.

27 Steven Craig Harper, *Promised Land: Penn’s Holy Experiment, the Walking Purchase, and the Dispossession of Delawares, 1600–1763* (Bethlehem, Pa.: Lehigh University Press, 2006), 46–71.

alleviate the colony's lack of hard currency, these loans mainly went to settlers seeking less than two hundred acres and less than £100.²⁸

Other colonies' land claims complicated the Penn family's ambitions. The first major conflict arose over the province's southern border with Maryland. During the 1730s, "Cresap's War" flared up between settlers from both provinces in a contested region west of the Susquehanna River. Both governments sent surveyors and militia to the region, but neither could gain the upper hand. A reprimand from the Crown led to a series of temporary boundaries between the two colonies until an official survey run by two English mathematicians, Charles Mason and Jeremiah Dixon.²⁹

One significant difference between Pennsylvania and the earlier colonies remained: surveys for land sales in Pennsylvania remained centralized at a provincial level, rather than the county or township level. As the colony developed and the provincial frontiers expanded deeper into the interior of the continent, deputy surveyors hired in Philadelphia took on the responsibility of overseeing the distribution of distant lands for the benefit of the Penn family. Treaties affirmed in 1749 and 1754 gave the province control over most of the Susquehanna River to its forks. In 1768, as a result of the Treaty of Fort Stanwix, the "New Purchase" extended Pennsylvania's sovereignty over most of the upper reaches of the Susquehanna, the West and North Branches. All the land in the New Purchase lay more than one hundred miles from Philadelphia, making it vital for the deputies to understand their instructions and cooperate with one another.³⁰

Typically, land purchasers in Pennsylvania underwent a multi-step process to receive paper titles to their claims. A prospective purchaser must first apply to the Land Office in Philadelphia for land. The Land Office would then issue a warrant to survey a given amount of land for that purchaser. A deputy surveyor would survey the land, and combine his survey with the warrant and

28 James T. Lemon, *The Best Poor Man's Country: A Geographical Study of Early Southeastern Pennsylvania* (Baltimore: The Johns Hopkins University Press, 1972), 23, 42–51, 218–228; Mary M. Schweitzer, *Custom and Contract: Household, Government, and the Economy in Colonial Pennsylvania* (New York: Columbia University Press, 1987), 114–167. German speakers came from a variety of property regimes that differed from the Pennsylvania system; Kain and Baigent, *The Cadastral Map in the Service of the State*, 120–173.

29 Patrick Kehoe Spero, "Creating Pennsylvania: The Politics of the Frontier and the State, 1682–1800" (Ph.D. diss., University of Pennsylvania, 2009), 116–171; Edwin Danson, *Drawing the Line: How Mason and Dixon Surveyed the Most Famous Border in America* (New York: John Wiley & Sons, 2001).

30 Munger, *Pennsylvania Land Records*, frontispiece.

the upfront fees to produce a return of survey. Prices varied somewhat, but in the mid-eighteenth century, one hundred acres of land usually cost fifteen pounds, ten shillings, half of which was due with the application. After receiving the return of survey and the remaining fees, the Land Office would issue a patent for the land to the purchaser, who could then settle after making arrangements to pay annual quitrents and registering the deed with the county. Eventually, as the frontier stretched further away from Philadelphia, the likelihood increased that purchasers would squat upon and improve lands first before requesting an official application. Squatters could sell their improvements, such as clearings, fences, cabins and outbuildings, which could be worth up to ten times the purchase price. These sales often took place after the squatter had attained a warrant but before formally patenting the land. Courts typically recognized squatters' rights to first purchase of a tract of land if the squatter had "quiet possession" (uncontested use) of the claimed land for seven or more years.³¹

While squatting posed a major threat to governmental profits, the solution of allowing "quiet possession" purchases mirrored decisions made in other early modern empires, like the Spanish practice of *composición*. The Russian government faced a similar problem with squatting, although nobles (rather than small farmers) tended to squat in Russia. During the sixteenth century, the Russian government attempted to compile cadastral records to determine the boundaries between the state's land and private landholders. In many parts of that vast territory, local nobles had encroached upon the state's land, farming it as their own. Lacking modern surveying techniques, Russian officials relied on local descriptions of boundaries, using descriptions such as the limits of seasonal flooding or the distance that one could hear a neighbor's herd of cows.³²

Because Russian nobles opposed state intrusion into their affairs, the government only pursued a Western European style of surveying reluctantly. When it did turn to geometric surveys, the state measured state lands and town lands only, leaving locals to determine private ownership. Had it been otherwise, the surveys would have offered a chance to regroup nobles' splintered landholdings to maximize agricultural efficiency, as Western Europeans had done. However, the nobles distrusted one another too much to make a serious

