THE AMERICAN YEOMAN: AN HISTORICAL ECOLOGY OF PRODUCTION IN COLONIAL PENNSYLVANIA

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ABSTRACT

MICHAEL D. SCHOLL: The American Yeoman: An Historical Ecology of Production in Colonial Pennsylvania.
(Under the direction of Dr. Carole L. Crumley)

This study examines climate, landscape and agricultural products, but it is essentially a study of an American yeoman class in colonial Pennsylvania. Yeomen emerged out of feudal hierarchies of manorial Europe as owner-operator agriculturalists. As part of the British colonization of North America, they reformed themselves into a social majority. In Pennsylvania they embraced shifting agriculture and a suite of risk-minimizing practices in response to changing weather patterns. By the end of the 18th century, the yeoman class had become a victim of its own success and it gave way to a class of farmers who used hired labor on rented land to chase a strong grain market. This work examines their changing ecological relations in order to explicate the American yeomen's transformation into farmers.

Historical ecology is an emerging theoretical approach which seeks to combine climate, social history, geography, and the practices of production in order to understand changes in landscape over the long-term. Information concerning class descriptions, agricultural products, livestock, bound labor, and risk-management strategies from 3551 inventoried households which contained about 25,000 people are placed within the context of social history, climatological observations and reconstructions, and geographic information system (GIS) data in order to chronicle the last days of the American yeoman.

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CHAPTER 1

YEOMEN

The Quiet Revolution

Late 18th century America was a place of revolutions. A political revolt wrested governance of a newly united thirteen colonies away from the British Crown. An economic separation of American commerce from the mercantilist policies of the Lords of Trade fostered the formation a modern capitalist economy. A third revolution in agriculture began as rural producers finally heeded the long-ignored advice of gentlemen-reformers who pushed for capital investment. On the underside of history (Frazier 1982:1), a quiet social revolution took place as a self-identifying class of American yeoman who had practiced low-risk, low-input shifting cultivation transformed themselves into farmers who chased a burgeoning international market.

The yeoman class was born as a late feudal military rank. For most of their 500-year history they structured their lives around personal ownership and operation of agricultural land. In colonial Pennsylvania, yeomen formed a rural majority whose values were a hegemonic template for the classes above and below them. The self-exploiting yeoman class stands in opposition to farmers, also an ancient British class, who were market-oriented entrepreneurs who employed wage laborers on rented land. This work seeks to explicate the passing of the American yeoman class in the late 18th century.

As a social and economic institution defined by a shared mode of production, any significant change in the yeoman class must be tied to changes in their ecological relations. Therefore, this work examines the climate, landscape, crops, livestock, labor, and risks to agriculture in 18th century Pennsylvania. Agriculture was the central business of the British colonies, but their practices are not very well known. Pennsylvania yeomen were typically literate (Tully 1972:304-306), but wrote almost nothing about cultivation. They learned and taught husbandry by working beside family and friends and made no effort to publish the secrets of their trade. As a result, the agricultural literature was predominantly authored by gentlemen-reformers who portrayed yeomen's practices as fostered by ignorance, fixed in time, and impervious to change.

Having only the critique to work from, many agricultural historians have either adopted the reformers' view or have avoided the period altogether. James T. Lemon (1987) has suggested that the perceived stagnation of colonial agriculture is acerbated by the topic's poor representation in academic journals (:76-77). Russell R. Menard (2006) has recently observed that the erroneous view that colonial agrarians followed the "dead hand of tradition" still persists (:109-110). There are notable exceptions. Gordon G. Whitney (1994:232-241) provides a concise review of the researchers who have found rationality in American colonial agriculture. This study seeks to peer beyond the rhetoric of 18th century class struggles and explore yeoman agriculture through an historical ecological study of production in Chester County, Pennsylvania. Chester is one of the three original counties of the Pennsylvania colony and is located in the Delaware Valley and to the northwest of the City of Philadelphia (Figure 1).

Modern Yeomen of the 20th Century

The yeoman class of colonial America did not survive the 18th century, but farmers with yeomen ideals have reformed themselves around risk-adverse strategies in each century. Rural Sociologist Sonya Salamon (1985) has identified a modern yeoman pattern in her studies of differential responses of 20th century Midwestern farm families to perceived threats. From her extensive fieldwork in Illinois, Salamon argues that farming families lay on a continuum of practice. On one end is what she calls the yeoman strategy, practiced by those whose chief goal is to perpetuate farming as "a way of life." On the other end are entrepreneurs who view agriculture as a business like any other, and important only for its profitability (:325-327).

Entrepreneurs in Illinois focus on wheat which is the most profitable sector of the agricultural market. They use a combination of owned and rented land in order to best utilize existing machinery and wage employees. Success in the entrepreneurial strategy results in land consolidation and eventual managerial absenteeism. The results of strategic failure are an unemotional liquidation of farm assets and movement to a more promising segment of the market (Salamon 1985:325-327). Entrepreneurs prepare their offspring for business by instilling values of familial independence and foreknowledge that they will operate unprotected within the market. Failure in business results in a geographic scattering of the family unit which produces loose social networks and a disconnection of households from their communities (Salamon 1985:326; Davis-Brown and Salamon 1987:149).

On the other end of the spectrum, yeoman seek to reproduce both the farm and the farmer. They stress ownership of the "family land" above profitability. Many yeomen reserve a pool of capital to purchase family land when it becomes available. Yeoman farms are kept

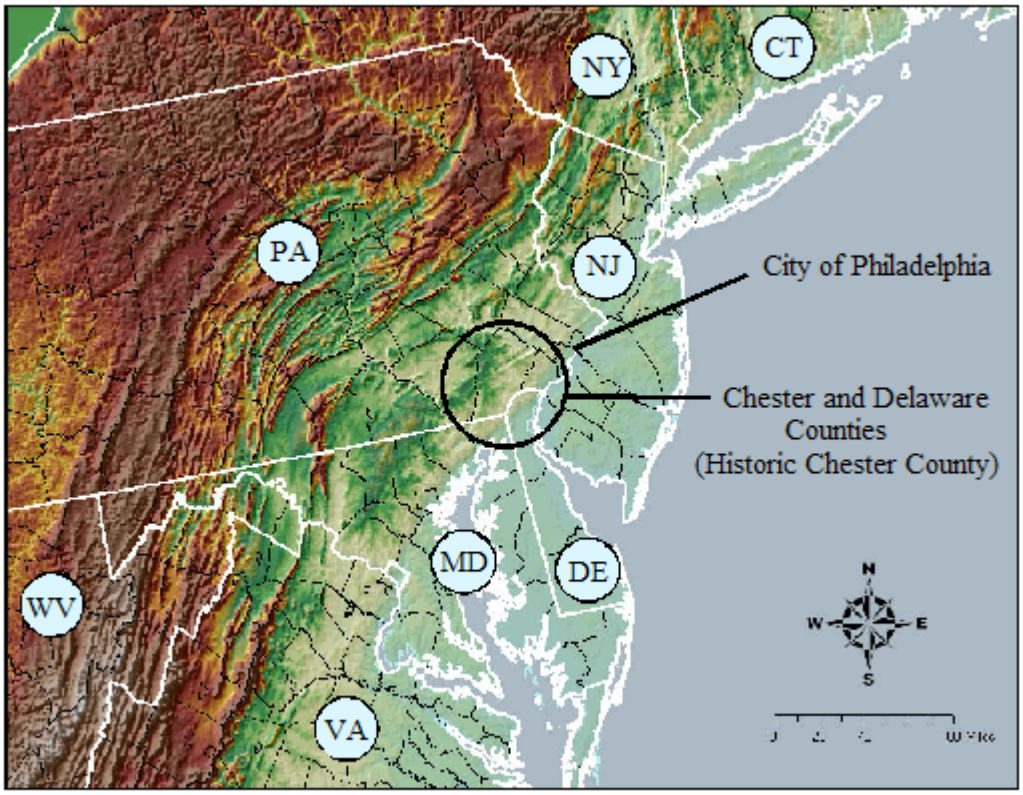

Figure 1. Location of Chester and Delaware Counties, Pennsylvania which Comprise 18th century Chester County (CT = Connecticut, DE = Delaware, MD = Maryland, NJ = New Jersey, NY = New York, PA = Pennsylvania, VA = Virginia, and WV = West Virginia).

small by the limitations of household labor and reduced labor efficiencies that accompany diversification into both grain and dairy products (Salamon 1985:325-327). The goal of fostering a new generation of farmer encourages familial cooperation. The drive for historical continuity is strong. One of Salamon's (1985) modern yeoman expressed his ideal in the following way:

> The money's immaterial. I want a comfortable living for myself, but the main thing is that's it's something I've put together and I want to see it stay together. It's something from the past, and I want it to go on. I'd like to come back in 500 years and see if my great-great grandchildren still have it. Maybe it'll be built up two or three times what it is now (:329).

The perpetuation of farms and farmers requires collective effort which produces complex networks of close social relations geared toward community stability (:369-370). Salamon's Illinois yeomen are not unique. Other researchers throughout the American Midwest have identified similar yeomen strategies in modern farming families (Barlett 1987:149).

Davis-Brown and Salamon (1987) argue that the differing goals and strategies result in varied reactions to perceived dangers to the farm. For entrepreneurs, fiscal threats are subservient to the needs of the nuclear family. In a businesslike fashion, problems are ameliorated by a liquidation of assets, or forestalled through increased capital investment. In contrast, threats to yeoman farms endangers an habituated social identity which is perceived to be a part of an unbroken historical continuity. Protection of the farm, a family heirloom, is valued above the needs of individual members of the household. The risks of potential failure are reduced by collective support and sacrifice. However when systemic failure does occur, the result is often catastrophic (:370).

In Salamon's (1985) study area, the Grey Prairie region of south-central Illinois, yeoman and entrepreneur strategies partially overlap ethnic divisions between descendants of

German-speaking Russian Catholics and Protestant "Yankees" from the eastern United States (:327). Bradley H. Baltensperger (1983) has suggested that the yeoman strategies were a form of "cultural rebound" of remembered ethnic practices reformed after becoming established by following local practices (:75-88). Salamon (1985) recognizes that "many aspects of farming, community, and agricultural structure are byproducts of overarching family ethnic farming goals," but argues that such structures are not unique to any one ethnic group (:326-327). The yeoman strategy may be communicated and reified through ethnic identities, but the yeoman goals are an institution of class defined by a shared position in the relations of production and not restricted to any particular ethnic group.

Pioneer Yeoman of the 19th Century

Allan Kulikoff (1989, 1992, 2000) has used the term "yeoman" to describe classes of independent agriculturalists of the late-18th and early-19th centuries who pushed against the American frontier. Kulikoff has argued that these yeoman classes were a new capitalist formation unknown in Britain and had descended from the lower, peasant classes of Europe. Imbued with ideology of independence fostered by the American Revolution, the pioneer-yeomen emerged out from under the political control of gentlemen-landowners. They formed a democratic society of small freeholders through persistent dissent and often violent conflict with colonial powers. Kulikoff contends that these new classes would have been short-lived, had it not been for the 1803 Louisiana Purchase which provided room for expansion and continued self-rule (1989:140-144, 1992:34-59, 127-151, 2000:203; 289-292). Within the expanded territory the pioneer-yeoman pursued "an agrarian way of life – based on energetic labor by the entire family, subsistence production, neighborly exchange, sale of surpluses, and

movement to new lands" (Kulikoff 2000:292). Stephanie McCurry (1995) has identified a class of yeoman farmer in the South Carolina low country who had a greater focus on food that other cotton producers and who used their rights as landowners to hold off the predations of their wealthier planter neighbors (:5-7, 64-70).

The subject of the present study is a precursor class of self-identifying yeomen common in the American colonies and who formed a social majority in Pennsylvania. American yeomen were not inventors of a completely new way of life, but were reinterpreting an existing ecological strategy with roots in post-medieval Europe. The critical period of overlap between traditional and pioneer yeomen was the two decades before the American Revolution. The descendants of European peasants learned yeoman values and practices during their tenures as servants, cottagers and day-laborers under American yeomen. Armed with freedom dues, wages, and a set of cultural knowledge these farmers of the Early Republic carried yeoman practices to the American frontier.

Traditional Yeomen of the 18th Century

The majority of rural Pennsylvania agrarians were true yeomen in the sense that they identified themselves by the term in official documents. However, the term was not a part of daily speech like the larger social divisions of master and servant, landlord and tenant, and free man and Negro. Some historians have rightly expressed concern that the term "yeoman" has been subject anachronistic overuse and note that with the exception of a Pennsylvania politician named George Logan, those who used the term have not left a substantial literary footprint (Appleby 1982:835-838). However, in colonial America yeomen were an extension

of a centuries-old class designation which retained much of the same meaning it held in Britain.

Mildred Campbell (1942) has traced the historical trajectory of the British yeoman. The class occupied a middle position above the peasantry who posed only customary rights to land within manors, and gentlemen landlords who formed the base of the nobility (:1-63). Yeomen originated as an early medieval military rank denoting a particularly skilled retainer whose reward for long service often included land. By the 15th century the term came to designate a class of agrarian freeholders and well-to-do tenants who possessed a right to address grievances in court, hold public office, and rise in station (:389-394). British colonists brought their class structure with them to the New World. The transplantation was aided by a recognition by British law, their position as a social majority, parallel structures in the home countries of other immigrants, and vast expanses of readily obtainable land.

For anthropologists, yeomen are an inconvenient social configuration. Historically, they have held a position above peasantry, but at the same time they shared much with them. Economically, yeomen are similar to peasants in that they use household labor to produce for their own subsistence and a broader market (Wolf 1966:11; Foster 1967:2-3; Diaz 1967, Halperin 1977:12). However, they differ in that peasants are typically viewed as inherently non-capitalistic (Chayanov 1966) and an underclass (Dalton 1972:406).

Most researchers view American yeomen as capitalists, or at least capitalistic. Modern practitioners of yeomen strategies are full participants in the global market. However, 18th century yeomen resided on the semi-periphery of the emerging global market (Lemon 1972, 1980; Wallerstein 1980:179-180). Additionally, some have argued that colonial Americans retained a peasant's world view and lacked the social structures of modern capitalism

(Henretta 1978, 1980; Rappaport 1996:xi-xii). Perhaps the most important distinction is that most Chester County yeomen would have taken an affront to being called a peasant. The colonial proprietor and his agents were very careful to describe all rural agrarians as "country people" even though his plans included both freeholders and European-style manors staffed by "feeble and poor Families" (Myers 1912:274-275).

The economic independence that yeomen enjoyed in Britain and the American colonies suggest that they fit best within Robert McC. Netting's (1993) "small-holders" (:20-21). However, that category is also problematic. Netting (1993:2) characterizes small-holders as those who seek to intensify labor on small farms in the context of relatively dense populations. While this may have accurately described yeomen in England and Wales, in colonial America labor was carefully husbanded on large plantations in the context of very low population (Lemon 1972:169). Nevertheless, in most other ways the yeomen of Pennsylvania fit the smallholder ecology which is predicted on diversified production informed by "folk knowledge" and "practical experience" (:320-334).

Yeoman Ecology

Anthropologist Peggy F. Barlett (1987) has described the "yeoman strategy" as inherently conservative and which seeks to use "less energy and is more oriented toward sustainability." She suggests that it is "more like a climatic adaptation" than entrepreneurs whose strategies are "more like a colonizing adaptation to abundant energy resources" (:149). The stark contrast between sustaining yeomen and colonizing farmers is contraindicated by American yeomen's role as frontiersmen and farmers as occupants of long-settled regions. Nevertheless, Barlett establishes some useful characterizations. She argues that

entrepreneurial strategy maximizes capital accumulation, but requires high inputs of energy which inflates economic risk. Risk is experienced and mediated through familial individualism. Failure on the part of one member does not jeopardize the family unit as a whole. Farmers value "growth, consumerism, competition and individualism" which are consistent with a focus on a global market and favored by the late 20th century political hegemony (:149). By extension, the yeoman strategy lowers risk by minimizing inputs of capital and energy and, as Davis-Brown and Salamon (1985) maintain, yeomen experience failure collectively (:369).

Whether one is discussing Salamon's modern yeomen, Kulikoff and McCurry's pioneer yeoman, or Campbell's British yeomen, one finds a dozen common elements. (1) Yeomen have legal rights which give them control of agricultural land and produce. (2) They are self-exploiting and predominantly utilize household labor. (3) However, they will use hired labor and rented land to achieve short-term goals. (4) Yeomen value the reproduction of their way of life as well as profit and (5) rely on inter-generation and inter-household cooperation to achieve that end. (6) Profits are accounted over the long-term and (7) they insure long-term profit through low-risk practices. (8) Yeomen participate in the market without being entirely driven by it and (9) tend to keep their land holdings in check with household size. (10) The yeoman class grows proportionally to the placement of offspring on new land. (11) Cooperative action leads to fewer incidences of loss of land holdings. (12) However, such failures are concomitant with a loss of a social identity and familial purpose.

Colonial yeomen left few personal accounts concerning their view of the on-going social change. However, if their class identity was closely tied to an agrarian way-of-life, then the loss of class consciousness in the late 18th century must be contemporaneous with changes

in the agricultural practice. Therefore, a study of climate, landscape, crops and livestock should reveal the changes in the material base of the yeoman class.

The author seeks to followup on Carole L. Crumley's quest for methods for studies of landscape, the material manifestation of the relations of humans and their environment. In doing so, this work appends historical studies such as Mildred Campbell's *The British Yeoman* and Robert C. Allen's *Enclosure and the Yeoman*. This study furnishes additional production data to James T. Lemon's *The Best Poor Man's County*, a landmark study in cultural geography and corrects the poor view of colonial agriculture in Steven Whitcomb Fletcher's encyclopedic *Pennsylvania Agriculture and Country Life*. For anthropologists, a study of American yeomen helps connect Robert McC. Netting's *Smallholders, Householders* to current practitioners of yeoman strategies as they are so well described in the work of Sonya Salamon and other researchers of rural sociology.

Yeomen in 18th Century Chester County, Pennsylvania

Chester County is one of the three original counties of the Pennsylvania colony established by William Penn in the late 17th century. Penn legitimized his proprietary rights through a series of purchases from Native Americans and by offering citizenship to Swedes, Finns, and Dutch who were the decedents of earlier colonies. Penn recruited additional settlers from Western Europe and they imported servants and slaves from Europe, the Carribean, Africa and the southern American colonies. The historical literature concerning 18th century Chester County is extensive and well-developed. One of the central works concerning Pennsylvania agriculture is James T. Lemon's (1972) *The Best Poor Man's Country: A Geographical Study of Early Southeastern Pennsylvania.* Lemon's work remains an

important contribution to the history of the region. However, his reconstructions of 18th century agriculture (:150-183, 208-217) relied on spotty contemporary observations from adjacent regions, and a small sample of probate inventories. The development of computerized databases and new techniques for analyzing production data from probate inventories, geographic information systems, and a renewed attention to climate encourage a return to Chester County for a more detailed exploration of American yeomen.

The Chester County Archives' index of Wills and Administrations between 1713 and 1870 indicates that yeoman were populous throughout the first half of the 18th century, grew in the 1760s and 1770s, but dropped away in the 1780s (Figure 2). The adoption of a printed form for appraiser's bonds in 1761 increased the frequency with which class was recorded. However, the effect was small. In proportion to all classed persons, the frequency of yeomen followed a pattern of growth established in the 1750s and increased 7-percent in the 1760s. Decedents are occasionally called yeomen in 19th century probates, but their days as a social majority had passed (Figure 3). Since the class identifiers are inherently political, and the growth of the yeoman class between 1750 and 1780 must have been part of an ultimately failed revitalization of class identity. This project seeks to discern what those underlying conditions to the last gasp of the American yeoman class, and the rise of the American farmer.

A matter of importance is the terminology used to refer to colonial agrarians. It has been common practice to refer to anyone who cultivates the soil as a "farmer" regardless of their relations to production. That practice is consistent with the ideology of democratized classlessness in the 19th and 20th centuries, but doesn't follow common usage in the colonial period. In the 18th century, rural Pennsylvanians perpetuated the British differentiation between a "farmer," who practiced a market-oriented approach with hired labor on rented

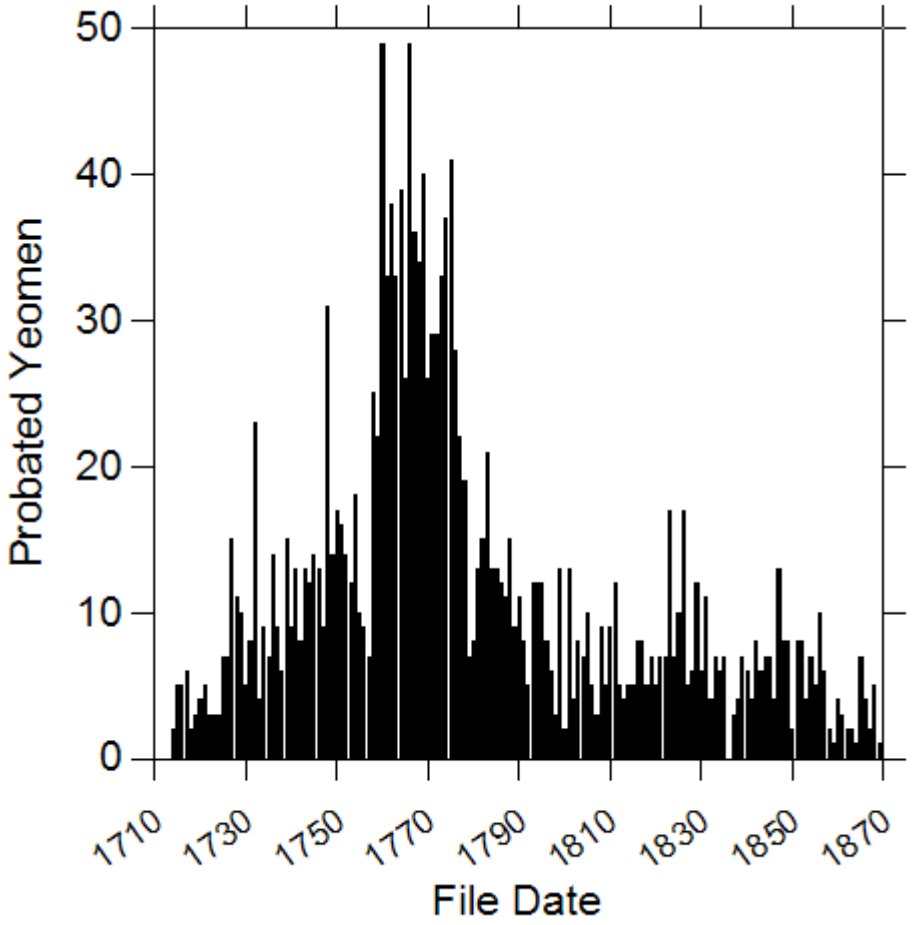

Figure 2. Persons Described as Yeoman in Chester County Probate Index, 1713-1870 (By File Date; Chester County Archives Wills and Administrations Index 2006).

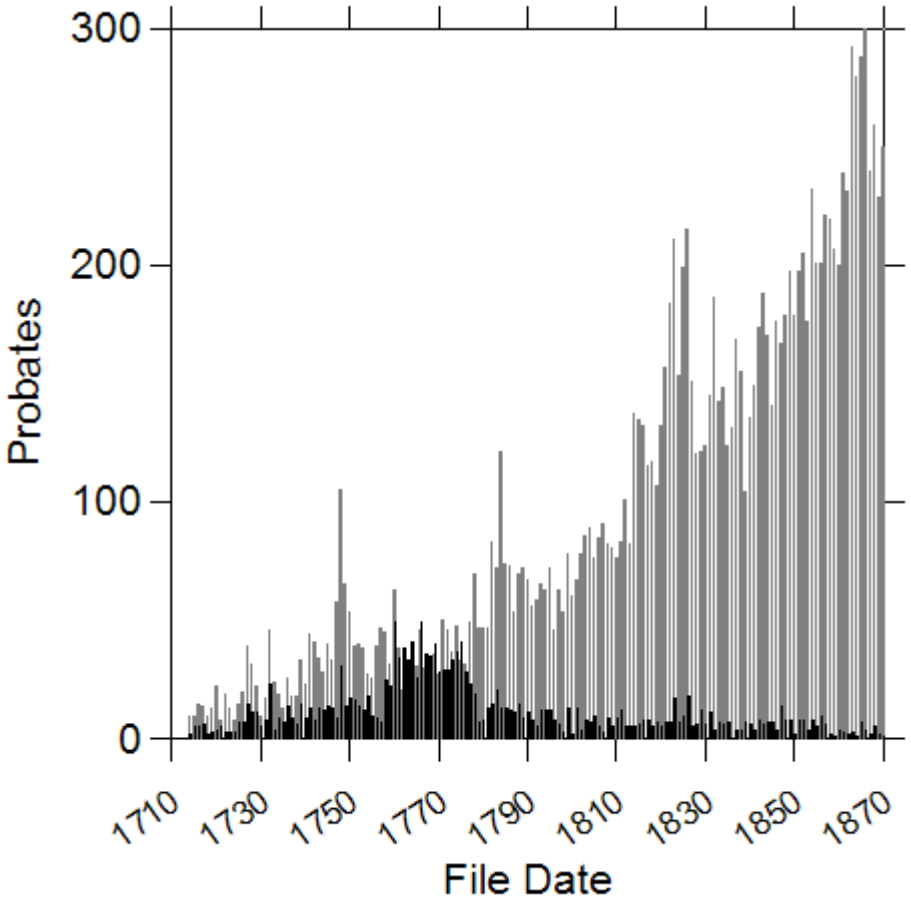

Figure 3. Persons Described as Yeoman (in black) and All Other Probates (in gray) Chester County Probate Index, 1713-1870 (by File Date; Chester County Archives Wills and Administrations Index 2006).

land, and "yeomen" who operated their own freehold. In Chester County self-identifying farmers were a small minority. Nevertheless, Philadelphia merchants often referred to all agrarians as "our farmers" in the same manner as their factors in London.

In later centuries the land worked by a farmer would be properly called a "farm." However, in the 18th century yeomen referred to their lands as "plantations," a term that adds yet another layer of confusion. Current American English associates plantations with large holdings in the southern colonies which were operated by a planter class who used drivers and bound labor to produce export crops. This work follows the 18th century by reserving "farmer" and "farm" for the small number of agricultural entrepreneurs in the 18th century and the emerging social majority in later centuries. The term "yeoman" is used to describe those who operate their own land and follow a risk-adverse strategies. As will be discussed in a later chapter, yeomen formed the social majority in 18th century Chester County. Therefore the term is appropriately used to refer to all agrarians in general.

The Approach of Historical Ecology

Historical ecology was developed in the late 20th century by researchers frustrated with the persistent dichotomy between nature and culture in the social sciences. An entrenched disciplinary division of labor ensured the continued production of culture-less explanations of prehistory, and histories in which environment played but a small role (Moneyhon 1980; Crumley 1994, 1996, 2007; Balée 1998). Notable methodological forays were made toward incorporating environmental and social histories (Bilsky 1980; Cronon 1983). However, it was not until Marquardt and Crumley's (1987) essay entitled "Theoretical Issues in the Analysis of Spatial Patterning" that landscape was recognized as the necessary

focus of those wishing to merge human history and the environment. As relates, humans and their environment are bound in a dialectical relationship which manifests spatially as landscape. Whether one reads the landscape to learn the past, or studies the processes which affect landscape, the approach seeks to explicate human-environment relations over the long term (Marquardt and Crumley 1987; Crumley(1995a, 1996a, 1996b, 2007). As an ecological artifact, landscape provides both evidence and defines factors with potential relevance to changes in human ecological practices.

Historical ecology offers new uses for old data by bridging the gap between material objects and social formations. Things like probate inventories take on new import because they contain regular and precise samples of agricultural production reflecting the practices and fortunes of the yeoman class. Since agriculture was the prevailing ecological pursuit of early British America and the material basis of wealth in colonial society, its study has large historical import. A focus on landscape enables researchers to identify relevant ecological factors as those which have contributed to its formation. In the case of Pennsylvania yeomen, those factors include class history, climate, soils, settlement pattern, records of production, class structure, crops and livestock, labor, environmental and market risks, and the relationships between these lines of evidence.

Summary of Findings

The following chapters trace the development and eventual end of the yeoman class in colonial Pennsylvania. This first chapter has reviewed the historical and anthropological understandings of yeoman strategies toward production. Chapter 2 discusses the history of the efforts of gentlemen reformers to change the way that yeoman practice agriculture. The

yeoman class originated as a feudal rank who gained land and legal rights for exceptional military service. In subsequent centuries they formed themselves into a middling class of small landowners and well-to-do tenants with long leases. The class grew in intervening centuries as landlords removed peasants in order to concentrate on wool production. The resulting high food prices and legally repressed wages of depressed wages of displaced husbandmen fueled the class' growth. However, the loss of the peasantry meant that yeomen became the new target of the rhetoric of agricultural reform developed to justify the dissolution of peasant's open fields. As persons with expressed legal rights, yeomen enjoyed an immunity from direct intervention. The advice of gentlemen reformers fell on deaf ears and yeomen never felt the need to explain their trade secrets. As a result, the agricultural literature has been dominated by reformers who have only rarely considered that yeomen practices were more than mere traditionalism.

Most emigres to Pennsylvania came from the European yeomanry or soon acquired land and joined their ranks. Contemporary observers argued that Pennsylvania yeomen had squandered a rich inheritance by allowing their animals to graze unsheltered and only opening new fields when old ones had become exhausted. Despite these perceived shortcomings, late-century observers noted that American yeomen enjoyed a better standard of living and possessed a greater potential for growth. Export records are sparse, but those that have survived suggest that yeomen fed themselves and burgeoning American cities, and shipped large quantities of wheat and other goods to Britain, southern Europe and the Caribbean Islands.

As a class that is both laborer and owner, yeomen's fortunes were more closely linked to the weather than other classes. Regardless of the quality of the harvest, a laborer collects

his wage and the landlord his rent. Yeomen embraced both famine and feast. Chapter 3 discusses the climatological history of Pennsylvania as it is reflected in contemporary observations, navigation records, meteorological observations, and a extremely valuable series of reconstructed temperature and precipitation. Pennsylvania is located along an axis of the "westerlies," prevailing polar jet stream whose movement causes rapid and unpredictable changes in weather. The reconstructed climatic data compares favorably with direct meteorological observations and suggests a movement of the path of the westerlies. As a result, local weather patterns were generally warm and wet before 1740 and then rapidly changed over to predominantly cool and dry weather. The 1760s and 1770s were somewhat warmer, but the springs remained cool and the all seasons were comparatively dry. After 1780 the weather had returned to the warm and wet weather of the early 18th century.

A principal component analysis conducted in the final chapter suggests that increasingly cool springs adversely affected agricultural production, in particular depressing wheat yields, by shortening the growing season. Yeomen responded to a shift to cooler summers and persistently dry weather in the 1760s and 1770s by inter-cropping wheat and rye, and diversifying grain production. Above all other factors, it was the risk-reducing responses to climatic change that were most closely correlated with the rise and fall of the yeoman class in Chester County, Pennsylvania.

The qualities of soil, locations of natural meadows, ecological history and distribution of 18th century settlement are presented in Chapter 4. That chapter is informed by historical demographic and geographic information system (GIS) data. The GIS data indicates that in all parts of the county agrarians were well-provided with high-quality arable land and meadows. The size of the townships and numbers of households recorded in tax assessments reveals that

after 1730, households were evenly distributed across the county. That relatively uniform pattern indicates that there is little need to consider geographical dispersion in the analysis of agricultural practice within the County. Through a process of hosting, European colonists had learned Native American practices of shifting cultivation and, much to the horror of reformers, they taught it to each wave of new immigrants.

Chapter 5 reviews the characteristics of 3551 sampled probate inventories of Chester County residents who passed between 1713 and 1789. Yeomen's agricultural practices were reconstructed from production data contained within inventories of the possessions of recently deceased persons of property. Typically, two independent appraisers made a complete list of debts owned the estate, quantity and values of slaves, servants, household goods, agricultural and craft products, tools and livestock. Minimally, these inventories document the name of the owner, township, inventory date, and the type and valuation of goods, chattel and debts.

Under British common law, only one's most personal effects were held by the individual. Most other goods were the legal possession of the head of the household. Based on historians estimates of typical household size, this study includes the material culture and produce of 25,000 persons. Recent work indicates that similar records have been archived throughout Europe and her numerous colonies. The present analyses have the potential for broad applicability and offers an opportunity for broad, cross-cultural comparisons.

Appendix A contains a detailed chronology of the authorship of Chester County probate inventories. A reader unfamiliar with 18th century weights and measures of agricultural products, land and currency may consult Appendix B. Unless otherwise stipulated, all dates have been converted to the new date system established in 1752 in order to synchronize the American calender with those in Europe. By general agreement, September 2,

1752 was followed by September 14, 1752, and first day of 1753 was January 1, rather than the old date of March 25 (Futhey and Cope 1881:50-51). Agricultural goods and chattel are expressed as decimalized Pennsylvania pounds (£), shillings (s.) and pence (d.). Annual conversion rates to British pounds sterling are available in Bezanson, Gray and Hussey (1935) and the United States Bureau of Census (1960:Z-357). Monthly exchange rates have been estimated by McCusker (1978:175-188). Inventories valued in Continental money were converted to specie, the traditional unit of valuation, using internal evidence or rates in similarly dated estates.

Probate data were examined from the perspective of exploratory data analysis (EDA) which focuses on pattern recognition rather than a testing null-hypotheses (Hoaglin and Velleman 1981). This approach is critical to examinations of material culture in probate inventories. Individually, each record says much about a particular household on one particular day, but are difficult to generalize. It is only when they are aggregated and reduced to a conceptual entity — a typical yeoman on an average size plantation — that patterns of change become recognizable. Those data informed graphs and statistical calculations generated with SPSS Inc.'s Systat version 10 statistical package.

Inventory dates indicate that mortality was highest in the spring and autumn. A comparison with Philadelphia data suggests that respiratory disease may have been a persistent cause of death among people who leave inventories. As discussed in Chapter 3, many contemporary observers of weather were motivated by a "Climatist" perspective which associated illness, particularly epidemic disease, with specific weather conditions. A principal component analysis (PCA) comparing the reconstruction of Philadelphia regional temperature and rainfall to mortality of inventoried Chester Countians found no strong correlations. The

analysis revealed a weak association between mortality and wet and cold winters. Citing contemporary diarists accounts, it is likely that this relationship reflected the dangers of winter travel and accidental exposure.

The descriptions of decedents social status in probate records are used in Chapter 6 to explore the 18th century class structure. Analysis indicates that there was a wealth hierarchy, of sorts, in rural Pennsylvania. However, the majority of those who left inventories belonged to an extremely large yeoman class which included more than three-quarters of all inventoried men.

The richest estates belonged to a small class or graziers who acted as middlemen between rural yeomen and city butchers. More commonly, the upper class included rural gentlemen who increased their wealth by money lending, but most kept an active hand in agriculture. For the most part, Chester County gentlemen were merely wealthy yeomen who continued to work their own fields in adherence with an hegemonic yeoman ideology. Above the yeomen majority was an upper middle class was occupied by physicians, merchants, soldiers and sailors, and clergymen. Below yeomen were farmers, husbandmen, widows, and artisans. The lowest classes of inventoried persons were laborers and school masters.

Despite the numerous grades of wealth, agriculture was the primary enterprise of every class but schoolmasters. The households of gentlemen, merchants and artisans alike turned their hand to agriculture. In terms of functional differences in relations to the environment and market, there were only two significant classes in Chester County, yeoman and their laborers.

Chapters 7 and 8 examine the changing frequencies of inventoried goods and chattel in probate inventories. Among these possession were grain, tools and animals which formed the

working capital of Chester County yeomen. These estimates are the first continuous series of agricultural production data for colonial America. It is not until the first agricultural census in 1840 that similar data was produced.

Wheat was the Pennsylvania's main cash crop, and early colonists grew to the near exclusion of other grains. Total production of Chester County wheat rose throughout the century, but only because of strong population growth. Individually, yeomen grew less wheat as the century progressed. Between 1740 and 1780 yeomen inter-cropped their wheat with rye as a means of using the fast growth and hardiness of rye to protect the more valuable wheat. After 1760 yeomen diversified their grains to include greater quantities of maize, which they called Indian corn, and oats. The movement away from wheat was carried out in the context of falling yields, small parcel sizes and cooler spring temperatures. However, as it will be demonstrated in a later chapter, the strong market price for wheat compensated for the reduced labor efficiencies and yeomen continued to grow wealthy.

Chester County yeomen kept horses, cattle, swine, sheep, bees, turkeys and ducks. Much to the horror of reformers, these animals ranged free in both summer and winter. Oxen were rarely used, and horses pulled plows, carriages and wagons. The numbers of livestock increased only slowly over the course of the century. Their numbers were held in check by the availability of natural grasses in meadows and fallow fields. Yeomen used the tops and young blades of Indian corn, clover, and English grasses to augment natural grass, but only a few yeomen invested their efforts into these fodder crops. Most relied on natural grasses to feed their stock.

Labor was a precious resource in colonial America. The frontier promised land to even the poorest free person, so wage laborers came at a high price. Yeomen's agricultural cycle

was such that they had to plant, harvest or thresh in all but the dead of winter. Many yeomen resorted to bound labor and one in five inventories included appraisements for slaves, servants or apprentices. Chapter 9 discusses labor relations in Chester County and compares the rates of exploitation of free offspring, servants and slaves. Even with the practice of freedom dues and the use of bound labor presented substantial long-term savings over wage labor. Over the course of 21 years, a slave or three menservants working in agriculture could save their master the price of a small plantation. Domestic help was as necessary, but much less profitable and a master might clear 100£ over the same period. Yeomen tended to prefer servants. In the short-run they presented the best economic return with lower initial investment. However, over the course of several servant contracts, enslaved labor provided the highest rate of savings over wage labor.

Chapters 10 and 11 explore Chester County yeomen's methods for protecting themselves from the effects of environmental hazards and market fluctuations. Yeomen used time-tested methods of field scattering, shifting cultivation, crop diversification, and inter-cropping to spread the effects of environmental hazards. Appraisals of fields of similar crops in probate inventories indicate that yeomen's scattered fields served to spread their risk over space and insured that localized disasters would not damage an entire year's crop. Yeoman's practices may have inoculated yeomen against the "Hessian" or wheat fly. The pest struck in other states, but probate inventories and contemporary accounts contain no evidence of that pest striking in Chester County before 1790.

The hard labor of breaking land meant that yeomen had a mix of old, mature and new fields. The values of standing grain suggests that new fields were not always the most prolific. Instead valuations of grain on "old" and "new" fields suggest that in some circumstances old

fields produced more grain by slowing maturation until the favorable summer weather. Reformers complained that yeoman's shifting cultivation meant that they planted the same crop on the same field for year after year. Doing so meant that grains which had fallen from stalks during harvest were reintroduced into the next years crop. As a result of these practices, the next crop needed only light seeding and the seed stock was likely to have preserved characteristics which allowed the easy threshing grain without the labor of gleaning fields.

Crop diversification and inter-cropping were means of spreading risk over product. At the cost of producing for the market, Chester County yeomen eschewed the highest potential profits for wheat and instead chose the safer route of producing a greater amounts of locally consumed grains. When they did raise wheat, yeomen increasingly inter-cropped it with rye. In the later part of the century, yeoman's retraction from the wheat market may have been influenced by their decreasing ability to predict market prices. Comparisons of the inventoried and market values indicate that after 1760 appraisers had increasing difficulty predicting the price of wheat. While this uncertainty may have hastened their movement away from wheat, but yeomen had been growing less of it since the 1720s. A principal component analysis conducted in the final chapter indicates a strong correlation between these risk reducing strategies, warm winters, cool summers, doughtiness, and the growth of the yeoman class. A finding which gives quantitative support for the common observation that the fundamental yeoman strategy is one of risk-avoidance.

The movement away from wheat was concomitant with fall in wheat yields. Some contemporary observers and numerous historians have charged that the new agriculture was adopted out of necessity as shifting cultivation had lead to widespread soil exhaustion. Estimates of wheat yields from inventory data agree that wheat yields had fallen throughout

the second half of the century. However, soil fertility is just one of the many factors that influence yields. In shifting cultivation, soil fertility is the product of the ratio of the period cropped to that in fallow, rather than a linear path to exhaustion. Comparison of the typical cultivated acreage with estimates of typical parcel sizes indicate that the length of natural fallows were shortened in the second half of the century. A principal component analysis in the final chapter confirms that yields fell as fallows shortened, but it also indicates an equally strong correlation with cooler springs which shortened the growing season. There was also a reduction in the average number of fertilizer producing livestock, but herd sizes were curtailed in proportion to the quantity of grazing land. The number of animals per acre was held steady. These data suggest that falling yields were the result of increasing constraints on natural fallows and a shorter growing season.

In addition to unforeseen changes in weather, yeomen also faced market risks. Their position on the semi-periphery of the emerging global market and the British Crown's merchantilist policies meant that yeomen could only react to fluctuations in the international market. As a result, their best tools were market abstention, diversification of household employment, and re-investment of their profits back into their local communities. Philadelphia merchants exported Chester County flax seed, beef and dairy products, but what they truly desired was wheat, flour and bread. Initially, Chester County yeomen chased the wheat market to the exclusion of most other grains. In the 1720s the growing of rye and Indian corn had all but disappeared. In the following decades individual yeomen increasingly abstained from the wheat market by putting more of the crop in other grains. Wheat fell from 90-percent of all grain sown in the 1720s to just 40-percent in the 1780s. However, strong population growth and immigration meant that yeomen collectively grew more wheat.

A second way in which yeomen spread risk over product was by the adoption of manufacturing trades. The rural trades were carried out in support of local agrarians and grew only slowly. Evidence from probates indicates that one in four households produced manufactured goods, but there was only a 5-percent increase in the relative number of manufacturers between the 1730s and 1780s. A principal component analysis conducted in the final chapter suggests that manufacturing followed the agricultural market rather than the fortunes of the yeoman class. However, manufacturing had not yet outstripped the profits of agriculture. Decedents described as artisans tended to leave smaller estates than yeomen, but trades proved to be a viable alternative for those without access to land.

Chester County yeomen spread risk over producers through a system of social banking wherein the profits from agriculture were placed in the hands of friends and family at interest. It was a practice which remained common throughout the century with about 70-percent of inventories reflecting loans to others. Loans and extensions of credit represented almost 50-percent of all inventoried wealth. Such loans were the means by which young yeomen funded their acquisition of land. In turn, the lender gained interest, social status, and the ability to call in debts in the cases of catastrophic financial loss. The prevalence of social banking undermines the argument that the colonial American economy lacked a system of finance.

The final chapter presents a synthesis of the preceding chapters in order to expose those factors which underlaid the transformation of yeomen into farmers. The general trends of 26 ecological factors of yeoman lives suggests that over the course of the century, yeomen had a persistent downward trend in the efficiencies of shifting cultivation due to shorter fallows and a truncated growing season. Nevertheless, they had made themselves wealthy through a cautious approach to a strong market. A principal component analysis suggests that

strategies of risk-aversion were a defining aspect of yeomen's ecological relations. Yeomen took advantage of the economic opportunities of the wheat market, but class membership waxed and waned with the practices of inter-cropping and market abstention through crop diversification. These risk minimization strategies were implemented in response to warm winters, cool summers, and dry springs, autumns, and winters in the second half of the century.

In a nut shell, the results of these diverse analyses indicate that the American yeoman class grew and structured itself around a suite of risk-adverse practices which preserved financial success despite inclement weather and waning labor efficiencies. The yeoman class passed because it was a victim of its own success. As the weather began to turn around in the last two decades of the century, Chester County agrarians left off risk minimizing strategies and the associated yeomen class ideologies which conveyed them. The county had changed in the intervening century and it was no longer a frontier promising land for a small annual proprietary tax. Land had become expensive as the county had been taken up and subdivided.

For the first time the future was uncertain for young yeomen. The continuation of social banking meant that there was significant capital available to purchase land. However, the county was near capacity. Young yeomen were faced with the choice of abandoning shifting cultivation and intensifying production, or pushing out into the frontier. Positioned as they were between an international market hungry for Pennsylvania wheat and a functionally endless frontier, many left. The descendants of yeomen who stayed in the county solved the land shortage by abandoning shifting cultivation for tight crop rotations supported by hired labor and capital inputs. By the middle of the 19th century, the grandsons of Chester County

yeomen became manufacturers of farm equipment and leaders in the literature of agricultural reform. They found fault with nearly every practices of their forefathers.

Contemporary critic's charges that the colonial agriculture was at a mere subsistence level is not well supported by these data. Pennsylvania yeomen produced a marketable surplus which fed themselves, the growing American cities, Britain, southern Europe and the Caribbean Islands. Rather than being stuck in the past by mere traditionalism, the goods and chattel in probate inventories indicate that their practices were complex, well-ordered, and sufficiently flexible to responded the changes in climate and market. It was success, not failure that brought a voluntary end to the yeoman class in Pennsylvania.

CHAPTER 2

HISTORY

The Problem of Yeoman Agriculture

If viewed only through the eyes of contemporary writers, Pennsylvania yeomen would appear to have squandered a rich inheritance. The advocates of colonization promised settlers that once they became established, they could expect yields of grain twice those in Britain and continental Europe. However, mid-century reformers were dismayed by the state of American agriculture. In their view colonial husbandry was a curio cabinet of outdated tools and inscrutable methods practiced by people who were irrationally opposed to change. Having only the literature authored by gentlemen-reformers, many historians have been led to believe that colonial agriculture was hopelessly backward.

In his standard history of American agriculture, Wayne D. Rasmussen (1960) argues that the labors of nine in every ten working persons were insufficient to raise agriculture above a "near-subsistence level" and left the colonies vulnerable to the "spectre of famine." With the exception of Native American domesticates, colonial agriculture "used most of the same tools and followed many of the same practices in use in Biblical time" and "but a step removed from the Middle Ages" and was largely cutoff from the agricultural advances in Britain (:*v-vi,* 3).

John F. Watson (1860), a primordial chronicler of the history the Philadelphia region, described the agriculture of early settlers as "extremely rude and imperfect." He lamented that colonists had failed to adopt the best practices of their day which included rotations of crops, extensive manuring of grain fields, and use of clover and lime. Watson argued that early reformers were dismissed by their peers as "a penny wise, a pound foolish," but in time were vindicated (2:81). In 1864 Charles L. Flint wrote in *Eighty Years' Progress of the United States* that the central problem was a lack of education. The critical fault was that:

> ...the boy was trained up to a narrow routine of labor, as his fathers had been for a century before. He often affected to despise all intelligent cultivation of the soil, and not only scrupulously followed the beaten track, but was intolerant of all innovation, simply because it was innovation (:23).

Other researchers allowed that colonial agrarians experimented with new methods, but their efforts were undermined by fundamental flaws in their practices.

William H. Brewer (1883) saw colonists as hopeful, but largely unsuccessful experimenters who attempted to adapt European agriculture to the American environment. He attributed their failure to two shortcomings. The first problem was a "system of repression" by the British crown which discouraged the formation of agricultural societies which were necessary to foster and communicate new discoveries. A second critical fault was an inability to overcome a persistent shortage of quality fodder which left their herds small and deteriorated in quality. Brewer argued that had it not been for the availability of Indian corn (maize) for feed, the colonial herds might have suffered extinction (:513-517).

Percy Wells Bidwell and John I. Falconer (1925) agreed that animal fodder was "strikingly deficient" in the American colonies. They noted that Native Americans had opened up the forests by burning off the underbrush, but the resulting wild rye and broom grass was poor animal feed (:19-20). Bidwell and Falconer surmised that:

> On their poorly cultivated fields little fertilizer of any sort was used, their implements were rough and clumsy, livestock was neglected, and the same grains and vegetables were raised year after year with little attempt at a rotation of crops, until the land was exhausted (:84).

It was certainly true in that few 18th century agrarians stabled their livestock or rotated their crops, but researchers gave little space to the idea that there may have been some pragmatic reasons for doing so.

In his studies of Pennsylvania agriculture, Stevenson Whitcomb Fletcher (1947) recognized that Pennsylvania was the "bread basket of America," but was quick to add that grain was planted "until the tortured land rebelled" and their livestock were "under-nourished and poorly sheltered" (:185-186). Fletcher (1950) repeated reformers' claims that "farm implements of early settlers were few, cumbersome and inefficient" because they had been "made by the farmer himself." Until the last decades of the 18th century, plows were "little better than those used by their ancestors in Europe and Asia thousands of years before" and that colonists threshed grain as inefficiently as "farmers of Babylon and Egypt" (:89-100).

In the 1970s, there began a bifurcation in the view of colonial agriculture. Researchers like Gregory Stiverson (1976) continued to argue that the "limitations imposed by available agricultural implements" and the "necessity of doing work by hand" kept American production hovering only slightly above their own consumption, and exports were the aggregation of small "subsistence surpluses" (:37-38). However, other researchers began to find fault with the traditional perspective. Cultural geographer, James T. Lemon (1972) argued that there was no incentive for Pennsylvania agrarians to adopt intensive methods and that reformers viewed "English farming models uncritically and failed to recognize the unique environmental and economic conditions" of the British colonies (:150, 169). The view has gained a few, but persuasive advocates (Miller 1986; Earle 1988; Merchant 1989; Whitney

1994:232-241). More recently Russell R. Menard (2006) has recognized that in "early America, where land was cheap and labor dear, it seldom made sense to follow the 'best' European practices" (:109). Not only did colonial yeoman act in a rational manner which fit their environmental and social situation, they did so successfully.

Shipping records reveal that a steady stream of wheat and other provisions flowed from American ports (U.S. Bureau of Census 1960:757, Z21-34). A contemporary observer reported that in 1755 Pennsylvania produced a surplus of food sufficient to feed an additional 100,000 people (Smith 1775:4; Miller 1936:120), or about two-thirds of the colony's population (U.S. Census 1960:756, Z1-19). A decade later, but still twenty years from the emergence of the new agriculture, Philadelphia merchants shipped 367,522 bushels of wheat and 18,734 tons of flour and ship bread (Bidwell and Falconer 1925:139). Ship bread is an unleavened biscuit and a forerunner of 19th century hardtack and 20th century pilot bread. Using the conversion rates listed in Appendix B, the 1765 wheat exports would have provided 150,000 people with one-half of a 4p. loaf of bread each day. Those shipments helped feed a number of people equal to about one-half of the populations of Philadelphia and the surrounding regions of Pennsylvania, Delaware, and southern New Jersey (U.S. Census 1960:756, Z1-19).

By design, much of the American produce went to Britain. Max Schumacher's (1975) examinations of London's importation records revealed that between 1768 and 1772, Philadelphia merchants sent to Britain an average of 67,649 bushels of wheat and 28,960 tons of flour and ship bread (:153). Those wheat products would have provided approximately 82,500 people a daily ration of a half-loaf of bread. In addition to wheat, London imported significant quantities of other Delaware Valley foodstuffs (:153, 164). With their half-loaf of

bread, each person could have also enjoyed a third of a pound of cheese or butter, and almost a pound of preserved beef or pork. Since London was just one market, the actual levels of production were substantially higher.

Admittedly, the exportation records are patchy, but they suggest that Pennsylvania's rural producers not only fed themselves and their rapidly growing towns and cities, but also victualed England, British Carribean, Ireland and southern Europe (U.S. Census 1960:761, Z-76). Rather than trapped at a subsistence level, Pennsylvania was truly a bread basket which helped feed Britain and steadily increased exports of foodstuffs throughout the 18th century (Lemon 1972:28-29). The discordance between these two views of the productive capacity of the American colonies originates in the one-sided literature of British agricultural reform and is a material manifestation of the class tensions between gentleman and yeoman.

Class Tensions Between Yeomen and Gentlemen

The critical distinction between the two middle classes of post-medieval Britain was their relation to production. Yeomen were self-exploiting agrarians and gentlemen eschewed manual labor to practice law, medicine, religion and military arts and sustained themselves through the collection of rents (M. Campbell 1942:34-35). Gentlemen of all stripes exhorted rural producers to increase the grain harvest in order to support growing numbers of urban manufacturers. The agricultural reform movement provided the material support for the wealth of nations. Capital intensive agricultural practices mirrored the shifting center of hegemonic power within the modern world economy described by Immanuel Wallerstein (1974, 1980, 1989). The movement was established in the 17th century Dutch Republic, now known as the Netherlands, and were then adopted by Britain and France in the 18th century,

and then the United States in the 19th century. The core technology was the use of fodder crops to increase the size of herds and foster production of fertilizer. The use of clover was perfected in 17th century Flanders and in the 18th century British gentlemen coupled clover with high-yielding grasses (Overton 1996:100, 110; Shiel 1991:55). Americans were familiar with fodder crops, but it wasn't until the late 18th and early 19th century that they were widely adopted in Pennsylvania (Fletcher 1950:130-132).

Despite reformers' persistence, yeoman assiduously resisted their advances (M. Campbell 1942:167-179). A central issue was practicality of untested methods. Even Lord Ernle (Prothero 1961), a champion of reform, had to admit that the literature included many "doubtful or ridiculous" suggestions. However, yeoman don't appear to have been interested in any advice, good or bad. In his 1652 *The English Improver Improved*, Walter Blith was clearly frustrated when he complained that:

> ...mouldy old leavened husbandmen, who themselves and their forefathers have been accustomed to such a course of husbandry as they will practice, and no other, their resolution is so fixed, no issues or events whatsoever shall change them (cited in Prothero 1961:110).

The complaint would echo through subsequent centuries. In 1727 Dr. Richard Bradley, a professor of Botany at Cambridge and an important compiler of agricultural knowledge, complained that when he extended advice to British yeomen "they will ask me whether I can hold a plow, for in that they think the whole mystery of husbandry consists" (Prothero 1961:110-111). Bradley clearly missed the critique that his advice was predicated on hypothetical rather practical knowledge. However, the exchange is an illustrative sound-bite for fundamental impasse between reformers and practicing agrarians. Similar statements were made by frustrated American reformers in the 18th century.

In Lord Ernle's (Prothero 1961) view, he likened the progress of agricultural reform to "a heavy hammer and many blows to drive a nail through heart of oak" (:134). Agriculture was learned through familial and local social relationships. The advice of gentlemen had little appeal to yeomen since, unlike a relative or neighbor, the reformer would not be there to share in the consequences of a bad investment. If yeomen had bothered to reply to the reform movement, Fletcher (1950) imagined that the Pennsylvania yeoman's reaction to the reform literature would have been:

> We want no information on husbandry; we know all about it. Give us labour; we want not your books of information (:340).

Even the famous Pennsylvanian John Bartram who possessed a rare expertise in both the natural sciences and practical husbandry, had to be prodded to discuss agriculture. When he did, it was often an expression of desire to leave it behind and devote himself entirely to the botany (Bell 2004:9-10).

John Bartram is an illustrative example of the tensions between gentlemen and agrarians in the 18th century. Bartram was born to a Chester County yeoman family in 1699. An avid naturalist from a young age, some prominent Philadelphians introduced Bartram to Peter Collinson, a London textile merchant who shared similar interests (Bell 2004:3-4). Their friendship spanned 35 years and Collinson introduced him to some of the greatest botanists of their age, but Bartram's class was a persistent impediment to his acceptance by gentleman naturalists.

Collinson's initial interest in Bartram was as a source of seeds, and at first asked the American to withhold his musings on the natural history of the samples. A complicating factor was Bartram's straightforward writing style and freestyle spelling. Bartram persisted, and in short time, Collinson learned to accept that an insightful naturalist could also be a rustic. As a

means of income for Bartram the two began accepting subscriptions from European horticulturalists for American *flora* and *fauna*. Collinson had such clout that he could impose on the proprietor himself to ferry seeds across the Atlantic. Collinson shared Bartram's letters with Lord Petre who came to admire his "plain Natural way" of writing and became one of their best customers. Collinson furthered Bartram's reputation by reading his papers to the Philosophical Society of London and negotiated a royal stipend which brought Bartram substantial fame (Darlington 1849:59-300; Armstrong 2004:33-43; Bell 2004). Less welcome assistance came in the form of advice concerning Bartram's and encouragement to affect the appearance of a gentleman.

When Collinson arranged for Bartram to meet a fellow naturalist, John Custis in Virginia., he sent Bartram some fine cloth for a new suit of clothes. Collinson kindly requested that he "go very Clean, neat & handsomely Dressed" for "these Virginians are very gentle, Well Dress'd people, & look phaps More at a Man's Outside than his Inside." In turn, Collinson warned the Virginians to expect a "down right plain Country Man" and advised that if they "not Look att the Man but his Mind... His Conversation I dare say you'll find compensate for his appearance." Custis would later comment "I have ever met with and never was so much delighted with A stranger in all my life" (Armstrong 2002:59-65). Benjamin Franklin had given similar warnings in 1751 when he introduced Bartram to Jared Eliot, a Connecticut preacher who authored the first volume on American agriculture. Franklin described Bartram as "a plain and illiterate man" [in the sense of not formally educated], but also assured Eliot that "you will find he has merit." Franklin gave Bartram an additional seal of approval when he related that Bartram had communicated with "the greatest naturalists in Europe, and will be proud of an acquaintance with you."(Sparks 1882 7:54-56).

Despite his talent, Bartram had to bargain his way into gentlemanly circles with proper referrals and rare botanical samples. Bartram's experiences are a metaphor for the class barriers which prevented the spread of agricultural knowledge. There could be no true scientific debate if those with practical experience would not speak, and those in the academy would not listen. The result was that there were few practical tests on reformer's advice and they remained the sole authors of the agricultural literature.

The Literature of Agricultural Improvement

Samuel J. Rogal (1994) has annotated more than 1,000 works on agriculture printed in Britain and America between 1660 and 1820. Many reformers were inspired by works like the 1718 publication of Switzer's *The Country Gentleman's Companion, or, Ancient Husbandry Restored and Modern Husbandry Improved* in which he called for a revival of the agricultural arts. Numerous ancient texts were put back in print. Among these was Benson's 1724 translation of Virgil's *Georgics* which was written in the first century B.C., a rendering of Xenophon's fourth century B.C. *Oeconomicus* was published in 1727, and an English translation of Columella's first century *De Re Rustica* was published in 1745 (Prothero 1961:473; Rogal 1994:34-37). With the exception of Columella, these works were more poetic and political than practical. *De Re Rustica's* focus on olives and viticulture was of limited direct applicability. Nevertheless, these works were held up by reformers as an idealized goal of what should have been possible.

The most influential books among reformers were texts written in favor of enclosure of British manors, a process by which manorial lords replaced peasants working collectively with walled sheep runs and tenancies. As Robert C. Allen (1982) accurately states, the process

was "invariably initiated by landowners because they expected their tenant farmer would pay higher rents" (:937). Gentlemen pushed for enclosure from every direction. Lawyers undermined commoners' customary land-rights. Landowners questioned the quantity and quality of produce, and the condition of the fields. Economists typified common fields as wasteful and unprofitable when compared with a potential output if enclosed. Social reformers condemned common areas as sources of crime and bad morals (Prothero 1961:31-175). American yeomen had left collective agriculture when their ancestors acquired property. However, once enclosure was complete, yeomen became the new target of reform.

The reformers' rhetoric focused on the inefficiencies of traditional practices. They charged that collective farming blunted individual initiative and discouraged improvements in practices and the implements of husbandry. The peasants' fragmented fields were said to have inhibited drainage and impeded efficient plowing. Balks and pathways between fields were seen as a waste and a source of weeds. Peasants wasted time traveling and moving implements between fragmented fields. Herding livestock in common areas allowed unguided breeding, communicated disease, and wasted manure. Lastly, it was claimed that the common areas instilled idleness which encouraged beggary and thievery (Prothero 1961:31-175).

A rare defense of the open field system was John Cowper's 1732 *Essay Proving that Inclosing Commons and Common-Field-Lands is Contrary to the Interest if the Nation* which argued that enclosure was injurious to small-holders and the poor. He acknowledged that some displaced people had begun new industries, but enclosure prompted so many to leave that many regions became depopulated (Prothero 1961:151-158). Cowper's observations have been supported by economic modeling by Cohen and Weitzman (1975) who conclude that depopulation was a predictable result of the decrease in food production and increased

rents which accompanied enclosure. Looking back from a 20th century vantage point, Prothero (1961) finds a certain truth to the old adage that "Enclosures make fat beasts and lean poor people." He points specifically to the loss of customary access to wooded commons which provided both fuel for their heaths and browse for their livestock (:291). Having to purchase these resources was too much for an already impoverished people.

In his 1650 *Inclosures Thrown Open,* Henry Halhead outlined the process by which enclosures were carried out. The feudal attachments which disallowed peasants from leaving their manors, had also served to protect their occupancy. There had to be an appearance that commoners were leaving voluntarily. As a first step, landlords would attempt to disrupt traditional field customs and then offer enclosure as the solution to the resulting shortfalls and strife. Should that fail, the landlord targeted holdouts with repeated legal suits which kept the commoner away from his fields. The last resort was a cash buyout. While enclosure had a dramatic impact on peasants, it presented yeomen with new opportunities to employ cheap labor, amass profit and purchase more land (Prothero 1961:124-125, 290-291).

Yeomen and Enclosure

As Mildred Campbell (1942) describes, a clear title, legal rights, and service to the courts protected British yeomen from all but the most aggressive landlord. Yeomen's occupation of the jury box put them in the position of mediating enclosure's progress in the local courts. Yeoman would often side with commoners, but at other times they accepted bribes to pack juries. In the short run, yeomen benefitted from enclosure. Landlords had set legal limits to wages and retarded food production by converting grain fields into sheep runs. Displaced husbandmen, highly skilled agricultural laborers, subsidized yeomen households by

selling their labor at the legal limit rather than the higher market value. Yeomen's domination of the food market provided them capital with which to increase their holdings as enclosed manors failed, or the nobility needed quick cash for foreign wars. The class grew in size and wealth (:64-78, 150-155, 212, 314-360). However, in the long run yeomen lost the ability to play one side off the other. No sooner were the peasantry driven off, than the rhetoric of improvement was turned against them.

Prothero (1961) argues that prior to the agricultural revolution, British yeoman were fundamentally cultivators of open-fields (:297-301). That is to say that yeomen practiced a similar kind of agriculture to that on the manor, but were free from collective agreements which mediated peasant practices. Many reformers saw the adherence to the open-field system as mere traditionalism. However, recent work by historians (McCloskey 1972; 1975a, 1975b; 1976; 1989; 1991; Yelling 1982) and cultural ecologists (Winterhalder 1990) have argued that the inefficiencies of the open-field system served to reduce or dilute the risks of crop failure.

Robert C. Allen (1982, 1991, 1992, 1995:4-5), Michael Turner (1986), and Allen and O'Grada (1988) have demonstrated that enclosures were not anymore efficient than open-fields. They argue that effect of enclosure was not to increase efficiency, as much as a method for increasing rents to extract a larger share of the surplus. Allen (1995) points to post-enclosure literature such as W. T. Thornton's 1843 *Pleas for Peasant Proprietors* which argued that small-scale owner-operators were more efficient than tenants (:9-10). More recently, Allen (1992, 1999) has picked up a thin thread in agricultural history which suggests that operators of open-fields were innovators who first adopted fodder crops (Havinden 1961; Yelling 1977:166-167) and an early view that the agricultural revolution developed independently of enclosure (*c.f.* Kerridge 1967:19).

Allen (1992, 1999) argues that the British agricultural revolution was carried out in three phases. The first was a period of rising grain yields between 1520 and 1740 which he dubs the "yeoman revolution." The additional production was accomplished by domestic selection of seeds, adoption of nitrogen fixing crops, and a freedom from the tenants' conundrum that efficiencies merely encouraged higher rents. A subsequent "landlord's revolution" occurred between 1740 and 1800 and was marked by rising rents, but a negligible advance in the efficiency of production. The revolution was completed in the first half of the 19th century with the development of modern agriculture (1992:13-17, 204-210, 1999:215-216). This view bucks a conventional wisdom which typifies landowners as innovators, and the under-classes as passive resistors of change. Historians' initial reactions to Allen's thesis ranged from acceptance to incredulousness (Langdon 1994; Holderness 1995; Overton 1995). However, an additional review of rents throughout these three periods has addressed many of the criticisms of the earlier work (Allen 1999:217-222).

The long-term result of European enclosure was a permanent modification of the feudal class system. The material base of the landed nobility shifted from populations of retainers to market profitability. Enclosure failed to live up to many of its advocates' promises and dislocated peasants became a landless proletariat whose wage-labor fueled both the industrial and agricultural revolutions (Prothero 1961:60, 75, 151, 267, 291, 299, 307). Yeomen made gains between the 15th and 18th centuries by acquisitions of land and their ranks were swollen by the descendants of peasants who found some advantage in the nascent world-system economy. This yeoman middle class formed the core of the colonists who came to Pennsylvania.

Most Pennsylvania colonists had originated in the environmentally meager portions of Europe. The earliest came from the back country of Scandinavia and the Netherlands. They were followed by people from impoverished Wales and the western grazing lands of Britain, war-torn forests of southwestern Germany, and Scottish borderlands by way of northern Ireland (Lemon 1966; Aberg 1988; Bender and Smith 1964; Dyck 1967; B. Kollmorgen 1943; Levy 1988; Redekop 1989; Weslager 1987, 1988; Smaby 1988; Glatfelter 1990; Smylie 1990; Fogleman 1996 and others). These once sparsely populated regions were settled as medieval manors during Europe's Little Optimum (A.D. 1150-1300), a period of climatic warming and colonial expansion. Charles R. Bowlus (1974) argues that favorable weather pulled settlers to the cultivate marginal soils, while coastal flooding pushed people away from the ancestral centers of settlement (:88-90). These frontier colonists were initially successful, but rising populations, cooling weather, and the opening of the American colonies fostered a second emigration to the New World. Yeomen were well suited to the colonial adventure. They possessed the cost of passage, purchase price of land, and the requisite agricultural skills.

The Early Promise of Pennsylvania

William Penn, the colonial proprietor, promised prospective colonists that the Pennsylvania soil readily accepted English crops and that it was common to reap 30 to 60 bushels of barley from a thinly sown acre. In a 1681 letter he promised prospective colonists that new arrivals could prepare fields in fall and winter, sow a crop in the spring, and reap a large crop of Indian corn by the end of their first year. He argued that one did best by following the prevailing English husbandry and collecting winter fodder for their animals (Myers 1912:211).

Two years later Penn wrote proudly about a single barley plant which had produced an impressive 70 kernels which he held as material evidence of the fecundity of Pennsylvania's soils. Penn attempted to lay to rest the common concern that the American soil was not amicable to high producing English grasses. He had some old grass seed cast on an area leveled with back dirt from the excavation of the foundation of his manor house. He noted that not only did the seed take root, but it came in thick enough to mow and was not uprooted by feeding livestock (Myers 1912:228n1, 264-265). The knowledge that American soils could sustain their nitrogen fixing grasses must have been a comfort to emigrating yeomen, but on arrival they quickly abandoned fodder crops as an unnecessary expense of labor.

A self-nominated colonial recruiter named Gabriel Thomas reported in 1698 that Pennsylvanians should expect a yield of 20 to 30 bushels from an acre sowed with a single bushel of seed. These claims must have had a dramatic effect on potential colonists, since they were twice the wheat yields produced in Britain (Myers 1912:319, 328; Overton 1979:371, 1984:246, 1990:932; Turner 1982:504; Allen 1988:123; Clark 1991a:447-448; Glennie 1991:273; Overton and Campbell 1993:70).

Dr. Francis Daniel Pastorius was a more cautious observer, but he saw great promise in the colony for his patchwork congregation of German-speaking Pietists and Quakers. In 1700, Penn showed Pastorius one of his barley plants which bore 50 seeds. The reverend summarized his opinion with the phrase "one swallow does not make a summer," but was cautiously encouraged. Pastorius made sure that his readers understood that a newcomer's first crop must be of Indian corn, a crop that was unfamiliar to most contemporary Europeans. Secondly, he warned perspective colonists that very hard work would be necessary.

Nevertheless, Pastorius assured prospective emigres that they will be well rewarded when they "put the plow to the land in good earnest" (Myers 1912:398, 405).

Pastorius was also the first critic of Pennsylvania agriculture. In his view, not only had their Swedish and Dutch predecessors neglected to convert the Indians to Christianity, but they were also indifferent husbandmen. In 1700 he related:

> [The] old inhabitants are poor agriculturalists. Some of them have neither barns nor stables, and leave their grain for years together unthreshed and lying in the open air, and allow their cattle, horses, cows, swine, etc., to run in the woods summer and winter, so that they derive little profit from them (Myers 1912:397).

These complaints concerning colonial Americans' seemingly lackadaisical practices was repeated throughout the 18th century. Few considered that there may be valid ecological reasons behind such behavior, and most interpreted it as a moral failing. He paralleled early colonists' shortcomings in agriculture with Biblical Adam's fate after his expulsion from the Garden of Eden. Pastorius argued that as Adam was destined to "eat his bread in the sweat of his brow," unproductive colonists would be sentenced to hardship and recommended that "those who think to spare their hands may remain where they are" (Myers 1912:395-397).

Pastorius' connection between Christian faith and agricultural performance was the first of a long line of similar critiques which foretold hardship and stagnation. At best colonists' practices were seen as having remained unchanged since antiquity, or at worse, had degenerated from ancient times. In either event, these critics have convinced many researchers that colonial agriculture was rife with faults that held production at a near subsistence level for nearly a century.

The movement to reform American agriculture was instigated by an international network of gentlemen pen-pals who exchanged advice, observations, complaints and

occasionally boxes of seeds. These men included such notables as Benjamin Franklin and John Bartram, and Peter Collinson in London. The literary voice of the American reformers was Reverend Jared Eliot of Connecticut. Eliot's first essay on agriculture was circulated in 1748 among his circle of progressively minded gentlemen. He received sufficient encouragement to author several more. Benjamin Franklin ordered 50 of each of the two first essays for sale in his Philadelphia shop (Eliot 1934:27). Fletcher (1950:340) reports that Franklin had trouble even giving them away, but a search of Franklin and Eliot's published papers and letters have failed to confirm or deny that observation.

Eliot's compiled essays became the first book-length critique of American agriculture. His first essay picked up the religious theme of early 18th century reformers and exhorted his fellow Americans to rediscover the practices described in biblical and classical texts. Eliot (1934) argued that:

> Every observing reader of History must have taken notice of the account given of great Numbers of People living on and having their Subsistence from very small parcels of Land, and mighty Armies are raised from a small Territory, which is to the surprize and admiration of the Reader; which will afford a great variety of useful Reflection (:30).

Eliot suggested that agrarians turn to rules of husbandry in the Christian Bible (1934:30-36). These instructions are not stated explicitly. Instead, Eliot (1934) reverse-engineered moral instruction expressed in agricultural metaphors into rules of husbandry. In guidance in Proverbs 27:26 concerning humility, became a lesson on the value of goats to clear and manure new land. Advice in Ecclesiastes 11 that working day and night insures one against life's unpredictability, was interpreted by Eliot as agreement with Jethro Tull's recommendation to sow during the morning dew. The agricultural metaphor in Isaiah 28 which recommends orderly and finite solutions was seen by Eliot as an artifact of an ancient

way to thresh grain. The story in First Kings 19 which hold spiritual journeys above mundane labor, reminded Eliot of heroically effective plows which had been lost in antiquity. Lastly, a lesson in generosity in Second Corinthians, which he renders as "He that soweth sparingly, shall reap also sparingly: and he which soweth bountifully, shall reap also bountifully," inspired a discussion of the optimal seeding rates (:35-38).

Eliot's essays had little effect outside his circle of friends and did little to change agricultural practices (Grasso 1993:526-527). However, he had begun the process of collecting some of the most practical advice from rather voluminous literature. His efforts were aided by his willingness to entertain the advice of a yeoman. Benjamin Franklin introduced Eliot to John Bartram and the two began a lengthy exchange of letters (Eliot 1934:110-111, 191-206). In 1752 Eliot quizzed Bartram on Jethro Tull's claim in his *New Horse Hoeing Husbandry* that the secret to soil fertility is repeated plowing. Tull argued that well broken ground allowed nutritive dews to penetrate the soil and facilitated root formation. Bartram refuted Tull's hypothesis and suggested that "ye fertiliseing materials will be exhausted tho we artifitialy pulverise ye earth as much as we please" and cited an associate whose experiments with repeated plowing found that it merely exhausted the land that much sooner (Eliot 1934:191-194). Despite the appreciation that Bartram received for his input, the tone of the literature of agricultural reform had a persistent negative view of practical agriculturalists.

In 1762, Jared Eliot's nephew H. W. Robinson of South Kingston, Rhode Island wrote of his frustration with those who failed to follow gentlemanly direction:

> Farming is a Boundless Ocean of Knowledge & Wisdom: and the Philosopher only can direct the Labourer who commonly (with us) is little better than a Nethenim of old. Such is the miserable contracted State of our Farmers in the midst of a vast expansive Garden fill of Weeds of various sorts & the

> Labourers know not how to 'til and improve the ground to the Glory of its Author or their advantage (Eliot 1934:252).

"Nethenim of old" is a reference to servants who operated biblical temples under the close supervision of a caste of educated priest. Robinson captured a common feeling among Eliot's circle of reformers. A poorly preserved letter written by Charles Read of Burlington, New Jersey (Ross 1929:52-72; Eliot 1934:223-224; Woodward 1941:*xi-xxii*) spelled out the essence of the reformers' frustration with yeomen:

> I perused your [Eliot's] two Essays on Field Husbandry, and think the public may be much benefitted by them; but, if the farmers in your neighborhood are as unwilling to leave the beaten road of their ancestors as they are near me, it will be difficult to persuade them to attempt any improvement. Where the cash is to be laid out on a probability of a return, they are the very averse to the running of any risk at all, or even expending freely, where a gentleman of a more public spirit has given them ocular demonstration of the success (Eliot 1934:223-224).

Although Read's personal experiences with agriculture improvements were mixed, he remained faithful to the movement. Read was fully aware of yeomen's aversion to risk, but didn't fully understand, or demurred from exploring their underlying reasons.

Between 1748 and 1751, Pennsylvania was visited by Peter (Pehr) Kalm, a Swedish academic with expertise in agricultural theory and educated by the famous naturalist Carolus Linnaeus. Kalm's expedition was sponsored by the prestigious Swedish Academy of Natural Sciences who desired to improve their nation's agriculture with new plant species adapted to a northern climate. Kalm followed the path of Bartram's botanical samples. He began with a visit with Collinson in London for a survey of English agriculture in surrounding counties. Benjamin Franklin was the first to collect Kalm and his man servant from the Docks at Philadelphia. However, Kalm spent most of his time in Pennsylvania at John Bartram's

plantation at Kingsessing, Philadelphia County on the Schuylkill River (Benson 1937:vii, 16-17).

Kalm was a careful and enthusiastic naturalist who recorded everything from subterranean insect life to Native Americans customs (Benson 1937:245-274). Kalm had a generally favorable view of the colonists, especially their food, but found that the American pattern of shifting cultivation and long, natural fallows was "the same method of agriculture as the Indians" (:308). Kalm repeated many of the same critiques Pastorius had made 50 years earlier. In October of 1749 he recorded his disapproval of the local practices of shifting cultivation:

> Agriculture was in a very bad state hereabouts. Formerly when a person had bought a piece of land, which perhaps had never been plowed since Creation, he cut down a part of the wood, tore up the roots, tilled the ground, sowed seed on it, and the first time he got and excellent crop – But the same land after being cultivated for several years in succession, without being manured, finally loses its fertility of course. Its possessor then leaves it fallow and proceeds to another part of his land, which he treats in the same manner. Thus he goes on till he has changed a great part of his possessions into grain fields. And by that means deprived the ground of its fertility. He then returns to the first field, which now has pretty well recovered, This he tills again as long as it will afford him a good crop; but when its fertility is exhausted he leaves it fallow again and proceeds to the rest as before (Benson 1937:97 *cf*. 308).

From Kalm's perspective, the Pennsylvanian's treatment of their livestock was equally problematic. He noted that manure was lost since it was "customary here to let the cattle go about the fields and in the woods both day and night" and "neither housed in winter nor tended in the fields" (Benson 1937:55, 97-98, 236-237).

Kalm blamed the colony's natural fertility for the development if their suite of careless agricultural practices. He lamented that most American yeomen saw science "as mere trifle, and the pastime of fools" and they hadn't considered that "an infinite deal of labor" would be necessary to restore exhausted land. Kalm concludes that:

> ... the grain fields, the meadows, the forests, the cattle, etc. are treated with equal carelessness; and the characteristics of the English nation, so well skilled in these branches of husbandry, is scarcely recognizable here... their eyes are fixed upon the present gain, and they are blind to the future (Benson 1937:98, 307-309).

Kalm's prognosis may be overly judgmental, but as Benson (1937) notes, Kalm was equally critical of Swedish agriculture (:vii). Nevertheless, his critique establishes that American agriculture originates in, and retains aspects of Native American practices and confirms that Pennsylvania yeoman shared the reticence of their British counterparts to adopt agricultural reform.

Not all views were gloomy. In 1767 Job Johnston, a schoolteacher of Oxford, Chester County wrote to his kin in Slatabogy, County Londonderry (Derry, Doire), Ireland that Pennsylvania was a land of plenty, but not above comparison:

> ... it is My Judgement, of what I have observed that fruit trees in this Country destroy themselves by the Very Weight of their fruit. As for Grain, where land is Good and well laboured it turn out to admiration; some Acres will produce Thirty, some Twenty and in Common the Land hereabouts will produce between fifteen & Twenty Bushels of Good Wheat, that will Weigh sixty or sixty two pounds per Bushel. The Land they plows three times, and allows three packs [pecks] of Wheat to sow an acre. Rye grows exceeding well here; Barley Does not do so well here as at home, they allow two Bushels to sow an acre. Oats does pretty well here but not so well as at home, and indeed this year there was None in this part of the country they are Commonly ripened before they come to perfection, owing I Suppose to the heat of the Climate, and they Make No other use of them here than to feed their horses; they allow only Two bushels to sow an acre here in a grain called Buck Wheat Very Good, and is of Great service, and produces to admiration, the Common time of sowing this Grain is about the Twentieth of July and in less than three Months May have it in Meal, they allow three pecks to sow an acre, and they will have in a Common Way between Twenty and thirty Bushels off an acre (Davies 1983:320-321).

One advantage for Americans was the use of maize which was commonly called "Indian corn." The current American habit of calling maize "corn" was not common until the 19th century. Johnston was a fan of high yields that can be achieved by planting Indian corn:

> Here is a very serviceable grain called Indian Corn, and where it is well Laboured and Duly attended will reward the Labour with four or five hundred fold, two Quarts is what they allow [an acre,] the Ground here in a general way are but shallow, and is very easy [to work,] a boy and two horses will plow an acre very easy in a Day. As [for the] Grass there is pretty Good Lowland Meadows, which is mowed [twice,] as to their pasturage or upland, the grass is not extraordinary [but make] Cattle Very fat, the Inhabitants here Give their Cattle Salt [which] they tell Me Makes them thrive. Every farmer has yearly two [or three] acres of Turnips, which turn out to their advantage, all roots [do very] well here, potatoes does exceedingly well in Most parts where they [may care] to Raise them: here is also Cucumber, Water Mellons, Mush m[ellons,] [squashes,] and pomkins [pumpkins] in Great abundance (Davies 1983:320-321, bracketed text is the present author's speculation for text missing in the original).

The school master's letters are an extremely valuable resource because they offer an informed comparison between northern Ireland and the Pennsylvania colony. Johnston may have wanted to impress his kin, but his account relates ways in which American production both exceeded and fell short of that in Ireland.

No doubt Johnston's relatives were dutifully impressed by the yields of wheat. His quotes of 15 to 30 bushels per acre matched or exceeded those of contemporary Britain (Turner 1982:504; Overton 1984:246; Allen and O'Grada 1988:98, 102; Clark 1991a:447-448; Overton and Campbell 1993:70). Despite the success with wheat and rye which grew "exceedingly well," the yields of barley and oats fell short of those in Ireland. Eighteenth-century Ireland has traditionally been viewed as an agricultural backwater. Arthur Young, the famous late 18th century surveyor of British agriculture suggested that Ireland was 500 years behind England (Allen and O'Grada 1988:107). That view is not well supported. Allen and O'Grada (1988) have used Arthur Young's own data to demonstrate that Irish wheat and oats yields were only slightly less than those in England, and barley yields were significantly higher (:97-108). Based on Johnston's observations, Chester County yeomen enjoyed greater wheat yields than those in Ireland and England, but trailed behind Ireland in barley and oats.

Known only as "An American," the anonymous authors of the 1775 *American Husbandry* (Carman 1939) gave Pennsylvania farmers a mixed review. The secrecy concerning the origins of this text is unfortunate since it robs the reader of the opportunity to explore potential class, regional, or disciplinary biases. Nevertheless, the work provides an important view of Pennsylvania agriculture on the Eve of the American Revolution. In terms of wheat production, the first of two chapters concerning Pennsylvania is complimentary:

> Wheat is the grand article of the province. They sow immense quantities, about the latter end of September generally; rising from two or three bushels of seed an acre, which on good lands yield from 25 to 35 bushels per acre; on fields of inferior quality, or such as are almost exhausted by yielding corn, they get from 15 to 25 bushels, and sometimes not so much as 15, but this never happens without owing to prior bad management (Carman 1939:113).

The reported wheat yields on good land approximates those reported Johnston. The persistence of an extensive, shifting cultivation with natural fallows was a sore spot for nearly all reformers of agriculture. Despite a good showing with wheat, "An American" was critical of Pennsylvanians' use of natural fallows:

> Some few planters have summer fallow for wheat, in the English manner, but the common preparation is the ground lying what they call fallow... viz. leaving the land, after it is exhausted by yielding corn, to recover itself under a crop of spontaneous growth, weeds or whatever Trumpery comes: or else they sow it in succession, after wheat and other corn. It is owing to this general bad management that they get not greater crops (Carman 1939:113-114).

Gentlemen-reformers preferred the use of fallow crops such as English grasses, nitrogen fixing legumes and turnips which fed livestock and produced additional manure. Such a course of agriculture increased yields, but also demanded additional labor to prepare and plant fallows, manage herds, and to collect and spread manure.

The second chapter on Pennsylvania, probably by a different author, had a more favorable view of yeoman practices. After some lengthy calculations which demonstrated an

English farmer's greater return on investment, he noted that the Pennsylvania yeomen enjoy a lifestyle "full equal with a country gentleman in England" and possessed benefits such as room for geographic expansion, ownership rather than a lease, and an easy reinvestment of profits (Carman 1939:148-150). Nevertheless, the author follows up with a number of reforms and their projected economic benefits. For the first time, the author reported some successes in transforming yeomen's agricultural practices:

> I may remark that the most beneficial practice increases in Pennsylvania. It is to be attributed to more enlightened knowledge spreading in the province, from the voyages to Britain being more frequent, and from books of husbandry being more read in proportion to the increases of wealth and luxury: the same causes will doubtless by and by operate, however gradually, in introducing other practices which in Europe have been found beneficial (Carman 1939:114).

The authors of *American Husbandry* were accurate in their observation that some Pennsylvania gentlemen had begun to push for agricultural reform. However, on the eve of the American Revolution the yeoman class in rural Pennsylvania was wealthier and more numerous than they had ever been. A change would come about, but it wouldn't be for another decade.

CHAPTER 3

CLIMATE

Yeoman and the Weather

Of all the agrarian classes, yeoman were perhaps the most affected by poor weather. Since they relied mostly on their own labor, yeomen had few mediators between them and the selective forces of the environment. As owners of the means of production, their immediate fortunes were tied to the efficacy of their cultural adaptations. In years with poor harvests laborers collected their wages and gentleman their rent, but the yeoman had to weather the storm. On the other hand, in times of feast, yeomen's profits were their own. As a result, the history of yeomen is also a history of climate.

An incorporation of climate into social history presents two complications, detection of past weather and the fact that it is concurrent with every human event. Meteorological phenomena are often ephemeral, sometimes chimerical, emerge from complex systems which can be difficult to understand, experienced locally, and open to multiple interpretations. A common solution is the use of proxies which preserve the general trend of the weather which are calibrated through multiple lines of climatological data.

Historians of climatic history have developed a number of techniques to reconstruct the climates of the last 500 years. Common sources of data are instrumental and qualitative meteorological observations, tree-rings, navigational data such as captains logs and port

closings, glacial movement and ice cores, volcanic eruptions, biological information like pollen, phytoliths and packrat middens, and synthetic reconstructions. An interested reader is directed to H. H. Lamb (1977), Frank N. Egerton (1978), Alan D. Hecht (1985), W. R. Baron (1989); Raymond S. Bradley and Philip D. Jones (1995), and Dave Egan and Evelyn A. Howell (2001) for synthetic overviews of data, methods, and results. In most cases researchers must make due with the data available to them. However, one should never underestimate the gradual effects of long-term climate change (de Vries 1980:603), or assume that short-term calamities had no long-term affects (Overton 1989:77).

The seductive omnipresence of climate encourages the easy conclusion concerning its role in history. It is a similar danger for any ecological factor. Even for agrarians, it is a mistake to assume that cultivators are affected in proportion to the changing climate. Weather's effects on the lives of agriculturalists are non-linear since environmental disasters can be offset by storage, sharing, and other low-risk strategies. The slippery slope into environmental determinism can be avoided by consulting multiple lines of ecological evidence. A researcher must not only identify potential cause, but also propose complex explanation for human events by comparing the multiple aspects of ecological relations (Crumley 1987:237-264; 1994:1-16). The case for environmental causality rests on the proximity and duration of the fit of the trajectories of climate and human history.

The Regional Weather Pattern: The 1740 Climate Shift

In the northern hemisphere, the 18th century is marked by a gradual warming from two centuries of relative cold (Bradley and Jones 1995:674). In Europe the period between 1550 and 1800 is commonly referred to as the "Little Ice Age" and marked by weather sufficiently

cool and wet to suppress grain production (Lamb 1977:423-473; Pfister 1980:665-696; Fagan 2000:43-52). The weather was similarly cool in North America, but was broken by two short periods of warm temperatures in the 17th century, and a third warming trend which began about 1740 and continued into later centuries (Bradley and Jones 1995:674). The change in weather was recognized by American colonists, but its effects varied by locality. Thomas Jefferson (1853) wrote that in Virginia their springs had become warmer and noted that between 1741 and 1769 no fruit at Monticello was ruined by late frosts (:89). The longtime residents of the Delaware Valley had similarly noticed a change, but they found that their springs had become colder.

A prominent Philadelphia merchant, Isaac Norris the eldest, maintained that prior to 1740 the captains of ships knew to clear the Docks of Philadelphia before the middle of November (old date) or they ran the risk of being trapped by ice in the river. However after 1740, the river would not freeze until the middle of December (old date; Benson 1937:275-276; Hazard 1828 2:151-154; Watson 1860 2:348-349).

The warmer winters were followed by colder springs, drier summers, and cooler autumns. Delaware Valley Swedish-Americans told Peter Kalm that an old adage, *"Påsk bittida, Påsk sent, alltid gräs"* or "Easter early, Easter late, always grass" [translation the present author's] no longer held true. The warming weather and green fields which had once always come by February had begun to come in late March or early April (old date). Because of the late start the meadow grasses were said to have grown less high. However, Peter Kalm suspected that the perception of late sprouting annual grasses was the result of the over-grazing by cattle.

Kalm's informants argued that summers had once been so wet that it was sometimes difficult to harvest. After 1740 the summers had sometimes become too dry. While others said that summer rains were as they had always been. All agreed that the weather had become much more inconsistent in comparison to when they were young. Peter Kalm witnessed the chimeric nature of Pennsylvania weather which could change several times in a day. Particularly when winds from the northwest brought cold air (Benson 1937:275-277).

Writing at the turn-of-the-19th century, Dr. Benjamin Rush summarized the received wisdom that:

> . . . the climate of Pennsylvania has undergone a material change. Thunder and lightning are less frequent; the cold of our winters, and the heat of our summers, are less uniform, than they were forty or fifty years ago. Nor is this all: the springs are much colder, and the autumns more temperate, than formerly, insomuch that cattle are not housed so soon, by one month, as they were in former years (Hazard 1828 2:151).

Rush's reference to housed cattle suggests that he was talking about weather somewhat later than 1740. Not all observers were in agreement. At mid-century, Nils Gustafson a nonagenarian resident of the Swedish settlement at Racoon Creek, New Jersey felt that the "weather had always been pretty uniform ever since his childhood," storms were of the same severity, and that snow fell in about the same quantity. However, Gustafson believed that the heat of summers and cold of winters were sometimes more severe than they had once been (Benson 1937:270-271).

Benjamin Rush was dubious of these claims and suspected that the perceptions of older residents were attributable to new fashions of dress and dimmed memories of youth. In Rush's opinion mean temperatures had not changed significantly, but he embraced the idea that the seasons had increased in their irregularity and severity. Without a regular series of thermometer readings, Rush argued, these observations could not be confirmed (Hazard 1828

2:151-154). Those data did exist, but in Dr. Rush's time they were scattered in foreign academic journals, diaries, and apparently lay forgotten in the archives of the American Philosophical Society.

Dr. Rush favored an hypothesis put forward by Dr. Williamson, a fellow member of the American Philosophical Society, who argued that a shift in the climate of southern Europe was the product of deforestation in the north. To Rush's mind, the vast forests to the north and west of Pennsylvania precluded a warming effect. Rush sought ti test his argument with a comparison of the winters of 1739-40, [he certainly meant the famously cold winter of 1740-1741], 1779-1780 and 1804-1805. Based on the length in which the port was closed and the depth of snow, Rush argued that the winter of 1740-1741 was colder than that of 1779-1780, but both were less severe than the hard winter of 1804-1805 (Hazard 1828 2:151-154). From that rather spotty data Rush concluded that there was no general pattern of warming in the region.

The Local Weather Pattern: Pennsylvania's Chimerical Climate

Colonists found Pennsylvania's climate to both unpredictable, rapidly changing, and subject to seasonal extremes uncommon in Europe. Although, Philadelphia is located along a latitude well to the south of London, the colony's average temperatures were in comparison generally cooler in winter and warmer in summer (Myers 1912:318; Benson 1937:56). In 1729 Thomas Makin described the common perception of Pennsylvania's weather in the following couplets:

> Nay, oft so quick the change, – so great its pow'r –
> As summer's heat and winter in *an hour*!
> Sometimes the ice so strong and firm, we know
> That loaded wagons on the river go!

But yet so temp'rate are some winters here,
That in the streams no bars of ice appears! (Watson 1860 2:348).

Peter Kalm opined that there was "hardly a country on earth in which the weather changed so often in a day as it does here" (Benson 1937:56).

As Brent Yarnal and Daniel J. Leathers (1988) have explained, the changeability of Pennsylvania's weather results from its location along the path of the tropospheric westerlies. These prevailing winds are powered by the earth's rotation and carry polar air westward across the northern hemisphere (Figure 4). Pennsylvania is bisected by the mean path of the polar front jet stream, where warm, subtropical air meets the cold air of the poles. Small movements of the polar front in the troposphere can have large implications for surface temperatures and rates of precipitation. Using a 20th century sample, the authors conclude that meridional (north-south, latitudinal) movement produces decades of lower temperatures and either unusual dryness or wetness depending on the front's mid-continental position. Zonal (east-west, longitudinal) movement produces warmer temperatures and variable precipitation depending on its exact course (:624-639).