31 Munger, *Pennsylvania Land Records*, 40, 104; Schweitzer, *Custom and Contract*, 97–101.

32 Robert Givens, "To Measure and to Encroach: the Nobility and the Land Survey," in ed. R.P. Bartlett, A.G. Cross, and Karen Rasmussen, *Russia and the World of the Eighteenth Century* (Columbus, O.: Slavica Publishers, 1988), 534.

effort to imitate British or Dutch enclosure patterns. This was despite general dissatisfaction among many aristocrats with the layout of their estates, which often had overlapping landholdings across many regions.³³

Russian surveys conducted during the eighteenth century failed to determine the exact extent of government landholding. The government abandoned a national survey conducted in 1754 after eight years of staunch resistance from the nobility, without having completed the measurement of lands around Moscow. A more comprehensive survey began in 1766, measuring most of European Russia by 1796. The state only attempted to reassert control over its landholdings when local nobles encroached upon public lands in an egregious way. This discreet approach cemented a good relationship with the nobility. As a result, the state forfeited control over an estimated 135 million acres of land. This solution failed to bring money into the state's coffers, but resembled decisions in Spanish America, Pennsylvania, and elsewhere. Governments eschewed surveys and land registration when they felt weak or unwilling to antagonize the populace.³⁴

To ensure accurate surveys, English surveyors used a compass and standardized chains to measure land. Developed by Edmund Gunter in 1620, the chain contained one hundred links of 7.92 inches apiece, with a brass ring placed at ten link increments. These rings made noticeable markers for intermediate lengths of the chain. Sixty-six feet in length, each chain extended four perches (or rods) of sixteen and a half feet. Eighty chain lengths made one mile, so ten square chains made one acre, greatly simplifying surveyors' mathematical calculations. When measuring, the front carrier placed a pin in the ground at his position, which the rear carrier gathered. By using ten pins, surveyors had a convenient way to keep track of how far they had traveled. For shorter distances, they employed offset staffs ten links in length. Typically, surveyors employed local chain carriers, but took on the role of the rear chainman when necessary.³⁵

Field books aided surveyors as they prepared their returns of survey, the official documents needed to purchase land in early America. For example, on 20 December 1760, John Lukens conducted a brief traverse survey on a field in southeastern Pennsylvania. For his own records, he noted his measurements in a small field book:

33 Isabel de Madariaga, *Catherine the Great: A Short History* (New Haven: Yale University Press, 1990), 134–135, 179; Givens, “To Measure and to Encroach,” 537–547.

34 Givens, “To Measure and to Encroach,” 534–543.

35 Richeson, *English Land Measuring*, 109; Love, *Colonial Surveyor in Pennsylvania*, 30–35.

Survey for Thos. Craige Decem 20th 1760

a piece of Land part of his Fathers tract

Beginning at a Corner in the Road Thence $S44\frac{1}{2}W$ $112\frac{3}{4}$ ps. Thence along the Middle of the road $N85\frac{1}{4}W$ 20 and $N78W$ 22 ps $N26\frac{1}{2}E$ 60 ps Hick Saplin Then $N47\frac{1}{2}W$ 10 ps Thence $N26\frac{1}{2}E$ $81\frac{1}{2}$ ps post then $S47\frac{1}{2}E$ $87\frac{4}{10}$ to the place of Beg Containing —

Lukens's cramped handwriting, lack of punctuation, and sentence fragments spanning multiple lines typified these informal notes. In the above passage, Lukens described a resurvey that sectioned off a portion of a man's land into a new parcel for his son, Thomas Craige. At the corner of the property beginning in the middle of the road, Lukens wrote the compass bearing to the next corner: " $S44\frac{1}{2}W$," meaning forty-four and one-half degrees west of due south. Using a chain, he recorded the length of the line between those two points in perches of sixteen and one-half feet: " $112\frac{3}{4}$ ps." This process continued until he completely enclosed the lot, identifying and marking the other corners (a hickory sapling and a fence post) and logging bearings and lengths along the way.³⁶

After finishing their field work, early American surveyors completed a return of survey, which contained the information in the field book, along with ownership details about the surveyed tract and its neighbors, possibly accompanied by a sketch or plat map of the property. The return of survey noted the acreage in the tract, which surveyors calculated from their notes. When surveyors did their jobs properly, the lines they ran around the lot closed, forming a solid tract. In Pennsylvania, the surveyor general checked his surveyors' math before approving returns of survey. Improper surveys resulted in settlers paying too much for their land or receiving more land than they had purchased.³⁷

In 1711, the province established a regular set of fees for securing lands. Afterward, surveying fees in Pennsylvania followed a general pattern, although the legislature adjusted the precise rates from time to time. By 1752, surveying up to one hundred acres cost seven shillings and sixpence. Every additional hundred acres cost three shillings. Buyers paid surveyors two pence per mile for traveling and six shillings, sixpence for returning the survey to the land office. Chain carriers worked for three shillings per day. The Land Office collected five

36 [John Lukens], Survey Book, 1760, John Lukens Papers, American Philosophical Society, Philadelphia, Pa.

37 For a typical return of survey, see James Hamilton Jr., draught of survey of Northumberland lot for Jonathan Dickinson Serjeant, 21 May 1788, John Lukens Papers, American Philosophical Society.

shillings to check whether a warrant for land was clear of other claims, and demanded nineteen shillings to file a return of survey on the property. Deputy surveyors drew these fees in the field, and the surveyor general obtained a proportion of the funds they collected. At mid-century, the surveyor general received one-third of his deputies' earnings. A deputy surveyor working part-time might earn £30 or more per year in fees. While this would not be enough money to retire upon, most surveyors worked as craftsmen, and their earnings amounted to substantial secondary income.³⁸

In a newly opened region, the Land Office accepted warrants for land purchases, which the surveyor general then directed to his deputies, who technically had the sole responsibility for surveys conducted within their districts. The Penns' official instructions illustrate their difficulties with corrupt deputies. For example, Thomas Smith received a deputy surveyor's commission in Cumberland County, in what is now central Pennsylvania, on 10 February 1769. Upon posting a £200 bond, he received lengthy and sometimes overlapping directions from Richard and Thomas Penn, and from his immediate superior, Surveyor General John Lukens. Based on the experiences of previous decades, these orders anticipated various deceptions that previous surveyors had employed. In one directive, the Penns demanded that Smith employ only honest and well respected chain carriers who took an oath of impartiality before a local magistrate. This received specific mention because dishonest or careless chain carriers could add or subtract large portions of land with measuring errors.³⁹

To maximize their profits from quitrents and land sales, the Penns needed the province to settle evenly, without gaps of unsold ground. Left to choose their own tracts, settlers would avoid hills, stony soils, and pine barrens. To counteract this tendency, the Penns told Smith, "You shall lay out all Lands as regular and nearly contiguous as the places will bear, admit, or allow

38 *The Statutes at Large of Pennsylvania from 1682 to 1801*, ed. Robert L. Cable, 18 vols. (Harrisburg: 1896–1909), 2:331–348 (1711); 3:96–112 (1715); 3:367–380 (1723); 5:161–178 (1752); Love, *Colonial Surveyor in Pennsylvania*, 110, 123. For perspective, James Logan lived as a gentleman on £200 per year during the 1720s; Francis Jennings, "Incident at Tulpehocken," *Pennsylvania History* 35, no. 4 (October 1968): 335–355 at 348. A pound equaled twenty shillings while a shilling equaled twelve pence.

39 Burton Alva Konkle, *The Life and Times of Thomas Smith, 1745–1809: A Pennsylvania Member of the Continental Congress* (Philadelphia, Pa., 1904), 31–35. For similar commissions, see Deputy Surveyors' Duplicate Commissions and Instructions, 1713–1848, Record Group 17-XXI, Pennsylvania Historical and Museum Commission, Pennsylvania State Archives, Harrisburg; Munger, *Pennsylvania Land Records*, 57–60.

of, -- unless directed by ye warrant to the contrary." The Penns combined this demand for rectangular tracts with orders that the surveyors set aside choice lands in proprietary manors reserved for their family. The family would hold one tenth of the province's land in reserve until property prices rose in the future, securing their long-term financial interests. This tenth should have amounted to between two and three million acres. By the 1770s, however, the province's deputies had only set aside six hundred thousand acres for manors.⁴⁰

Ironically, the manors created the otherwise detestable gaps in settlement. Initially, the Penns hired overseers whose foremost duties involved preventing squatters from encroaching upon the manors. Many of the province's most fertile lands remained empty out of fear that tenants might be difficult to evict and could deforest or otherwise devalue the property through bad management. Widespread squatting in distant reaches of Pennsylvania frustrated these plans: for example, in 1730 Scots-Irish families illegally occupied the sixteen thousand-acre Conestoga Manor in Lancaster County. While measures such as burning squatters' cabins could deal with this problem temporarily, by the 1740s the Penns felt compelled to begin drawing up long-term leases for their manors.⁴¹