While greatly changeable, there are recognizable patterns to Philadelphia weather. Gregory J. McCabe Jr. (1990) has developed a statistically derived typology of daily weather systems at Philadelphia using data collected between 1954 and 1988 (Figure 5). His model includes three varieties of relatively fair weather with less than 50-percent mean daily cloud cover (Figure 6, outer circle), and three cloudy weather types (Figure 6, inner ring) denoted by providing greater than 50-percent cloud cover.

The fair weather types include a High Pressure (HP) system typified by cold northerly and northwesterly winds (270° to 44°) created by an upstream high pressure system. As a high

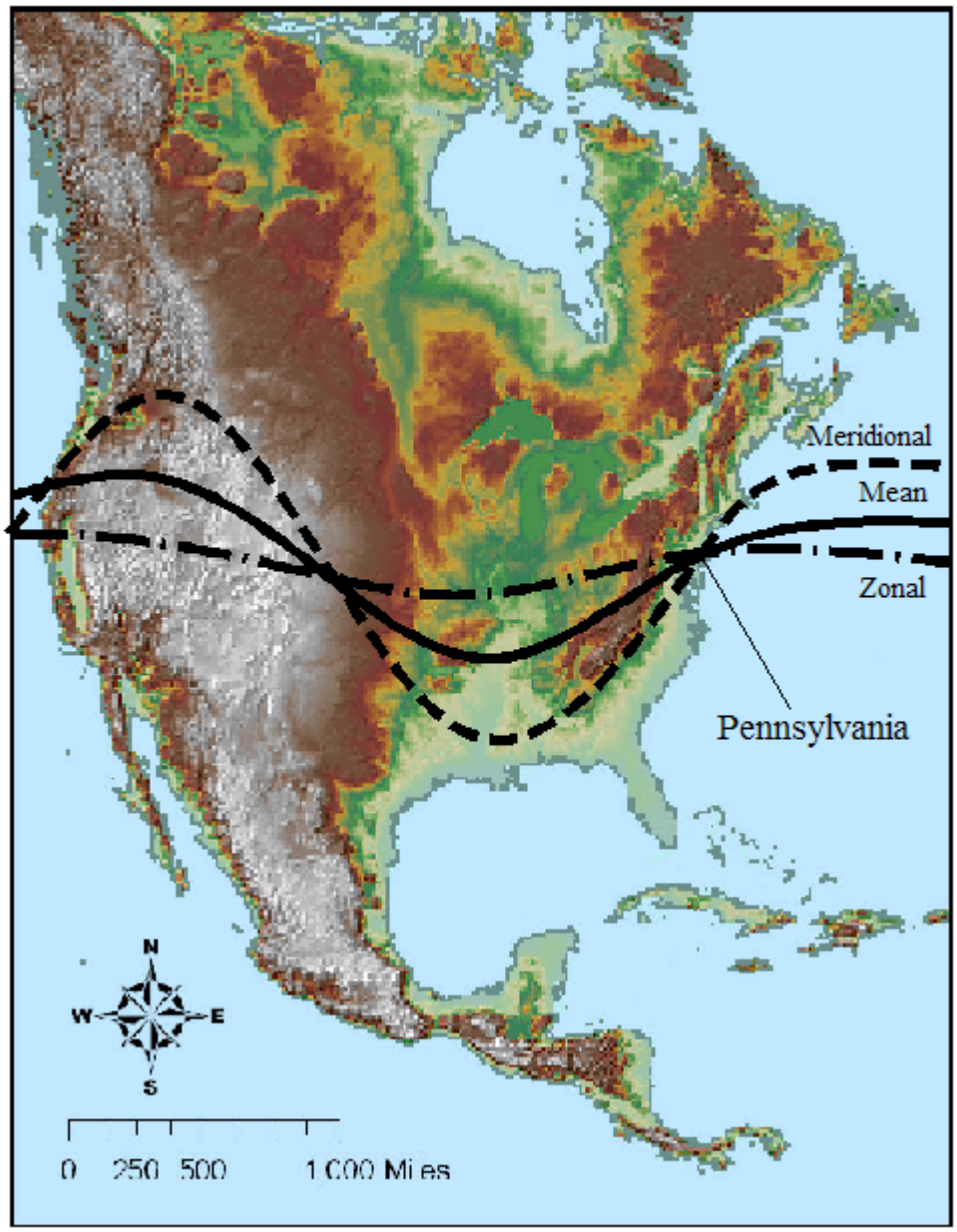

Figure 4. Mean Path, Meridional and Zonal Extent of Polar Front Jet Stream (Redrawn from Yarnal and Leathers 1988:626).

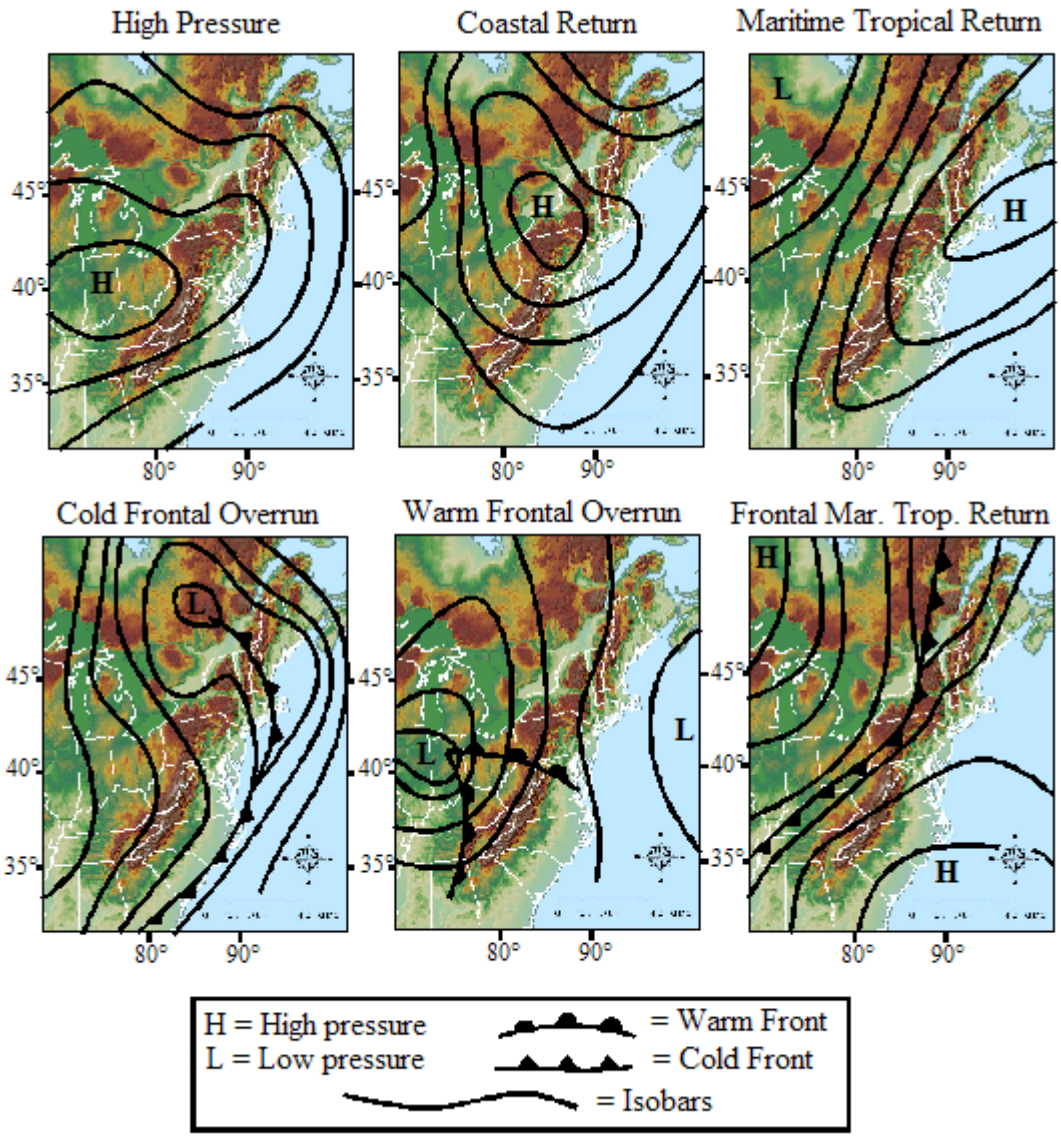

Figure 5. McCabe's Six Types of Daily Surface Weather at Philadelphia, Pennsylvania (Redrawn from McCabe 1990:7).

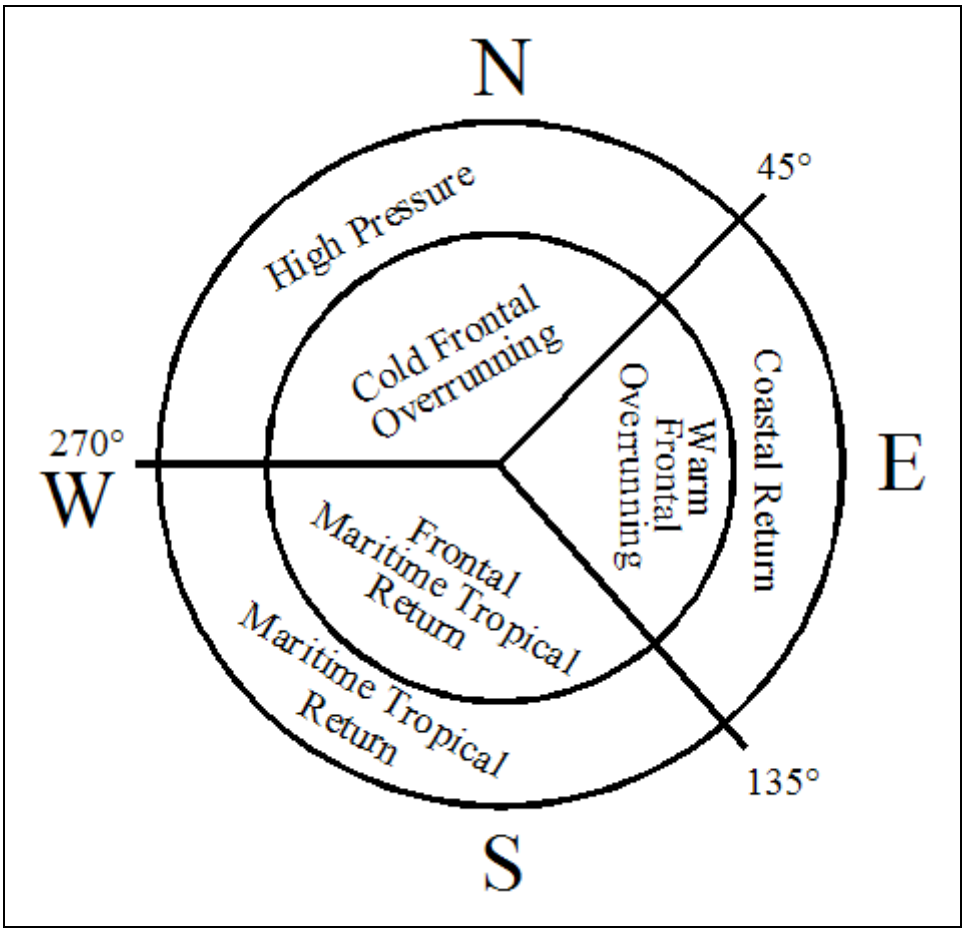

Figure 6. McCabe's Model of Weather at Philadelphia, Pennsylvania. Compass Points Refer to Wind Direction. Center Ring Divides Cloudy (>50%) from Fair (<50%) (Redrawn from McCabe 1990:5).

pressure system moves to the north of Philadelphia, Coastal Return (CR) type weather dominates and is typified by warm easterly winds (45° to 134°). The movement of high pressure systems to the east of Philadelphia produces the Maritime Tropical Return (MTR) which is accompanied with south and southwesterly winds whose character his heavily influenced by ocean conditions. Cloudy weather marks rapidly changing temperatures, which produce Cold Front Overrunning (CFOR), Warm Front Overrunning (WFOR) and Frontal Maritime Returns (FMR). In McCabe's 20th century sample, the most common weather types were High Pressure, Frontal Maritime Returns and Cold Front Overrunning (:1-7). Overrunning refers to a front of lighter density air in motion above a denser body of air and is usually associated with elevated precipitation. As may be expected, rain follows clouds. In the 20th century sample, the Frontal Maritime Tropical Return and Warm Front Overrunning brought the greatest rain to Philadelphia, with the Cold Front Overrunning following close behind. The other systems brought little appreciable rain (McCabe 1990:15).

The great utility of McCabe's (1990) weather model is that it only requires that an observer know wind direction and a relative degree of cloudiness. This information is often recorded as part of meteorological observations which often contain temperature, descriptions of cloud cover, wind direction, and sometimes also barometric pressure. Or can be reconstructed from contemporary accounts which offer sufficient descriptive evidence to reconstruct the prevailing weather pattern.

Contemporary Commentary on Weather

The sources of contemporary commentary include oral history, newspaper accounts, and letters of Philadelphia agents for various trading companies. Important sources include

Peter Kalm's interviews in his *Travels in North America* (Benson 1937), Hazard's (1828) *Register of Philadelphia* and Watson's (1860) *Annals of Philadelphia and Pennsylvania in the Olden Times*. Additional observations are available in translations of the contemporary journals of David Shultze (Berky 1952, 1953) and Reverend Henry Melchior Muhlenberg (Tappert and Doberstein 1945). Bezanson, Gray and Hussey (1935) have collected references to weather's effect on agricultural production in merchant letters as part of their study of colonial prices in Philadelphia. Historical climatologists have enjoyed considerable success reconstructing relative weather indexes from such qualitative data in New England (Baron 1995). However, the observations for Philadelphia are patchy and surpassed by a long record of Philadelphia port closings, direct meteorological observations, and a reconstruction of temperature and precipitation. Nevertheless, the merchants accounts will serve as an independent check on an estimation of yields in a later chapter.

Navigational Data

Hazard's (1828 2:23-26, 151-154, 379-386) "Effects of Climate on Navigation" provide estimates of winter closings of Philadelphia's docks as result of ice in the Delaware River (Figure 7). These data serve as a general measure of winter temperatures, but it must always be remembered that bodies of water have nonlinear relationship with temperature (Ladurie 1971:426; DeVries 1980:606; Landsberg 1980:639). There are many factors which affect port closures such as river speed and volume, upstream temperatures, spring freshets which drive off ice, size of ships, and the schedules of traffic. Perhaps the most significant influence was precipitation. As Benjamin Rush observed at the turn of the 18th century, the Delaware seldom became frozen until it had been "chilled by the fall of snow" (Hazard 1828

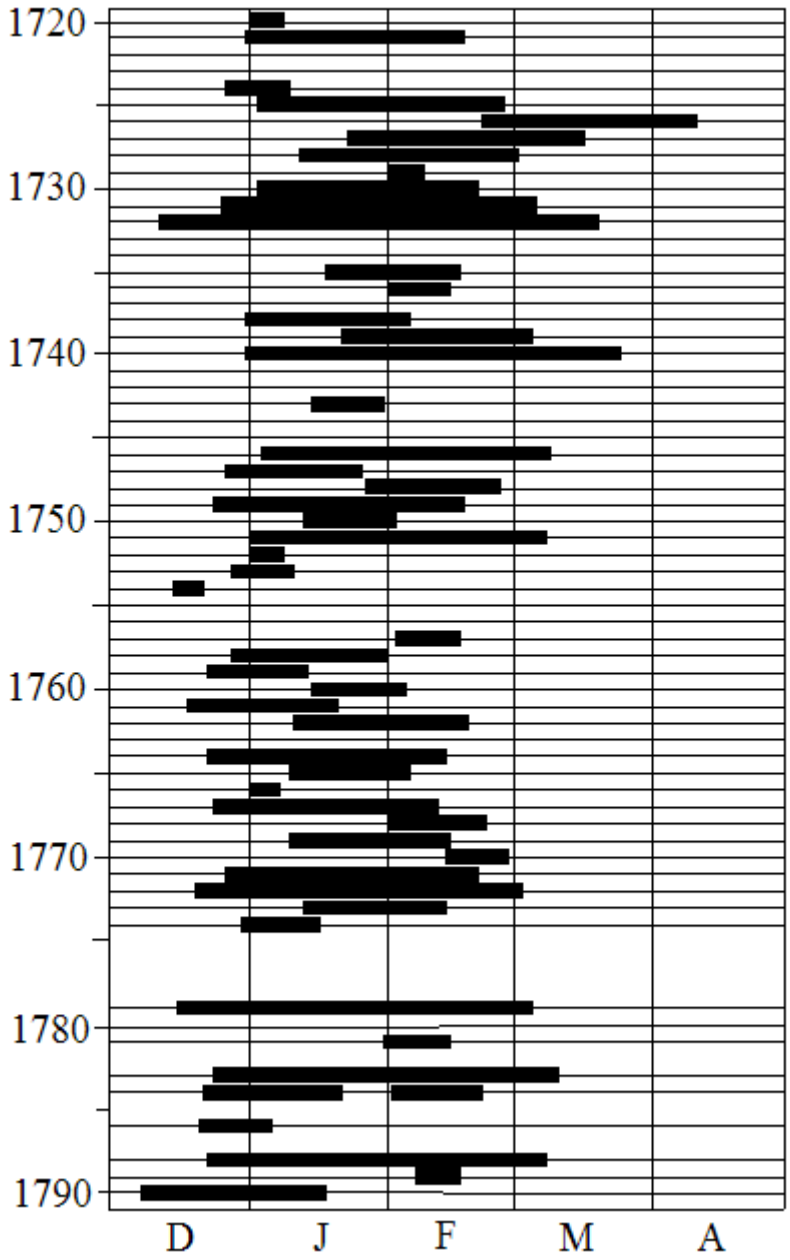

Figure 7. Winter Closings of the Port of Philadelphia, 1720-1790. Absence of a narrow lines indicates no data available (Sources: Hazard 1828 2: 23-26, 151-154, 379-386; Watson 1860 2:347-369; *Pennsylvania Gazette*).

2:151-154). It is likely that the snowfall fostered the formation of ice by conveying freezing temperatures from the troposphere to the surface of the river.

The navigation data suggests that port closings were generally unpredictable with icy winters followed by years without closings. Ship traffic suggests that the Delaware River froze earlier and cleared sooner in the second half of the century. Winter closings before 1750 did not begin until late December or early January. After that date, ice would appear in mid-to late-December. In other words, the navigational data suggests the opposite of the perceived pattern. In icy years before 1750 the river tended to remain closed until after mid-March. In the second half of the 18th century the river was commonly clear by the end of February or the first week of March. The disagreement between the navigation records and contemporary observers suggests that some other factor, most likely winter precipitation, could have been influencing port closures. Fortunately, there are numerous existing instrumental observations made in and around Philadelphia provide some further evidence of the 18th century climate in the Philadelphia region.

Observations at Philadelphia, a Proxy for Chester County

The 18th century was a period of great experimentation with thermometer technology and Landsberg (1985) provides conversions for 36 scales which were in use (:50). Most American instruments were calibrated to Fahrenheit's scale which included an "old" scale (°oF) which placed the freezing point of water at 30°oF, and a "new"scale (°F) which places freezing water at 32°F. Some visitors like Peter Kalm arrived with instruments which followed the Swedish Academy of Sciences' 1740 recommendation for Celsius's (°C) scale. Celsius originally set the freezing point as 100°C, but by general agreement it was quickly inverted

into the centigrade scale that is in use today. Reaumur's (°R) scale for spirit thermometers were popular among French speakers like Pierre Legaux who operated a vinery in Philadelphia County. The Royal Society in London advocated Hauksbee's (°H) scale, although its members published data using a diversity of scales.

When working with meteorological observations made with early instruments, a researcher must consider the accuracy and placement of the observers' instrument and the schedules of observation. Early thermometers often differed in construction and scale, frustrating efforts to make simple comparisons. In a 1751 letter to Jared Eliot, Benjamin Franklin complained that no two of his three Fahrenheit thermometers gave the same reading (Sparks 1882 7:52). The variance between thermometers was a very real concern for the 18th century meteorologist. However, most observers took care to calibrate their instrument to other instruments or natural anchors such as the temperature of equal parts salt, water and ice, freezing water, human body temperature, or boiling water.

The way in which meteorological observations were made passed through a series of common standards. Jacob Jurin (1723), a Secretary of the Royal Society of London, recommended that meteorologists keep a journal of barometric pressure, temperature, wind force and direction, precipitation and general description of the weather. Landsberg (1985) faults Jurin's scheme for recommending Hauksbee's instruments which have poor uniformity, and his recommendation that observations should be taken in an unheated interior room. As early as 1729, Jurin's schema was amended to direct meteorologists to collect their observations outdoors and out of direct sunlight (:55). The common schedule of observations was to record an early morning and early afternoon readings in order to capture the extremes of daily temperature.

There are a number of direct meteorological observations taken from southeastern Pennsylvania and northern Maryland. Some early works have compiled early data sets (Pierce 1847; Blodget 1857; Schott 1876), but they are far from comprehensive. The earliest instrumental observations in Philadelphia may be those collected by Cadwallader Colden during the winter of 1717 and spring of 1718 (Mass. Historical Society 1858 42:166; Ludlum 1966:*xi;* Nese and Schwartz 2005:4). However, Colden's observations could not be located.

Kirch and Sauer's Germantown Observations, 1731-1732

The earliest surviving instrumental observations for colonial Pennsylvania were rediscovered by James M. Havens (1958) in an article by Christfried Kirch (1737) in the *Miscellanea Berolinensia ad incrementum scientiarum,* the journal of the *Konigliche Akademie der Wissenschaften* at Berlin. Kirch reported a series of observations collected between mid-November 1731 and late October 1732 by someone he identified as "S**" of Germantown (:123-129), a village located about six miles to the northwest of the city. It is likely that Kirch's observer was Johan Christoph Sauer Sr. (Chistopher Saur, Sower, Sowr) a printer of some note who had moved to Germantown in 1731 (Kelsey 1921:243-254). The identification requires confirmation, but it was quite common for Pennsylvania printers to also be men interested in the sciences.

The data set includes morning and afternoon readings and was recorded by a spirit thermometer made by Fahrenheit himself. As Kirch (1737) relates, his instrument was divided into 24 major degrees and four quarter, or minor degrees and was made about 20 years prior to his writing (:129). That would place the thermometer's date of manufacture around 1717, the same year that Louise Diehl Patterson (1951) says that Fahrenheit adopted the present or

"new" scale. Fortunately, Kirch (1737) provides three points of comparison with a newer instrument, also made by Fahrenheit. Sauer's thermometer measured five *graduum minorum* (5°F) lower at great cold, 6°F lower at intermediate temperatures, and 6.5°F lower at high heat. Kirch estimated an appropriate correction of + 6°F (:129). Landsberg (1967) has reinterpreted Kirch's data, but the unpublished white paper could not be located.

Havens (1958) discarded Kirch's adjustment because he questioned whether one could correct for any specific errors when "any one of them could be operating" and noted that the Germantown data was "so much lower than present-day observations that it is probable that the thermometer was subject to greater error" than that considered by Kirch (:213). Havens derived a new correction by calculating the mathematic fit of the data to temperatures observed between 1871 and 1930. Based on the result, Havens recommended a correction factor of +7.5° F to each monthly average (:214). However, Havens' correction is based on the erroneous assumption that the range of early 18th century temperatures was similar to that at the turn-of-the 20th century. There is good reason to believe that the period in question was extraordinarily cold, and colder than Haven's late 19th and early 20th century data.

The winter of 1731-1732 was one of seven times in the 18th century that the Delaware had become sufficiently frozen in the 18th century for foot traffic to cross from Philadelphia to New Jersey (Benson 1937:271; Hazard 1828 2:23, 151-152; Watson 1860 2:349-350). That winter also witnessed the longest closing of Philadelphia's port (see Figure 7). The river freezing was immortalized by a sad event. In late January, Samuel Burroughs and his young son were returning to New Jersey from the Philadelphia market when they broke through the ice and were drowned. Burroughs body was recovered soon after, but the ice hampered recovery of the son until spring *(Pennsylvania Gazette* 1:909, 1000). The following winter of

1732-1733 came early and the river was full of driving ice in November. The local paper commented that it was "a Thing rarely happening so early in the Year. Many People are ill with violent Colds, and Wood is risen to an excessive Price" (*Pennsylvania Gazette* 1:1161; Watson 1860 2:349). Contemporary observations and navigation data suggests two very cold years. The values in Table 1 were adjusted using Kirch's original correction factor of 6°F. Those days without two observations were dropped, and seasonal averages were calculated from three month means.

Kalm and Bartram's Kingsessing Observations, 1748-1750

The next series of surviving instrumental observations were collected by Peter Kalm and John Bartram in 1748, 1749 and 1750. These data include morning and afternoon temperature readings, wind direction, and a general description of the weather conditions. In keeping with the latest technology in Sweden, Kalm's thermometer was scaled in centigrade (°C). Peter Kalm's observations taken at or near Philadelphia include those taken between his landing at Philadelphia in mid-September 1748 and the beginning of his long journey to New York at the end of May 1749 (Benson 1937:739-760). During that time Kalm made numerous short trips in the Delaware Valley, but he remained in the general vicinity. No corrections were applied for these small geographic displacements.

During his travels north, Kalm conscripted the dutiful, but preoccupied John Bartram to continue his observations. Kalm later apologized to his readers for the brevity of Bartram's descriptions, but he excused Bartram because of his employment in "business of greater consequence, that of cultivating his grounds, he could not allow much time for this."

Table 1. Seasonal Mean Temperatures (°F) in the Philadelphia Region, 1731-1792.

	Spring (MAM)	Summer (JJA)	Autumn (SON)	Winter (DJF)	Location	Source
1731	---	---	---	31.4	Germantown	Kirch 1737
1732	54.2	69.9	---	---	Germantown	Kirch 1737
1748	---	---	57.5	35.4	Kingsessing	Benson 1937
1749	53.8	76.4	53.9	---	Kingsessing	Benson 1937
1753	---	---	57.4	36.6	Nottingham	Landsberg et al. 1968
1754	52.0	71.8	57.2	36.4	Nottingham	Landsberg et al. 1968
1755	54.8	73.5	56.4	38.9	Nottingham	Landsberg et al. 1968
1756	52.4	73.1	58.3	38.1	Nottingham	Landsberg et al. 1968
1757	51.8	75.1	56.5	38.0	Nottingham	Landsberg et al. /Bond
1758	51.8	73.0	54.9	34.2	Philadelphia	Bond in APS 1839
1759	47.7	71.4	55.6	---	Philadelphia	Bond in APS 1839
1767	51.2	73.6	55.1	34.4	Philadelphia	Bond in APS 1839
1768	48.2	68.6	52.0	34.2	Philadelphia	Bond in APS 1839
1769	49.7	73.0	52.3	33.3	Philadelphia	Bond in APS 1839
1770	48.2	71.7	54.3	32.8	Philadelphia	Bond in APS 1839
1771	50.7	70.3	54.7	34.3	Philadelphia	Bond in APS 1839
1772	45.6	73.2	55.0	34.3	Philadelphia	Bond in APS 1839
1773	52.3	76.3	54.8	33.1	Philadelphia	Bond in APS 1839
1774	52.6	71.4	55.7	37.7	Philadelphia	Bond in APS 1839
1775	54.2	71.1	53.9	34.2	Philadelphia	Bond in APS 1839
1776	51.0	72.3	56.5	32.6	Philadelphia	Bond in APS 1839
1777	49.9	72.3	49.6	---	Philadelphia	Bond in APS 1839
1786	---	---	---	29.3	Spring Mill	Legaux 1787
1787a	53.5	72.5	53.6	28.9	Spring Mill	Legaux 1787, 1788
1787b	53.5	71.6	52.8	30.3	Nazareth	Reichel in APS 1839
1788a	51.6	71.0	56.3	29.2	Spring Mill	Legaux 1788, 1789
1788b	50.3	72.0	54.7	29.3	Nazareth	Reichel in APS 1839
1789a	48.0	75.0	---	---	Spring Mill	Legaux 1789
1789b	47.3	73.5	51.8	33.5	Nazareth	Reichel in APS 1839
1790a	51.7	70.8	50.0	---	Nazareth	Reichel in APS 1839
1790b	51.5	---	55.5	31.1	Philadelphia	Carey 1790, 1791
1790c	52.3	73.8	55.5	31.3	Philadelphia	Young 1790, 1791
1791a	58.8	73.8	54.4	28.8	Philadelphia	Carey 1791, 1792
1791b	58.1	73.8	55.8	28.8	Philadelphia	Young 1791, 1792
1792a	53.6	74.0	---	---	Philadelphia	Carey 1792
1792b	53.6	71.5	---	---	Philadelphia	Young 1792

Bartram's readings were taken between June 1749 and January 1750 at his home in Kingsessing which was located about four miles southwest of the city (Benson 1937:738-769). Kalm and Bartram's data were interpreted into monthly averages using those days with both a morning and afternoon readings and converting the results to Fahrenheit's scale.

Kalm and Bartram's observations contained the first matching set of cloud and wind direction data taken for Philadelphia, and offers sufficient information to reconstruct daily weather patterns (Table 2). Daily weather patterns were estimated by comparing wind direction and cloudiness with McCabe's (1990) weather model for Philadelphia. In those cases were the pattern was unclear, the pattern of temperature change and prevailing winds were used to assist in the interpretation.

Brooke's Nottingham Observations, 1753-1756

Henry Baker of the Royal Society of London published a series of observations collected by Dr. Richard Brooke of Prince George's County, Maryland. Brooke's first series of meteorological observations include twice-daily temperatures, wind direction and a general description of weather between September 1753 and August 1754. Brooke's second series includes high and low monthly values between September 1754 and December 1756. By necessity, the seasonal values for Autumn 1754 through Autumn 1756 in Table 1 were generated from monthly medians, rather than averages. Each set of observations is accompanied by valuable descriptions of effects of weather change on humans, animals, and crops (Brooke and Baker 1760a:58-69, 1760b:70-82). Brooke's home in Prince George's County is approximately 75 miles southwest of Chester County. In order to compensate for the geographic dislocation, the Nottingham data were reduced to Philadelphia using

Table 2. Seasonal Weather Patterns at Philadelphia from Meteorological Observations, 1748-1792.

	HP	CFOR	CR	WFOR	MTR	FMTR	Days
Spring (MAM)							
Kalm 1749	30.4	14.1	1.1	1.1	30.4	22.8	92.0
Legaux 1787	15.2	12.0	0.0	8.7	25.0	39.1	92.0
Legaux 1788	7.6	17.4	1.1	20.6	23.9	29.3	92.0
Legaux 1789	23.9	37.0	4.3	9.8	10.9	14.1	92.0
Young 1790	20.7	25.0	4.3	18.5	15.2	16.3	92.0
Young 1791	35.9	15.2	7.6	5.4	16.3	19.6	92.0
Young 1792	19.6	12.0	4.3	19.6	20.7	23.9	92.0
Summer (JJA)							
Bartram 1749	39.3	22.5	11.2	2.2	19.1	5.6	89.0
Legaux 1788	9.8	27.2	1.1	13.0	15.2	29.3	92.0
Young 1790	5.4	14.1	3.3	10.9	20.7	45.7	92.0
Young 1791	14.1	16.3	3.3	5.4	30.4	30.4	92.0
Young 1792	12.1	20.9	7.7	20.9	20.9	17.6	91.0
Autumn (SON)							
Kalm 1748	47.6	11.9	2.4	2.4	27.4	8.3	84.0
Bartram 1749	28.7	13.8	6.9	5.7	24.1	20.7	87.0
Legaux 1787	19.8	30.8	2.2	7.7	23.1	16.5	91.0
Legaux 1788	13.2	33.0	1.1	5.5	19.8	27.2	91.0
Young 1790	28.6	28.6	0.0	7.1	20.7	14.3	91.0
Young 1791	25.3	24.2	1.1	7.7	28.6	13.2	91.0
Winter (DJF)							
Kalm 1748	46.8	26.0	0.0	0.0	11.7	15.6	77.0
Coombe 1770	24.0	40.0	0.0	0.0	20.0	16.0	75.0
Legaux 1786	17.8	18.9	12.2	22.2	14.4	14.4	90.0
Legaux 1788	43.3	34.4	0.0	1.1	13.3	7.9	90.0
Young 1790	27.8	24.4	1.1	2.2	22.2	22.2	90.0
Young 1791	35.2	33.0	1.1	6.6	15.4	8.8	91.0

(Number of Days of each weather pattern; HP = High Pressure, CFOR = Cold Front Overrunning, CR = Coastal Return, WFOR = Warm Front Overrunning, MTR = Maritime Tropical Return, and FMTR = Frontal Maritime Tropical Return).

Landsberg, Yu and Huang's (1968) seasonal regressions for Baltimore, a city in a county adjacent to Nottingham (Table 3).

Table 3. Brooke's Temperature (°F) Observations at Nottingham, Maryland and Reduced to Philadelphia.

	Spring (MAM)	At Phila.	Summer (JJA)	At Phila.	Autumn (SON)	At Phila.	Winter (DJF)	At Phila.
1753	---	---	---	---	58.3	57.4	39.3	36.6
1754	53.6	52.0	72.3	71.8	58.0	57.2	39.0	36.4
1755	57.2	54.8	74.6	73.5	56.6	56.4	41.8	38.9
1756	54.1	52.4	74.1	73.1	59.7	58.3	40.9	38.1
1757	53.3	51.8	76.7	75.1	56.8	56.5	---	---

Bond's Philadelphia Observations, 1758-1759, 1767-1777

A meteorological register commonly attributed to Phineas Pemberton resides in the collections of the American Philosophical Society (APS). The register is mentioned in the society minutes as early as 1768, and again in 1775 and 1787 (APS 1884:13, 98, 264). However, the attribution must have been made *in memoriam* since Phineas Pemberton had died many years before the first observation. Some researchers have attributed the readings to his grandson, Israel Pemberton Jr. (Gelber 2002:19-20; Nese and Schwartz 2002:5), but there is little to connect him with the journal. The source of the 1758-1759 observations remains uncertain. The series beginning in 1767 was most certainly collected at the Pennsylvania Hospital under the direction of Dr. Thomas Bond. Dr. Bond had made his interest in meteorology clear in 1768 when he recommended to the APS a new method of recording

meteorological observations. He was also the member of record who submitted a portion of the Pemberton manuscript in 1775 (APS 1884:13, 98).

Dr. Bond instigated the keeping of regular meteorological observations in April 1766 when he requested from the managers of the Pennsylvania Hospital at Philadelphia:

> ...the liberty to put up a Meteorological Apparatus in the Picture Room for keeping a Register of the Weather and an exact account of the Epidemic Diseases thereby caused in this country A Neat Copy of which with an account of all the curious cases which present in the Hospital I will annually deposit in the Library for the Perusal of Posterity (Morton and Woodbury 1895:496).

The managers gave their permission and soon after Dr. Bond donated the necessary meteorological equipment. The task of recording to the observations fell to a student-curator who looked after the hospital's scientific collections (Morton and Woodbury 1895:496-470, 553). Abstracts of the Bond data were published anonymously in the early 19th century as monthly averages of morning lows, afternoon highs, and mean daily temperatures between January 1758 and December 1759, and January 1767 and December 1777 (APS 1839:395-398). The early series was combined with Brooke's December 1756 observations to calculate winter values for 1757.

In addition to Dr. Bond's observations, a week of data was collected between December 30, 1766 and January 7, 1767 by "F.A.S." Those initials suggest that the observer was an anonymous Fellow of the American Philosophical Society. The observations were published in the *Pennsylvania Gazette* to demonstrate the rapid change from "the greatest natural Cold ever known, that is 2 Deg. and a Half below 0 [°F], to a Degree of Heat equal to half the greatest Summer Heats known in this Climate." F.A.S. attests to the accuracy of his thermometer which had been calibrated to match an instrument at the Greenwich Observatory

in England (*Pennsylvania Gazette* 1767 3:2270). Considering the dates of observation and authoritarian tone of the writer, it is likely that the author was Dr. Bond.

Mason and Dixon's Chester County Observations, 1766-1768

Charles Mason and Jeremiah Dixon recorded several irregular series of temperatures in the vicinity of Chester County, Pennsylvania between December 1766 and June 1768 (Mason 1969). The observations were taken in an effort to account for the expansion and contraction of their instruments as they surveyed the boundaries between the Pennsylvania, Maryland and Delaware colonies. The orientation of the line had been in dispute since Penn first received his patent, so their work had to be of the highest precision (Meade 1982).

The earliest series of measurements consists of mostly afternoon temperatures collected between December 1766 and early June 1767 (Mason 1969:150-172). However, the lack of morning readings means they aren't readily comparable to other readings. A more complete set was taken between mid-June and early October 1767 by a local assistant named "Joel Bayley" (Mason 1969:172-173). The observer was probably Joel Baily Jr. of West Marlborough, a local astronomer who would later coauthor a paper concerning the 1769 transit of Venus (Biddle, Bailey and Thomas 1770:89-94; Futhey and Cope 1888:467). Baily made his temperature readings from a well-situated Fahrenheit thermometer hung two feet from the shaded north side of his house. The instrument must have been Mason and Dixon's, since there are no overlapping readings by the surveyors, and Baily's 1775 probate inventory did not include any meteorological equipment (CC Probate 2969). Baily's observations compare favorably with Dr. Bond's Pemberton Register. The average of mean monthly high

temperatures for July, August and September (81.5°F) is only slightly lower than the Bond Register's average (82.2°F).

Mason and Dixon encountered some troublesome variance from the expansion and contraction of their brass surveying rods which prompted them to take a regular series of morning and afternoon readings between February and early June 1768 (Mason 1969:196-210). However, Mason and Dixon's spring average of 57°F was substantially higher than the Bond Register data 48.2°F. The difference was probably reflects their interest in the temperature of brass rods exposed to direct sunlight, and their practice of not working on snowy days. Only Baily's observations were included in Table 1. Lastly, a single high temperature of 94.5°F was noted on July 5, 1769 by the astronomer David Rittenhouse at his observatory in Wilmington, Delaware. It was the greatest temperature to "have ever been observed at that place" (Barton 1813:139). The collected meteorological observations indicate that 1769 was warm summer, but not exceptionally hot.

Coombe's Philadelphia Observations, 1770-1771

A short series of observations was made between December 1, 1770 and February 15, 1771 by Thomas Coombe (1771) of Philadelphia (:70). The observer must have been Thomas Coombe Sr., since his son was in England during the period in question (High 1995:278). Coombe collected an "in doors" readings in an east-facing, ground floor doorway, and an "open air" reading on a north-facing, second story window sill. Coombe's devices were made by two different artisans, but were similarly calibrated (Coombe 1771:70-72).

The outdoor readings for December and January averaged 37.6°F, whereas the indoor average of those same two months was slightly higher at 38.3°F. The difference suggests that

the indoor readings were somewhat affected by the heat of the house. Coombe's out of doors observations were about 3°F higher than Bond's. In any event his observations contain valuable information concerning cloud cover and wind direction which can be used to approximate the prevailing weather pattern (see Table 2).

Miscellaneous Philadelphia Observations, 1773-1777

A 1773 *Pennsylvania Gazette* article reported a series of rapid temperature changes which had occurred on February 21 and 22. On the east side of the city, the temperature dropped from 8°F at 2:00 P.M. to 0°F by the morning of February 22. The cold snap was short, and by noon the temperature had again risen to 11°F. On the western side of the city, a morning observation had the temperature at -4°F. A third observer somewhere in the city reported that his instrument, and "approved one" constructed by Nairne, had read 0°F at 9:00 P.M. on February 21. The extreme cold had invaded his house and a "Glass of strong Wine" left less than nine feet from a fireplace full of burning hickory had "congealed to the Consistence of Snow, from Top to Bottom, by Morning" (*Pennsylvania Gazette* 1773 3:15488). These observations may be of little direct use, but these multiple readings of the same weather event suggest that thermometers had become relatively common and gentlemen-meteorologists were increasingly alert to unusual meteorological phenomena.

Jefferson's Philadelphia Observations, 1776

While attending the Continental Congress in Philadelphia, Thomas Jefferson (1776) used a Fahrenheit thermometer to take readings in July and August 1776. Although Jefferson was an experienced observer of the climate (Jefferson 1853:80-81), he remained passionate about the practice and took numerous readings in a day. For example, when the morning of

July 28 started to become particularly warm, Jefferson took 14 hourly observations to plot the rising temperatures.

An average of morning and a late afternoon readings suggest a mean temperature of 73.1°F for July and August 1776. This value is in close agreement with average of the same two months (73.5°F) in Dr. Bond's Pemberton Register. Because of their association with the signing of the American Declaration of Independence on July 4, 1776, Jefferson's observations have come under prior scrutiny.

As Paul H. Smith (1976) has discussed, some researchers have questioned the mild summer temperatures indicated by Jefferson's observations. Builders of mythology had imagined the delegates vexed by the summer's heat as they debated the Declaration (:297). The story had originated as early as 1874 when James Parton wrote in *Life of Thomas Jefferson* "Thursday, the fourth, was a hot day, the session lasted many hours; members were tired and impatient" (:191). While this bit of historical drama may have served as an accurate metaphor for the larger struggle for American Independence, it doesn't hold up to contemporary accounts. Smith's (1976) work with delegate's letters indicates that the final vote was taken about 11:00 A.M., just two hours after they had begun the session. Afterward, Jefferson was sufficiently free of duty to grab some lunch and make a 1:00 P.M. temperature reading. The highest temperature of the day was a comfortable 76°F (Jefferson 1776). Any doubts about Jefferson's observations are quashed by the journal of Robert Treat Paine of Massachusetts. His journal entry for July 4, 1776 was succinct: "Cool. The Independence of the States Voted & Declared" (Smith 1976:296-298).

Rittenhouse's Wilmington, Delaware Observation, 1783

In the gap between the end of Dr. Bond's Pemberton Register and the next lengthy series of meteorological observations were some temperatures readings collected over the course of three unusually hot days in 1783. On July 30 the *Pennsylvania Gazette* reported that:

> ...last week several persons in and about the city died by the excessive heat of the weather. Others lost their lives by imprudently drinking cold water when they were very much heated. -- The Coroner's register contains the names of 30 persons who have died suddenly within a few days past. The Mercury in Mr. [David] Rittenhouse's [Fahrenheit] thermometer was, on Thursday, as high as 94 degrees and an half, which is two degrees hotter than has been experienced in Philadelphia since the year 1769. State of the Mercury in the ingenious Mr. Rittenhouse's Thermometer: July 22, ninety-one degrees; July 23, ninety-four degrees; July 24, ninety-four degrees and a half; July 25, ninety-one degrees and a half; at three o'clock, P.M. each day (*Pennsylvania Gazette* 3:31678).

In the 21st century, Philadelphia summers in excess of 90°F in the shade are common, but in the 18th century such temperatures were unusual. The author's statement about the temperature in 1769 isn't supported by Dr. Bond's Pemberton Register (1767-1777) which indicates that it wasn't until July of 1773 that the City of Philadelphia first experienced temperatures above 90°F. Later observers noted that it wasn't until 1783 temperatures again rose that high (APS 1839:396). The numbers of probate inventories indicates that there was no increased mortality among Chester County heads of households during any of these summers (Appendix A).

Legaux's Spring Mill Observations, 1786-1805

In comparison with earlier years, the late 1780s and early 1790s is an embarrassment of riches with several sets of overlapping observations. The most detailed data was provided

by Peter Legaux (Pierre Le Gaux) who supplied Philadelphia printers with daily observations of temperature in Fahrenheit and Reamur's scales, barometric readings, wind direction, precipitation and a description of the weather. His point of observation was his vineyards at Spring Mill, Philadelphia County, located 13 miles north and west of the city. In his will, Legaux specified that his instruments were of his own making and that he had used the same ones throughout the course of his observations (Montgomery Co. Wills & Estates 1828).

Legaux observations provide sufficient data to reconstruct the prevailing weather patterns and total precipitation (Table 4) for Autumn 1786 to Spring 1789. He measured precipitation with an udometer divided into French feet (*pied de roi*), composed of 12 inches (*pouce*), with 12 lines (*lignes*) per inch, and 16 points (*Truchet points*) per line. The precipitation data was converted to English feet at the rate of one French foot to 12.8 English inches. Peter Legaux's (1787, 1788, 1789) observations between October 1786 and January 1790 were published monthly in *The Columbian Magazine or Monthly Miscellany* and were proabably continued anonymously in William Young's (1790, 1791, 1792) *The Universal Asylum and Columbian Magazine.* Legaux (1806) also published meteorological observations for 1805 in *The Philadelphia Medical and Physical Journal* (:100-125).

Table 4. Legaux's Precipitation Observations in Inches at Spring Mill, 1786-1789.

	Spring (MAM)	Summer (JJA)	Autumn (SON)	Winter (DJF)
1786	--	--	--	13.8
1787	9.1	10.9	6.2	7.1
1788	10.2	15.5	13.6	10.5
1789	12.2	16.1	--	--

Reminiscent of the myth concerning the weather during the signing of the Declaration of Independence, the 1787 debates over the final draft of the American constitution was said to have taken place during an exceptionally hot summer. James H. Hutson (1987) examined Peter Legaux's observations, excerpts from two contemporary journals, and some unpublished data compiled by David M. Ludlum of the American Weather History Center. Hutson invoked Ludlum's assertion that 1787 was a "cool summer" (:325-337). Reverend Muhlenberg found the weather in Philadelphia County to be cool in June, unremarkable in July, but early August to be "oppressive" (Tappert and Doberstein 1942 3:744-750). A comparison of Legaux's data with the mean of the 31 summers for which there are instrumented observations indicates the summer's average were almost dead average.