Often, the bounds of the proprietary manors remained murky enough to lead the authorities to suspect that the deputy surveyors profited by secretly selling manor land to settlers. The deputy surveyor Bartram Galbraith defended himself against this charge in 1763:

I have heard it roumerd that Mr. Steavenson of York, has acquainted the Proprietary Agents that the Proprietaries have lost some Hundreds of Pounds by me (& other Deputys) entering in within his Mannors with Surveys[.] If I ever have don aney such thing it must be unknown to me I have hitherto Strove to offitiate in my Trust with the Greatest diligence,

40 Konkle, *Thomas Smith*, 32–33. On proprietary manors, see Price, *Dividing the Land*, 266; Schweitzer, *Custom and Contract*, 89–96, 102–109.

41 Schweitzer, *Custom and Contract*, 89–96, 102–109; William H. Kain, "The Penn Manorial System and the Manors of Springetsbury and Maske," *Pennsylvania History* 10, no. 4 (October, 1943): 225–242; and Price, *Dividing the Land*, 266–267. On Conestoga Manor, see Willis L. Shirk, Jr., "Wright's Ferry: A Glimpse into the Susquehanna Backcountry," *Pennsylvania Magazine of History and Biography* 120, no. 1/2 (January/April 1996): 61–88 at 66–67; Charles Desmond Dutrizac, "Local Identity and Authority in a Disputed Hinterland: The Pennsylvania-Maryland Border in the 1730s," *Pennsylvania Magazine of History and Biography* 115, no. 1 (January 1991): 35–61 at 37; Egle, *Draughts of the Proprietary Manors*, preface.

Care, & honesty, I was capable of. I can stand with my Face Uncov'ed, my hands lifted, and Put mankind to thier Diffyance to charge me with bribery or Unjustice[.]

To circumvent further problems, the Penns instructed Smith to avoid surveying on manor lands without a specific warrant, because tenants or buyers of manorial land needed express approval from Philadelphia. Lukens clarified that Smith would reserve proprietary manors on warrants dating to October 1760. These backdated warrants would preempt any possible claims of prior improvement by squatters, even if they had illegally invaded Indian territory to establish their improvements before the New Purchase.⁴²

The Penns' vague demands for regular and contiguous settlements caused confusion among the deputies. For example, in February 1767, Galbraith wrote to Lukens from Lancaster County, having worked with a miller who intended to dam a creek. Galbraith wondered whether he might grant the man all his acreage along the streambed. Two years later, in Smith's instructions, Lukens clarified what to do in this situation: "provided the ground will in any wise admit of it," each tract of land on a river or creek should have a waterfront only one third as long as the property lines extending away at a right angle from the water. In this way, the first settlers in a bottomland could not monopolize it. If many separate homesteads could gain access to the water, settlers would inhabit all usable lands, thus creating more profits from land sales and quitrents. However, Lukens also admitted the broken land might sometimes prevent his deputies from surveying regular, contiguous tracts in the Pennsylvania backcountry. Thus, his orders gave surveyors the wiggle room to accommodate settlers seeking to acquire the best lands.⁴³

Balancing between the need for rectangular plots and the need to avoid broken ground proved difficult, if not impossible, because warrants typically came to a surveyor with the acreage already entered. To provide the correct amount of acreage in a mountainous area, or one with pre-existing neighbors, the survey had to trace an irregular shape across the landscape. Working near the Maryland border in Lancaster County, deputy surveyor Samuel Blunston followed the letter of the law, if not the spirit, by conducting his surveys on blank warrants and filling in the amount of acreage afterwards.⁴⁴

42 Konkle, *Thomas Smith*, 32–34; Bartram Galbraith to John Lukens, 9 September 1763, Box 1, John Lukens Papers, University of Delaware Special Collections, Morris Library (hereinafter "JLUD"), Newark, Del.

43 Bartram Galbraith to John Lukens, 27 February 1767, Box 1, JLUD. Konkle, *Thomas Smith*, 34–35.

44 Love, *Colonial Surveyor in Pennsylvania*, 114.

Lukens and the Penns devoted by far the most space in Smith's instructions to the proper division of labor in the Land Office, emphasizing that Smith could not survey without warrants from the surveyor general. Nor could he alter warrants in the field since this would have greatly disrupted the settlement process directed from Philadelphia. They also requested that he not delegate his surveys to outside surveyors, and only make returns of survey "on the spot." The Penns sought to avoid the problems that occurred when multiple surveyors did a single deputy surveyor's work, confounding property lines out of ignorance or disregard of where other surveyors had previously worked.⁴⁵

They beseeched Smith to return his surveys to Lukens' Philadelphia office within six months of receiving them. If Smith could not execute the surveys, perhaps because he could not find the settler in question or the settler refused to pay the fees, he needed to explain his inaction in writing. The proprietors also forbade Smith from handing over any of his records to local settlers before the surveyor general received them. A settler who held his own surveying records could more easily cheat the Land Office. This could involve not paying for the land, but producing the survey anyway as an intention of purchasing the land when another prospective buyer wanted it. A cunning settler might even try to use the Pennsylvania survey as validation of a cheaper title from another colony. To circumvent this kind of deceit, Smith also had to collect surveying fees directly from settlers.⁴⁶

Given the time constraints of the business and the lack of professionals in the field, mistakes could occur. To ensure reproducibility, the Penns required Smith to keep records of all his surveys and resurveys, including his field notes, so that the surveyor general might review his records. On request, he had to submit them to the surveyor general or to his successor as deputy surveyor. Lukens also asked Smith to name each tract that he surveyed. He intended for these names to dispel any bureaucratic confusion that might arise over individual tracts. In Smith's case, his district lay more than two hundred miles from the capital, and he might reasonably expect to conduct his business for months without ever hearing from Lukens.⁴⁷

Taken as a whole, the deputy surveyors' notes convey the pitfalls in the Pennsylvanian property system: deputies could betray the interests of either the proprietors or the settlers by neglecting or delegating their duties, by misallocating prime bottomlands or failing to prevent overlapping

45 Konkle, *Thomas Smith*, 32–35.

46 *Ibid.*, 32–34.

47 *Ibid.*, 32–35.

properties. Although land sales remained the primary means of gaining wealth from the colony, the proprietors relied on deputy surveyors to conduct their jobs on a commission basis, virtually without oversight. As Lukens warned Smith, “much will depend on the care & dispatch of the Deputy Surveyor, and I desire the people may not have any cause of complaint of your neglecting their business.” If the people did have cause for complaint, it might take months for the surveyor general to become aware of it.⁴⁸

Despite the Penns’ best intentions, efforts to meticulously regulate Pennsylvania’s surveying regime led to a point of diminishing returns. According to historian Mary Schweitzer’s estimates, “virtually half of the population” chose not to patent their lands formally until after the French and Indian War. The cumbersome, multi-step process of applying for and paying for surveys did not appeal to frontier settlers who had little to fear from the property claims of distant neighbors. Once the land became thickly settled and farmers needed to carefully subdivide their lands among heirs, legal documentation became more necessary. Even after the war, frontiers remained in Pennsylvania that attracted squatters. In the decade following the war’s conclusion, perhaps fifty thousand squatters descended upon the region around Pittsburgh, which both Pennsylvania and Virginia claimed.⁴⁹

Elsewhere, other early modern governments recognized the limited ability for surveys to regulate marginal lands. Russia chose not to carefully allocate its frontier lands. By the 1760s, nobles could claim lands in the southern frontier zone as long as they could populate them with peasants. By the late eighteenth century, the government had sent tens of thousands of peasants to frontier areas near the Caucasus Mountains and Central Asia without setting aside special lands for them to farm. Surveying efforts in these newly acquired territories focused on maps for military use, with property surveys only beginning in the 1790s in a handful of settlements, such as Orenburg.⁵⁰

Similarly, the Qing Dynasty spread its empire west into Central Asia without a centralized surveying regime. Surveyors had used advanced techniques

48 Konkle, *Thomas Smith*, 35.

49 Schweitzer, *Custom and Contract*, 199; Matthew C. Ward, “The Peaceable Kingdom” Destroyed: The Seven Years’ War and the Pennsylvania Backcountry,” *Pennsylvania History* 74, no. 3 (July 2007): 247–279.