Reichel's Nazareth Observations, 1787-1790

Rev. Charles Gotthold Reichel's collected meteorological observations at Nazareth, Pennsylvania between January 1787 and December 1790. Nazareth is located along the Delaware River and is approximately 75 miles north of the City of Philadelphia. Abstracted monthly averages of lowest, morning and highest, afternoon temperatures were published by the American Philosophical Society (1839:397). Reichel typically made his observations at sunrise and between 2:00 and 3:00 P.M. (Conrad 1804). Seasonal averages of Reichel's observations are quite similar to Legaux's data collected at Spring Mill and no geographic correction was made.

A bit of overlapping data was provided by the *Pennsylvania Gazette* which published readings for February 1 and 2, 1789. The readings demonstrate an eight hour period of falling temperatures from 10°F at 4:00 P.M. on February 1 to 0°F at midnight. By 5:00 A.M. the

mercury read -5°F. As the sun rose, the temperatures steadily increased throughout the morning, and climbed to 0° F at half past 8:00 A.M. (*Pennsylvania Gazette* 4:5950). Reichel's observations of the winter of 1789 indicate that the cold snap was an isolated incident within an otherwise typical season.

Carey and Young's Philadelphia Observations, 1790-1793

The best documented year in 18th century Pennsylvania is 1790. Reichel's observations are supplemented by data published in William Young's (1790, 1791, 1792) and Mathew Carey's (1790, 1791, 1792) nationally distributed gentleman's magazines. Young's *American Museum or Universal Magazine* included readings said to be taken at Philadelphia from a barometer, Reaumur thermometer, anemometer, and a general description of weather. The use of Reaumur's scale was so typical of Peter Legaux's observations that it is likely that he was the uncredited source of data and the point of observation was Legaux's vinery at Spring Mill.

Mathew Carey published daily observations of temperature, air pressure, wind direction, and general weather in his *The Universal Asylum and Columbian Magazine*. Carey's presentation of the data was exceptional in that each month the meteorological observations were coupled with a review of the prevailing diseases. An investigation of the intersection of weather and disease which would result in Carey's influential 1794 pamphlet *"A short account of the malignant fever, lately prevalent in Philadelphia*" in which he compared mortality rates with meteorological data to refute the "Climatist" position that course of the yellow fever epidemic closely followed the changing weather. The pamphlet included a short series of barometer and thermometer readings, winds direction, and weather descriptions for the period of August 1, to November 9, 1793 (Carey 1794:113-120).

Carey credits the famous astronomer Dr. David Rittenhouse with having "compiled" the meteorological data. Rittenhouse was a skilled crafter of instruments and astronomer, but is not associated with any other regular climatic observations. Carey's phrasing leaves open the possibility that Rittenhouse merely abstracted someone else's data. Quite possibly the originator was again Peter Legaux. Rittenhouse is an unlikely observer since his observatory was located in Wilmington, Delaware and his interest was in the stars. Carey may have borrowed Rittenhouse's scientific credentials and status as a gentlemen in order to bolster a tradesman's argument.

Reconstructed Meteorological Observations

Undaunted by the patchy and scattered meteorological observations for the 18th and early 19th centuries, climatologist Helmet E. Landsberg (1967), began to work on a method for the reconstruction of a long series of estimates for colonial America. To achieve this goal Landsberg, C. S. Yu and Louise Huang (1968) used an early 20th century data set to calculate seasonal linear regressions to describe climatological relationships between different regions of the eastern United States. These regressions were then applied to historic observations in order to estimate seasonal average temperature and precipitation for Philadelphia the Philadelphia region beginning in 1738 and into the 19th century (Figures 8 and 9). The reconstruction of the 18th century climate was informed by data from South Carolina (Lining 1743, 1748, 1753), Nottingham, Maryland (Brooke and Baker 1760a, 1760b), Cambridge and Ipswich, Massachusetts (Wigglesworth 1784; Cutler 1784; Blodget 1857), Monticello and Williamsburg, Virginia (Burnaby 1775; Jefferson 1944), and New York (Baker 1801; DeWitt

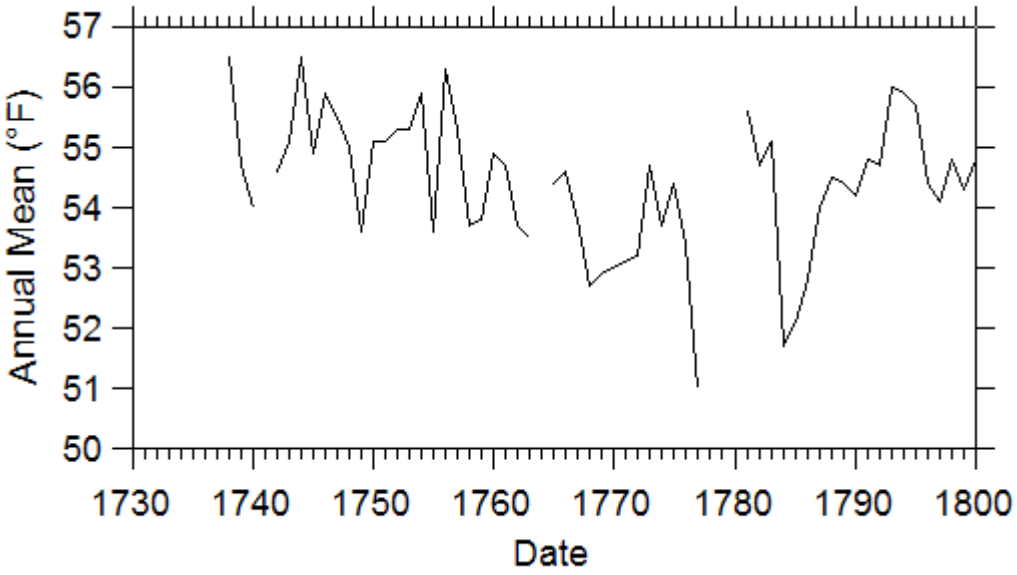

Figure 8. Reconstructed Annual Mean Temperature (°F) at Philadelphia from 1738 to 1800 (Source: Landsberg, Yu and Huang 1968).

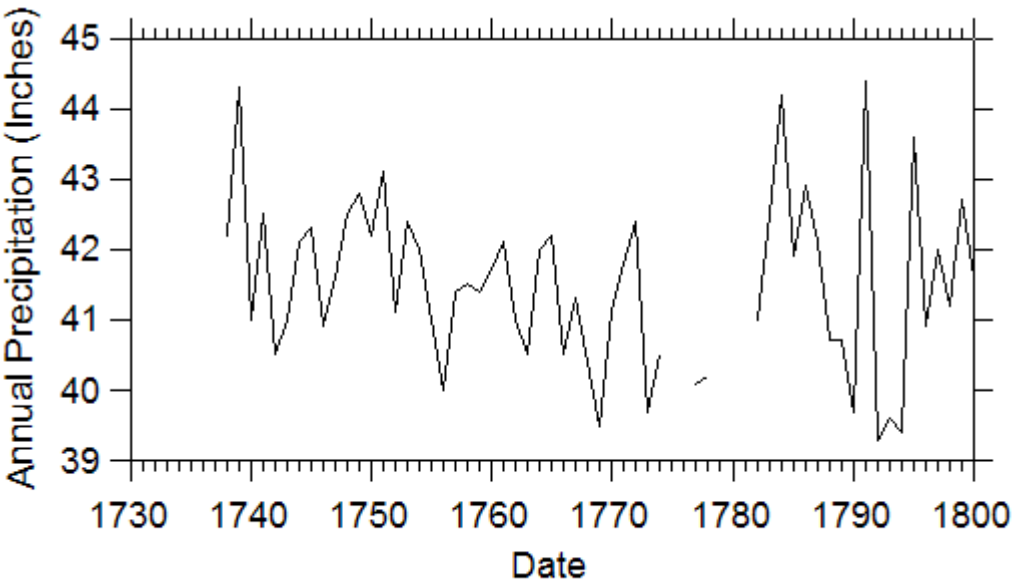

Figure 9. Reconstructed Annual Precipitation in Inches at Philadelphia from 1738 to 1800 (Source: Landsberg, Yu and Huang 1968).

1801a, 1801b). Precipitation data was estimated from Xanthus H. Goodnough's (1915) study of New England (:2-5, 13).

Landsberg, Yu and Huang (1968) included two warnings about their study. The firsts was that they felt the results should be regarded as provisional since it was likely that there was pertinent data which they had not consulted. Secondly, the time-series were reconstructed from multiple observations. As a result, the range of the data were driven toward an average producing "a regional rather than local picture of climatic conditions" (:5-8). The Philadelphia reconstruction has gained general acceptance (Lamb 1972:485, 577-579, 625-628; Thompson 1975:538-539; Baron 1992:77-81). Its proximity and completeness make it an excellent proxy for Chester County weather.

An unstated, but important point of consideration is that Landsberg, Yu and Huang (1968)'s reconstructions are based on relatively recent data spanning 1931-1960 (:6). The reconstructions accuracy is dependant on the degree that 18th century weather patterns were similar to those in the 20th century. A comparison of reconstructed and observed temperatures suggests that the reconstruction tends to underestimate actual variation and overestimate the observed values by 0.9 ºF (Figure 10). This error is likely to be the result of changes in the overall pattern of weather, for example the factors underlying global warming, but is also complicated by the number and accuracy of observations used to seed the model and the differences between regional and local climates. It should be noted that in Figure 10, Brooke's observations were aggregated with more distant data in the reconstruction, but because of their proximity they were also also used singly in the comparison with direct observations.

The precipitation data shows a similar trend toward accurately capturing the central trend, but underestimates the actual variation. In comparison with Peter Legaux's udometric

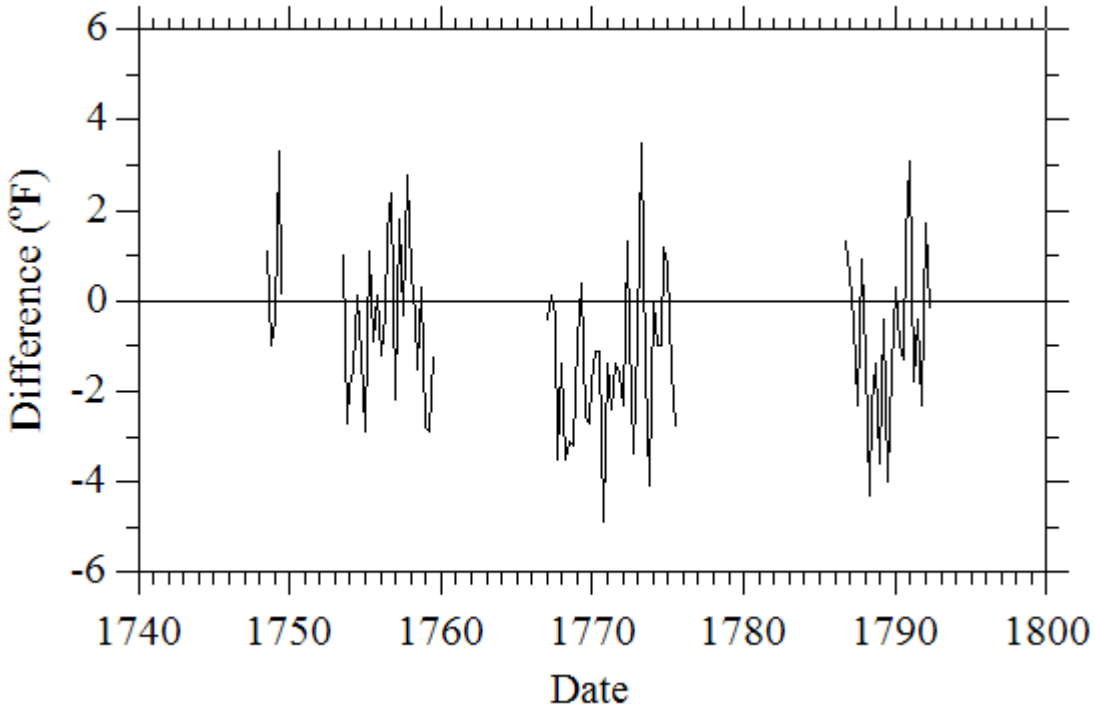

Figure 10. Variance of Observed from Reconstructed (Midline) Seasonal Temperatures (ºF) at Philadelphia, 1740-1800 (Benson 1934; Brooke and Baker 1760a, 1760b as interpreted by Landsberg, Yu and Huang 1968 and reduced to Philadelphia; APS 1839; Legaux 1787, 1788, 1789; Young 1790, 1791, 1792).

observations taken between the winter of 1786 and summer of 1789 Landsberg, Yu and Huang's (1968) estimations tend to embrace the central tendency and points to a disagreement concerning the precipitation in the fall of 1786 (Figure 11). The central trends of the data are similar, except for a significant disagreement in the quantity of precipitation in the winter of 1786. Legaux's observations of high precipitation are consistent with his observation of unusually persistent easterly winds which would have brought wet, oceanic air to the Philadelphia region as part of the Coastal Return and Warm Front Overrunning weather patterns (see Table 2). Legaux's observation that December was exceptionally wet is supported by diarists David Shultze of Montgomery County and Reverend Muhlenberg of Philadelphia County who each wrote of four snowfalls in that month. One storm lasted two days and a night and the resulting snow was described by them as "heavy" and "very deep" (Berky 1953:198-199; Tappert and Doberstein 1958 3:724-726).

The most likely cause for error in the reconstruction's estimation of precipitation is that it is based on a single geographic locality and therefore more heavily influenced by local variation. Despite a tendency to smooth extreme variation and an overestimation of temperatures, Landsberg, Yu and Huang's (1968) reconstruction captures the general trends and is therefore a reliable proxy for the climate of Chester County. The data set has some value as absolute values, but it is best utilized as a relative measure of the changing weather patterns. A fact that allows a test of the validity of the observations of contemporaries concerning the course of climate change in 18th century Pennsylvania.

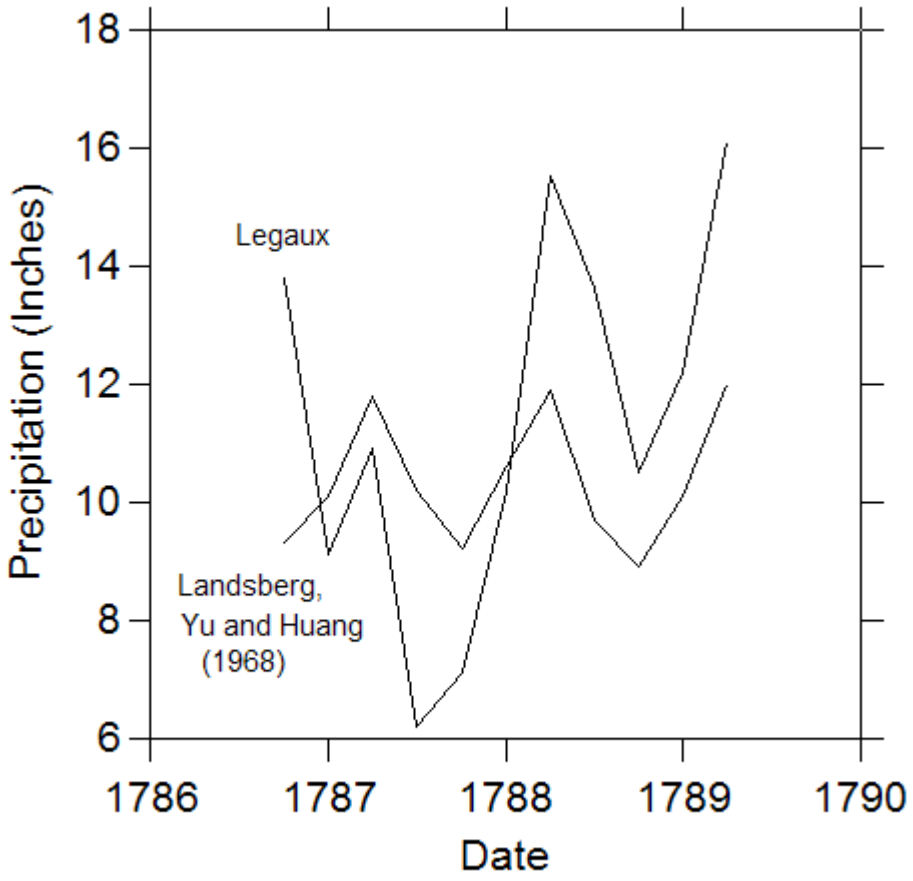

Figure 11. Comparison of Observed and Reconstructed Seasonal Precipitation in Inches at Philadelphia, Winter 1786-Summer 1789.

Climate Patterns in 18th Century Pennsylvania

Longtime residents of Philadelphia had observed that around 1740 there was significant shift toward late springs, dry summers, cooler autumns, and late winters (Table 5). Hazard's navigation data (see Figure 7) offers an opposing view indicating that before 1740, it was often the case that the Delaware did not clear of ice until late spring. Whereas after that date, the river was usually clear by late winter or early spring.

Table 5. Observed Climatic Shifts in Pennsylvania Before and After 1740.

	Before 1740	**After 1740**
Spring		
First warm temperatures	February	March or early April
Summer		
Uniformity	uniform	unpredictable
Severity	less severe	more severe
Precipitation	too wet	too dry
Autumn		
Temperature	warmer	cooler
Winter		
Delaware River froze	before December	before January
Uniformity	predictable	unpredictable
Severity	less severe	more severe

Landsberg, Yu and Huang's (1968) reconstructed seasonal temperatures and precipitation data doesn't begin until 1738. However, the reconstruction agrees with the contemporary perception that springs were increasingly cool after1740 (Table 6; Figure 12). In addition, the increasingly dry springs between 1740 and 1780 provides a likely explanation for both the lack of river ice and the slow appearance annual grasses (Figure 13). Some

Pennsylvanians had remarked that summer temperatures were less uniform and more severe than they had been in the early part of the century. Summer temperatures had not grown especially warm, but as contemporary observers and the reconstruction agree, they had become much drier. A condition which probably contributed to the season's perceived severity (Figures 14 and 15). Residents of the Delaware Valley had argued that autumns were cooler after 1740, a condition readily confirmed by the reconstruction. Winters remained cool after 1740, but they became drier which discouraged the early formation of river ice and kept river traffic open later than it once had (Figure 16). The available climatic data supports mid-century observer's assertions concerning both existence and direction of the change in weather.

Table 6. Trends in 18th Century Pennsylvania Climate.

	Before 1740	**1740 - 1760**	**1760 - 1780**	**1780 - 1800**
Spring	Warm & Wet	Cool & Dry	Cool & Dry	Warm & Dry
Summer	Warm & Wet	Warm & Wet	Warm & Dry	Warm & Dry
Autumn	Warm & Wet	Cool & Dry	Cool & Dry	Warm & Wet
Winter	Cool & Wet	Cool & Dry	Warm & Dry	Cool & Wet
Annual	Warm & Wet	Cool & Dry	Warm & Dry	Warm & Wet
Westerlies Path	Zonal	Meridional	Mean	Zonal

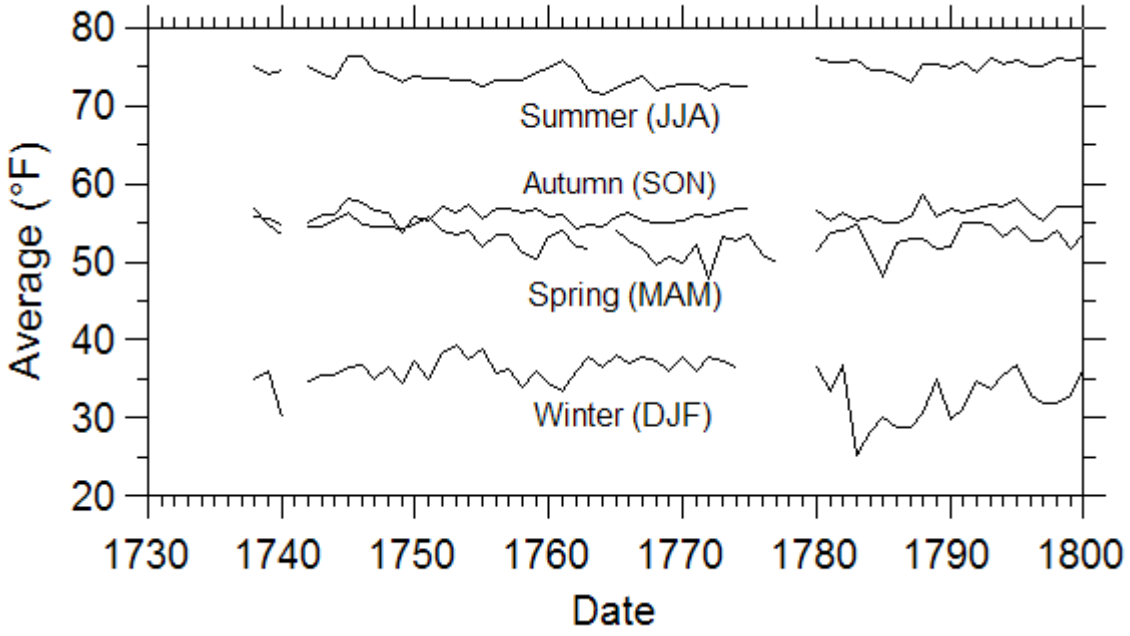

Figure 12. Reconstructed Seasonal Mean Temperatures (°F), 1738-1800 (Landsberg, Yu and Huang 1968).

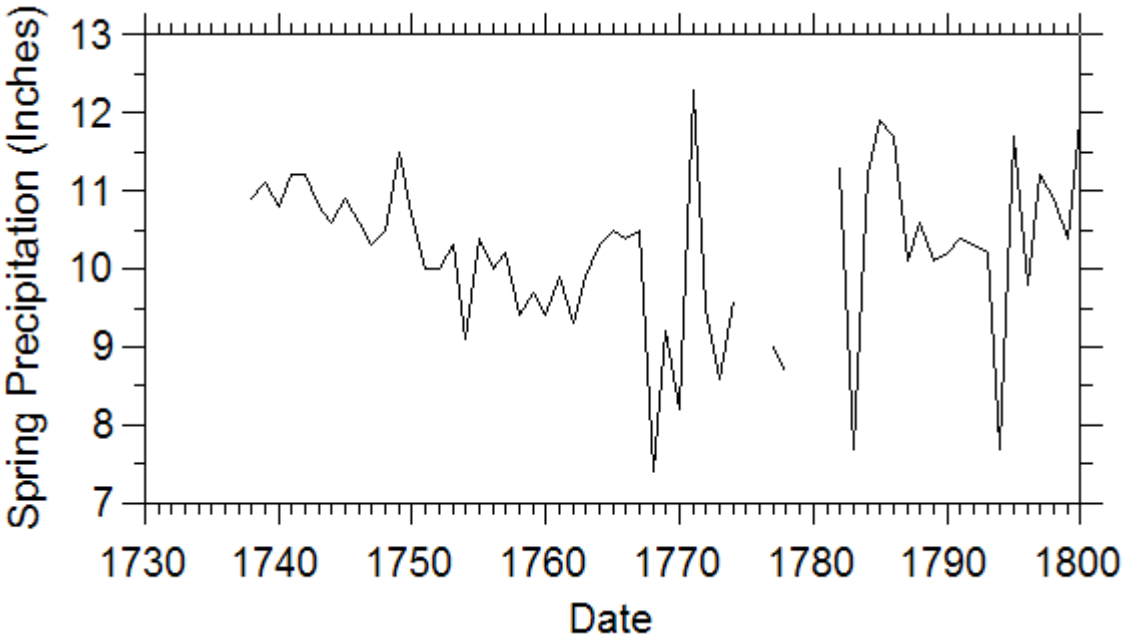

Figure 13. Reconstructed Spring Precipitation in Inches, 1738-1800 (Landsberg, Yu and Huang 1968).

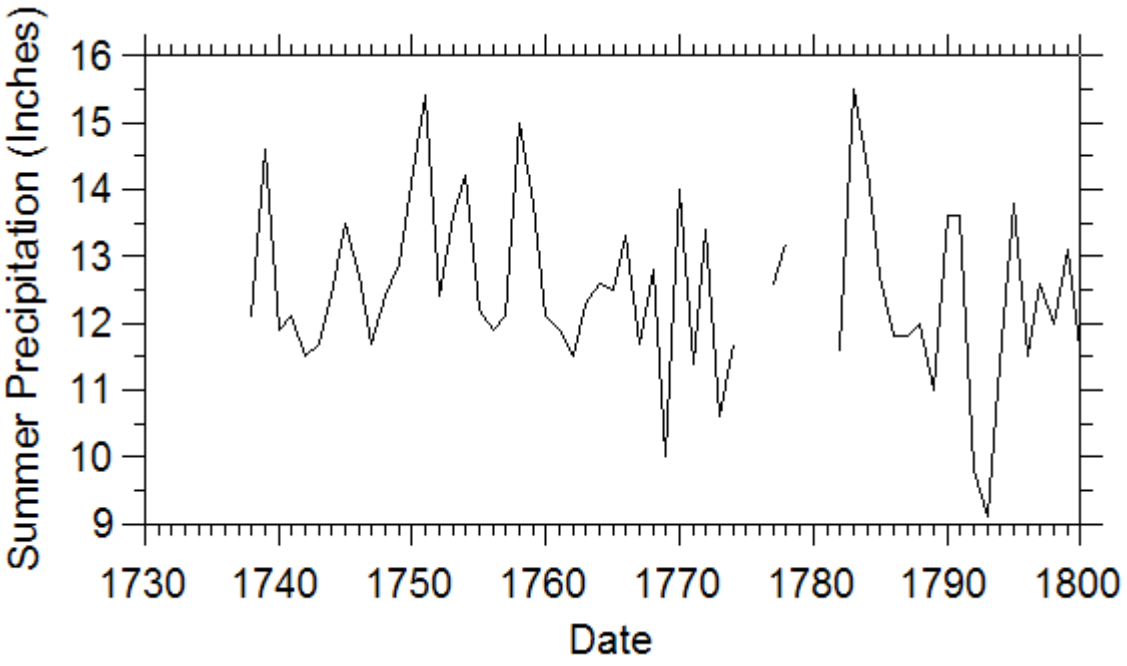

Figure 14. Reconstructed Summer Precipitation in Inches, 1738-1800 (Landsberg, Yu and Huang 1968).

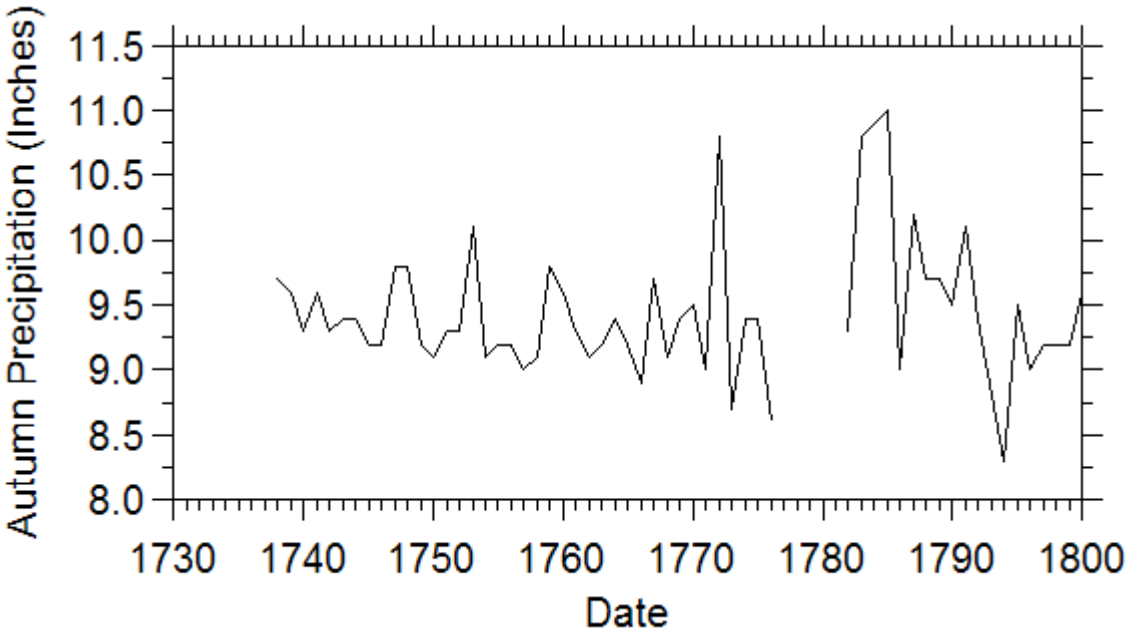

Figure 15. Reconstructed Autumn Precipitation in Inches, 1738-1800 (Source: Landsberg, Yu and Huang 1968).

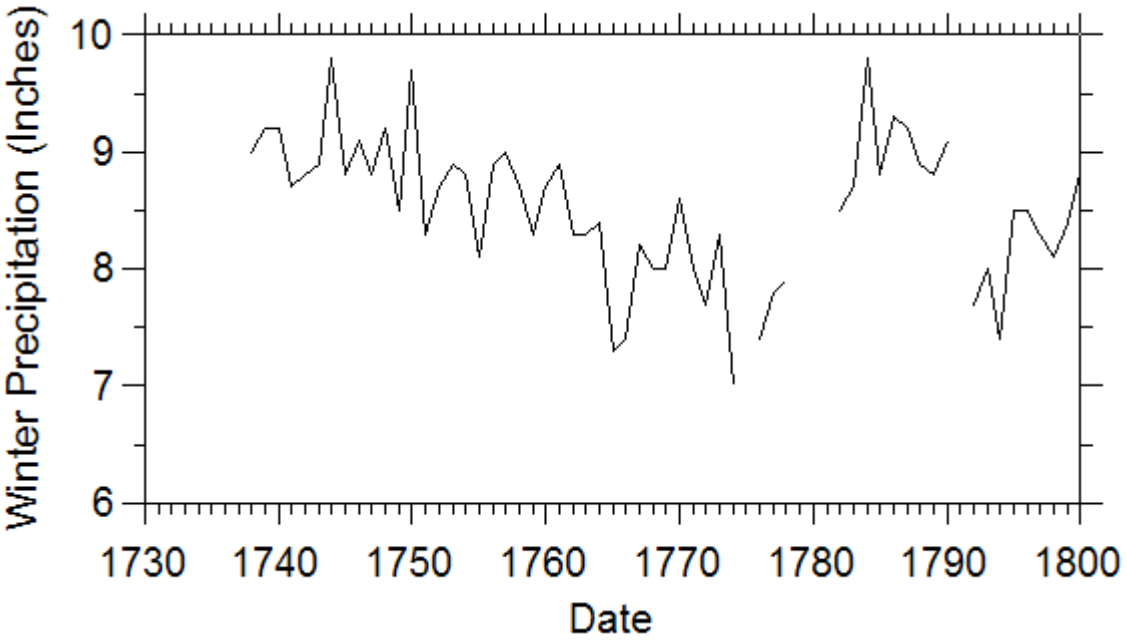

Figure 16. Reconstructed Winter Precipitation in Inches, 1738-1800 (Landsberg, Yu and Huang 1968).

As David Hackett Fisher (1980) has rightly warns, climatic periods should not be viewed as periods of static conditions, but as patterns formed by similar underlying processes (:824). Yarnal and Leathers (1988) have associated temperatures in Pennsylvania to the specific path of the mid-tropospheric westerlies (:638-639). The trends in Table 6 indicate that in the 1730s and early 1740s, the westerlies moved somewhat rapidly from a predominantly zonal (east-west) flow to a meridional (north-south) flow. Between 1760 and 1780 the polar winds followed a predominantly mean path which Delaware Valley residents found unpredictable and sometimes unexpectedly severe. In the last decades of the century the weather had returned to the warm weather typical of a zonal path. These changes are most likely linked to global scale phenomena such as variations in the Pacific/North American and North Atlantic Oscillations (Yarnal and Leathers 1988:638; McCabe 1990:17).

The results of these analyses suggest that contemporary observers were highly attuned to climate change and made accurate observations concerning the timing and direction of change. A difficult job considering the chaotic nature of weather in the Philadelphia region. The climate in Chester County was influenced by six prevailing local weather patterns, regional changes resulting from the fluctuations in the path of the polar front, as well as global scale phenomena which produced fundamental changes in the weather patterns. In order to be successful, Chester County yeomen had to find ways of ameliorating the worst effects of these changes.

CHAPTER 4

LANDSCAPE

Introduction

As the material aspect of human and environment relations, landscape is a persistent source of information about the past, and a unifying subject of study by historical ecologists (Crumley 1994:6). The goals of this chapter are to provide additional environmental context for the study of yeoman agriculture through an examination of land forms, agricultural potential, patterns of land occupation, historic political boundaries, and distribution of human settlement. These subjects will be explored using the methods of geomatics, the study of landscapes through the use spatially referenced data, typically those generated and manipulated through geographic information system (GIS) computer programs.

GIS data sets for Chester and Delaware County's modern topography, political boundaries, and soil characteristics were made available by the Pennsylvania State University's Office of Remote Sensing for Earth Resources (ORSES) through the Pennsylvania Spacial Data Access (PASDA) clearing house. The modern boundaries were modified to reflect early township boundaries, prime agricultural land, meadows, and changes in 18th century population. The GIS maps and analyses were generated using ESRI's ArcGIS version 8.3. The maps were rectified to the Pennsylvania State Plane Coordinate System, South Zone NAD 1983.

Chester County Topography

Prior to 1789, Chester County also included the current bounds of Delaware County which had the general shape of a parallelogram (Figure 17). Early Chester County was bound on the north and west by Berks and Lancaster Counties. Lancaster was formed out of Chester County in 1723 and the county contributed a tiny part to Berks County when it was formed in 1752. The residents of those regions weren't included in this study.

The historic county covered a little more than 600,000 acres (Kunkle 1963:1) and was bound on the east by the Schuylkill River which separated Chester County from Philadelphia County and Montgomery County after 1787. The Schuylkill flows into the Delaware River. The northern portion of the county was drained by the Pigeon, French, Valley and Perkiomen Creeks which flow into the Schuylkill River. A small portion of the southwestern edge of the country is in the watersheds of the Octoraro and Big Elk Creeks, tributaries of the Susquehanna River, which formed the western boundary of the county. The Susquehanna flows into the Chesapeake Bay. The majority of the county's creeks are direct tributaries of the Delaware River. These include the Brandywine, the largest and most centrally located of the county's stream valleys, and the Chester, Ridley, Crum and Darby Creeks which drained the southeastern portion of the county. The southern boundary of the county was formed by the Delaware River and the Mason-Dixon line which divided Pennsylvania from Maryland and Delaware.

Most of 18th century Chester County was located within the low rolling hills of the Triassic Lowlands of the Piedmont Province of the Appalachian Highlands. These 225 million year-old landscapes were composed of shale, sandstone, and limestone which had been eroded into relatively deep, silty and sometimes channery soils (Kunkle 1963:125). Channery soils are

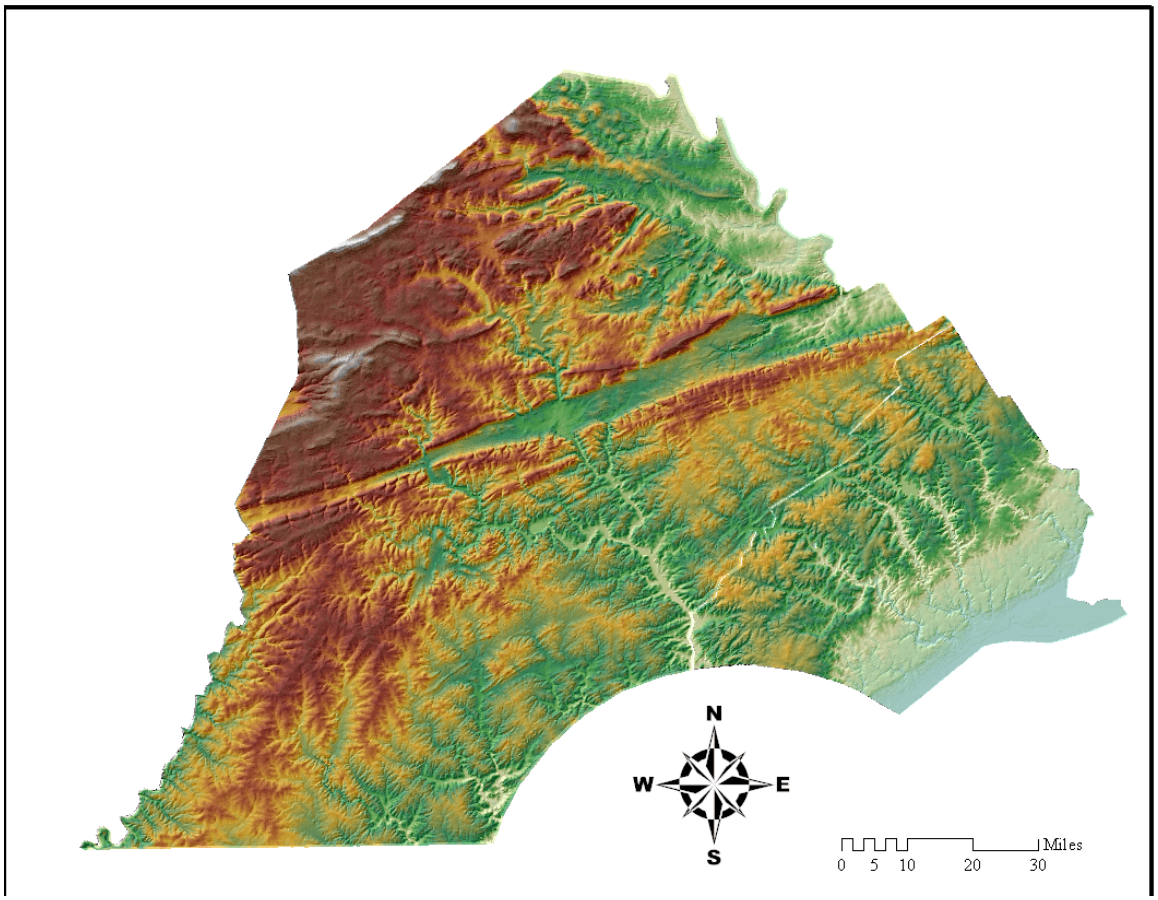

Figure 17. Topography of 18th Century Chester County, Pennsylvania (Source: National Elevation Data for Chester and Delaware Counties, U.S. Geologic Survey 1999; *N.B.* colors represent relative elevation and not ground cover).

those which contain hand-sized fragments of decomposing rock and are typically found in conditions were underlying beds of less durable materials have eroded into soil. The southeastern portion of the county is part of the Atlantic Coastal Plain and is composed of broad plains of Delaware River sediment. The county is bilaterally divided by the Chester Valley, a one to two mile-wide geologic fault underlain by limestone (Kunkle 1963:114). By virtue of its flat bottom and limited bisection by streams, the Chester Valley has formed an important conduit for colonists and merchants goods moving from Philadelphia to the southern colonies.

Chester County Soils

Chester County was composed of soils that were typically silty, well-drained and ably suited to agriculture. Prime agricultural soils, those belonging to the National Conservation Service's Soil Survey Geographic (SSURGO) Data Base Non-irrigated Capability Class 1 and 2, are spread relatively evenly across the county (Figure 18). The southeastern portion of the county is noticeably lacking prime agricultural soils, but in the 18th century that area had the same high-quality soil as the rest of the county. By the time that the original soil surveys in the late 1950s and early 1960s, the southeastern portion of the county had already become urbanized. That southeastern portion of the county was the first chosen for settlement by Native Americans and 17th century colonists who found that region well-suited to agriculture.

Irrigation was not commonly employed on crop lands in 18th century Pennsylvania, so consideration of hydrological data is not necessary. However, natural meadows were critical resource for the maintenance of livestock. The distribution of hydric soils approximates meadow land which was readily available throughout the county (Figure 19). The pattern of

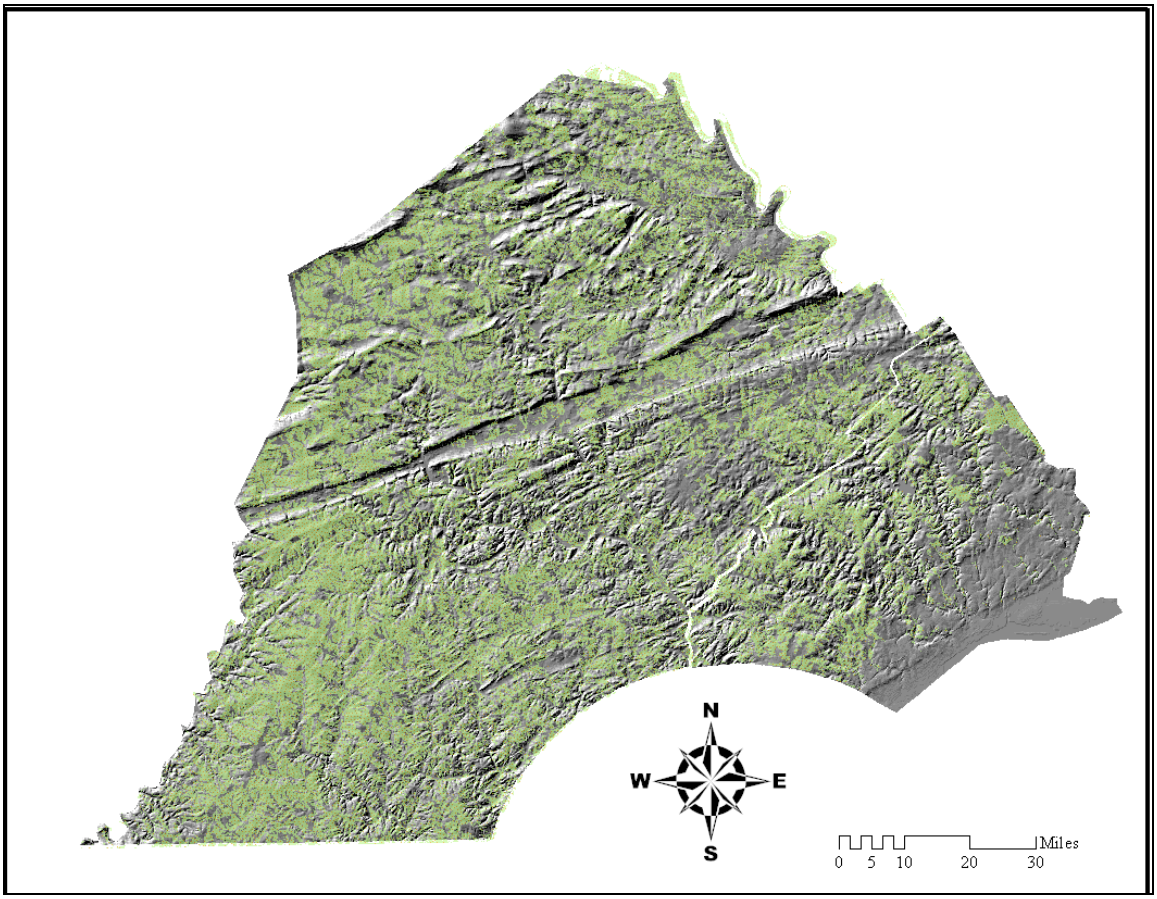

Figure 18. Prime Agricultural Soils in 18th Century Chester County, Pennsylvania (Non-irrigated Capability Class 1 or 2; Soil Survey Geographic Database of the U.S. Dept. of Agriculture, Natural Resources Conservation Service 1997; National Elevation Data Set for Chester and Delaware Counties, U.S. Geologic Survey 1999).

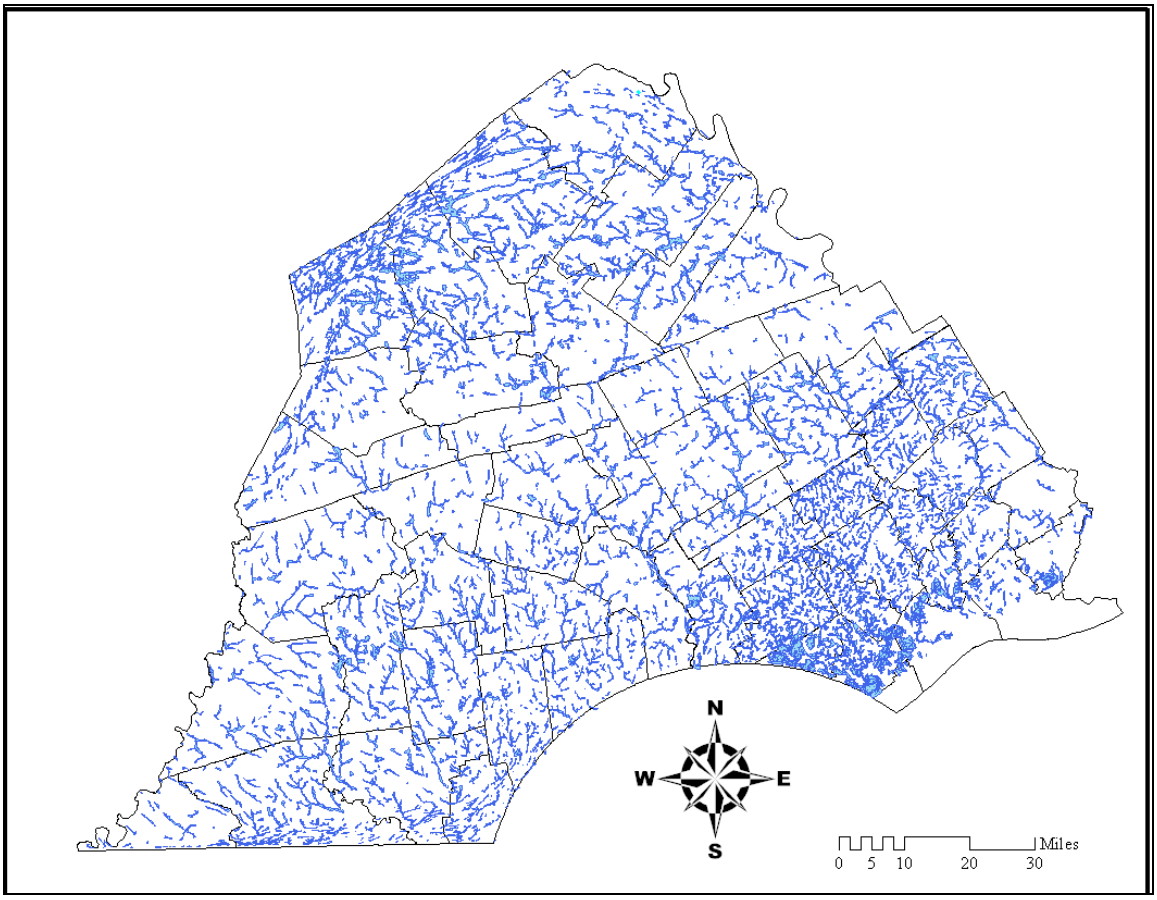

Figure 19. Natural Meadows and Township Boundaries in 1790 Chester County, Pennsylvania Hydric Soils; Soil Survey Geographic Database of the U.S. Dept. of Agriculture, Natural Resources Conservation Service 1997).

hydric soils in the southeastern corner of the county has been greatly affected by urban development, but in the 18th century it contained the best grazing lands.