50 Michael Khodarkovsky, *Russia’s Steppe Frontier: The Making of a Colonial Empire, 1500–1800* (Bloomington: Indiana University Press, 2002), 146, 161; Steven Seegel, *Mapping Europe’s Borderlands: Russian Cartography in the Age of Empire* (Chicago: University of Chicago Press, 2012), 67–73; Willard Sunderland, *Taming the Wild Field: Colonization and Empire on the Russian Steppe* (Ithaca: Cornell University Press, 2004), 93–94.

in China at least as early as the thirteenth century, to direct the creation of irrigation projects. Nevertheless, the state had little use for surveyors, because it used surveys primarily to reassess regional taxes. Since the Chinese government collected taxes through the Ming Dynasty system of quotas established in the sixteenth century, little incentive existed to conduct expensive new surveys. Surveys could be inaccurate or corrupt, which would do little to raise revenues, but still alienate local populations.⁵¹

In long held regions, Chinese policy adapted to local circumstances. In the recently pacified district of Sichuan, which insurgents had captured during the Wu Sangui Rebellion, the central government specifically forbade surveys for several decades during the late seventeenth and early eighteenth centuries. Officials recognized that reevaluating taxes would create more conflict and likely distress many loyal military families that squatted illegally there. Later, during the 1780s and early 1790s, Chinese authorities potentially miscalculated by conducting a lengthy cadastral survey in Shaanxi province to identify and root out illegally held properties. Similar efforts to crack down on organized crime led to the White Lotus Rebellion that began in the mid-1790s.⁵²

Recognizing that local differences in economy and strategic vulnerability mattered, the Qing Dynasty adopted a multifaceted approach to surveying. At a national level, the Qing court embraced modern Western technologies associated with the Enlightenment and Scientific Revolution. Twice, the court encouraged Jesuit surveying expeditions that resulted in comprehensive maps of China: initially from 1707 to 1717 and again between 1756 and 1758. Much of this interest in mapping corresponded to a Qing focus on understanding and defending its imperial borders. At the same time, in some newly conquered provinces, such as the predominantly Muslim region of Xinjiang, the government agreed to conduct a survey of lands to establish a baseline for taxation, and military colonists carefully surveyed their land claims.⁵³

51 Joseph Needham, *Science and Civilisation in China*, 7 vols. (Cambridge: Cambridge University Press, 1954–2004), 3:533–585; Peter C. Perdue, *China Marches West: The Qing Conquest of Central Eurasia* (Cambridge, Mass.: Harvard University Press, 2005), 336–337; F. W. Mote, *Imperial China, 900–1800* (Cambridge, Mass.: Harvard University Press, 1999), 731. I would like to thank Jonathan Skaff for his insight into the Chinese imperial government's attitude toward the frontier.

52 Yingcong Dai, *The Sichuan Frontier and Tibet: Imperial Strategy in the Early Qing* (Seattle, Wash.: University of Washington Press, 2009), 69–73, 152–58, 190–96, 289. Wensheng Wang, *White Lotus Rebels and South China Pirates* (Cambridge, Mass.: Harvard University Press, 2014), 72.

53 Needham, *Science and Civilisation in China*, 3:577, 585; Laura Hostetler, "Qing Connections to the Early Modern World: Ethnography and Cartography in Eighteenth-Century

While Pennsylvanian land policy did not have to account for a political situation as precarious as that of the Qing Dynasty, the province had pressing strategic considerations of its own. In addition to the earlier conflict with Maryland, boundary disputes arose as the province expanded in the years after the French and Indian War, leading to Virginia's occupation of the land surrounding the Forks of the Ohio and Connecticut's claims in Pennsylvania's northern tier. Surveying itself could not settle these boundary disputes, as surveyors could not operate at times when their governments lacked a monopoly on violence. The surveying lines only reinforced pre-existing agreements. To deal with Connecticut's invasion, the Penn family chose to try to rapidly settle the contested region of the Wyoming Valley, lowering prices on choice manor lands and opening up the frontier to favored purchasers in the hope that settlers with Pennsylvania titles would drive out their Yankee opposition (who held even cheaper land titles). Only the American Revolution prevented Pennsylvania from losing control over the region.⁵⁴

Regardless of the vulnerabilities inherent in Pennsylvania's system, large-scale land speculations that failed to benefit the Penn family only occurred sporadically. In the opening decades of the 1700s, William Penn's secretary James Logan availed himself and his partners of thousands of acres of choice lands without the knowledge of the Penns. Later, the New Purchase allowed the government to set aside twenty-four thousand acres as bounty land for officers who had served the province during the Seven Years War. Rather than locating this land in a single block, as required by the proprietors' instructions, the deputy surveyor Samuel Maclay staked out multiple tracts across several fertile valleys. In a similar manipulation of the system, other speculators secured forty-six separate land grants of up to five thousand acres before the land office opened the New Purchase to the public.⁵⁵

China," *Modern Asian Studies* 34, no. 3 (July 2000): 623–662; Perdue, *China Marches West*, 336–341; Benjamin A. Elman, *On Their Own Terms: Science in China, 1550–1900* (Cambridge, Mass.: Harvard University Press, 2005), 131, 200–203. Nicola Di Cosmo, "Qing Colonial Administration in Inner Asia," *International History Review* 20, no. 2 (June 1998): 287–309 at 304.