Native American Ecologies

When European colonists arrived in southeastern Pennsylvania they found thin, old-growth forests and Native American agricultural fields. Local Native Americans had used regular controlled burns to clear the ground cover. In December of 1632, David DeVries was still a day out from the mouth of the Delaware River when he smelled the smoke of fires that Native Americans had set to prepare the land for winter hunting (Myers 1912:15). As a result the repeated burnings, Chester County had a park-like appearance of large, widely spaced trees with little undergrowth. One longtime county resident commented that in his youth he "could have driven a horse and cart from one end of its [the county's] extremities to the other, in almost every direction, without meeting with any material obstruction" (Watson 1860 2:80-81). Niles Gustafson who resided on the east side of the Delaware River and was born around 1658 told Peter Kalm that in his youth "there was a fine space between the trees, so that one could ride on horseback without inconvenience in the woods, and even with a cart in most places" (Benson 1937:265).

The thin woods were broken in a few locations by clearings created by Algonkian-speaking Lenape who cleared fields by girding trees. Thomas Paschall wrote in 1683 that he knew several men who found clearings as large as a 100 acres (Myers 1912:254). However, a survey of Native American agricultural villages mentioned in early documents indicates that they were few in number (Cotter, Robert and Parrington 1992:18). There has been only a little paleo-botanical material recovered from excavations at these settlements. An early 17th

century site in nearby Lancaster County contained remnants of pumpkin and squash, but Indian corn (maize) has remained elusive (Custer 1996:310-312). John Bartram was probably the source of Peter Kalm's observation that local Native Americans grew Indian corn, pumpkins, squashes, gourds and several varieties of beans, some of which were European in origin (Benson 1937:74-75). Since Bartram was a renowned traveler and visited with Native Americans up and down the east coast, his observations may not be specific to Pennsylvania. Nevertheless, these crops fit the general pattern for Lenape agriculture in the century prior to European colonization (Kraft 1986:138-143).

A common method of cultivation prior to British colonization was to clear several acres by burning off the groundcover and hilling the topsoil. Indian corn (*Zea mays*) was planted at the center of each mound. Pumpkins, squashes and beans were sown along the sides of the mounds (Bidwell and Falconer 1925:11; Kraft 1986:138-143). The sloped surface of the mound kept the pumpkins and squashes well-drained and the beans climbed the stalk of the maize. Indian corn had been raised throughout the Americas for thousands of years, but it appears to have been adopted very late and grown only little in southeastern Pennsylvania. Jay F. Custer (1996) has argued that the region's relatively rich wild resources made more intensive production unnecessary (:297-300). As a result it may be that local Native Americans were practicing a large garden horticulture, rather than producing surpluses of maize for trade.

Swedish and Finnish Ecologies

The Native American ecology was embraced by Swedish and Finnish settlers who settled in the southeastern corner of the county in the mid–17th century. Many of the New

Sweden settlers were *"slavarna*," people forcefully indentured for small and large crimes (Aberg 1988:137). Among the settlers were Finnish speaking people who were forcefully ejected because their traditional "Swidden" or slash-and-burn horticulture had encroached on forested estates of noblemen. The founders of the New Sweden colony aspired to challenge the English monopoly on tobacco. However, a lack of technical skill and shifting political control of the region to the Netherlands, and then the British, meant that these plans never came to fruition (Weslager 1987:36-37, 1988:68-75; *c.f.* Jordon and Kaups 1989).

The New Sweden colonists quickly formed close social relationships with Native Americans. A descendant explained to Peter Kalm that:

> ...since they had no other people to associate with than native Indians, they soon began to differ more and more in their actions and manners from the Europeans and old Swedes and began to resemble the Indians. At the arrival of the English, therefore, the Swedes to a large extent were not much better than savages (Benson 1937:710-711).

As a result of their low numbers, pre-adaptation to slash-and-burn horticulture, and a willingness to adopt local practices, the 17th settlers made few changes to the landscape. Among the most significant ecological impact was the introduction of Old World domesticated grains, vegetables, and animals.

Nils Gustafson reported that settlers had brought with them European staples such as wheat, rye, barley, buckwheat, oats and winter cabbage (kale), carrots and turnips. They planted European flax and raised sheep for clothing. They had horses, cows, hogs and oxen and planted apples, cherries and peach trees. Swedes traded bread for rope made from a North American variety of hemp which proved stronger than its European counterpart. The Swedes and Finns adopted the local method of hilling soil to grow Indian corn, but modified the practice by planting rye between the mounds (Benson 1937:89, 266-269, 277-278). The early

residents of the Delaware Valley had most of the crops, livestock and tools of European market-oriented agriculture. However, their overall approach was rooted in the practices of slash-and-burn horticulture which made use of inter-cropping, shifting plots, and strategies focused on self-sustainment.

British Settlement

By the beginning of the 18th century, William Penn's agents had recruited sufficient settlers that they soon outnumbered the local inhabitants. Despite their greater numbers the new arrivals were less prepared than the New Sweden colonists. In a translated letter to his kinsmen in Bala, Merionethshire County (present Gwynedd County) Wales, the son of Thomas John Evans recounts his father's arrival to Pennsylvania in 1682 (Myers 1912). Evans' crossing was difficult. As his ship approached the Delaware Bay, a summer storm tore the sails and damaged the rudder and they had to endure a lengthy refit at Barbados. The wait had depleted most of their stores and the passengers arrived hungry.

Pennsylvania appeared to Evans to consist of nothing but wild woods and there was not a soul present to welcome the new arrivals. In the face of limited supplies, Evans set off to find food and shelter. As he walked, he daydreamed of milk and felt deep regret at having left Wales. The suddenly Evans came upon an old Swedish man standing in the path. They hadn't a language in common, and communication was somewhat hindered by the fact that the old man was quite drunk. Nevertheless, Evans was convinced to follow the man home where he was warmly welcomed by the man's wife and sons. The arrangement must have been a happy one. Evans spent the next three years with the family until he married a Welsh widow and established his own plantation (:451-459).

In the way that Swedes and Finns had learned from Native Americans, the British were similarly schooled in the local ecological practices by earlier settlers. Although, they emigrated from societies who grew many of the same crops, many immigrants came from urban areas or had very different traditional practices. For example, when Evans left Merionethshire County in the late 18th century, most yeomen and husbandmen focused on livestock to the extent that half of them grew no grain at all (Levy 1988:126, 298). In Pennsylvania, grains would become the important crop and livestock would be left to fend for themselves in the woods. Arguably, Thomas John Evans' experiences were that of just one person. However, his story presents an apt metaphor for the way in which hosting was the process by which the traditional ecology was communicated to newcomers. The pattern would persist throughout the century as bound laborers from Africa, Caribbean Islands, Ulster, and the German Palatine would become intimate with the Pennsylvania ecology during their service as slaves, servants and laborers.

Colonists were very resistant to external intervention in their practices of production. A number of governmental bodies had tried unsuccessfully to keep colonists from seasonally setting fires to clear leaves and underbrush. A 1676 law set down by the Duke of York held those whose fires escaped control were financially responsible for any damaged crops. William Penn later ordered that one in every five acres of woods should be left unburnt. The Pennsylvania Provincial Council passed a 1700 law which restricted burning to January and February, and a 1727 amendment required prior notice to everyone within a mile. In 1735, the Council barred the practice entirely (Fletcher 1950:3-4). Theses laws had little success. During his visit in 1749, Peter Kalm found that colonists widely ignored the laws against burning. He found that the woods were still sufficiently clear of underbrush that he could ride

a horse "even with a cart in most places" much like the Swedish colonists had nearly in the previous century (Benson 1937:265, 279-280).

Chester County Population

There were no colonial censuses, but historians have approximated population levels from county tax assessments (Futhey and Cope 1888:434; Lemon and Nash 1968:11; Simler 1986:549; Clemens and Simler 1988:115; Marietta 1995:536). Over the course of the 18th century the population of Chester County grew ten-fold from approximately 500 households in 1700 to 5000 households in 1800 (Figure 20). With the growth of population came subdivision and realignment of townships such that they numbered more than 50 by the end of the century (Figure 21).

Duane Eugene Ball's (1973) review of the reproductive histories of 180 Chester County women suggests that procreation was a significant influence on the county's population. Prior to 1730, women who reached their 40th year had an average of nine surviving children. His data indicates that fecundity dropped throughout the century, but remained relatively high. In 1790 the average was 6.6 offspring (:73). These statistics come with some qualifiers. Ball's estimates were drawn from Cope and Ashmead's (1904) genealogical data. Since the likelihood of inclusion in the sample is a function of the numbers of offspring who reached social prominence, it is likely that these values are skewed toward the most fecund women. However as the author notes, his estimates are in keeping with those for other contemporary English colonies (:75). Adrienne D. Hood (1996) has asked the same question of 1783 tax lists for five Chester County Townships. Her survey indicates that relatives and white servants averaged about 6.1 persons per household (:49).

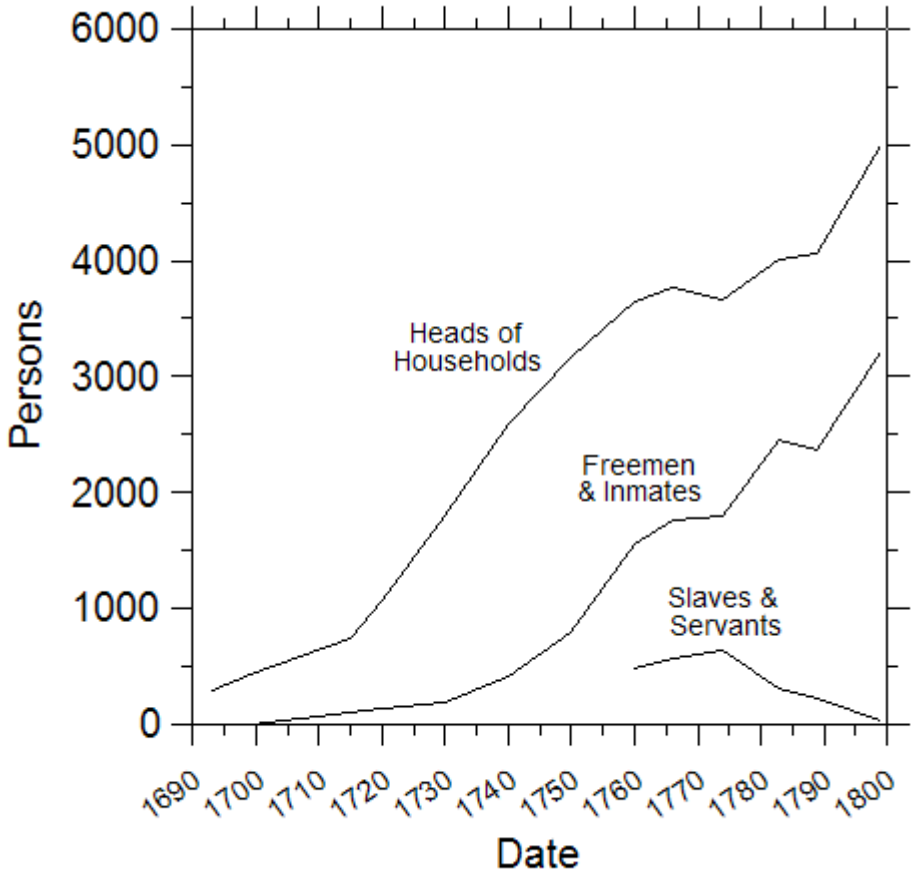

Figure 20. Chester County Population, 1690-1800 (Freemen are unmarried males, inmates are adult males in another's household; Sources: Futhey and Cope 1888:434; Lemon 1968:549; Clemens and Simler 1988:115; Marietta 1995:536).

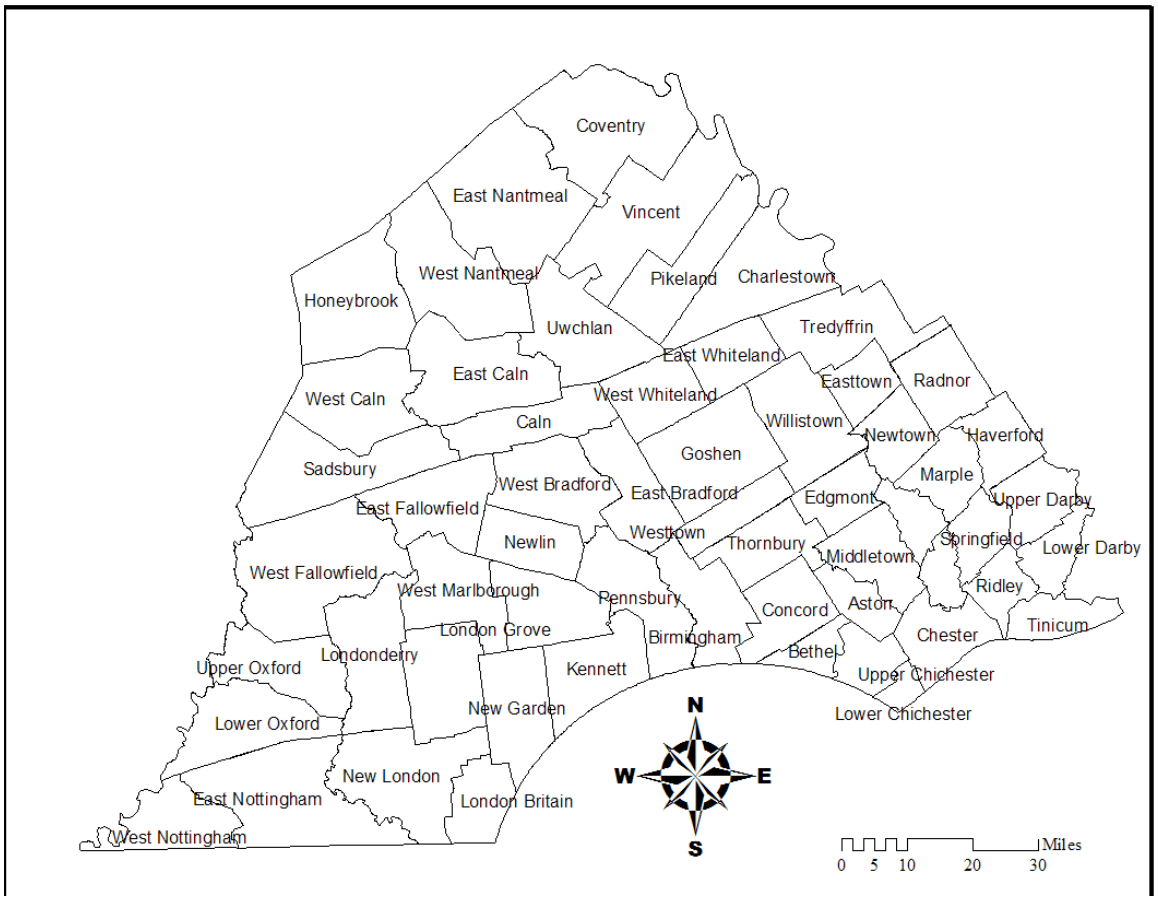

Figure 21. Chester County Townships in 1800.

Ball and Hood's estimates suggest that internal growth was more than sufficient to account for increasing population. However, Chester County was also a way-station from which pioneers launched forays to the south and west. Lemon (1972) estimates that each decade approximately 30-percent of late 18th century taxpayers moved onto other regions (:73-77). The tide of out-migration did not carry away all the new residents. As Sharon V. Salinger (1987) has noted, freed servants who served in Chester County tended to remain in the county, whereas those who served elsewhere were inclined to leave (:33-34).

During the early part of the century, settlement was most dense in the southern portion of the county (Figure 22). However, by 1750 settlers had distributed themselves evenly across the county (Figures 23 and 24). Concurrent with an increase in the number of households was a fall in the size of individual land holdings. Lemon (1972:88-89) and Ball's (1973:123) analyses of Chester County tax lists reveals that the large, 500 acre holdings of the 17th century were subdivided to 245 acres by the end of the first decade of the 18th century. Yeomen continued to subdivide their holdings throughout the century until an average plantation in 1764 was about 140 acres, and then about 125 acres between 1782 and 1791. Lemon (1972) has argued that under-reporting in 1760 tax assessments suggests that a third of the county remained unclaimed (:65). However, estimated number of heads of households and average land holding indicates that by the 1760s the county was already fully taken up and the only growth in households was at the cost of continued subdivision.

British rule had transformed Chester County's homogenous old-growth woods into a patchwork of agricultural fields, meadows and wood lots. The evenly distribution of high-quality soils and prevalence of meadowlands indicates that there should be few differences in agricultural practices between different townships. However, the greater density of hydric

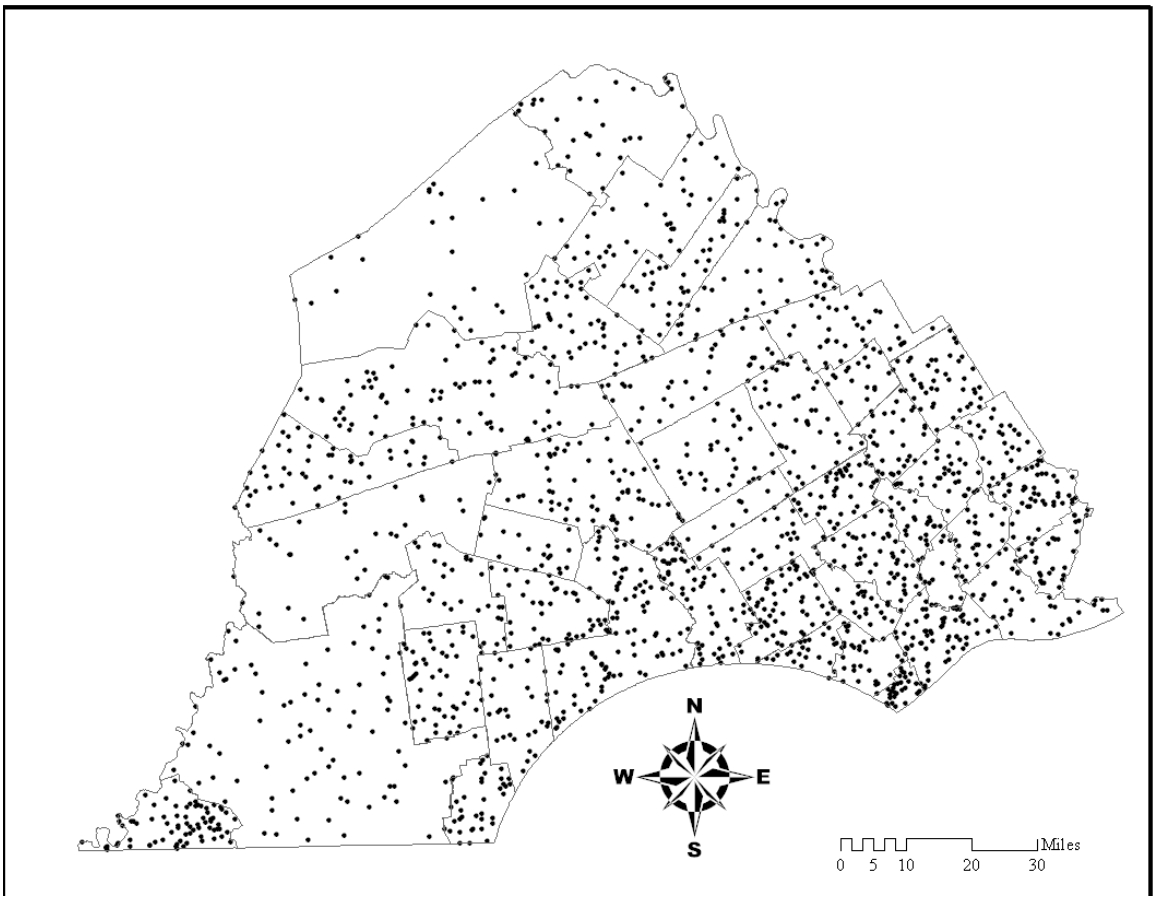

Figure 22. Distribution of Chester County Households by Township in 1730 (Sources: Futhey and Cope 1881:434; Simler 1986:549; Marietta 1995:536).

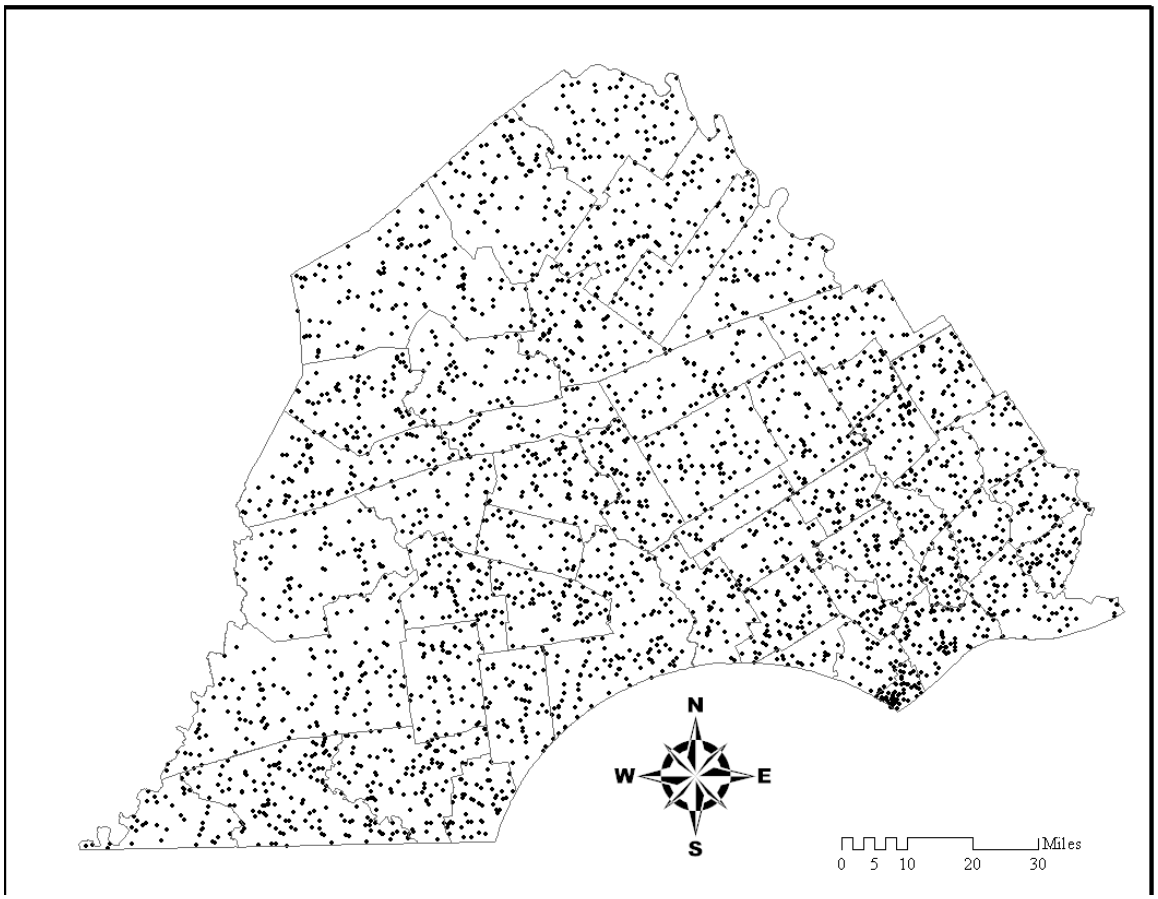

Figure 23. Distribution of Chester County Households by Township in 1750 (Sources: Futhey and Cope 1881:434; Simler 1986:549; Marietta 1995:536).

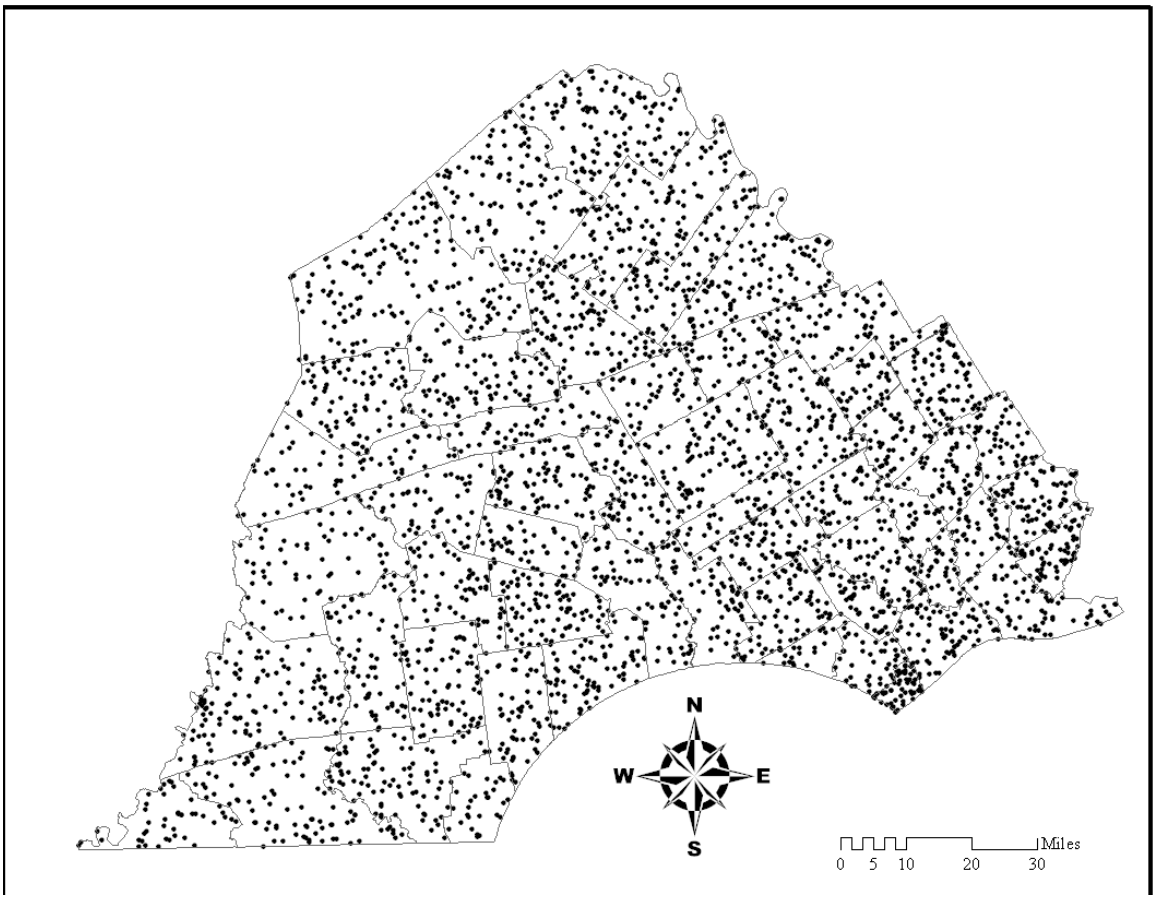

Figure 24. Distribution of Chester County Households by Township in 1780 (Sources: Futhey and Cope 1881:434; Lemon 1968:11; Marietta 1995:536).

soils in the Atlantic Coastal Plains of the southeastern corner of count may have encouraged the keeping of a greater numbers of livestock in that region. Models of the progress of settlement indicate that prior to 1750 there was a decreasing geographic bias toward the southeastern corner of the county. By 1760 the county had been largely taken up and required that any new plantations had to be formed by the subdivision of existing ones.

CHAPTER 5

INVENTORIES

The Construction of Probate Inventories

A critical data set for understanding British colonial production are the tools, crops, livestock, and bound laborers contained in inventories of the estates of deceased persons. These documents have deep roots, but they were not common until the rise of the yeoman class. The managers of production on British manors had authored annual accounts since the 13th century, but it wasn't until the 16th century that probate records were mandated for individual householders. As the middle class grew in size and wealth, British ecclesiastical courts mandated a probate process in order to preserve familial harmony during the distribution of estates. As the poorest and most vulnerable of the landed classes, yeomen also benefitted from the protections provided by a process carried out in open court and responsive to the pleas of legal claimants.

The keeping of probate records arose in other parts of Europe and colonization carried the practice to other places. Van Der Woude and Schuurman (1980)'s edited volume collected the work of researchers using similar records from Sweden and Finland, Netherlands, Germany, France and Crete. Since then, historians have begun work with similar documents authored in Costa Rica (Gudmundson 1989), Syria (Establet and Pascual 1992), Brazil (Barickman 1994, 1996; Frank 2001), Algeria (Shuval 2000), Jamaica (Burnard 2001),

and Australia (Shanahan 2001). As a common document with a broad geographic distribution, the development of new perspectives and methods provides continuing rewards.

The keeping of probate inventories in Britain's American colonies emerged out of the practices of England and Wales. The exact practices varied from colony to colony (Jones 1980a) in much the same was as British practices differed by diocese (Arkell 2000:4-5), but they all were similar grounded in English law. As Jeff and Nancy Cox (2000) have explained, British inheritance laws rest on Anglo-Saxon precedents which directed that a widow inherited one-third of the estate, another third was divided equally among the offspring, and the remainder was subject to the will of the deceased. This framework was adopted by the Norman authors of canon law who added the provision that unless amended by will, two-thirds of the estate was to be divided among the children (:19-23). The doctrine of the widow's third persisted throughout the 18th century, but it was common for Chester County husbands to bequeath their wives portions of the estate above her traditional share (Wilson Waciega 1987:45-46, Wilson 1992).

British estate law made a distinction between "real" and "personal" property. Real estate is composed of land and its improvements such as buildings, fences and orchards. Personal estate included things like clothing, weapons, horses, servants, cash and credits to which the deceased had exclusive use, but also to nearly all the contents of the house and barns. As a general rule, only clothing, some slaves and servants and small personal items were not property of the household.

As Tom Arkell (2000) clarifies, real and personal properties were split by Roman canon law which placed personal estates under the authority of ecclesiastical courts who oversaw non-criminal morality. Inheritance of real estate was governed by local, manorial

courts which, among other things, oversaw the often byzantine systems of customary land rights (:3-7). Although the estates of Americans were administered by secular magistrates, the legal segregation of moveable and real estates persisted in most places. An exception was in New Englanders where real and personal property were subject to a single probate process (Jones 1980b:242). Perhaps due to confusion over the prevailing practice, one in five Chester County inventories included a valuation for real estate. The land appraisals were not included in the total estate values reported in this volume.

The probate records for Chester County were recently reorganized, indexed, and microfilmed by the Chester County Archives and the Pennsylvania Historical Museum Commission (2000, Record Group 47). The reels include photostatic images of 4070 probate records beginning with the establishment of a county register of wills in 1713 and the formation of Delaware County from the southeastern corner of the county in 1789. The latter date is an appropriate endpoint since it coincides with the popularity of agricultural revolution techniques into the region and the passing of the yeoman class.

Of the 4070 probate records, 3551 contained inventories which were more than 90-percent complete and legible, and represented a household within the bounds of the county as it existed after Lancaster County was formed in 1729 and Berks County in 1752. Sampled probates represented 87-percent of the 4070 probate records on file for this period (Chester County Wills and Administrations 1 to 4070, hereafter CC W&A). If a typical Chester County household included seven persons, then this study includes the goods and chattel of about 25,000 people. The information in probates inventories were recorded and manipulated using dataBased Intelligence's Visual dBase version 5.7.

Chronologically, the first probate document was often a will and codicils. In the will the decedent typically named an executor or executors and directed them in the distribution of the estate *(c.f.* McCarthy, Rofini and Weir 1987). In cases where there is some doubt concerning the document's authenticity, an affidavit may be filed containing statements by witnesses to the signing of the will or people familiar with the deceased's handwriting. Executors were not obligated to serve, and often a particularly aggrieved widow renounced her position. Her replacement may be someone of her choice or picked by a local magistrate. If the deceased passed intestate, which is to say without a will, an administrator was assigned by a magistrate. Most administrators filed a bond guaranteeing their dutiful and honest handling of the estate. Sometimes the executor, but usually the local magistrate, solicited two or more appraisers to inventory the value of the deceased's personal estate.

Alice Hanson Jones (1980b) found that in many American colonies it was common to appoint appraisers who were relatives, family friends, or creditors (:242). The process was much more formal in Chester County, and like Jones found in Maryland, appraisers were bonded persons without a close interest in the estate. In many cases, the magistrates chose men for their expertise in the deceased's trade. Individually, the names of most appraisers appear on just a few inventories. Those cases where names appear on as many as a dozen inventories, they are inevitably the signatures of several different men of the same name. An accurate count of Chester County appraisers is hampered by such homonymic persons and an illegibility of some signatures. However, a rough count suggests that the sampled inventories were carried out by more than a thousand different men who were preforming a form of short-term, socially obligatory service. As a result, it would have been very difficult to perpetrate

any kind of widespread fraud, and in the aggregate the appraisers estimates have a high degree of reliability.

The final probate document was an executor or administrator's account of the dispersal of the estate which usually included a review of charges related to the funeral, household maintenance, and debt collection, and distributions. These final accounts often mentioned portions of the estate which had been overlooked or improperly listed by appraisers. Those corrections were also applied to the sample.

Most inventories were valued in terms of specie or "hard currency" which was tied to the value of Pennsylvania currency in relation to the values of other coinage. An exception was a brief period between 1779 and 1782, when some patriotic appraisers used Continental currency. However, as Continentals failed, appraisers returned to the traditional method. Administrators commonly did the conversion in their final account.

The primary focus of this study is ecological, rather than economic. Nevertheless, a basic understanding of personal finance is necessary in order to understand the ways in which goods and chattel were valued and exchanged. For detailed examinations of the larger colonial economy, a curious reader should begin with John J. McCusker's (1978) *Money and Exchange in Europe and America, 1600-1775*, John J. McCusker and Russell R. Menard's (1985) *The Economy of British America 1607-1789,* Mary M. Schweitzer's (1987) *Custom and Contract,* and David George Rappaport's (1996) *Stability and Change in Revolutionary Pennsylvania: Banking, Politics and Social Structure.*

Coinage was chronically in short supply in the American colonies and colonists made due with the currency of a variety of nations. For example, the estate of William Evans Esq. of Vincent Township included English guineas, half-crowns and shillings, as well as, Spanish

milled dollars, French Crowns and Portuguese "half Johanneses"(CC W&A 3489). The values of items in account books and estate inventories were tied to the exchange rates which were established by the government, and then mediated by a desire for the surety of precious metal. Softer currency took the form of bills printed by colonial, state and eventually federal government. Pennsylvania first printed paper money in 1723 and their value was tied to the weight of a silver Spanish dollar at the rate of $1 to 6 shillings (s.). In 1742 the Spanish dollar was revalued at 7.5s. (McCusker 1978:176-177). It was common for inventories to include small quantities of colonial and the "state" money printed after American Independence.

A third form of currency was the short-lived Continental currency which was purchased by patriots and optimists who tied their household fortunes to that of the new nation. The money's value was a reflection of the perceived outcome of the war, which in many ways had a surprise finish. Some carefully calculated rates of deprecation were published in a Philadelphia newspaper (*Pennsylvania Gazette* 3:28190; Berky 1953:121), but the authors of probate inventories and estate accounts had already begun to apply commonly accepted rates of discount to debts in Continental money.

The real world depreciation tended to run ahead of the official rates. From an initial value of $2.67 Continental to 1£ hard money in September 1, 1777, appraisers devalued Continental money to $4 in June of 1778, $5 in September and $6 in December of that year (CC W&A 3130, 3135, 3146, 3137, 3147, 3166, 3178, 3434). By July of the next year the value of 1£ had fallen to $14 and continued to decline to $20 in August, $24 in September, $38.50 in November, and $41.50 by the end of the year (CC W&A 3218, 3219, 3224, 3231, 3232, 3233). The value of Continental money held steady at $60 from December 1779 to November of 1780 and some accepted as much as $40 if the trade was for tangible goods (CC

W&A 3251, 3257, 3258, 3263, 3271, 3283, 3285, 3330, 3359). Speculators like "Old Dankel" of northern Philadelphia County who purchased $300 Continental for 4£ hard currency (Berky 1953:135) were soon disappointed. The all time low price of $75 in December of 1780 dropped again to $100 in March of 1781. By September of 1781 the value of Continentals plummeted to $64:1s. or $1280 per 1£ and was soon after acknowledged as completely worthless (CC W&A 3364, 3419, 3422, 3468, 3566). Those inventories valued in Continental money were converted to hard money using internal evidence, or the prevailing exchange rate in contemporary probates.

New Uses for Old Records

Probate records have been a long favored resource for historians. Mark Overton's (1980) bibliography of studies using British probates numbered in the hundreds. These studies have only grown in the intervening quarter century. The American research is equally numerous and has been used to examine political change (J. Main 1965, 1983, 1985; G. Nash 1976, 1979), capital formation (Jones 1972, 1980a, 1980b 1982, 1984; Mohanty 1987; Schweitzer 1987; Rosenberg 1992; Walsh 1999), wealth inequality (Lemon and Nash 1968; Menard, Harris and Carr 1974; G. Main 1975, 1977, 1982, 1994; Warden 1976; Shammas 1977, 1978 ; Smith 1984; Ward 1987; Wilson Waciega 1987, 1992; Carr and Menard 1999), consumption (Land 1967; Schiffer 1974; Schoelwer 1979; G. Main 1983, 1987, 1988; Walsh 1983; McMahon 1985; Trautman 1987; Perkins 1991; Shackel 1993), architecture (Candee 1987; Herman 1987; Benes 1987) and literacy (Tully 1972; Beales 1987). This list is far from exhaustive.

The present study uses probate records as a source for an examination of production. The approach isn't new, but it hasn't been common. Winifred Barr Rothenberg (1992) used probate records to estimate the availability of personal loans, but argued that inventories were insufficiently complete to discern production data (:59-61, 115). Susan M. Ouelette (1996) used Massachusetts inventories to inform her analysis of wool production. James T. Lemon's (1972) *The Best Poor Man's Country* used samples of Chester and Lancaster County inventories to construct an idealized model of an 18th century Pennsylvania plantation. Duane E. Ball (1973, 1975, 1976; Ball and Walton 1976) and Mary M. Schweitzer (1987) sampled Chester County inventories in their studies of the colonial economy. Adrienne D. Hood (1990, 1996, 2003) used samples of Chester County inventories to inform her analyses of consumers and producers of cloth.

The present study makes no attempt to revisit the work of others. Margaret Schiffer's (1974) catalog of Chester County household goods provides an informative map of changing material culture. At the risk of under-representing the labor of women, little can be added to Schiffer's descriptions of clothing and Hood's thorough analyses of textile manufacture. There is also little to add to Joan Jensen's (1986, 1988) chronicles of the growing dairy industry. Eighteenth century hand tools have been well-studied (Mercer 1929; Fussell 1952; Goodman 1964; Sloane 1964; Hindle 1975; Kababian 1978; Underhill 1981 and others) and there has been an adequate analysis of tools in Chester County probates (Ball 1973:159-169, 208-209).

There is however room to build on prior research concerning production from agricultural fields and stockyards. Lemon's (1972) cultural geography of southeastern Pennsylvania is a seminal work and there is little to be gained by repeating his exact analyses. However, his idealized model of agricultural practice and production was based on a small

sample and of probate inventories authored circa 1760. Therefore, there is room for a larger sample and analysis which covers a continuous data set covering a broader time period.

Duane E. Ball's (1973) dissertation anticipated many of the same topics examined in this work. He was the first to present a picture of yeoman production throughout the century and may have been the first to calculate crop yields from probate inventories. However, his sample was discontinuous and was based on an unstated number of probates. Ball's samples of agricultural produce and livestock (:145-159, 206-207) were aggregated by file date into four uneven time periods. His use of file date is problematic because they are based on the first record of a probate, which is very often a will which was written many years before the inventory was taken. Other irregularities include his use of insufficiently explained adjustments in his calculation of crop yields (:147). It is a shame that Ball's methods were not more clearly expressed, because it appears that he anticipated Mark Overton's (1979) method for calculating yields from probate inventories by half a decade.

This work revisits many of the same Chester County inventories, but it draws on a more complete and continuous data set. In the analyses of agricultural production, this study utilizes methods developed by historians of British agriculture and adjusted to American setting. Researchers have developed analyses using similar data sets to estimate annual crop yields, differentiate between "maximizing" and "satisfying" strategies through comparisons of crop choice and prevailing market price, and the identification of techniques associated with the British "agricultural revolution" (Yelling 1970; Overton 1979, 1984, 1985, 1990, 1991, 1996; B. Campbell 1983, 1995, 2000; Turner 1984; Clark 1987, 1991a, 1991b; Habakkuk 1987; Allen 1988, 1991; Campbell and Overton 1991, 1993; Glennie 1991; Overton and

Campbell 1991). The complete data set provides an opportunity to view production in the context of landscape, seasonal weather, and changing class structure.

The Characteristics of Chester County Probates

An important consideration for estimating production from inventories is the season in which the document was authored. Frequencies of sampled Chester County inventories by month suggest that most were authored in late spring and early fall, with a pronounced drop in the middle of summer (Figure 25). Midsummer was concurrent with the harvest of Pennsylvania's principle cash crops and the warmest part of the year. As a busy time of the year, it may be that inventories were put off until the harvest was complete. However, monthly frequencies of inventories appear to be gradual and do not display a post-harvest peak where appraisers played catchup (Appendix A).

The proximate cause for the creation of an inventory was the passing of a person with property. In only a few incidences was the cause of death mentioned in the probate record. The fact that Philip Tanner of East Nottingham was killed by a cougar (*Puma concolor*) in 1751 appears on his headstone, but not in the documents (Young and Goldman 1946; CC W&A 1379). Usually, the cause of death was only recorded when the decedent passed away outside the county. David Brackenrig, once of Londongrove, died in 1759 fighting French-allied Indians on the frontier (CC W&A 1786). In that same year George Kitler of Providence fell victim to the "flux," probably dysentery, while building a frontier fort (CC W&A 1775). In the summer of 1760, Mary Douglas of Londongrove drowned in the Eno River while visiting North Carolina (CC W&A 1974). Philadelphia papers rarely included the obituaries of rural people and most 18th century headstones have been cleared from churchyards.

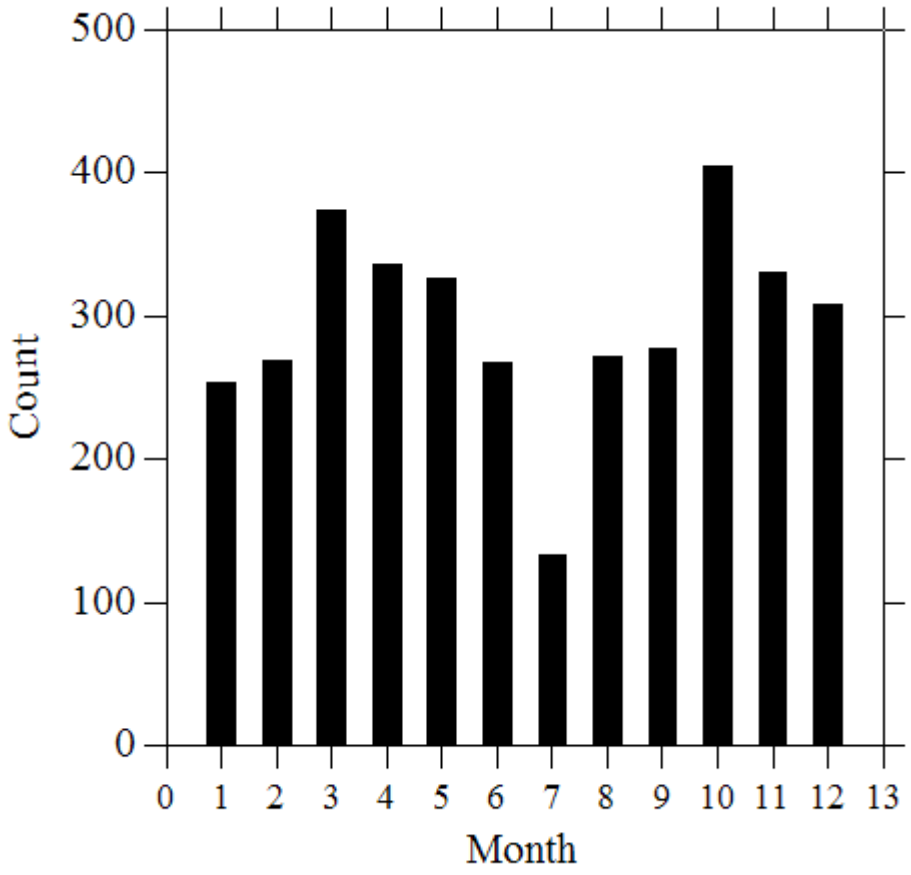

Figure 25. Frequency of Sampled Inventories by Month, Chester County Pennsylvania, 1713-1789 (Inventory date, New Date system, First Month of the year is January).