- 54 Daniel P. Barr, "Contested Land: Competition and Conflict along the Upper Ohio Frontier, 1744–1784" (Ph.D. diss., Kent State University, 2001), 134–289; Paul B. Moyer, *Wild Yankees: The Struggle for Independence along Pennsylvania's Revolutionary Frontier* (Ithaca: Cornell University Press, 2007); Loretta Treese, *The Storm Gathering: The Penn Family and the American Revolution* (University Park: The Pennsylvania State University Press, 1992), 106–114.
- 55 On Logan, see Francis Jennings, "The Indian Trade of the Susquehanna Valley," *Proceedings of the American Philosophical Society* 110, no. 6 (December 1966): 406–424. Edmund Physick was especially vociferous in his criticism of deputy surveyors, whom he believed

By the eighteenth century, the province had a firmly entrenched culture of surveying. Pennsylvania's inhabitants internalized surveying as an obvious precondition for uncontested land ownership. While this culture was typically English, not all eighteenth-century English-speaking colonies embraced surveying equally. The last British colony founded on the mainland, Georgia, struggled to establish a regular surveying system. Georgia initially borrowed surveyors from South Carolina, then experimented briefly with a lottery system for distributing land before relying on the more common Southern system of indiscriminate location.⁵⁶

The naturalization of surveying practices also came late to many regions of Latin America. Only during the eighteenth century did the Spanish use surveys as part of an effort to modernize and rationalize its empire by mapping and documenting the resources of its frontier regions. The state appreciation for surveying affected local practices as well. On the frontiers of North America, beginning in the 1730s, a series of long-lot surveys established centrally planned, irrigation-based farms in New Mexico and Texas. Later, in the early nineteenth century, the surveyor general of West Florida conducted extensive mapping of that territory, including as yet uninhabited regions.⁵⁷

Whereas Spanish Americans had primarily used surveys to order their cities, and eventually turned to surveying the frontier during the eighteenth century, colonial Brazilians resisted the practice of surveying for as long as possible. Brazilian towns lacked central planning, and the government continued to dole out much of the colony's land as *sesmarias*. The boundaries of these land grants were so vague that one historian wondered whether the government liked it that way, to keep "Brazilian planters ... busy plotting against each other rather than against the crown." In 1796, the crown repealed a 1795 order

were in the pocket of "Gentlemen," and derelict in their duties. Among those interested in the officers' tract were Samuel and William Maclay, Maclay's father-in-law William Plunkett, and Turbutt Francis, the brother-in-law of James Tilghman, the Secretary of the Land Office; *The Susquehannah Company Papers*, 4 vols., ed. Julian P. Boyd (1930; repr., Ithaca: Cornell University Press, 1962), 3:xiii–xx, 185.

56 Farris W. Cadle, *Georgia Land Surveying History and Law* (Athens, Ga.: University of Georgia Press, 1991), 8–59.

57 Elliott, *Empires of the Atlantic World*, 302, 353; Terry G. Jordan, "Antecedents of the Long-Lot in Texas," *Annals of the Association of American Geographers* 64, no. 1 (March 1974): 70–86; Alvar W. Carlson, "Long-Lots in the Rio Arriba," *Annals of the Association of American Geographers* 65, no. 1 (March 1975): 48–57; John R. Hébert, "Vicente Sebastián Pintado, Surveyor General of Spanish West Florida, 1805–17: The Man and His Maps," *Imago Mundi* 39 (1987): 50–72.

to measure and reorganize the *sesmarias* systematically, in recognition of the impossibility of the task. By this time, successful squatters along the frontiers of Minas Gerais could hold huge tracts for decades before claiming them as *sesmarias*, relegating surveys to the task of confirming the area claimed. The lack of organization in this system inevitably led to a series of land disputes. Even as late as 1843, so few competent surveyors worked in Brazil that the government abandoned an attempt to validate the boundaries of these tracts. As a matter of practice, following Brazilian independence in 1822, inhabitants could claim land by *posse*, or occupation. This policy lasted until 1850, leading to the growth of large estates occupied and defended by the wealthy. Only after 1850 did the government demand official land purchases, meanwhile confirming all previous claims of occupation as legal.⁵⁸

In 1688, the Englishman John Love began his surveying manual by writing, “It would be ridiculous, to go about praising an art that all mankind know they cannot live peaceably without.” He added that surveying was as old as the world, for how could anyone “set down to plant, without knowing some distinction and bounds of their land?” Even in ancient Egypt, “every rustic could measure his own land.”⁵⁹

Love’s statement was inaccurate, but nevertheless revealing. While surveys had been common in the ancient world, including Egypt, the medieval world largely did without them. By 1688, surveys did regulate land distribution in England, although Love obscured the relative recentness of this phenomenon. Writing at the end of a revolution within his profession, he lent new surveying methods an aura of traditional authority. During the preceding century and a half, English lords had transformed millions of acres of unsurveyed medieval landholdings into lots fit for a commercial land market. Mathematical advances associated with the scientific revolution made deftly measured boundaries

58 Smith, “Colonial Towns,” 6–11; Warren Dean, “Latifundia and Land Policy in Nineteenth-Century Brazil,” *Hispanic American Historical Review* 51, no. 4 (November 1971): 606–625 at 607–616; Marcia Maria Menendes Motta, “The Sesmarias in Brazil: Colonial Land Policies in the Late Eighteenth-Century,” *e-Journal of Portuguese History* 3, no. 2 (2005): 1–12; Hal Langfur, *The Forbidden Lands: Colonial Identity, Frontier Violence, and the Persistence of Brazil’s Eastern Indians, 1750–1830* (Stanford, Cal.: Stanford University Press, 2006), 97–105; John Charles Chasteen, “Background to Civil War: The Process of Land Tenure in Brazil’s Southern Borderland, 1801–1893,” *Hispanic American Historical Review* 71, no. 4 (November 1991): 737–760 at 738–745; Alston, et. al., *Titles, Conflict, and Land Use*, 34–35.

59 John Love, *Geodaesia: or the Art of Surveying and Measuring Land Made Easy*, 13th ed. (1688, New York, 1796), preface.

between estates possible, and surveying became the preserve of technocrats, not legal experts.⁶⁰

By the time Love wrote, surveys had also spread across the Atlantic to regulate land distribution in Anglo-America. English lords found surveys useful as a means for erasing traditional rights, whether those rights belonged to English peasants, the Irish, or Native Americans. Surveying could replace formerly tangled webs of ownership with clean lines, turning foreign, forbidding lands into “a white paper.” In settler colonies like Pennsylvania, governments could market surveyed lands to investors while simultaneously imposing order on the frontier. As Love knew, colonists often struggled with the mathematics of surveying, but needed to survey millions of acres anyway. This created a market for comprehensive training manuals like the one he had written.⁶¹

But while men could not live peaceably without surveying in the English-speaking world, this did not hold true for the other expansive empires of Love’s day. In frontier zones, surveying might discourage precious settlement or cost too much and improve taxation yields too little. Elsewhere, the government risked antagonizing local elites by pushing for exacting surveys. Landowners did not naturally clamor for survey-based patents, and only came to value them in countries like England, where documents supported land claims in court. Only over time, when the population had internalized the necessity for surveys, after the government felt powerful enough to assert the need for “progress,” did surveying become taken for granted.⁶²

Pennsylvania was thus an outlier, an early adopter of surveying technology on a frontier. Its early settlement coincided with the widespread acceptance of surveys in England and followed the influential Down Survey of Ireland. Its peaceful relations with Native Americans, reinforced by the backing of the Iroquois, allowed the colony to take Indian lands with relatively little fear of violence. In turn, surveyors imposed a rough geometric grid upon the countryside, attracting settlers. Prospective European or non-local American buyers could grasp the concept of purchasing lands that an expert could properly measure, assess, and map on a grid. Perhaps most importantly, the Penns faced little opposition from local elites. They were the local elites most affected by

60 Ruth Kark, “Mamluk and Ottoman Cadastral Surveys and Early Mapping of Landed Properties in Palestine,” *Agricultural History* 71, no. 1 (Winter 1997): 46–70 at 48–54; A. W. Richeson, *English Land Measuring to 1800: Instruments and Practice* (Cambridge, Mass.: MIT Press, 1966).

61 Love, *Geodaesia*, preface.

62 Jeremy Black, *The Power of Knowledge: How Information and Technology Made the Modern World* (New Haven: Yale University Press, 2014), 206–207.

surveys, and also the ones who desired them most. In many other early modern empires, preexisting landholdings in the hands of the powerful caused local resistance and could make surveys unattractive to the central government. Ironically, England's decentralized colonial schemes empowered local authorities like the Penns to embrace survey-based land distribution. This decentralization caused a more rapid embrace of surveying technology compared to more centralized early modern empires.