Susan E. Klepp's (1991) extensive research into mortality in Philadelphia provides comparative mortality data. However, the two populations were very different in composition. Inventoried Chester County residents were predominantly geographically dispersed, adults of the middle and upper classes who tended to be native-born. Philadelphia was a densely packed, heterogeneous population which included large groups of immigrants, urban poor, and included people of all age grades. Gilda Anroman's (2006) recent comparison of Klepp's crude death rates with those of modern countries suggested that many Philadelphians were "chronically ill, undernourished, debilitated and riddled with infection" (:63-64). There is no doubt that 18th century Philadelphia was the site of illness and relative poverty. Nevertheless, without standardization of the differences in age composition and number of newcomers to Philadelphia, such quantitative comparisons are unreliable (Palmore 1971). With those caveats in mind, Klepp's data for Philadelphia may shed some light on the death rates among inventoried Chester Countians.

A qualitative comparison of the crude death rate of inventoried Chester County decedents per 1000 taxpayers versus the rates for all Philadelphians suggests very different patterns of mortality (Figure 26). Mortality in Philadelphia generally rose during the first third of the 18th century, remained high throughout the middle third, and fell during the last third. Those in Chester County with surviving inventories had a relatively flat rate of mortality broken by a short periods of increased death. These spikes of mortality in 1717, 1720, 1727, 1732 and 1748 are not reflected in the Philadelphia data. However, the mortality of urbanites of the same class and age grades may have been masked by the higher mortality of young and poor.

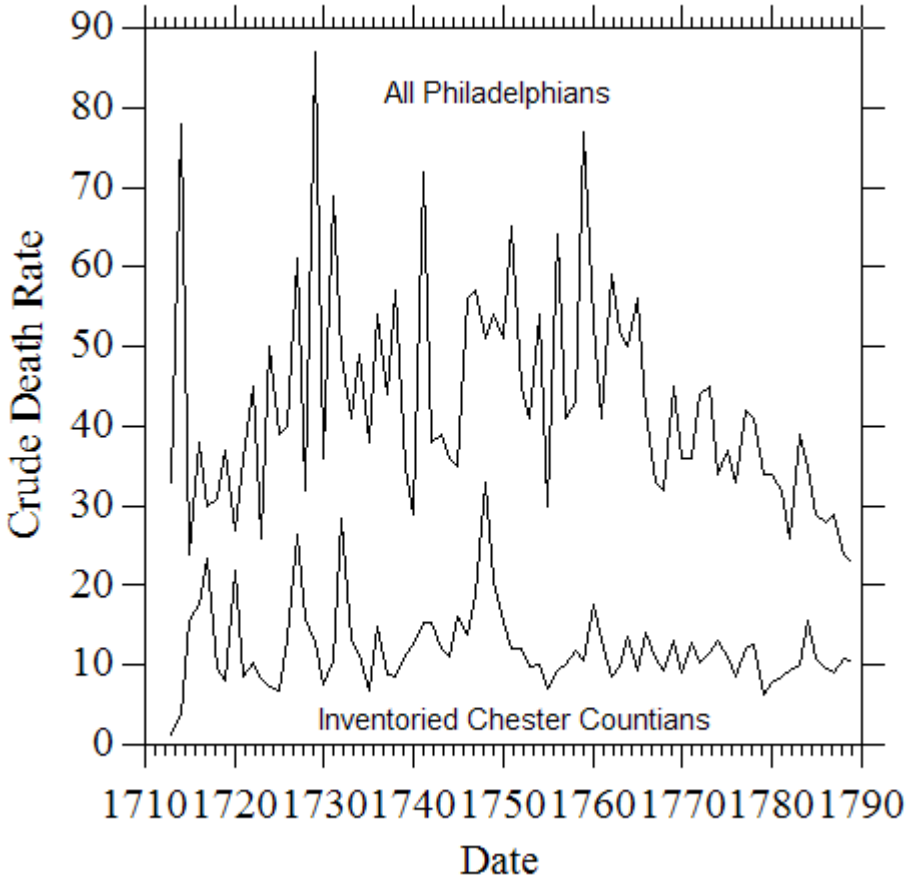

Figure 26. Crude Death Rates of Inventoried Decedents in Chester County, Pennsylvania (New Date, per 1000 Taxpayers) and All Philadelphians (Old Date and New Date, Klepp 1989:103-107).

Despite the lack of agreement between city dwellers and propertied rural people, there was some contemporary observations of endemic illness in Chester County. In the summer of 1717, Jonathan Dickinson noted that there was a "great prevalence of fever and ague in the country parts adjacent to Philadelphia" (Watson 1860 2:370). There was an unusual rise in inventories in October and November of that year (Appendix A). A similarly elevated rate of mortality occurred in the spring and fall of 1720, but there doesn't appear to be a contemporary diagnoses. The summer of 1727 was noted to be extremely hot (Watson 1860 2:353), but rise in the number of inventories rose and fell before the worst of the summer. The late spring of 1732 witnessed a peak in decedent mortality. In his *Epidemics of Colonial America*, John Duffy (1953) suggested that was a year of widespread epidemic of influenza. However, it was not until November that the *Pennsylvania Gazette* reported that large numbers of people had fallen ill with "violent Colds" (1:1161; Watson 1860 2:349) and the disease did not reach epidemic conditions until the end of that month:

> From all Parts of this Province, and even from Maryland, People complain of Colds, which are become more general than can be remember'd in these Parts before. Some ascribe this Distemper to the sudden Change of Weather into hard Frost, which we had about the middle of November; but others believe it contagious, and think 'tis communicated by infected Air, after somewhat the same Manner as the Small-pox or Pestilence (Pennsylvania Gazette 1:1164).

By early December, the *Pennsylvania Gazette* reported that the elderly were dying of colds and the young of pleurisy (*Pennsylvania Gazette* 1:1166). The two conditions were linked by pneumonia which was instigated by influenza which manifested as a cold, and resulted in an inflamation of the pleura of the lungs (Tennent 1739 in *Pennsylvania Gazette* 1:3535). These diseases were common in the 18th century, but the timing of the outbreak is wrong. Either Chester County was struck several months ahead of Philadelphia, or there were other causes for the increased mortality earlier that year.

The outbreak of pleurisy in 1748 is better understood and is concurrent with the worst mortality in inventoried Chester County residents. Its effects were widely observed in the region. The great chronicler of Pennsylvania, John F. Watson recorded that:

> February, 1748, as said by said [Rev. Richard] Peters' letters, was a time of great mortality in all the provinces; it was called 'the great epidemic of pleurisy.' It thinned the country so much, that it was said that servants, to fill the places of others in town and country, were bought in great numbers, as fast as they arrived. The Indians were afraid to come to a treaty by reason of the sickness. It stopped suddenly, before the summer came (Watson 1860 2:371).

Peter Kalm's Swedish-American friends in New Jersey related that in the autumn of 1748, pleurisy caused a "dreadful havoc" and particularly carried away the elderly (Benson 1937:198-199). Chester County inventories for that year reflect both the spring and fall outbreaks. The Swedes had also remembered a bad period of pleurisy which had broken out in 1728 (Benson 1937:199), a date which is concurrent with the down side of an increase in mortality which had peaked in 1727.

Albeit fragmentary, evidence suggests that some short periods with high rates of mortality among inventoried Chester County decedents were concurrent with epidemics of respiratory disease. The frequencies of inventories were highest in the wettest months just before and immediately after Pennsylvania's summer harvest. The spikes of high mortality all took place in the first half of the century, with the second half characterized by a relatively low and steady crude death rate for inventoried persons. These deaths are concurrent with the warmer, wetter weather prior to 1760, but on the surface there doesn't appear to be any clear patterns between seasonal temperature and rainfall and mortality. Nevertheless, Landsberg, Yu and Huang's (1968) climatic reconstruction provide an opportunity to explore the role of climate and mortality in rural Pennsylvania.

Principal Component Analysis of Death and Climate

As discussed in a prior chapter, the Climatist school of medicine had posited that weather had a significant influence on health and mortality. It was this interest which prompted the collection and publication of meteorological observations by physicians, academic societies, and gentleman's magazines. The climatist argument has long been discarded, but the collected data allows an exploration of the relationships between climate and mortality of inventoried Chester County persons of property through a principle component analyses. At the very least, the exercise demonstrates what poorly related data looks like, so that it can be compared with the strong results in the last chapter.

Principal component analysis (PCA) is analysis favored by advocates of exploratory data analysis (EDA) who are interested in projecting multiple lines of summarized data into a simpler and more easily interpretable map of covariance (Shennan 1997:265-307). PCA looks for correlations between lines of data and then reduces them down to components composed of factors with a like composition. In this case, a similar historical trajectory. It is important to remember that these kinds of factor analyses merely point to the potential for a causative relationship. Explanations of these relationship are subject to interpretation.

Principal components were calculated from seasonal averages of Landsberg, Yu and Huang's (1968) climatic reconstructions (temperature A-D, precipitation E-H) and crude death rates of inventoried Chester County residents (I-L; Table 7, Figures 27 and 28). Since the data are at multiple scales, the principal components were calculated from correlation matrices. The overall patterns reflected in the analyses are not very strong since the first two principal components explain only about 40-percent of the variance in the data.

Table 7. Principal Component Loadings of Climate and Mortality of Inventoried Chester County, Pennsylvania Residents, 1738-1789.

Component	1	2	3	4
A. Spring Temperatures	**0.62**	0.31	0.43	0.25
B. Summer Temperatures	**0.74**	-0.25	0.33	0.05
C. Autumn Temperatures	0.25	0.24	0.36	0.49
D. Winter Temperatures	-0.41	**0.73**	0.08	0.21
E. Spring Precipitation	0.48	0.03	0.18	-0.28
F. Summer Precipitation	0.11	-0.31	-0.32	**0.75**
G. Autumn Precipitation	0.18	**-0.68**	-0.48	0.05
H. Winter Precipitation	**0.68**	-0.36	0.16	0.06
I. Spring Death Rate	**0.52**	0.14	0.04	**-0.57**
J. Summer Death Rate	0.37	0.40	**-0.61**	-0.23
K. Autumn Death Rate	0.38	**0.51**	-0.35	0.17
L. Winter Death Rate	**0.63**	0.31	-0.47	0.15
Variance Explained	2.85	1.97	1.53	1.43
Percent Explained	23.73	16.45	12.73	11.93

The first component represents the climatic relationship with winter mortality. The associations are relatively weak, but mortality (L, underlies A) was highest in winters abundant precipitation (H) and to a lesser extent cold temperatures (D). These factors may reflect the dangers of winter travel on unpaved roads, fording icy rivers and accidental exposure. Contemporary diarists spoke of the dangers of winter travel. David Shultze's brother Melchoir died from injuries sustained when his horse which had lost its footing on an icy road (Berky 1953:5). In 1780 a wedding party crossing the Susquehanna to the north of Chester County broke through the ice. Bride, groom and 34 guests were lost (Ludlum 1984:58). One of Reverend Muhlenberg's persistent complaints was the perils of fording rivers in winter. After a young man was swept away by the Perkiomen River in January 1779, he lamented that the "river continues to snatch away one after another." Winter was a

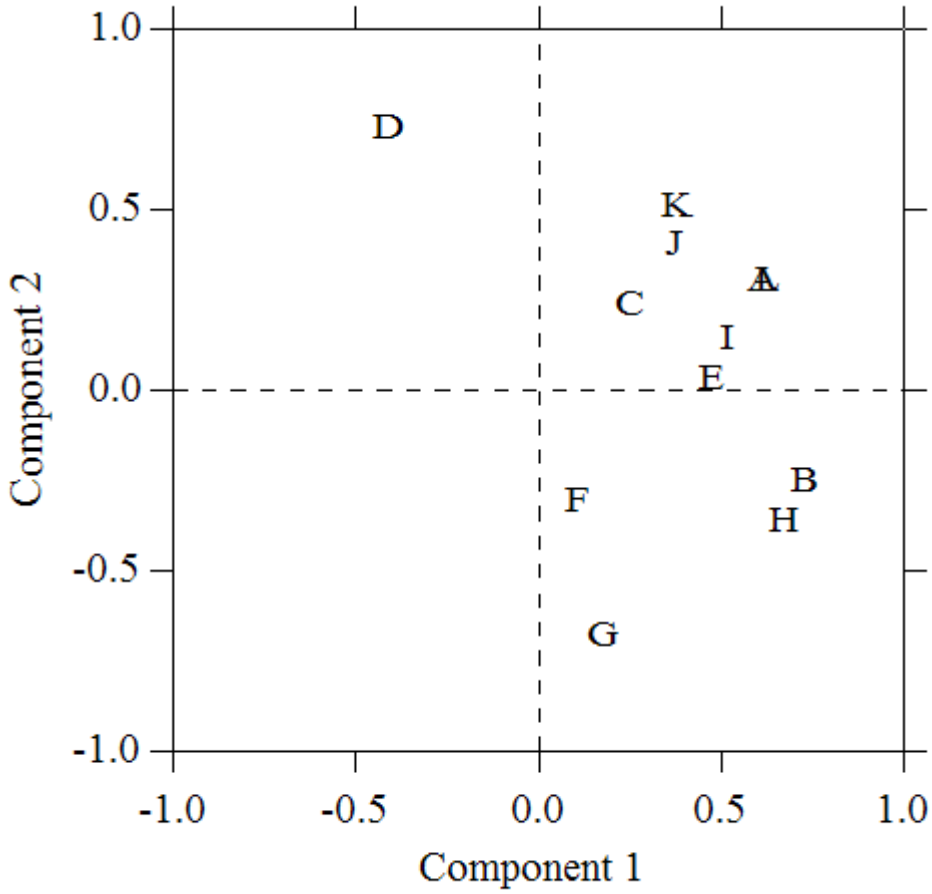

Figure 27. Factors of Principal Component Analysis of Climatic Factors and Seasonal Crude Death Rate of Persons Leaving Chester County Inventories, 1738-1789 (Graph is keyed to Table 7; Factors A and L overlap).

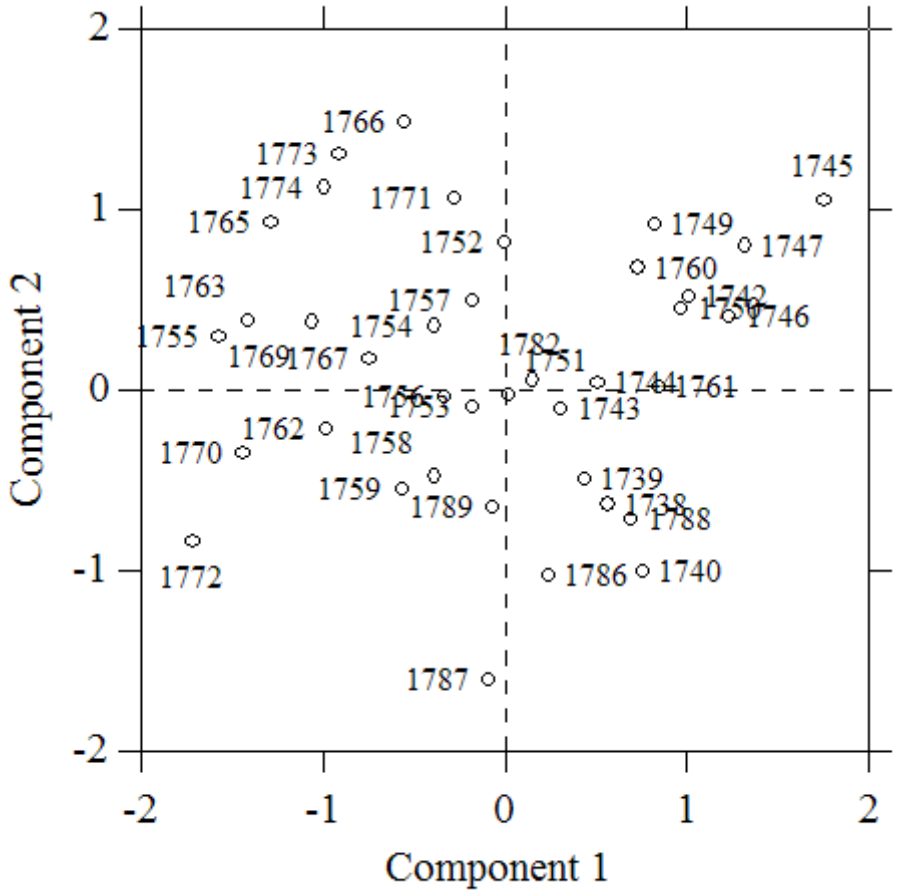

Figure 28. Scores of Principal Component Analysis of Climatic Factors and Seasonal Crude Death Rate of Persons Leaving Chester County Inventories, 1738-1789.

dangerous time for people with reduced mobility. One cold February night, late in his life, Muhlenberg became lightheaded while he performed an "act of nature"in his garden. He fell into the snowy ground beneath his currant bushes, and was unable to rise. He laid on the cold ground until an attentive neighbor heard his cries for help and saved the reverend from an ignominious end (Tappert and Doberstein 1942 3:212, 702). Ice, snow and cold temperatures were a genuine danger to persons of the inventoried class, but otherwise winter was a time of relatively low mortality.

Most inventories were authored in response to spring and autumn deaths. The deadliest months were March and October (see Figure 25). Autumn mortality (K) is captured by the second principal component which suggests that dry autumns (G) may have been hazardous, but temperatures had only small influence. There doesn't appear to be a clear causal link between the two, and the relatively weak correlation may be coincidental. A similarly weak relationship is reflected in the fourth component between increasing spring mortality (I) and rains (E), and deceasing temperatures (A). A causality between cold, damp springs and illness in the third component aligns with the Climatist's position. However, the potential relationship is extremely weak. A similarly feeble potential relationship in the third component between cool, wet weather and summer mortality. The low summer mortality and low correlation suggests that the relationship was probably coincidental.

The comparison of reconstructed climate and mortality suggests that the causes of death for inventoried persons were largely independent of weather. The one exception was a weak relationship between the severity of winter weather and mortality. This statistical relationship has been interpreted as reflecting the dangers of winter travel and accidental exposure.

Representativeness of the Sample

As Kevin M. Sweeney (1987) has demonstrated, only one-half to two-thirds of the taxpayers left probate records in his Wethersfield, Connecticut sample. Of those, fewer and fewer eligible probatees left records as the 18th century progressed (:32-34). However, not every taxpayer was necessarily eligible to be part of the probate process. Working on the same question on another New England sample, Holly V. Izard (1997) identified a number of persons who were not part of the probate process because they had divested themselves of property. Typically, they conveyed their holdings to a younger relative and stipulated support for himself and any remaining dependents (:158-161). She found that other taxpayers who did not leave a probate were often young men who lived as inmates in the another's household (:161-162). In aggregate, Izard found that fully three-quarters of those without probates had been excluded for appropriate reasons (:158) suggesting that fears that probate records were hopelessly incomplete were groundless. While these data are drawn on New England data sets, it is likely that the well-preserved Chester County records are similarly complete.

CHAPTER 6

CLASS

Social and Economic Equity in Chester County

Forty years ago, James T. Lemon and Gary B. Nash (1968) demonstrated that the distribution of taxable wealth among free males in Chester County had become increasingly unequal as the 18th century had progressed. It is a finding that has garnered much attention from historians interested in the emergence of social inequality. Lemon and Nash's data fueled regional comparisons by G. B. Warden (1976:603) and Gloria T. Main (1977:560-567) which indicate that taxable wealth in Chester County was more evenly distributed than in the northern colonies and the upper south (Figure 29). Jack D. Marietta (1995) used a larger Chester County data set to identify a wobble in the trend. He demonstrates that the fortunes of the upper 10-percent declined between 1718 and 1750, but turned around after mid-century suggesting that much of the rise in inequality due to the good fortunes of the established upperclass.

Carole Shammas (1993) has rightly cautioned that these measures of wealth do not consider the inequities inherent in slavery, servitude and coverture. Coverture is a principle unique to the history of British law which holds that a woman's property became her husband's at marriage. This forfeiture was balanced by dowery rights which reserved one-third of her husband's estate for her use (Cox and Cox 2000:22-23). Other sources of

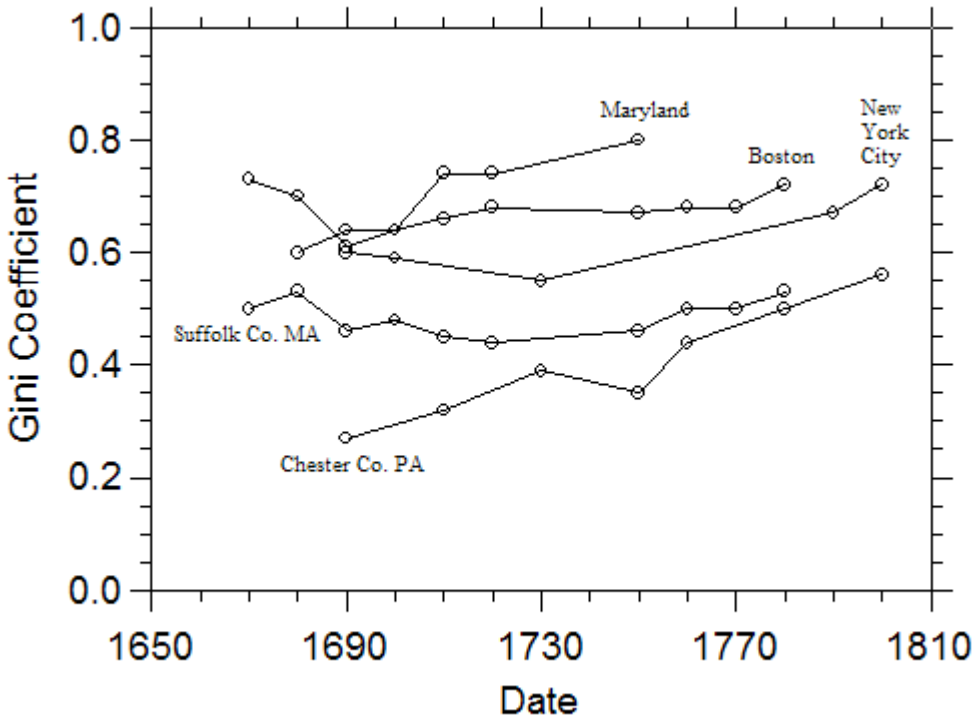

Figure 29. Wealth Inequality Among Taxpayers in Colonial America as Measured by Gini Coefficients (Source: G. Main 1977:560-567; *N.B.*: Gini coefficients reduce wealth differences between each fifth of the population to a single value, 0.0 = absolute equality, 1.0 = absolute inequality).

women's power was prevalent religious values which stressed marital partnerships (Levy 1988:193-230), social activism of Quaker women (Soderlund 1987), and a high degree of economic independence by women of means (Wilson Waciega 1987). These factors fostered greater gender equality in Pennsylvania than was commonly found in other American colonies. However, women's suffrage still had a longtime to come.

Although abolitionists had been active in the Pennsylvania since the 17th century, the laws governing gradual abolition were not passed until late in the 18th century (DuBois 1899; G. Nash 1973, 1988, 1990; Soderlund 1985; Soderlund and Nash 1991). Chester County residents regularly used slave labor (see Figure 20) and continued to hold slaves into the 19th century. Servants in Pennsylvania were fewer in number and are believed to have had shorter contracts than in other British colonies (Lemon 1972:10; Galenson 1981:124, 139), but Chester County residents participated fully in the trade of indentured laborers.

A factor contributing to wealth equality in early Chester County was the limited authority and benevolent attitude of the colonial proprietors. As Jean R. Soderlund (1983:19-29) relates, the Lords of Trade had learned from the ten previous American colonies that they had to curtail proprietary authority in order to maintain financial control. However, William Penn had royal allies who were financially and politically indebted to his war-hero father. The result of lengthy negotiations was that Penn's charter granted him only middling authority. Penn and his colonists were free from direct Parliamentary or royal control like that experienced in Virginia and New York, but stopped short of the kingly authority invested in the proprietor of Maryland or the corporate self-rule allowed in Massachusetts.

Once Penn had gained his charter, Penn and his representatives faced difficulties in establishing a judicial system, quelling internal political struggles, and collecting quit rents. In

Britain, the King-in-Council repealed nearly every legislative act and forced the Pennsylvania judiciary to constantly revise and reissue laws and protective tariffs. Penn's control of his governors was hobbled by the Pennsylvania legislature's control of both taxation and the gubernatorial salary. There was little local cooperation in the collection of quit rents, an annual land tax, and the legislature had little inducement to exert themselves for a distant third party. Moreover, Penn's Quaker values encouraged him to reject his agents' suggestion to collect quit rents by military force. The lack of a proprietary income contributed to Penn's personal misfortunes which included a short stay in a London debtor's prison and ill-health which left the management of his affairs to quarrelsome relatives and geographically estranged governors. In time Penn's sons would become proprietors in residence, but their efforts were hampered by a populace that had come to expect a high level of autonomy (Lemon 1972:26-27; Schweitzer 1987:4-18).

Both a colonial and later national capital, Philadelphia's chief influence was political, rather than economic. This is not to say that the city didn't play an important role in oversees trade. Historians regard the city as the focal point of the British American "bread basket" (Ball and Walton 1976:116; Cochrane 1993:31) and Philadelphia merchants shipped great quantities of wheat to Britain, the Carribean colonies, and southern Europe (Lemon 1972:27-31). However, city merchants were not backed by the special legislated privileges found in some other colonies which allowed merchant-lawmakers to direct the type and scope of production (Schweitzer 1987:217-229). Philadelphia merchants had to be satisfied with the role of middlemen between rural producers and London trading houses. It is within this relative freedom that Chester County yeomen flourished. Both colonists and historians agreed

that the lack of a hierarchical organization in 18th century Pennsylvania made it "the best poor man's country in the world" (Lemon 1972:*xiii*).

Despite its egalitarian origins, the distribution of taxable wealth in Chester County became increasingly unequal and steadily rose to levels in keeping with other northern states, England, and in Wales (Main 1977:560; Soltow 1981, 1984, 1989:264). Undoubtably, the nascent American hierarchy was nurtured by the replacement of disarticulated parliamentary, royal, and proprietary interests with a unified national government centered in nearby Philadelphia. As Ireland (1995:267) has persuasively argued, Pennsylvania's ratification of the constitution came only after Anti-Federalists' concerns with the potential growth of "privilege, hierarchical structures, and authoritarian institutions" was superceded by the immediate problem of tax debt and falling market prices. Federalists promised that these obstacles would be overcome by unification which would foster "security, prosperity, international respect, and commercial opportunity." The majority of Chester County voters chose economic growth over social equality, and thereby aligned themselves with the Federalist core in Philadelphia (Ireland 1995:182-216).

Contemporary observers linked productivity in Pennsylvania with prevailing ethnic stereotypes. Benjamin Rush, a noted Philadelphia physician, held that one could identify the plantations of Pennsylvania Germans from their English neighbors by the fertility and neatness of their holdings. Benjamin Franklin admired Pennsylvania German's "habitual industry and frugality" and their ability to "under live others." Pennsylvania's Governor George Thomas credited the large German population with the colony's high level of productivity. Whereas Germans were regaled for their industry, Scotch-Irish yeomen were seen as natural-born frontiersmen who were indifferent agriculturalists (Lemon 1966). These accounts appear

unanimous in their opinion. However, the perceived differences are not reflected in contemporary records.

Lemon's (1966) sample of Chester and Lancaster County tax lists found little differentiation between ethnic groups and concluded that "religious beliefs, social status, and economic circumstances" were better indicators of productivity than largely undifferentiated stereotypes of national character (:496). Chester County probate inventories strongly supports that finding. Persons with clear ethnic differences do not appear to be engaged in substantially different agricultural practices. Determining a decedent's religion is a difficult matter since few churches kept membership records and many 18th-century burials were not marked. The information which does survive suggests that it was common for people of the same surname to belong to different denominations. Lastly, it is unlikely that the difference between the various Protestant faiths would have a substantial effect on their agricultural practices. As a common element of ethnic identity, religion was also probably not a significant factor in agricultural practice. As a result, this study focuses on the social status reflected by class.

Probates as Evidence of Class Structure

As George David Rappaport (1996) argues, the class hierarchies of Europe were not carried-over into colonial Pennsylvania and urban politics were structured by an "associational system" of interlocked religious congregations, trade organizations, and social clubs (:63-134). However, among agricultural producers, a truncated version of the traditional classes of Britain was retained and perpetuated. It has been a common practice for students of history to follow the democratized usage of 19th century American, and refer to all agricultural classes as "farmers" without reference to their relations to production. As Lorna Weatherill (1996)

discusses, researchers who work with probate inventories commonly resort to classification from outside the documents themselves or merely grade decedents by inventory value (:208-214). However, doing so collapses thing like gender and social status into economics. Since this study seeks to understand productive strategies, the recognition of people with common goals and responsibilities takes precedence over economic standing. Therefore, these analyses use the self-identified descriptions of class from the within the probates themselves.

Chester County probate records contain a large sample of class descriptors and associated inventories of goods and chattel which allow an exploration of their ecological strategies. The inclusion of class designations appears to be more than a legal artifact. They were introduced, reviewed and accepted by the deceased, executors, magistrates, county clerks, appraisers and heirs of the estate. The designations were taken sufficiently seriously that William Pyle's will was corrected by crossing out the word "yeoman" (CC W&A 980). A little over half of the 3136 sampled probates of males and 415 probates of females included a class designation somewhere in probate documents (Table 8). The 1760s was period of increased use of class terms, with a dramatic fall in the 1780s (Table 9). Most of those changes were the result of change in fortunes of the yeoman class.

Social Mobility

Most probated persons were men of European descent, but property was the only prerequisite for participation in the probate process. Six people were described in their probate documents by an indicator of race, and most, if not all, were once held as slaves and at least one ex-servant had gained property in Chester County.

Table 8. Expressed Class in Chester County Inventoried Probates, 1713-1789.

Free Men		**%**
Grazier	5	<1
Yeoman	1179	69
Farmer	59	4
Husbandman	19	1
Laborer	29	2
(total agriculturalists)	1290	76
Weaver	50	3
Cordwainer, Shoemaker	36	2
Blacksmith, Farrier	31	2
Carpenter, Joiner, Turner	30	2
Tailor, Clothier	25	2
Cooper	19	1
Miller, Millwright	15	1
Tanner	14	1
Wheelwright	10	1
Mason, Plasterer	10	1
Saddler, Collier	9	1
Shipwright, Stay Maker	6	<1
Fuller, Worsted Comber	4	<1
Maltster	4	<1
Glazier, Thatcher	3	<1
White Smith	1	<1
Scythe Maker	1	<1
Forge Master	1	<1
Sawyer	1	<1
Wagon Master	1	<1
Baker	1	<1
Gardener	1	<1
Paper Maker	1	<1
Tradesman	2	<1
(total artisans)	276	17

		%
Innkeeper, Tavernkeeper	26	2
Merchant, Storekeeper, Clerk	15	1
Chapman, Peddler, Trader	8	<1
(total merchants)	49	3
Gentleman, Esquire	47	3
Physician	9	<1
Clergy	9	<1
Schoolmaster	6	<1
Soldier	6	<1
Sailor	4	<1
(total free men)	1697	100
Free Women		**%**
Widow	225	91
Spinster, Single Woman	17	7
Yeoman	2	1
Tailoress	1	<1
Innkeeper	1	<1
(total free females)	246	100
Bound People		**%**
Apprentice	35	3
Man Servant	390	33
Maid Servant	204	18
Child Servant	12	1
Servant	123	11
Male Slave	179	15
Female Slave	157	13
Child Slave	43	4
Slave, unpecified	22	2
(total bound people)	1165	100

King Cuff and his sisters Prudence Ford and Jane Salmon were freed by the Worrall family of Middletown. The siblings continued to maintain close relations with the family and used wills to establish members of the extended Worrall family as their executors (CC W&A 3810, 3811, 3812). By doing so, they obligated their former masters to insure that their

estates passed to their siblings and children rather than any spouses or other potential claimants.

Table 9. Frequency and Value of Inventoried Probates With Class Designations, Chester County, Pennsylvania, 1713-1789.

Date	Sample	Class Indicated (%)	Value (£)	% Change
1713-1719	75	41 (55)	171	---
1720-1729	206	114 (55)	218	27
1730-1739	291	157 (54)	211	-3
1740-1749	560	264 (47)	243	15
1750-1759	482	251 (52)	277	14
1760-1769	648	511 (79)	368	33
1770-1779	609	369 (60)	369	0
1780-1789	680	237 (35)	499	35
	3551	1944 (55)	297	

A woman without a surname known as "Bilha, Negro," or "Black Bilha" was freed by Deborah Nayle, a Thornbury widow in 1751. In addition to her freedom, Bilha inherited 25£, clothing, and household furnishings which were equal to those she had used during her years of service (CC W&A 1389; Jensen 1986:40). Few freed slaves were so fortunate as to have even a small part of the proceeds of their labor returned to them. She made good use of it. In the years prior to her death in 1768, Bilha increased her estate to 90£ through her work as a seamstress and by the judicious lending of money. As she had received a legacy, Bilha used her will to pass some of her best garments to daughters of the Darlington family for whom she felt a special affection, and to provide a legacy for her brother Joseph Hunt who was enslaved under the name "Negro Jack" (CC W&A 2430).

Little is known about Richard Coleman of Goshen except that he left a modest estate which included reapers' tools and many yards of cloth. Coleman's goods and chattel suggest that he made his living as a husbandman and that he was probably survived by a wife who was a seamstress. Coleman probably had relatives in Virginia since his executor traveled there in order to settle the estate (CC W&A 1142). Also of Goshen Township was Benjamin Lane a "free Malletto" (CC W&A 2227). In the 18th century, Mulatto was an intermediate racial category. Lane was a successful cooper and agrarian who had £170 in various loans. Lane was described as a yeoman in the bond signed by his appraisers, and he left an estate of higher value than many of his class.

While upward mobility from servant or slave was possible in Chester County, it didn't often occur. The six inventoried probates in the sample is rather small when compared with the often nameless 401 enslaved people listed within the sampled inventories. Nevertheless, these few inventories suggest that race did not lock the door to social mobility in 18th century Pennsylvania. The same lack of legal barriers was true for indentured servants. However, becoming a person of property was similarly difficult.

Sharon V. Salinger's (1987:115-136) study of 18th century Pennsylvania servants indicates that those who stayed in the colony and acquired land were in the minority. It is likely that few of the mostly anonymous 729 servants listed in Chester County inventories left estates of their own. An exception was Peter Nosseter (Nonsette, Noset, Nossett, Nossiter) who rose from servitude (Salinger 1987:122-123) to leave an estate that was equal to a yeoman's and which included servants, tools and agricultural products (CC W&A 1503).

Class Comparisons

Comparisons between classes are hampered by the extreme differences between sample sizes. The yeomenry dwarfs every other class. Therefore, the values of inventoried goods and chattel have been expressed as Tukey box plots. Sometimes called box-and-whisker or box-and-dot plots, Tukey box plots reduce the influence of outliers and incorporates statistical confidence intervals which act to ameliorate the effects of differential sample sizes. The features of a box plot include a waist which marks the median value, a box which specifies the mid-spread or central half of the data, whiskers or tails which represent the first and last quarter of the data, asterisks mark outliers and circles represent extreme outliers (Figure 30). The central notches mark the 95-percent confidence interval, therefore overlapping notches indicate significantly similar samples (Hoaglin and Velleman 1981; Drennan 1996:39-44).

The total values of inventoried 18th century Chester County estates reveals that there was a large middle class framed by a small upper class of graziers, gentlemen and physicians, and lower class occupied by laborers and schoolmasters (Figure 31). Yeomen dominated the middle class and were framed by an upper middle class of merchants, military and the clergy, and a lower middle class of husbandmen, widows and artisans.

The Upper Classes

Graziers

Chester County graziers were a small, tight-knit class of extremely wealthy colonial-capitalists who fattened livestock for the urban market. Graziers appear rather late in probate records, the first was not until 1769, and the other four were inventoried in the 1780s. They

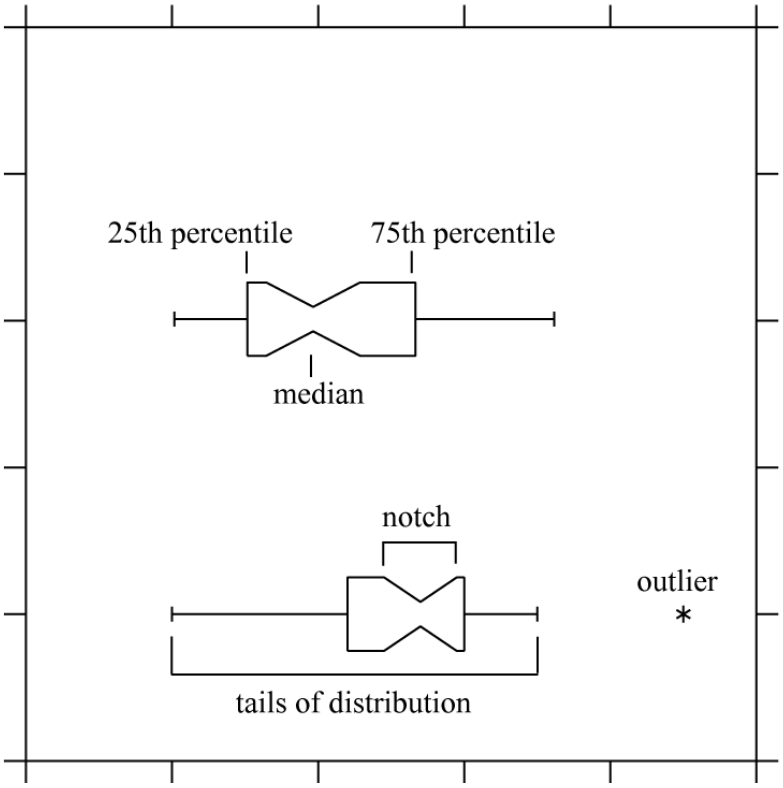

Figure 30. Schematic of a Tukey Box Plot.

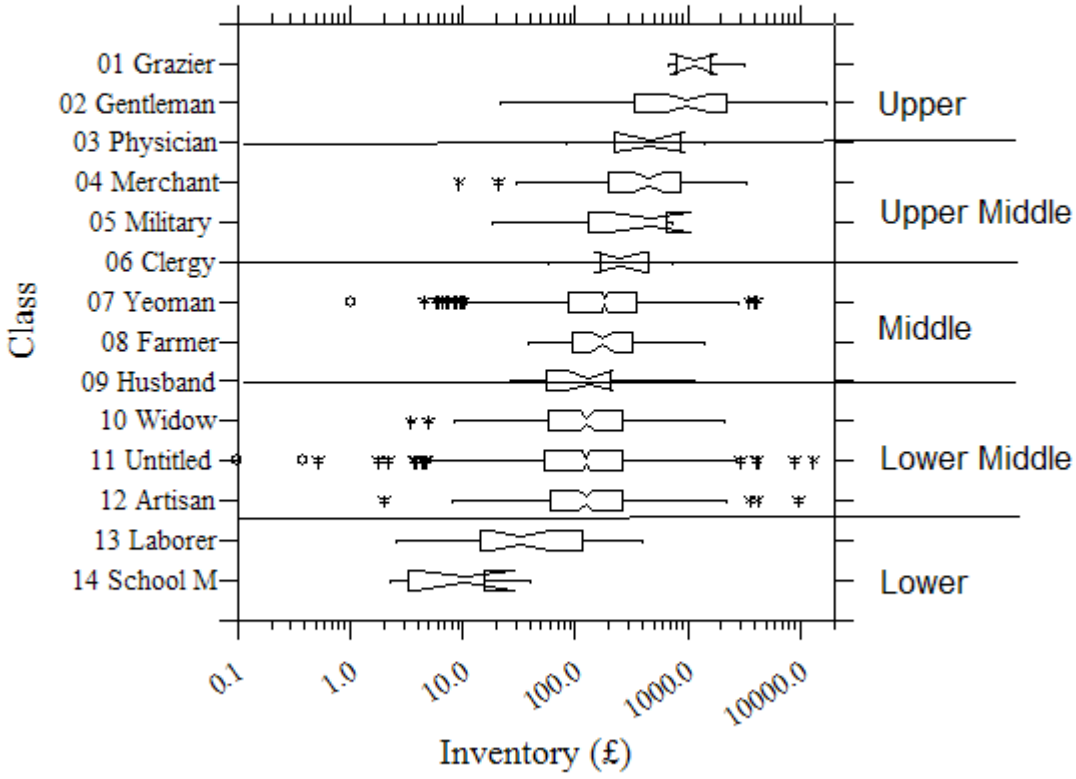

Figure 31. Class Wealth by Value (£) of Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (*N.B.* Inventory value is expressed on a Log10 scale, ranked and ordered by statistical similarity at the greater than 95-percent confidence interval).

Table 10. Mean Inventory Value and Patterns of Agricultural Investment in Chester County, Pennsylvania Inventories, 1713-1789.

Class	Mean Inventory Value (£)	Sample Size	With >5£ Ag. Goods (%)	Mean Horn-Corn-Tool (% of total Ag.*)	Estate in Ag. (%)	Loans (%)
Grazier	1478	5	5 (100)	76-21-03	40	34
Gentleman	1690	47	39 (83)	67-22-11	8	69
Physician	585	9	8 (89)	68-24-09	12	49
Merchant	647	49	36 (73)	55-34-11	10	54
Military	407	9	5 (56)	52-33-15	28	26
Clergy	317	9	7 (78)	71-20-08	19	30
Yeoman	303	1179	1024 (87)	60-28-12	27	43
Farmer	290	59	57 (97)	61-28-10	35	36
Husbandman	195	19	17 (89)	61-22-18	25	42
Widow, Single	208	246	102 (41)	65-24-12	8	57
Untitled	257	1607	1190 (74)	61-26-13	24	40
Artisan	284	276	210 (76)	61-24-16	17	48
Laborer	84	29	7 (24)	67-26-11	7	73
School Master	13	6	0 (00)	0-0-100	1	12

*Horn includes all livestock, Corn includes grain, fodder, fruit, fiber and vegetables.

occupied the southeastern townships of Tinicum, Darby and Lower Chichester, where they took advantage of the grassy islands at the confluence of the Delaware and Schuylkill Rivers and proximity to the Philadelphia's butchers, innkeepers and merchants. Their position allowed them to accumulate large estates which placed them in the same economic standing as gentlemen (Table 10). Three graziers were also described by an additional class title. The earliest grazier was described as a yeoman, whereas the later two were called gentlemen (CC W&A 2465, 3578, 3584) which is partial evidence for a general rise in the classes' social standing.

Charles Robinson of Tinicum Township's probate records offer a view of the graziers' business (CC W&A 3653). Robinson formed a partnership with Edward Laskey, a Philadelphia victualer, and John Hoof of "Irish Town" in the Southwark District of Philadelphia County. In addition to keeping stock on his own property, Robinson leased more than 330 acres of meadows and upland at Longhook Island, Plumb Hook, Irish Town, and Boone Island. His 1784 inventory shows that land leases represented 22-percent (249£) of the total value of his estate. Two of his leases had a remainder of four and six years remaining which suggests Robinson intended a prolonged commitment toi grazing. Chester County graziers formed a tight social circle. Robinson assigned a fellow grazier, Philip Peirce of Kingsessing, Philadelphia County, as the administrator of his estate. He rented meadows from William Smith of Tinicum, a fellow grazier (CC W&A 4014) who was probably, but not definitely, a kinsman to graziers John Smith, Junior and Senior of Lower Chichester (CC W&A 3578, 3584).

As would be expected, graziers were more invested in livestock than any other class (Table 9). Although Robinson was inventoried in winter when herds were likely to have been at their smallest, one-half of his estate was composed of livestock. His herds included a one-half share of 40 steers, 30 oxen, 10 cows, eight horses and nine swine stabled at his home plantation. The large number of steers and oxen suggests that his customers were butchers and wagon masters. Fodder was a critical resource. Robinson possessed a one-half share of 15 stacks of hay and oats valued at more than 275£. He also grew grain, but only in small quantities indicating that it was slated for household consumption. Since laborers traditionally purchased and maintained their own harvesting equipment, graziers' inventories have very few

agricultural tools. Charles Robinson's only tools were hay forks and a pick for cutting drainage ditches.

Gentlemen

Men described as gentlemen or esquires formed the majority of the upper economic class in Chester County and typically left inventories valued at 1690£ (Figure 32). In Europe gentlemen eschewed manual labor and devoted themselves to the study of law, medicine, or the military arts. They supported their manors by collecting rents or mercantile pursuits. In 18th century Chester County the title was the mark of success career and included several lawyers, a sheriff (CC W&A 2321), a retired Continental Major (CC W&A 3371), and at least three men who were once known as yeoman, but retired as gentlemen (CC W&A 88, 3872, 2453). Physicians and most military men occupied a distinct and less wealthy classes. Unlike their British counterparts, most Chester County gentlemen (83-percent) remained active in the agricultural market. More than half possessed agricultural tools and products valued at 100£ or more. In 1796, Thomas Cheyney, Esquire of Thornbury wrote to British kinsmen that:

> I know many men that are worth thousands of pound that will mow, make hay, reap, and draw hay and grain into their barns as steady as hirelings; and those-that are able, if they do not work, are looked upon with contempt. Herein the country they are slighted, and are not company for anybody (Futhey and Cope 1881:339).

Although many gentlemen met social expectation by performing manual labor, their proportional investment in agriculture was small. However, because of their great wealth, their agricultural holdings were still quite substantial.

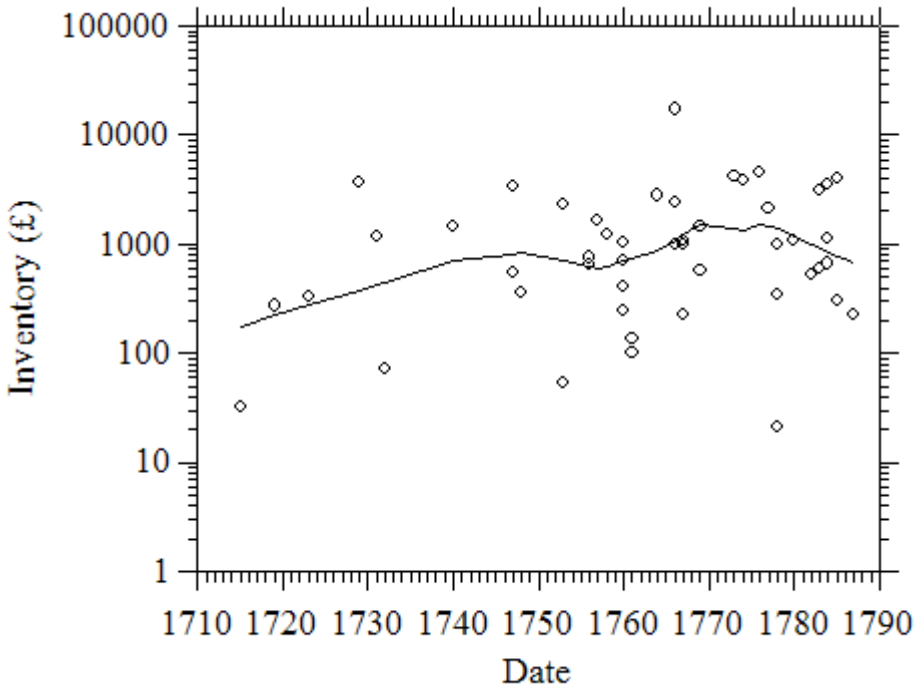

Figure 32. Value (£) of Gentleman's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

One of Chester County gentlemen's economic strategies was to be a lender of money. The lending of money was a common practice people of all classes. Most inventories (70-percent) listed funds in another's hands. On average these amounts represented 45-percent of the total value of all estates. However, the practice was dominated by gentlemen who not only had more money to lend, but also loaned out a large proportion of their wealth. On average 69-percent of a gentleman's estate was "put to work" through mortgages, bonds, and notes. The practice was not only enriching, but it was essential to their continued claims to the position of a petty nobility.

The interpersonal system of credit was linked to the larger economy. Colonial America was located on what Immanuel Wallerstein dubbed the "semi-periphery" of an emerging world-system economy which was under the hegemonic dominance of Britain and France (1974, 1980:179-241). Britain's American colonies served to produce food and raw materials which were exchanged for goods manufactured in the home country. Rural producers, Philadelphia merchants, and the factors of London trading houses were linked by a system of book accounts. London merchants would balance imports by shipping goods unavailable in the colonies. Account holders moved funds and made large purchases through bills of exchange drawn on their London account. These bills were often received by third parties and became a form of currency. Loans of large amounts of money, usually connected with the sale of land or business, were guaranteed with a bond or note which specified a interest rate, payment schedule, and penalty for forfeiture. Smaller amounts resulting from day-to-day commerce or between trading partners were tracked through a system of double-column accounts which were kept by storekeepers and rural producers (McCusker 1978:116-131, 175-182; Schweitzer 1987:117-123).

The functioning of this complex system of accounts, personal bonds and self-authored bills was predicated on social relations lying outside of market exchange. Holders of London accounts had to trust that they would be compensated by fairly priced goods. Those who accepted a third-party bill of exchange must have faith that it hadn't been forged and that the gentleman-backer would have sufficient funds to cover the charge. Inherent in the issuance of a personal loan was the expectation that the borrower was sufficiently industrious to complete the transaction. Book accounts required an agreement concerning the values of goods and services, and trust that there will be an eventual reconciliation. This must all be carried out in the context of a mobile frontier society and easy emigration. These various forms of economic exchange had some legal backing. However, appeals to authorities required a burden of proof and possible court costs. In short, reputation was everything.

Exchanges were mediated by a careful consideration of the character of one's trading partners. A bill of exchange was only as good as the reputation and fiscal health of the men who backed it. The terms of bond were negotiated in light of personal, gender, familial, class and race relations. The opening of a book account established a social, as well as economic relationship, which was likely to persist for a number of years. The acquisition and maintenance of a gentlemanly status were not only predicated on rents and profession, but also his conduct and success as a lender of money.

Without a doubt, wealthiest man in 18th century Chester County was the mysterious Joseph Parker, Esquire of the Borough of Chester (CC W&A 2262). Parker was a Chester County institution having served as the Prothonotary, Court Clerk, Recorder of Deeds, and Register of Wills for more than 50 years. He also served as a Justice of Peace for more than a decade (Ashmead 1884:267; Futhey and Cope 1888:364-365, 372-373). His name appears

time and again on the reverse sides of Chester County wills and administrations. The words "Mr. Parker" was sufficient address for these documents to have arrived in his hands.

While he was a well-known administrator, little is known about him. He may have been the 14-year-old Quaker boy sent in 1701 from Bartholomew Close, London to live with his Uncle Robert Heath in Pennsylvania (Myers 1902). In 1715 a young Joseph Parker appeared as a member of another household in Chester, By June 1716, he was hired by the county court and regularly appeared as a witness to Chester County deeds (Bryant 1997). In Willis P. Hazard's (1898) revision of John F. Watson's *Annals of Philadelphia* he describes Parker as:

> Joseph Parker was educated in mercantile pursuits. He was active, ardent, impulsive, and kind-hearted. Esteeming the calls of charity as imperatively demanding his personal attention, he was ever the friend of the unfortunate (3:414).

Mr. Parker was in the position to respond to a gentleman's charitable duties. At the time of his death in 1766, Parker had amassed an unprecedented fortune of 17,341£. His estate was three times larger than the next wealthiest decedent and more than the typical estates of 50 yeomen. More than 90-percent of his estate was composed of mortgages, bonds, notes and book accounts. Despite having filed decades of probate records, he left no will and his inventory included only eight lines:

	£	*S.*	*D.*
To Purse and Apparell	1232	4	9
To the Principal due on fifty four Mortgages	9954	11	6
To Interest thereon	1826	2	3
To the principal due on forty six Bonds	3041	18	8
To the Interest thereon	760	17	2
To Sundry Notes	27	7	10
To Book accompts	194	6	8
To Household Goods Implements of husbandry} Horses Cattle etc. }	303	10	--
	17340	18	10

While the essence of brevity, Mr. Parker's inventory displays the degree to which a gentleman's wealth was invested in lending, and suggests that it was a lucrative pursuit. The fees he collected for writing and filing documents had provided a steady income. However, it was his backing of mortgages which provided the largest source of income.

Physicians

Physicians straddle the divide between the upper, and upper-middle classes in 18th century Chester County. In colonial America the profession was carried out by formally trained physicians, military barber-surgeons, traditional healers, and herbalists (Meier 1976). The nine Chester County "Practitioners in Physick" who left inventories appear to have been trained in scientific medicine and their primary source of income was the practice of their profession. In comparison with gentlemen, physicians similarly invested only little (12-percent) in agriculture, favored livestock over grain, but only about half of their estates were in the form of debts to the estate. Some of that money was recorded as personal bonds and book accounts which probably included outstanding debts of patients who had difficulty paying. Physicians had some protection from default because heads of households were responsible for his residence's medical expenses. It was common for executors to deduct the price of physicians bills for the decedent and his charges.

The Upper-Middle Classes

Merchants

The wealth of merchants and the military were statistically similar to physicians at the bottom of the upper class, and the clergy at the bottom of the upper-middle class. The

merchant class was highly varied, and included the keepers of inns, taverns, and stores, as well has traveling salesmen called chapman, peddlers and traders. Merchants had only a small investment in agriculture (10-percent), generally that grown for household consumption, fodder in innkeeper's stables, and small quantities of food at retail. Merchants commonly had a little over half their estate lent to others. Much of it in the form of book accounts with customers and suppliers.

Merchants' primary niche was as suppliers of manufactured goods, liquor, spices and luxuries. Chester County merchants would sometimes purchase goods from rural producers (Kennedy 2000). However, the large number of inventories which include grain or flour at the local mill suggests that the true middlemen of the wheat trade were millers. Some particularly frugal producers traded directly with Philadelphia flour merchants. David Shultze of northern Philadelphia County (now Montgomery County) had often sent a member of his household to Philadelphia with wheat in the hopes of getting the best price (Berky 1952).

Military

The estates of the nine inventoried decedents identified as soldiers and sailors were mostly wealthy men who pursued military careers, served on privateers, or were owners of small boats. The military class earned most of their income from the practice of their profession. Sailors tended to make personal loans, whereas soldiers more often invested in agriculture. All the sampled soldiers had seen service in the Revolutionary War. The soldier with the smallest estate was Philip Bostil of Kennett had served as private in the 5th Pennsylvania Regiment before being wounded in October 1779. He was then promoted to Sergeant Major in Captain Matthew McConnell's Company of the Regiment of Invalids (CC

W&A 3587; Linn and Engle 1890:275). The date of his induction into the invalid regiment suggests that was one of the two privates wounded when the 5th Regiment fought at Stoney Point, New Jersey (Trussell 1993:275).

Captains Samuel Culbertson, Henry Baker, John McKee, and Colonels Matthew Boyd and Cornelius Sheriff were all veterans of Pennsylvania militia units who left substantial estates (CC W&A 3233, 3349, 3381, 3495, 3838). Captain McKee served in the "Mifflin Guard," the First Regiment of the Pennsylvania Volunteers (Ashmead 1884:90). Captain Baker served as a private in the Pennsylvania State Rifle Regiment and was recorded as missing-in-action at the Battle of Long Island on August 27, 1776 (Montgomery 1906:259; Trussell 1993:165, 177-180). His eventual reappearance and promotion suggest that Baker had been captured and imprisoned by the British forces occupying New York.

The remaining Chester County officers all served in the "Flying Camp" as volunteer militia who acted as a home guard and provided support for Continental forces. Cornelius Sheriff served as a first lieutenant (Durant 1886:31-36) and then signed on as Deputy Quartermaster General with Major General John Sullivan's expedition against the Six Nations (Cook 1887:315). Sullivan's goal was to counter movements of British-allied Iroquois against colonials settlements in northern Pennsylvania and New York (Trussell 1993:14-15). The date of Sherriff's death indicates that he died during the expedition or soon after his return. Captain Culbertson was captured with General William Montgomery's 4th Battalion of Chester County Militia at the battle of Fort Washington, New York. He spent four years as a prisoner of war and died soon after his release. Colonel Boyd also served under Montgomery and was killed by a fall from his horse. His widow later married General Montgomery (Futhey and Cope 1881:64-66, 485, 508).

The common theme of those soldiers who died in the war or soon afterward was that they saw service in militia units and were captured in the early days of the war. If the were able, they returned to agriculture. However, the British prisons were infamously harsh and there may be good reason to suspect that these men were left weakened from their long incarceration. Of the six officers, only Captain McKee lived long enough to see the war's official end with the Treaty of Paris in September 1783.

The sailors included two boat owners and a privateer. The "shallopman" Andrew Cochran owned a flatboat which he operated at the Chester docks on the Delaware River (CC W&A 3034). At his death in 1731, Benjamin Moulder of Chichester was part owner a sloop "Happy," a shallop, a storehouse and wharf (CC W&A 403). David Ford of Lower Chichester signed onto the privateer Brigantine "General Putnam" in 1776 (CC W&A 3580). The Brig General Putnam was owned by New London, Connecticut merchants and won numerous prizes in the Atlantic (*Pennsylvania Gazette* 3:20455, 23053, 23092, 25845, 25865, 25971, 27238, 27267, 27361). Ford apparently used his share of the prize money to retire. His 1784 inventory contains only household goods.

Clergy

Clergymen occupied the lowest of the upper-middle classes and the poorest of the those engaged in a gentlemanly pursuits. Clergymen's estates were statistically similar to both military men and middle class yeoman, and included nine reverends of Protestant faiths. The clergy tended to make a moderate investment in agriculture (19-percent), favored livestock over grain, and did not often lend money at interest. It is probable that most of what they would have loaned out was offered as charity.

The Middle Classes

Yeomen

The middle classes were dominated by yeoman who composed 69-percent of all inventoried persons and 76-percent of free men identified by class. There can be little doubt that the yeoman majority contributed to the wealth equity in 18th century Chester County. Traditionally, the yeomanry included those who worked their own land using their household as the prime source of labor. The growth of the class in the first half of the 18th century was due to a ready availability of land, a favorable wheat market, exploitation of bound labor, and an immigration pattern that drew heavily from the middle classes of Europe.

Mildred Campbell (1955, 1959) has argued from class descriptions on lists of passenger on 17th century British ships that American colonists were predominantly of the middle classes of Britain (1955:1-20, 1959:63-89). Although her data best describes the immigrants to earlier colonies, historians of the Delaware Valley have favored that interpretation (Lemon 1972:7; Levy 1988:25-52). Not all researchers are in agreement. David W. Galenson's reinterpretation of the same data suggests to him that the colonists had emerged primarily from the laboring classes (1978:499-524, 1979:264-277). That "peasant origins" view of American colonists is paralleled in some current research (Kulikoff 2000). However, Galenson's conclusion is based on the assumption that an unrecorded class designation on a ship list signified that the immigrant was an unskilled laborer.

Mildred Campbell (1979) correctly argues that the unrecorded entries are merely incomplete, and their actual classes probably followed the pattern of those for whom that information was preserved (:277-286). It is certainly the case that unidentified decedents in Chester County contained persons whose estates embrace a range of classes. A yeoman origin

of American colonists is supported by Mark Overton's (1980) analysis of probates made in Norfolk and Suffolk Counties, England. Overton found that yeoman inventories grew from about one-third of probates in the late 16th century, to more than half by the early 18th century. The increase was fueled by socially mobile husbandmen, a class of skilled agricultural worker, who had dropped from approximately one in four inventoried decedents to about one in ten (:209). Two important implications of Overton's data are that American colonists were drawn from a population which was increasingly of the middle ranks, and that American and British yeomen were part of the same centuries-long social movement.

The yeomanry was not only large, but also diverse in that it included people with skilled trades and persons who were both well established and rather recent members of the yeomanry. Fourteen of the inventoried decedents were described in their probate records as both a yeoman and as a practitioner of a manufacturing trade. These men included two blacksmiths, two carpenters, a woolcomber, framework knitter, cordwainer, tailor, wheelwright, mason, collier, shopkeeper, sailor and waterman (CC W&A 2, 604, 1267, 1442, 1786, 1788, 1986, 2286, 2446, 2458, 2534, 2660, 2691). A man who described himself as a laborer in his will, was judged a yeoman by the appraisers of his estate suggesting that he had acquired land late in his life (CC W&A 250).

Between 1713 and 1789, yeomen left inventories with an average value of £303, although the range included valuations as much as four times that amount and as little as a single pound (Figures 31 and 33). The average wealth of yeoman grew steadily after 1720, but the trend was often out of step with the other classes. Yeomen estates failed to participate in the growth of 1710s and 1720s, but shored up falling estate values in the 1730s (Table 11). Throughout the 1740s and 1750s, yeoman's fortunes kept pace with those of all classes, but

fell behind the increase in overall probate values during the 1760s. The lack of growth in yeomen's fortunes was accompanied by an increase in their numbers. Between 1756 and 1776 the yeoman ranks were swelled by people both wealthier and poorer than those of the previous half century. This sudden growth marked the height of the yeoman class in British America.

Table 11. Number and Average Value (£) of Yeomen's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789.

Date	Yeoman Inventories (%)	Mean Value £	Percent Change
1713-1719	20 (49)	205	---
1720-1729	71 (62)	183	-11
1730-1739	99 (63)	223	22
1740-1749	137 (52)	241	8
1750-1759	152 (61)	286	19
1760-1769	350 (68)	305	7
1770-1779	243 (66)	340	11
1780-1789	107 (45)	488	44
	1179 (61)	303	42

In the dozen or so years following the American Revolution, fewer and fewer decedents were described as yeoman, but those who remained left behind more precious estates. Despite the disruptions of the American War of Independence, the average value of yeomen's personal estates increased by 11-percent in the 1770s whereas the overall trend remained flat. Yeomen were losing membership faster than the were gaining wealth and lost 20-percent of their numbers in the 1770s. The established trend of rising estates and falling numbers continued throughout the 1780s (see Figures 2 and 3).

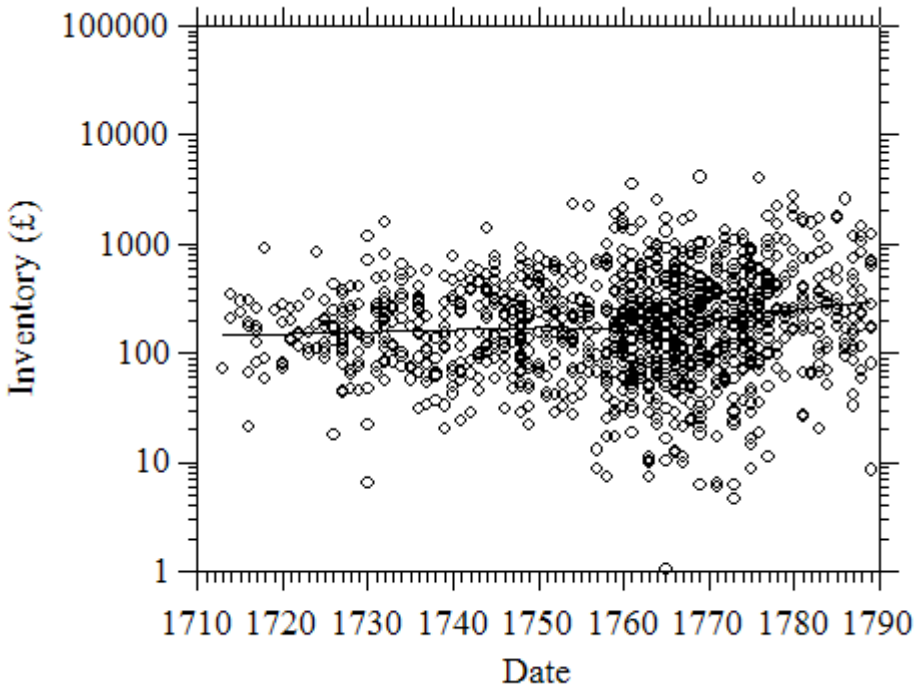

Figure 33. Value (£) of Yeomen's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

Farmers

In current parlance, "farmer" has come to mean anyone employed in agriculture without regard to their relations to production. However in late medieval Britain, farmers were a class of entrepreneur who operated leased land with hired husbandmen (M. Campbell 1942:27n). In 18th Chester County the term "farmer" appears to have been used by relatively well-off landowners who augmented their own holding with leased land. Although few in number, the farmer class grew rapidly throughout the 18th century (Figure 34), a pattern which persists into the 19th century to the point where the class becomes hegemonic, and farmer became synonymous with anyone having to do with agricultural production. The inventories of 59 Chester County farmers demonstrate an investment in agriculture second only to graziers and that they possessed a level of moveable wealth close to that of yeomen. Farmers invested only moderate portions of their estate in loans. Their approach to agriculture was very much like that of yeoman.

Husbandmen

Husbandmen were agricultural artisans who worked as long-term employees and who collected a negotiated wage and benefits. The ecological niche of the husbandman class was the open manors of Europe where they established themselves as skilled agrarians who managed their landlord's fields, orchards and meadows and were seen as a "petty farmer" (M. Campbell 1942:25-33; 82). After enclosure, those husbandmen who had not found the means to acquire land engaged in long-term agreements with local landlords and well to do yeomen. Concurrent with a decline in employer demand was a long, slow dissolution of the class.

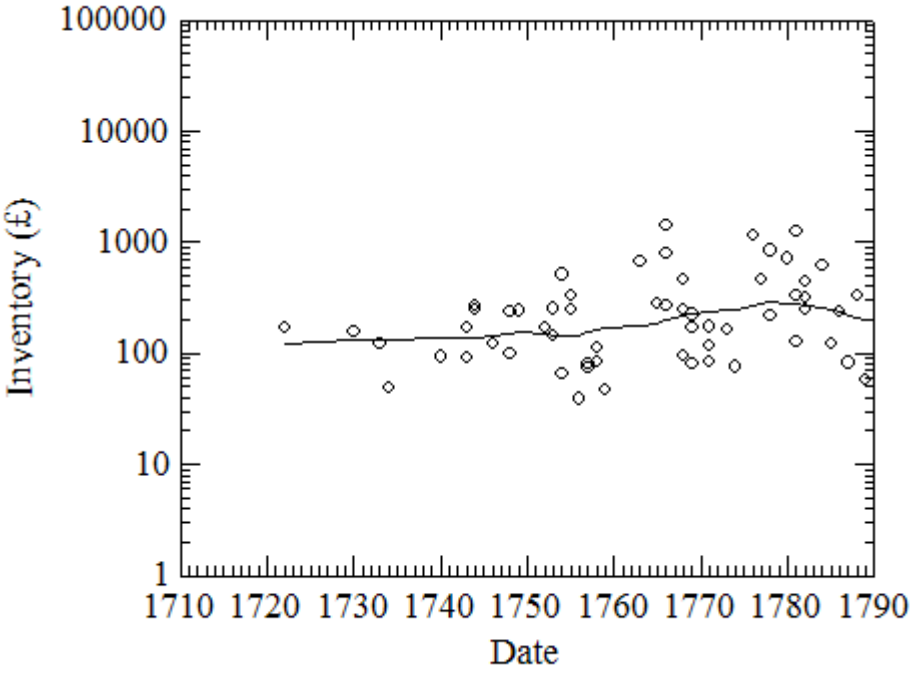

Figure 34. Value (£) of Farmer's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

Between the early 16th and early 18th centuries husbandmen fell from one-third of East Anglia agrarians to only one-tenth (M. Campbell 1942:27; Overton 1980:209).

The 19 inventories of Chester County husbandmen reflect the final days of the husbandman class. In a movement that presages the end of their yeoman employers, husbandmen appear only sparsely in probates authored after 1750. However, like yeomen, husbandmen broke up in the context of an increase in the value of their estates (Figure 35). Husbandmen invested moderately in agriculture overall, but possessed more implements of husbandry than any other class. Although husbandmen were traditionally landless, at least three Chester County husbandmen had acquired land. However, it may have been unimproved or he may have lacked sufficient labor or desire to establish their own plantation. Despite their low position in the relations of production, labor was in demand in the colonies and husbandmen accumulated estates whose values straddled the divide between the middle and lower-middle classes.

The Lower-Middle Classes

Widows

The principle of coverture meant that a woman's property became that of her husband at marriage. Woman owned property either as single women or as widows who stood as their husbands' legal "relict." However, as Lisa Wilson Waciega (1987) has argued, some widows in early southeastern Pennsylvania were active participants in business before and after their husbands' death. Nevertheless, most Chester County husbands who left wills between 1750 and 1790 did not intend for their wives to be economically independent. Nearly one-third left their wives with only the house and furnishing and just 7-percent left their widows the entire

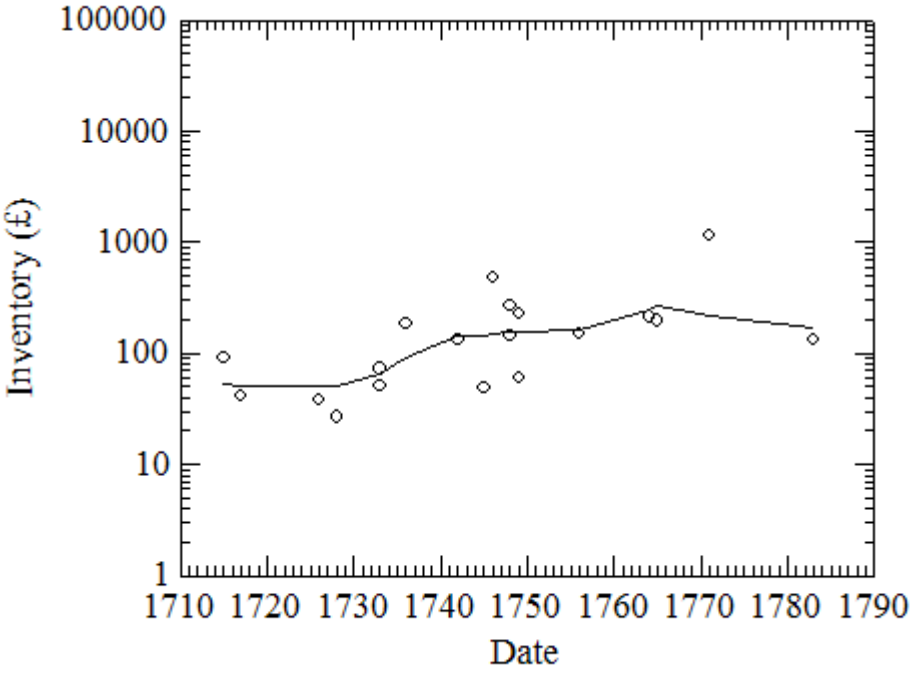

Figure 35. Value (£) of Husbandman's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

estate. Husbands commonly bequeathed their wives continued occupation within the household and a regular share of the proceeds (Wilson Waciega 1987:45-46, *c.f.* Wilson 1992).

As a class which overlaps nearly all others, widows, spinsters and single women followed the general pattern of the yeoman majority, but their wealth was somewhat diminished by the division their husbands and fathers estates (Figure 36). Women lent moderately, but only a few were heavily invested in agriculture. Most inventoried women (59-percent) had less than 5£ invested in agriculture and, on average, only 8-percent of their estates was composed of livestock, foodstuffs and agricultural tools. Nevertheless, some were actively engaged with the broader economy. Ruth Hoskins operated the Pennsylvania Arms at Chester (CC W&A 668) and Susanna Clayton of Chichester was described as a tailoress (CC W&A 1926). Catarina Shuster and Margery Baldwin were each described as yeomen, although neither of their inventories contained agricultural goods nor chattel (W&A 668, 3353, 3768). One might dismiss the attribution as a simple clerical error. However, considering the numbers of people who reviewed the probate documents, it is probably an acknowledgment of an achieved social status.

Untitled Persons

One cannot assume that people without a stipulated class were automatically part of the lower social ranks. The values of their inventories overlap all but the most wealthy households (Figure 37). In the aggregate, the value of their inventories place them in the lower-middle class. This suggests that the wealthier people tend to be better described, but

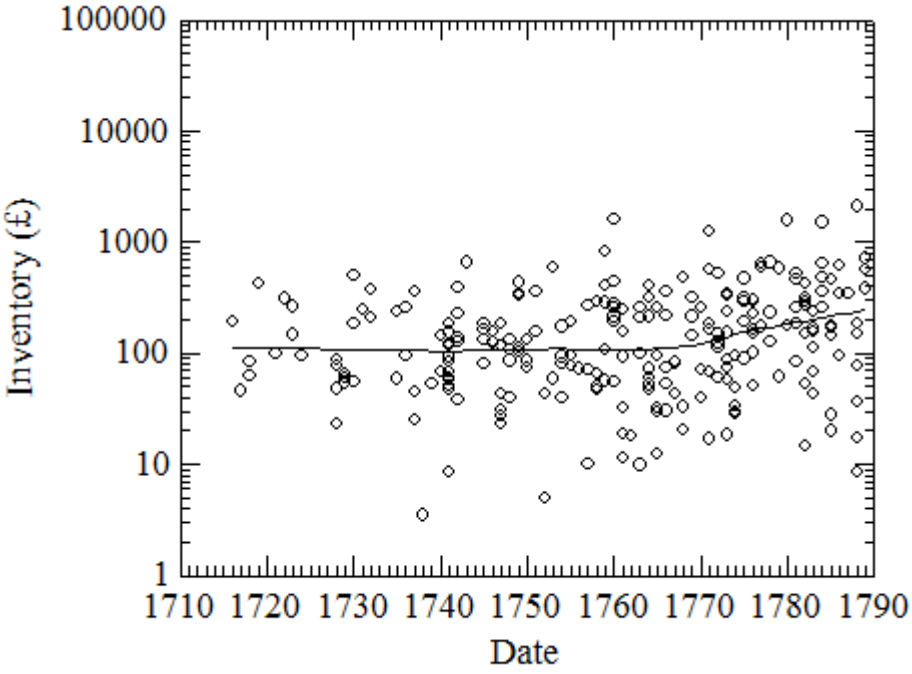

Figure 36. Value (£) of Windows, Spinsters and Single Women's Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve is at 0.5 tension).

not overwhelmingly so. As a group, their investments in agriculture and lending habits were very much like the yeoman majority.

Artisans

Benjamin Franklin estimated that in late 18th century Pennsylvania there was 100 cultivators for every artisan or manufacturer (Fletcher 1947:9-10). Franklin must have been making a distinction between urban artisans and rural people in general. Artisans represent 16-percent of inventoried men with a class identifier. The line between artisans and cultivators was a porous one and most artisans (76-percent) had more than 5£ in agricultural goods and chattel. They were as deeply invested in agriculture as the yeomen majority. Rural artisans combined agriculture and manufacturing as a way of augmenting and diversifying production. The numbers of rural manufacturers grew slowly throughout the 18th century (Figure 38).

The line between tradesmen and agriculturalists is further blurred by their symbiotic relationship. Rural manufacturers practiced trades which supported agriculture. Millers, millwrights, maltsters, coopers, tanners, and wagon masters processed and carried their produce to market. Carpenters, joiners, turners, sawyers, masons, plasterers, glaziers, and thatchers helped build and furnish their homes and barns. Blacksmiths, farriers, scythe makers, and wheelwrights hammered out a cultivators' tools and furnishings. The iron was generated from recycled tools and local mines. Iron had great value, and 9-percent of inventories included a box of "old iron," worn out implements which awaited recycling at the local forge.

Arthur Cecil Bining (1987) has surveyed the numerous iron forges in the eastern and southern portions of the county. A number of these iron workers left inventoried probates. The goods and chattel of Forge Master John Young of Vincent included 5800 pairs of

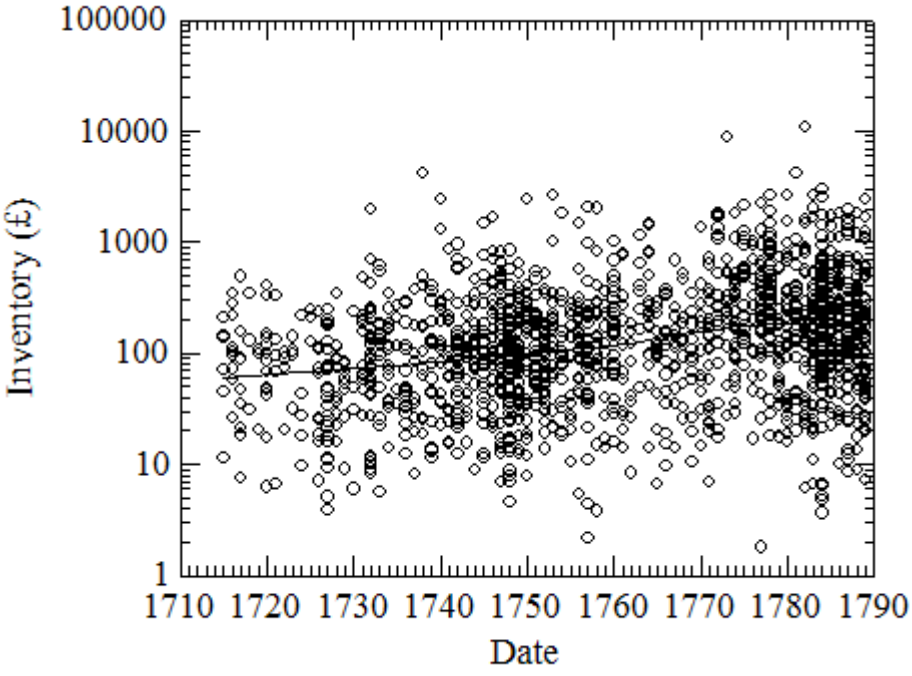

Figure 37. Value (£) of Unspecified Class' Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

horseshoes valued at 145£ in 1781 (CC W&A 3322). Samuel Nutt Sr. and his son of the same name had interest in the Coventry Iron Works, Rock Run Furnace, Coventry Steel Furnace, Reading Furnace No. 1 and 2 and Warwick Furnaces (Bining 1987:171-172). Their inventories included many tons of pig iron, cart boxes, iron plates and large quantities of trade goods such as molasses and rum (CC W&A 626, 658). The stores commonly associated with forges may have served as convenient way of bartering for old iron and dispensing the manufactured sent by English traders to balance their purchases of iron. The locally produced metal was regarded as somewhat brittle and inferior to European iron (Fletcher 1950:90). Nevertheless, Pennsylvania was the primary source of American iron exported to Britain (Bining 1987:162). Pennsylvania also supplied other colonies. The 1770 inventory of Edward Bayliffe of Newlin included 11 tons of pig iron which he had sent "on adventure" to Boston (CC W&A 2539).

Weavers, fullers and worsted combers, tailors and clothiers, cordwainers and shoemakers helped keep an agrarian household dressed. Cloth working employed the majority of Chester County artisans and most women. A little more than half of sampled inventories included some piece of spinning equipment or a loom (Table 12). The product of their labor was substantial. However, as Adrienne D. Hood (1994, 1996, 2003) has persuasively argued, these efforts fell short of domestic demand. Despite a steady increase in the presence of spinning equipment, hemp and flax throughout the 18th century (Hood 1996:51-53) most clothing was made from bolts of store-bought cloth made in British textile mills.

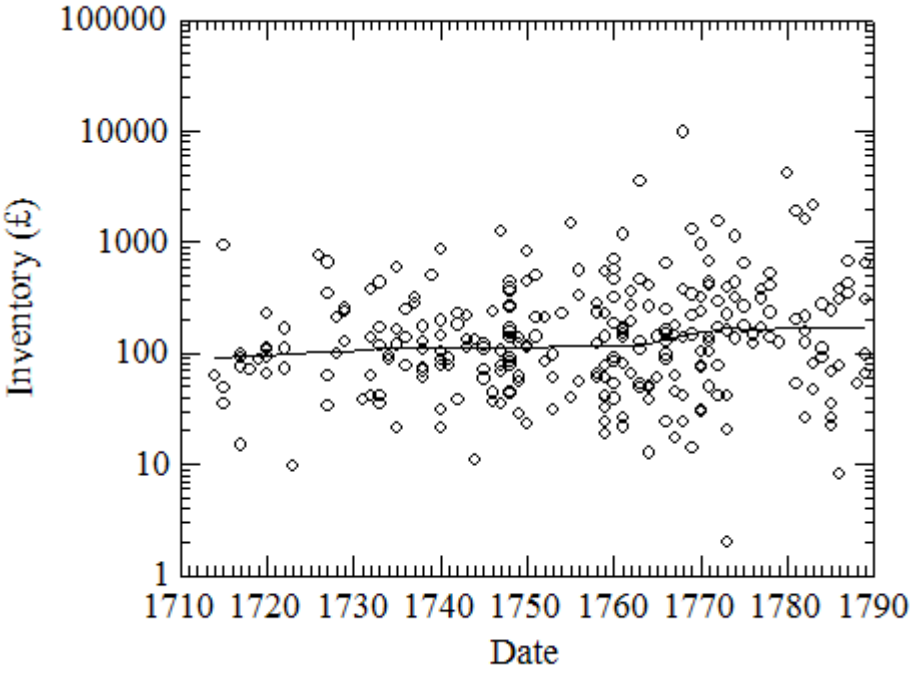

Figure 38. Value (£) of Artisan's Inventoried Goods and Chattel, Chester County, Pennsylvania,, 1713-1789 (LOWESS curve at 0.5).

Table 12. Textile Production in Chester County, Pennsylvania, 1713-1789.

	Sample	With Looms (%)	With Spinning Equip. (%)	With Flax & Hemp (%)	With Wool (%)	With Cotton (%)
1713-1719	75	2 (03)	9 (12)	5 (07)	6 (08)	0 (00)
1720-1729	206	8 (04)	62 (30)	12 (06)	27 (13)	0 (00)
1730-1739	291	22 (08)	113 (39)	36 (12)	30 (10)	1 (<1)
1740-1749	560	47 (08)	261 (47)	115 (21)	86 (15)	2 (<1)
1750-1759	482	36 (07)	234 (49)	111 (23)	68 (14)	0 (00)
1760-1769	648	42 (06)	321 (50)	200 (31)	74 (11)	1 (<1)
1770-1779	609	51 (08)	384 (63)	240 (39)	110 (18)	3 (<1)
1780-1789	680	44 (06)	398 (59)	222 (33)	99 (15)	0 (00)
	3551	252 (07)	1782 (50)	941 (26)	500 (14)	7 (<1)

The Lower Classes

Laborers

As the bottom of the economic scale in Chester County were laborers and schoolmasters. Both yeoman and farmers employed laborers who worked by the day or season. Their wages and benefits were calculated by considerations of the traditional rate for the specific task to be preformed and adjusted by the prevailing labor market. Laborers accounted for just 29 inventoried decedents (2-percent) and had no specific geographic focus. Laborers invested little of their estates in agriculture, but were typically in the possession of a reaper's tools and sometimes a horse. One in four laborers augmented his wages with a small field of grain or sheep. Although few in number, the laborer class persisted throughout the 18th century (Figure 39) and would grow substantially throughout subsequent centuries.

Laborer's left relatively meager inventories with a majority of their wealth in the hads of others. A portion of this money was in unpaid salaries, but it also included small notes and

book accounts. For example, 67£ of Daniel Graham of Sadsbury's 89£ estate inventoried in 1745 was composed of back wages from five different employers for work performed over the course of one, two and 12 month stints. One employer had paid extra to also have the use of Graham's horse. Although of relatively meager means, Graham still lent more than 12£ in small promissary notes (CC W&A 929). Laborer's lending and uncollected wages wasn't merely generosity, but was also a means of banking funds with person of means who could be tapped in times of need.

Schoolmasters

At the bottom of the classes of probated decedents were schoolmasters, the intellectual laborers of the 18th century. Prior to the establishment of public schools in the early 19th century, schoolmasters included instructors in established academies and people who were little more than skilled tradesmen who taught reading and writing. Reverend Henry Muhlenberg complained in 1745 that "every *servant* can play the part of a schoolmaster and make his living by schoolteaching in the winter and farm work in the summer" (Tappert and Doberstein 1942 1:99).

Many schoolmasters were indentured servants. Some of them had a habit of authoring their own freedom certificates. Lawrence Murphy who ran away from a city of Chester hatter in 1730 was described as a skilled weaver and schoolmaster (*Pennsylvania Gazette* 1:387). James Davenport taught school in Sadsbury Township for two and a half years before running from his master in 1769 *(Pennsylvania Gazette* 3:44250). John Scollay, John McCormick and James McCormeck used their writing skills to forge documents for themselves and others to

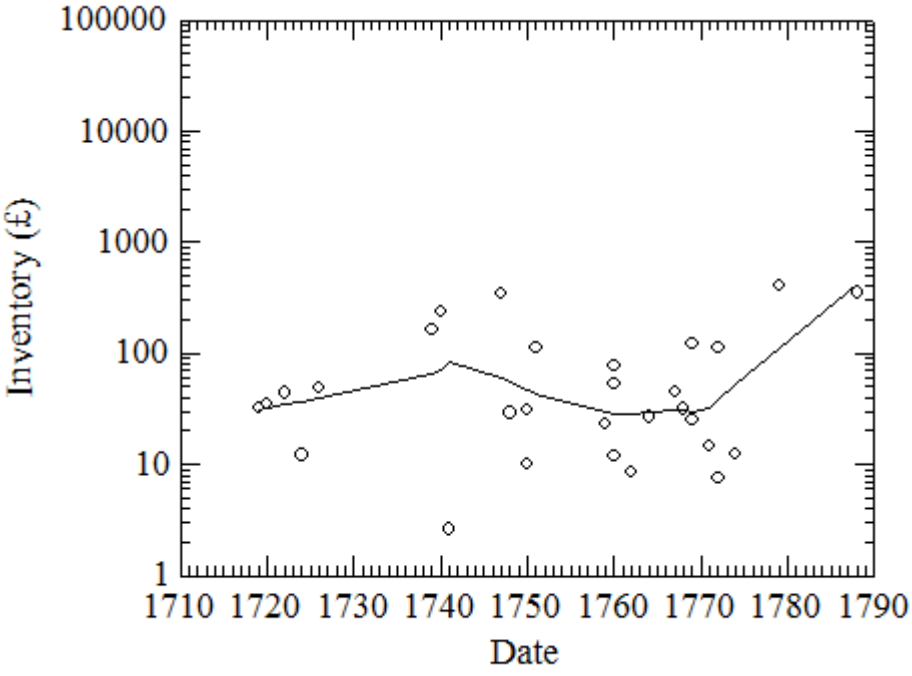

Figure 39. Value (£) of Laborers' Inventoried Goods and Chattel, Chester County, Pennsylvania, 1713-1789 (LOWESS curve at 0.5 tension).

assist their escape from undesirable masters in 1770 and 1772 (*Pennsylvania Gazette* 3:46438; 47003, 52372).

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The inventoried Chester County schoolmasters were all free men, but they had very little to their names. Their main source of income was a small salary for teaching and whatever they made reaping at the harvest. Some may have arrived as servants, but most appear to have been kinsmen of established Chester County families who passed at a young age.

Class in 18th Century Chester County

The class structure of 18th century Chester County contained the same basic elements of the traditional rural classes of Britain. These data suggest that they participated in the same social trends which resulted in the loss of husbandmen, persistence of gentlemen, merchant and labor classes, and growth of the farmer classes. In Chester County relative wealth equity was fostered by a large yeoman class. Yeomen not only dwarf all other classes, but the productive strategies of other classes were not very different from the social majority. Most merchants and artisans were cultivators themselves, and all catered to yeoman clientele. While

acknowledging internal differences in wealth and class attitudes, agricultural production in 18th century Chester County was dominated by yeoman ideals and practices. As a result, the following analyses of livestock, grain production, labor, and risk will regard all inventoried decedents, with or without class indicators, as part of a single, hegemonic yeoman majority.

CHAPTER 7

CROPS

Goods

The traditional wording of inventories describes moveable personal estate as "goods and chattel," a phrase which married the Old English and Norman French words for property. At one time, they had each referred to property in general. However, by the 14th century "goods" gained the connotation of something inanimate that was created or planted by people, and "chattel" referred to living creatures held in bondage (Oxford English Dictionary 1971). Chattel will be discussed in subsequent chapters. The present concern is the goods of agricultural production, namely grains and fiber.

Corn, Crop and Grain

In current usage, when a speaker of American English says "corn" they are usually referring to the Central American domesticate maize (*Zea mays)*. However, the word has changed meaning in the last two hundred years. In 18th century Pennsylvania, corn retained the British meaning of cereals in general and included wheat, rye, spelt, barley and buckwheat. For example, the appraisers of yeoman John David of Radnor's 1750 inventory described a field as "To Corn in the Ground Six acre of wheat at 10 sh. per acre" (CC W&A 1295). Oats were considered a fodder crop, and it was common for appraisers use phrases like "corn, oats

+ flax" which represented a tripartite categorization of cereals, fodder and fiber (CC W&A 1156).

With only one exception, 18th century Chester County appraisers used the words "corn," "grain" and "crop" interchangeably. In 1744, John Davis and Enoch Bonsall valued the "Corn and Grain" at Josiah Hibberd's Darby plantation at 13£ (CC W&A 899). Whether they were making some kind of distinction, or merely recognizing the two common terms is unclear. The three terms for cereals had differing periods of popularity, and more appraisers had begun to use grain (Table 13).

Table 13. Descriptors of Cereals in Chester County Inventories Probates, 1713-1789.

	"Corn" (%)	"Grain" (%)	"Crop" (%)	Sample Size	Average Value of Indian Corn (£)
1713-1719	**17 (100)**	0 (00)	0 (00)	17	2.53
1720-1729	**36 (82)**	5 (11)	3 (07)	44	1.68
1730-1739	**54 (84)**	7 (11)	3 (05)	64	2.56
1740-1749	**55 (71)**	13 (17)	9 (12)	77	3.40
1750-1759	**28 (57)**	7 (14)	**14 (29)**	49	2.45
1760-1769	**34 (52)**	17 (26)	**14 (22)**	65	3.49
1770-1779	13 (38)	**19 (58)**	2 (06)	34	3.72
1780-1790	11 (16)	**51 (73)**	8 (11)	70	4.19
Total	248 (59)	119 (28)	53 (13)	420	3.52

Although it was initially the most common term, descriptions like "corn in the field" or "corn in the barn" declined steadily throughout the 18th century. At mid-century, many appraisers experimented with "crop" as a potential way of avoiding confusion between corn in general and maize which they called Indian corn. It was a problem that was noticed in 1751 by

the appraisers of John Hunter, tanner, of Whiteland who recognized the evolving language and wrote "Corn of all sorts" (CC W&A 1397).

Crop is still in use, but after the American Revolution most appraisers preferred the word "grain" for cereals. The change in terminology was concurrent with an increase in the value and quantity of Indian corn in Chester County inventories and may have been influenced by simple practicality. However, it was also a period of an increasing adoption of the language of gentlemen reformers who usually preferred the Norman market name "grain" over the Anglo-Saxon field designations of "corn" and "crop." In any event, the changes were part of the formation of a distinct and common American language of production. In 1888, W. H. Brewer noted that the traditional British usage had disappeared from American language. He stated that Indian corn had become merely "corn" in both practice and legal statute, and that he had never heard an American-born cultivator use anything other than "head" to describe an ear of wheat, rye or barley (1888:399n).

Chester County appraisers were usually quite careful to differentiate between Indian corn and cereals in general. However, there were a few incidences where the meaning is open to interpretation. When the appraisers of the estate of John Boyle, a husbandman of Fallowfield, wrote "Wheat Corn and Oatts and Raye" the structure of the sentence suggests that they were probably referring to wheat seed, oats and rye (CC W&A 569). However, it is also possible that the word "Indian" was assumed or accidently dropped. Moses Turner, an Oxford chapman's inventory included "Corn in ears" (CC W&A 2063). In modern usage, the word "ear" would suggest Indian corn. However, traditional usage of the word was to describe any cereal still in its sheaf. Fortunately, these two incidences represent a very few cases where the intent was unclear. In addition, in only 13-percent of cases did appraisers fail

to provide sufficient description to determine which of the seven cereals they planted (Table 14). "Meslin" is a mixed crop of wheat and rye.

Table 14. Grains in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain (%)	Value (£)	£ Per Bu.	Estimated Bushels (%)	£ Per Acre	Estimated Acres (%)
Wheat	1,258 (63)	24,553 (51)	0.26	94,435 (49)	1.08	22,734 (54)
"Meslin"	564 (28)	9,714 (20)	0.19	51,126 (27)	1.04	9,340 (22)
Rye	632 (31)	3,209 (07)	0.24	13,371 (07)	0.80	4,011 (09)
Indian Corn	653 (32)	2,296 (05)	0.17	13,506 (07)	0.77	2,982 (07)
Oats	523 (26)	1,422 (03)	0.11	12,927 (07)	0.73	1,947 (05)
Barley	254 (13)	745 (02)	0.20	3,725 (02)	0.95	784 (02)
Buckwheat	311 (15)	496 (01)	0.15	3,307 (02)	0.92	539 (01)
Spelt	3 (00)	5 (00)	0.09	56 (00)	--	--
Misc. Grain	619 (31)	5,323 (11)	--	--	--	--
	2,012 (100)	47,763 (100)	0.18	192,453 (100)	0.90	42,337 (100)

Wheat (Triticum aestivum)

Chester County cultivators grew more wheat than any other grain. Wheat was not only the most numerous item, but it also accounted for about half of the value, quantity, and acreage of inventories cereals. The actual production of wheat was even a bit higher since it was also a component of inter-cropped grains which agricultural historians often describe as "meslin" after a common name for the bread which is made from a mix of flours (Fletcher 1950:151). Chester County appraisers never used that term, instead referring to it as simply "wheat and rye." In a few rare cases barley was included as well. If one assumes that at least

one half of meslin was composed of wheat, that grain accounted for two-thirds of Chester County's total cereal production.

It is unclear what varieties of wheat Pennsylvanians grew in the 18th century. Later agricultural reformers were careful to track the breeds of grain they introduced from other parts of the world, but appraisers made no reference to varieties. Despite his being sent to gather information on marketable crops, Kalm's journal says very little about wheat (Benson 1937).

Southeastern Pennsylvania was home to a number of internationally known botanists such as John and William Bartram, Humphry Marshall, and William Darlington, but their shared focus was the natural world. Marshall's (1786) one foray into practical agriculture was to advocate the planting of fodder crops (in Darlington 1849:582-585). William Darlington's (1853) *Flora Cestrica: An Herborizing Companion for the Young Botanists of Chester County* recognized a spring and winter varieties of wheat, and notes that its appearance was variable and included hues of white, pale yellow and brown. However, he makes no attempt at differentiating local wheat from other varieties. There may well have been too much variability to easily do so. A late 17th century inquiry in Oxford, England identified 13 varieties of wheat in use in just that one locale (Overton 1996:106-107).

Chester County appraisers made few distinctions in reference to the more than 3,800 short tons of wheat they inventoried between 1713 and 1789. In about 50 incidences appraisers described grain by the season in which is was sown, principally mentioning winter grain. In about 10 cases the appraisers described spring or both winter and spring grains. Phrases like a field of "summer grain" and a "fall crop" referred to the season of harvest rather than quality of the seed. In current language, "winter wheat" is often used to refer to hard,

high protein and glutenous varieties of bread flour, and "spring wheat" for softer, lighter cake flour. However, these distinctions are of recent origins.

The majority of Chester County households who possessed grain, had wheat products in the form of sown seed, standing crops, unthreshed sheaves, threshed kernels, cleaned grain in linen bags, and kegs of flour or bran (Tables 15). A careful appraiser often included the specific quantities of seed expressed as quarters, bushels, pecks, dozens or sheaves, and the acreage of field crops (see Appendix B for colonial weights and measures). Between 1713 and 1760, the typical Chester County yeoman planted between 22 and 25.5 acres of wheat. After that date, the mean acreage of wheat fell in each decade as wheat was replaced by locally consumed grains.

Table 15. Wheat in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Wheat (%)	Mean Value (£)	£ Per Bushel	Mean Bushels	£ Per Acre	Mean Acres
1713-1719	43	31 (72)	23.32	0.15	155	1.00	23.32
1720-1729	105	65 (62)	14.40	0.16	90	0.63	22.86
1730-1739	183	103 (56)	16.87	0.14	121	0.66	25.56
1740-1749	327	203 (62)	13.72	0.16	86	0.63	21.78
1750-1759	275	166 (60)	18.27	0.21	87	0.73	25.03
1760-1769	366	217 (59)	18.90	0.24	79	1.05	18.00
1770-1779	360	243 (68)	23.89	0.30	80	1.54	15.51
1780-1789	353	230 (65)	23.61	0.32	74	1.60	14.76
	2012	1258 (63)	19.52	0.26	75	1.08	18.07

A comparison of the estimated average quantities reveals that yeomen usually planted winter wheat in September and spring wheat in February and March (Table 16). The winter wheat was harvested in July and spring wheat in August. These data indicate that Peter

Kalm's mid-century observation that wheat and rye were planted in late September captured the time when planting was commonly finished, and his observation that the grain was ripe in mid-June marked the very beginning of the harvest (Benson 1937:75). There was a steady decline in the quantity of wheat in yeoman's barns in the months following the harvest. However, those with wheat tended to keep about half the crop on hand throughout the year. No doubt this grain would be used for household consumption, but it was also likely that producers were banking grain until personal need or a favorable market encouraged its sale. Their freedom from the "Corn Laws" of Britain meant that Chester County yeomen could refuse sale until grain was most dear in Europe.

Table 16. Wheat by Month in Chester County, Pennsylvania Inventories, 1713-1789.

	With Bushel Values (%)	Mean £ Per Bushel	Mean Bushels	With Acre Values (%)	Mean £ Per Acre	Mean Acreage
January	42 (09)	0.25	49. 05	18 (06)	1.40	11.05
February	33 (07)	0.22	51. 92	19 (07)	0.76	13.13
March	62 (13)	0.26	57. 14	38 (13)	1.10	14.23
April	54 (11)	0.23	45. 70	39 (14)	1.02	13.12
May	48 (10)	0.24	65. 13	36 (13)	1.08	12.63
June	43 (09)	0.26	60. 11	35 (12)	0.98	12.16
July	13 (03)	0.27	72. 36	11 (04)	1.07	14.48
August	30 (06)	0.26	88. 48	6 (02)	1.23	11.91
September	36 (07)	0.30	77. 07	12 (04)	1.13	16.39
October	53 (11)	0.27	94. 30	30 (11)	1.03	14.68
November	44 (09)	0.25	87. 62	19 (07)	1.13	12.35
December	32 (07)	0.27	59. 93	20 (07)	1.37	14.07
	490 (100)	0.26	69. 50	282 (100)	1.08	13.30

Britain's Corn Laws were a collection of mercantilist economic policies which controlled the price and sales of grain. British producers were forbidden from engrossing

quantities of grain or forestalling sales in order to take advantage of the changing market (M. Campbell 1942:184-196). By fixing prices and barring the exportation of grain in lean times, these laws leveled the market and acted to keep bread affordable for the urban poor. However, they also meant that rural producers could not take advantage of a strong market price. Chester County yeomen were free of most legislated constraints and their inventories suggest that they regularly forestalled sales of wheat. Whereas British farmers had to quickly send their product to market, American yeomen usually only sold their crop after the next one had already come in.

Chester County wheat was taken to market along various paths. Most of it was sent to local mills where it was ground, separated from the outer bran and course flour "middlings," and placed in casks. Some enterprising merchants had the flour baked into loaves of "ships bread"which was an unleavened biscuit preserved by dehydration. A small proportion of inventories included marketable quantities of these goods (Table 17). Most producers allowed the miller to act as a middleman with the exporter. For example, James Townsend of Birmingham's 1745 inventory included "Thirty Bushels of Wheat in Benjamin Taylor's Mill" which the appraisers set aside "for the use of the family" and Joseph Rogers of Vincent's 1778 estate included "179 bushels & 10 lbs. Wheat left at Rowland Evan's Mill" (CC W&A 960, 3434).

Others producers dealt directly with merchants. Thomas Pennell of Middletown's inventory included more than 15 tons of wheat, nearly a short ton of flour and 330 lbs. of bread. No doubt they were to be transported on his ship, the Brigantine Wilmington (CC W&A 1306). Philadelphia merchants made purchases in Chester County. When John Ackroyd died in 1784, he left goods in storage which included 21.5 short tons of flour, four short tons

of middlings, more than a ton of ship bread, and 340 bushels of bran and shorts (CC W&A 3620). The grain was probably scheduled to be sent to Britain to replenish the stock he sold at his dry goods store on Third Street in Philadelphia (*Pennsylvania Gazette* 3:19935).

Table 17. Wheat Flour, Bran and Bread in Chester County, Pennsylvania Inventories, 1713-1789.

	With Wheat	With Flour	Mean Flour	With Bran	Mean Bran	With Bread	Mean Bread
1713-1719	31	3 (10)	64.29	--	--	--	--
1720-1729	65	12 (18)	14.51	--	--	--	--
1730-1739	103	23 (22)	18.63	2 (02)	3.44	--	--
1740-1749	203	29 (14)	9.25	7 (03)	1.01	--	--
1750-1759	166	25 (15)	12.07	4 (03)	1.57	2 (01)	18.47
1760-1769	217	36 (17)	9.73	11 (05)	1.25	--	--
1770-1779	243	31 (13)	22.11	15 (06)	1.85	4 (02)	3.07
1780-1789	230	26 (11)	19.32	3 (01)	11.41	1 (00)	10.83
	1258	185 (15)	15.69	42 (03)	2.28	7 (01)	8.58

Other producers dealt directly with local businesses. Michael Kennedy's (2000) study of the ledgers of 18th century ironworks and mills in southeastern Pennsylvania revealed that grains, principally wheat, rye and oats, represented a significant proportion of the goods sold by county residents. Wheat was sold more often than more perishable products like butter, milk and meat (:600-605).

Spelt (Triticum aestivum subsp. spelta or Triticum spelta)

Spelt is a variety of wheat with a heavy-hull which protects it from spoilage, but can be difficult to remove. The grain is most commonly associated with early 19th century German-speaking Pennsylvanians (Fletcher 1950:153), but the four Chester County decedents

who planted spelt between 1755 and 1771 carried last names which originated in Wales, England and the Netherlands (CC W&A 1554, 2040, 2364, 2664). In the one instance in which the value and quantity of spelt were recorded, it was appraised at a lower value lower than any other grain. Its low value may have reflected the extra labor necessary to remove the thick and tightfitting chaff. In the 19th century that work was carried out by especially equipped mills (Fletcher 1950:153).

In the 18th century spelt appears to have been intended as fodder and was grown by inter-cropping it with oats. The 1771 inventory of yeoman John Starrett of East Nantmeal lists "oats and spelts in ye sheaf" (CC W&A 2664). That mixture is a common recipe for quality horse feed. However, it may have also be grown as food. For example, the 1767 estate of yeoman James Fleming of East Caln included "Wheat, Rye and Spelch in the ground" (CC W&A 2364), which suggests that the spelt was planted as part of the winter crop for human consumption.

Rye (Secale cereale)

Rye was a secondary crop that was just as likely to be sown in conjunction with wheat as it was grown in a field by itself. On average, Chester County inventories included 23 bushels, or slightly more than a half a ton, of rye (Table 18). Current breeds of rye include winter and spring varieties, but Chester County appraisers never made that kind of distinction once the rye was out of the field.

Rye was primarily a domestic product and was eaten as a component of brown bread made from wheat and rye. Rye straw was the material of choice for thatching roofs and weaving beehives and baskets (Fletcher 1950:151). Most of which appears to have been eaten

as bread, but the incidences of rye meal in inventories are quite low. Only a dozen inventories authored after 1748 include rye flour. Although rye bread was later associated with German-Americans, the decedents with rye flour had last names primarily originating in Britain. The inclusion of rye meal may suggest the point in which rye was grown in sufficient quantities to be recognized as a marketable commodity and therefore worthy of appraisement.

Table 18. Rye in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Rye (%)	Mean Value (£)	£ Per Bushel	Mean Bushels	£ Per Acre	Mean Acres
1713-1719	43	3 (07)	1.75	--	--	0.50	3.00
1720-1729	105	10 (10)	2.20	0.12	25.08	0.42	3.67
1730-1739	183	25 (14)	2.47	0.18	17.01	0.46	4.78
1740-1749	327	77 (24)	2.60	0.17	14.74	0.53	4.74
1750-1759	275	68 (25)	3.22	0.15	21.83	0.51	5.16
1760-1769	366	121 (33)	3.91	0.19	19.63	0.61	6.42
1770-1779	360	166 (46)	6.98	0.27	22.86	1.27	5.91
1780-1789	353	162 (46)	6.60	0.22	28.84	0.90	6.54
	2012	632 (31)	5.08	0.22	22.80	0.80	5.72

A contributing factor to rye's marketability is the growth of the whiskey industry (Table 19). At the turn of the 19th century, William Strickland observed that except for that used by German women to make bread, rye was "entirely consumed" by distillers of whisky for sale to "Irish frontiersmen" (Fletcher 1950:151). While rye was increasingly produced in Chester County throughout the century, it wasn't until after 1760 that whiskey began to appear in inventories and dominate a niche once held by Caribbean rum (Table 18). The whiskey industry had little impact on the production of metheglin, an ancient variety of honey wine, and cider. Cider was the most common fermented beverage and was a daily drink by

people of all ages. It was often thinned to make "water cider" or turned into apple vinegar to be used as a food preservative.

Table 19. Stills, Spirits, and Fermented Beverages in Chester County, Pennsylvania Inventories, 1713-1789.

	Stills (%)	Metheglin (%)	Rum (%)	Whiskey (%)	Wine (%)	Beer (%)	Cider (%)
1713-1719	--	--	2 (02)	--	2 (02)	2 (02)	--
1720-1729	3 (01)	--	--	--	--	--	4 (02)
1730-1739	5 (02)	1 (<1)	6 (02)	--	--	1 (<1)	13 (04)
1740-1749	7 (01)	4 (01)	6 (01)	--	1 (<1)	2 (<1)	38 (07)
1750-1759	10 (02)	5 (01)	13 (03)	--	6 (01)	1 (<1)	36 (07)
1760-1769	21 (03)	14 (02)	19 (03)	4 (01)	14 (02)	3 (<1)	61 (09)
1770-1779	28 (05)	11 (02)	7 (01)	11 (02)	8 (01)	1 (<1)	45 (07)
1780-1789	15 (02)	11 (02)	4 (<1)	12 (02)	6 (01)	2 (<1)	62 (09)
	89 (03)	46 (01)	57 (02)	27 (01)	37 (01)	12 (<1)	259 (07)

"*Meslin"*

As previously mentioned, Chester County yeomen often inter-cropped wheat and rye as a winter crop. Historians of agriculture commonly refer to these grains as "meslin" after a common name for light rye bread made from a mixture of flours. Chester County appraisers never used the term, and usually just referred to the crop as "wheat and rye." Lord Ernle (Prothero 1961) traces the mixing of the flours to ancient Britain where it had been known as *mixlilio* during the period of Roman influence, *mestilon* in the 13th century, *miscellin* in the 16th century, *massledine* in the 17th century, *mashelson* in the 18th century, and maslin in the 19th century (:8). In American English the bread is usually called "meslin."

Gentlemen reformers were in disagreement over the wisdom of planting a mix of wheat and rye. Thomas Tusser wrote in the 16th century that "rye tarry wheat" such that the ripe wheat would begin to fall from the stalk before the rye had ripened. However, a contemporary named John Fitzherbert recommended mixed cropping to prudent husbandmen (Prothero 1961:8-9). The varied experiences may have been the result of differences in planting schedule, location, climate and seed. The mean acreage of meslin indicates that the quantity of inter-cropped wheat and rye followed the same course as wheat. It was sown in the largest quantities in the first half of the century, but waned in the second half (Table 20). Much of that fall is due to a reduction in the overall production of grain accompanying falling parcel size in the second half of the century. Although crops grew smaller, the practice of inter-cropping wheat and rye became increasingly popular such that in the 1760s four in 10 grain producers mixed their grain fields.

Table 20. "Meslin" in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Meslin (%)	Mean Value (£)	£ Per Bushel	Mean Bushels	£ Per Acre	Mean Acres
1713-1719	43	3 (07)	18.47	--	--	--	--
1720-1729	105	7 (07)	13.10	0.15	32.00	0.59	11.99
1730-1739	183	29 (16)	11.87	0.10	29.50	0.40	17.21
1740-1749	327	82 (25)	13.62	0.15	116.94	0.56	24.93
1750-1759	275	89 (32)	14.53	0.19	67.53	0.73	17.48
1760-1769	366	147 (40)	16.80	0.22	53.65	1.03	17.37
1770-1779	360	114 (32)	23.56	0.19	139.41	1.52	14.31
1780-1789	353	93 (26)	17.81	0.21	40.20	1.36	13.72
	2012	564 (28)	17.22	0.19	78.38	1.04	17.01

The growth of the practice of inter-cropping suggests that rye may have been resistant to whatever forces were depressing the production of wheat. The average value of a field of meslin tended to closer to wheat than rye, but the average bushel price was less than that of wheat or rye grown individually. That relationship suggests that inter-cropped wheat and rye was most valued when it was in the field, but less so in the barn. This middling value indicates that the value of inter-cropping was its assurance in the delivery of a crop, rather than the quality of the resulting grain.

Barley (Hordeum vulgare)

Barley was a quick maturing summer crop. Peter Kalm reported that barley was sown in April and ripe at the end of July (Benson 1937:75). Barley was principally grown in small quantities for the production of beer which was a relatively uncommon fermented beverage in the county (Table 21, see Table 19). Only one in 10 those households who grew grain raised barley and those few who did typically sowed only a single acre. Sixteen inventories included malt mills suggesting that some households made their own beer, but most sold their barley to a "maltster" who would sprout the barley in order to convert its carbohydrates to sugars.

Chester County brewers included four Maltsters for whom brewing was a major undertaking. William Levis, a Kennett Maltster, died in 1747 possession of a malt house which contained 800 bushels or 13.6 tons of malt valued at 130£ (CC W&A 1034). Assuming a ratio of 6 lbs. of malt per five galleons of water, Levis' stores would have produced about 700 barrels of beer. His death contributed to the extraordinary mean value of malt in the 1740s and his stores were equal to the barley production of dozens of households. While the brewing of beer was a minor industry, it persisted throughout the century. Barley and malt

were grown in its largest quantities in the first half of the century, but persisted in the second half as a part of the rural ecology.

Table 21. Barley and Malt in Chester County, Pennsylvania Inventories, 1713-1789.

	With Barley or Malt (%)	Malt Mean Value (£)	Barley Mean Value (£)	Barley £ Per Bushel	Barley Mean Bushels	Barley £ Per Acre	Barley Mean Acres
1713-1719	3 (07)	--	1.87	--	--	--	--
1720-1729	8 (08)	1.80	4.48	0.12	57.17	--	--
1730-1739	31 (17)	2.33	2.70	0.11	28.46	--	--
1740-1749	38 (12)	13.54	6.28	0.14	16.74	1.25	1.00
1750-1759	39 (14)	2.25	2.38	0.15	13.85	0.60	1.00
1760-1769	46 (13)	1.38	2.17	0.17	11.72	--	--
1770-1779	52 (14)	0.88	1.77	0.25	12.33	1.00	0.75
1780-1789	37 (10)	1.36	2.59	0.28	12.41	--	--
	254 (13)	3.50	2.93	0.20	--	0.95	0.88

Indian Corn (Zea mays)

Indian corn represented only 5-percent of the appraised value of all grain grown in Chester County (Table 22, see Table 13), but it grew in importance throughout the century. Maize had been grown in the Middle Atlantic prior to British occupation and the colonial proprietor recommended it as a starter-crop for new colonists. Indian corn had provided early colonists with critical sustenance, but in the 1720s, it all but disappeared from Chester County fields. In subsequent decades yeomen planted increasing quantities of Indian corn until it became a substantial market crop after the American Revolution. Cornmeal appears in nine inventories. The earliest of which appeared in 1758 and the remainder postdate 1768. The low frequency of cornmeal in inventories may suggest that Indian corn was a fodder crop.

However, domestic staples like rye flour was also similarly rare in inventories. Since Indian corn is found in households with and without livestock, it is probable that it was consumed by both Chester County yeomen and their animals.

Table 22. Indian Corn (Maize) in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Maize (%)	Mean Value £	Mean £ Per Bushel	Mean Bushels	£ Per Acre	Mean Acres
1713-1719	43	7 (16)	2.53	--	--	--	--
1720-1729	105	8 (01)	1.68	--	--	--	--
1730-1739	183	35 (19)	2.56	0.16	18.51	0.65	4.25
1740-1749	327	72 (22)	3.40	0.11	34.64	0.59	3.63
1750-1759	275	75 (27)	2.45	0.11	19.54	0.46	8.85
1760-1769	366	136 (37)	3.49	0.17	19.27	0.75	5.98
1770-1779	360	149 (41)	3.72	0.20	19.27	1.15	4.84
1780-1789	353	171 (48)	4.19	0.18	22.50	0.86	19.92
	2012	653 (32)	3.52	0.17	21.92	0.77	8.94

Some researchers appear to have overestimated the role of Indian corn in Pennsylvania. In their classic investigation of colonial prices at Philadelphia, Bezanson, Gray and Hussey (1935:56-66) argued that Indian corn was second only to wheat in the Philadelphia grain market. A title properly held by rye. Philadelphia merchants may have exported Indian corn from other colonies, but it is more likely that the authors misread references to "corn" as Indian corn rather than grain in general. For example, the authors interpreted a 1736 reference to "old corn" as Indian corn, rather than the crop of a previous year (:57). Similarly, a merchant's statement that in Barbados "there is now a much greater call for corn than flour" (:61) isn't necessarily a call for maize, but a desire for unmilled wheat to supply the island's mills. A clear indicator that merchants were sometimes referring to

winter grains was a Philadelphia merchant's observation in mid-February 1768 that "No corn yet comes up, tis supposed it will be about 2 shillings 6 pence per bushel" (:63). Indian corn, a summer crop and typically wouldn't have been planted, let alone sprout, for another two or three months. At least in some cases, Bezanson, Gray and Hussey (1935) appear to have taken references to "corn" has Indian corn. As a result, both quantity and price of Indian corn are likely to have been overestimated and the quantity of wheat to have been underestimated.

Oats (Avena sativa)

One can make oats palatable by crushing and long boil to form a porridge. However, it was only in later centuries that industrially cut, rolled and steamed oats became a regular part of the American diet. In 18th century Chester County, oats were a fodder crop used to supplement hay. Even yeoman John Brennen of Upper Darby, whose household made use of flour, bran, rye meal, corn meal and buckwheat flour didn't include oatmeal (CC W&A 2472). Oats were grown in relatively large amount prior to 1740, but suffered a drop in popularity until after the American Revolution (Table 23). Oats were planted as a summer crop in April and harvested in August (Benson 1937:75).

Buckwheat (Fagopyrum esculentum)

Despite its name, buckwheat is not a grass but a vine with a relatively large seed. Buckwheat had periodic popularity in the 1750s and 1780s, but for most of the century was grown in only small amounts (Table 24). Only three inventories authored between 1769 and 1788 included buckwheat flour, but that number is about the same proportion as possessors of rye flour and cornmeal. Peter Kalm reported that buckwheat was planted and harvested in

July, and if planted any earlier, the plants would flower and won't produce seed. If planted too late, it might have been ruined by frost (Benson 1937:75, 183). The life cycle of buckwheat may account for its relative rarity since it required attention during the busiest time of the year.

Table 23. Oats in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Oats (%)	Mean Value £	£ Per Bushel	Mean Bushels	£ Per Acre	Mean Acres
1713-1719	43	5 (12)	4.18	--	--	--	--
1720-1729	105	10 (10)	1.84	0.08	27.16	0.18	4.91
1730-1739	183	27 (15)	1.65	0.07	19.64	0.25	6.00
1740-1749	327	77 (24)	2.17	0.08	27.84	0.80	2.82
1750-1759	275	63 (23)	2.44	0.08	30.55	0.64	2.50
1760-1769	366	110 (30)	2.04	0.10	21.84	0.62	2.19
1770-1779	360	115 (32)	3.98	0.15	28.49	0.92	2.77
1780-1789	353	116 (33)	2.90	0.10	26.79	1.40	6.50
	2012	523 (26)	2.72	0.11	26.38	0.73	3.14

Table 24. Buckwheat in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Buck (%)	Mean Value £	£ Per Bushel	Mean Bushels	£ Per Acre	£ Mean Acres
1713-1719	43	1 (02)	1.75	--	--	--	--
1720-1729	105	--	--	--	--	--	--
1730-1739	183	8 (04)	0.62	0.07	8.54	--	--
1740-1749	327	14 (04)	0.92	0.08	8.34	--	--
1750-1759	275	26 (09)	1.65	0.12	20.15	--	--
1760-1769	366	59 (16)	1.03	0.13	8.12	0.75	1.08
1770-1779	360	98 (27)	1.56	0.19	8.59	--	--
1780-1789	353	103 (29)	1.83	0.15	13.08	--	--
	2,012	311 (15)	1.59	0.15	11.03	0.92	1. 08

Fletcher (1950) asserted that buckwheat was commonly associated with the rural poor since an adequate crop could be grown on infertile soils (:152-153). His source for that comment was probably Henry M. Muhlenberg's journal. In September 1784 the reverend commented that an early frost had withered the buckwheat blooms. Noting that buckwheat is "a necessary article of food for man and beast" and feared that "when it fails it is hard for the poor" (Tappert and Doberstein 1947 3:613). It is true that bushel values of buckwheat were lower than those of wheat, rye and barley. However, Chester County buckwheat producers left inventories which averaged 150£ higher than grain producers who didn't grow it. Muhlenberg himself was quite pleased when friends and parishioners made him a gift of buckwheat flour. It may well be that urban poor sought to economize by eating buckwheat, but much of the buckwheat grown in Chester County was consumed locally.

Flax (Linum usitatissimum)

Flax was an important domestic crop for fiber used to make linen clothing, bedding and grain sacks, and for seeds which were ground for linseed oil or used as cattle feed. The best fiber is made from stalk which was harvested while green, and the best oil was made from the seeds of a plant allowed to mature (Barker 1917:503). Flax was a minor crop before 1730 when it was grown as a raw material for weavers (Table 25). As the century progressed, increasing numbers of Chester County yeomen grew flax, but it never represented more than a small part of the total planted acreage. Historians have noted that flax seeds were an important export crop, particularly to Ireland (Doerflinger 1986:103; Wokeck 1989:135; R. Nash 1995:338-339; Hood 1996:50). Philadelphia exported 70,000 bushels in 1752, about 85,000 bushels in 1767, and more than 110,000 bushels in 1771 (Flint 1864:89-90). Chester

County yeomen were probably glad to have the income from the flaxseed. However, the labor involved in sowing, pulling, rippling, retting, scutching, hackling and spinning flax meant that they were unlikely to plant more than that which satisfied local consumption. Chester County yeoman typically planted an acre or two in flax.

Table 25. Flax in Chester County, Pennsylvania Inventories, 1713-1789.

	With Grain	With Flax (%)	Mean Value (£)	£ Per Acre	Mean Acres
1713-1719	43	5 (12)	0.81	--	--
1720-1729	105	12 (11)	1.28	--	--
1730-1739	183	35 (19)	1.09	--	--
1740-1749	327	115 (35)	1.21	--	--
1750-1759	275	111 (40)	1.25	0.69	1.81
1760-1769	366	194 (53)	1.06	0.86	1.23
1770-1779	360	236 (66)	1.96	1.65	1.19
1780-1789	353	213 (60)	2.06	1.50	1.96
	2,012	921 (46)	1.57	0.91	1.73

Processing flax for fiber began with the pulling of the green plant out of the ground leaving the roots intact. The stalks were often cured which served to dry the stalks. Since the roots were still intact, the seeds also continued to mature until they were removed by threshing or by rippling through an iron comb (Barker 1917:505-506). Appraisals of iron combs and ripples in probate inventories indicates that both methods were used in Chester County. Rippled seeds were commonly fed to cattle, whereas cured seeds could be crushed to produce linseed oil (Barker 1917:506-507).

Despite its many uses, only the 1770 inventory of yeoman John Carter of East Bradford contained linseed oil (CC W&A 2572). Undoubtably, he had his flaxseed at a nearby

oil mill which was the first of its kind in the county (Lemon 1972:200-202). Carter's 11 galleons of linseed oil was valued at about 2£. Others lfax growers sold their seeds to local flax dealers like Charles Corbett, a cooper of Ridley. Corbett filled casks with flaxseed and then shipped them out of a small port in New Castle County, Delaware. His 1777 inventory records that he had recently shipped 68 half-casks containing a total of 74 bushels of seed. Since his last shipment he had filled another 20 half-casks, and had crafted another 30 half-casks for additional seed (CC W&A 3748).

Once the seeds were removed, the linen fibers were loosened by retting (rotting), either through a prolonged submersion in water or exposure to precipitation. The plants intact roots continued to hydrate the plant and accelerated decomposition. Once throughly rotted, the flax was dried and bleached by exposure to sunlight. The fibers were removed from the stalk by "scutching," a process where the worker broke the brittle bark by twisting and striking with a hand or paddle (Barker 1917:506-513). The released fibers retained a fair amount of oil and once they were hackled with a metal brush to divide the fibers, they were sufficiently pliable for spinning and weaving.

Hemp (Cannabis sativa)

The primary use of hemp in colonial American was in the manufacture of rope. Hemp was found in only 98 inventories and rarely in large amounts. The typical lot of hemp weighed about 75 lbs. and was valued at 1£ 7s. Hemp appeared in less than 1-percent of inventories in the decades between 1720 and 1760, and in seven to 10-percent of inventories afterwards. A ropemaker's twist appeared in only a few inventories, and it is likely that the hemp rope was made and consumed locally.

Overton's Net Yield Measure of Grain

In his efforts to clealry identify the advent of the agricultural revolution in Britain, Mark Overton (1979) became frustrated with the patchy and inconsistent data concerning crop yields. Historians of agriculture had generally agreed that gentleman-agrarians had developed high yielding methods prior to the 19th century, but there was a wide diversity in the opinions concerning when, why, and where these events had occurred. In order to construct a more continuous and consistent set of data, Overton turned to production data contained in East Anglian probate inventories.

Overton's method rests on his observation that for any given crop cycle, the acreage sown and harvested bushels of grain are part of the same statistical population. If sample sizes are sufficient, one can estimate a mean annual yield by dividing the per acre value of grains in the ground by the per bushel value of harvested grains. The calculation can be represented by the formula:

$$y = (b/£)/(a/£) = b/a$$

where "y" is the yield, "b" is mean bushels harvested, "a" is mean acreage sown, and £ is the monetary unit. The usual practice was to value grain in the field in terms of its expected yield. However, Overton found in his East Anglia sample that some appraisers valued newly-sown grain in terms of the cost of seed and the labor required to sow it. In order to exclude those valuations, Overton limited his sampling of acreage estimates to the three months prior to harvest, typically June, July, and August, and used bushel estimates which were firmly after harvest, usually from October through February (:370-386). In a subsequent study of 17th and early 18th century Oxfordshire inventories, Robert C. Allen (1988:123) solved the problem by excluding holding of less than 10 acres or those which had yields of less than five bushels per

acres. Overton (1990:931) has argued that such a method would tend to eliminate years with poor harvests. Neither of these corrections is necessary for Chester County. Appraisers nearly always estimated the value of a field of grain by its expected yield. A single exception appears in the July 1755 inventory of Samuel Shanks of West Nottingham which included four acres of wheat valued at only 1 shilling per acre, a value roughly equal to the cost of ploughing and seeding (CC W&A 1578).

In Chester County the per acre values of wheat newly sown in fall and spring are not much lower than at harvest (see Table 14). The highest valuations were in December and January, which may reflect the expectation that the the winter wheat's early start was likely to produce higher yields than spring grain. Wheat was appraised at its highest in September, a time when the previous crop was most dear and when many yeomen had yet finished threshing the first of their grain. It was also not necessary to exclude inventories from certain months. Chester County producers kept an average of 40 bushels, more than a ton, of wheat on hand throughout the year (see Table 15). There may have been some loss to spoilage, but Chester County yeomen were secure in their ability to feed their households, their neighbors, and reserve a surplus available to take advantage of a favorable market.

Chester County relative yields were serialized by harvest year and calculated from acreage values listed in inventories from the prior winter and spring, and bushel values from the subsequent summer and fall. For example, the yield estimate for 1743 was calculated by comparing acreage values of standing in inventories authored between July 1, 1742 and the last day of June 1743, with the bushel values of harvested grain in inventories dated between July 1, 1743 and June 30, 1744. The results of the application of Overton's Net Yield Measure to Chester County inventories indicates that relative yields of wheat were highly

variable, but the mean value rose in the first half of the century, peaking around 1745, and then dropped throughout the second (Figure 40). This pattern approximates the inverse of the market value which climbed as yields fell after 1745 (Bezanson, Gray and Hussey 1935:422-428). The mean yields fell in each decade after the 1740s (Table 26).

Table 26. Mean Yields (bushels/acre) by Decade from Overton's Net Yield Measure of Chester County, Pennsylvania Inventories, 1713-1789.

	Wheat	"Meslin"	Rye	Barley	Oats	Indian corn
1713-1719	7.41	--	--	--	--	--
1720-1729	6.21	11.09	8.36	--	4.00	--
1730-1739	5.58	--	4.88	--	5.21	4.48
1740-1749	6.90	--	3.69	6.40	40.04	11.78
1750-1759	6.23	3.64	5.06	12.07	23.62	5.98
1760-1769	5.68	--	4.62	--	9.28	1.80
1770-1779	5.55	6.04	4.98	3.47	8.81	6.67
1780-1789	4.86	--	9.82	--	4.48	13.20
	5.90	6.92	5.92	7.28	14.70	7.32

The efficacy of the method as applied to annual yields is born out by contemporary observations collected from merchant accounts by Anne Bezanson, Robert D. Gray and Miriam Hussey (1935) as part of their classic study *Prices in Colonial America*. As the middlemen in the trade, merchants make excellent sources for big picture appraisals of the annual harvest. However, one must be aware that they had a product to sell and were usually careful to put the harvest in the best light. As a result, most of their discussion mostly concerns good crops.

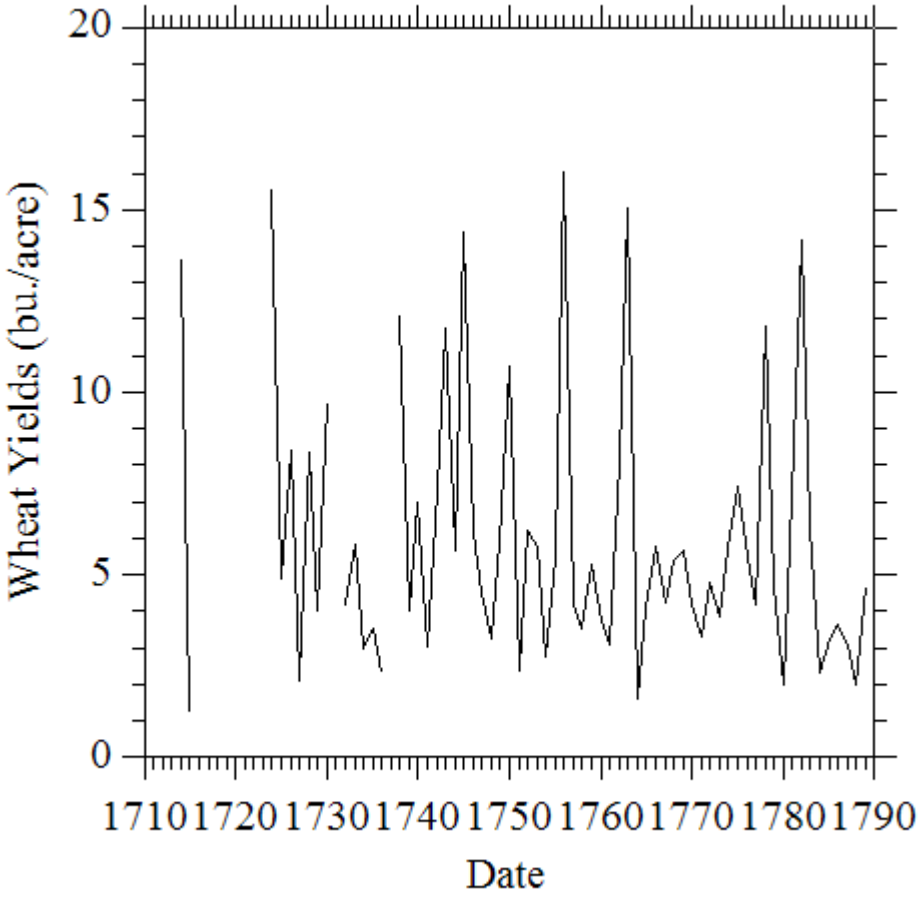

Figure 40. Relative Wheat Yields by Overton's Net Yield Measure of Chester County, Pennsylvania Inventories, 1713-1789 (by harvest year).

The relatively high yields of 1724 are supported by a Philadelphia merchant who described that year's harvest as "prodigious" (Bezanson, Gray and Hussey 1935:11). The 1728 harvest was described as the "best as well as much the largest we have ever had," although the quantities of grain in inventories suggests moderate yields. A factor may have been a late spring which had encouraged rural producers' grind all the wheat they had on hand in order to feed their livestock with the bran and chaff. The yield estimates for 1729 agree with a contemporary merchants' observation that the "Fall crop was only 2/3rds the normal yield" and that the 1730 yields were in keeping with "greatest crop that ever was raised in Pennsylvania" (:16-17).

The low yields in 1734 match a merchant's disappointment that the harvest "did not prove so good as expected" and produced grain which was "small and lighter than usual" (Bezanson, Gray and Hussey 1935:23). Yield estimates from Chester County inventories indicate that the trend had persisted for several more years. There is insufficient data to reconstruct the yield in 1737, but a merchant observed that the "harvest is got in very well, the grain is very good and the crop large" (:25). That good crop was followed by exceptional yields in 1738. The back-to-back good crops greatly pleased Philadelphia merchants. One flour vender observed that "we have now near twice the quantity of wheat, and well housed, that we ever had in one year" (:26). Unfortunately, the good times didn't last.

The wheat yield of 1741 is reflected in a merchant's concern that the "crop of wheat did not prove so large as we expected." The wheat supply was at a deficit because of the particularly severe winter of 1740-1741. Many yeoman had fed their wheat and Indian corn reserves to their livestock. Some producers had even resorted to purchasing grain for bread and the governor took the unusual step of prohibiting merchants from exporting grain

(Bezanson, Gray and Hussey 1935:28). A Philadelphia merchant consoled a business partner by observing that small wheat crop was "good in kind" (:29). A friend of the proprietor wrote that the 1742 "harvest is all got in exceedingly well and the greatest crop that has been known" (:30). The yields reflected in inventories were strong, but not record breaking. Yeoman's grain reserves may have not recovered from the bad winter. However, the quantities of wheat in 1743 inventories was substantial. A Philadelphia merchant offered confirmation by writing "Our farmers are now in the height of their harvest and a fine crop they have" (:30).

The strong yields 1745 and 1756, and the poor harvest of 1747 were noted by contemporary observers. The harvest of 1745 was so large that yeomen were too busy cutting and threshing to get it to the mills. A merchant wrote his trading partners that "our farmers are of the opinion that we never had a better, both for quality and quantity" (32-:33). The harvest was so poor in 1747, that it could not be ignored. A merchant explained that a bout of "West weather mildewed the wheat so that the crop was not 'worth reaping'" (:35). The usual practice was to plow it under as a green manure. Ben Franklin protected his colony's reputation when he told Jared Eliot that there had previously been good harvests:

> We have had as wet a summer as has been known here these thirty years, so that it was with difficulty that our people got in their harvests. In some parts of the country a great deal of hay has been lost, and some of the corn mildewed; but in general the harvest has been very great. The two preceding summers (particularly the last) were excessively dry (Eliot 1934:220).

The relatively high yields of wheat in 1750 passed without comment, but of the 1756 harvest Dr. Richard Brooke of nearby Nottingham, Maryland observed that the wheat harvest was "the most of any year since the settlement of this country" (Brooke and Baker 1760b:74). With a few exceptions, the letters of Philadelphia merchants discussing wheat harvests in the

first half of the 18th century agree with the estimates calculated from inventories. As the century progressed, the larger population of probate inventories served to increase the accuracy of the yield estimates.

In addition to merchant's observations about the size and quality of the harvest, contemporaries and historians have offered a number of quantitative estimates of grain yields in the region (Table 27). These observations have their use in defining the likely range of yields, but they are problematic in that they rarely are tied to a specific year and often mark the extremes rather than the central tendency of yields. In order to compare Chester County yields with past estimates and yields in other places, a gross measure must be calculated by estimating that the grain which may have been expended in bringing in the harvest. The results are the first continuous set of crop yields for an American colony.

Allen-Glennie Gross Yield Measure of Grain

In an attempt to approximate gross yields, Robert C. Allen (1988) complicated Overton's measure by considering parish tithes and costs of production. The costs associated with breaking land, plowing and sowing seeds were embodied in the appraised value of crops in the field. However, the costs of harvesting grain were commonly paid by direct bartering or sale of a portion of the crop. Allen's original measure held that with the exception of threshing, costs of production were constant to acreage rather than yield. Paul Glennie (1991) has argued that tasks such as reaping, binding and carting were more appropriately constant to yield. The revised Allen-Glennie Gross Yield Measure can be expressed as:

$$y = (0.9((£/b)+ r + 0.9c)/((£/a)- t)$$

Where “y” equals yield per acre, “£/a” is mean valuation per acre, “£/b” is mean valuation per bushel, “r” equals the per bushel cost of reaping and binding, “c” equals the per bushel cost of carting, “b” is bushels of crop, and “t” is the cost of threshing per bushel. The modifier 0.9 represents the remainder after the collection of the parish tithe.

Table 27. Estimates of Delaware Valley Gross Grain Yields, 1683-1796.

	Wheat	Rye	Barley	Buck wheat	Oats	Indian Corn	Source
1683	--	--	45.0	--	--	--	Myers 1912:228
1685	--	--	45.0	--	--	--	Myers 1912:264
1698	--	--	25.5	--	--	--	Myers 1912:310
1714-1731	8.1	9.3	--	--	--	3.6	Ball 1973:150-151
1734-1745	7.1	9.3	--	--	--	2.5	Ball 1973:150-151
1748	20.0	20.0	--	30.0	--	--	Benson 1937:183, 274
1750	8.0	--	--	--	--	--	Lemon 1972:154
1750-1770	7.9	5.6	--	--	--	4.0	Ball 1973:150-151
1760-1800	10.0	12.5	15.0	15.0	15.0	15.0	Lemon 1972:152-153
1767	17.5	--	--	25.0	--	40.6	Davies 1983:320-321
1775	30.0	--	57.5	--	35.0	40.0	Carmen 1939:113-116, 141-142
1775	17.5	--	35.0	--	--	30.0	*ibid.* on worn land
1775	<15	--	22.5	--	--	--	*ibid.* on exhausted land
1775-1790	7.5	7.9	--	--	--	4.8	Ball 1973:150-151
1777	11.5	13.8	--	--	--	--	Futhey and Cope 1881:105-106
1790	10.0	10.0	--	15.0	20.0	15.0	Fletcher 1950:319
1791	10.3	--	--	--	--	--	Fletcher 1950:124, 145
1796	16		--	--	--	--	Futhey and Cope 1881:339
1801	6	--	--	--	--	--	Bidwell and Falconer 1925:101

The Allen-Glennie Gross Yield Measure must be modified to fit the Pennsylvania ecology. Chester County yeomen were free from the substantial parish tithe on final yields, but they were obligated to pay a relatively low proprietary quit-rent based on total acreage owned. Quit-rents were an artifact of the feudal relationship between lords and freeholders

and stood in the stead of traditional obligatory services. A second factor is the costs of production. The Allen-Glennie formula includes the wages that British farmers had paid their laborers. Yeomen use mostly household labor who were compensated in goods and shelter. Nevertheless, it is likely that wheat that would be eaten or sold to provide for the household, was equal to the costs of reaping, threshing and carting. The wages of paid labor will be used to reflect the consumption of household labor.

For colonial Pennsylvania the Allen-Glennie Gross Yield Measure should be modified to the following formula:

$$y = ((£/b) + r + c) / ((£/a) - t - q/p)$$

The proprietary quit rent and county taxes are represented by "q" which is divided by "p" the proportion of the total crop represented by wheat (see Tables 24 and 26). Quit-rents were originally paid in winter wheat, but the logistics of collection proved beyond the proprietorship. Sometime around the turn of the 18th century, the payment was changed to cash at the rate of 1s. per one hundred acres of land. In 1732, the proprietor increased the rate to 2s. 6d. per hundred acres. Squatting and evasion of rents were reported problems, but those practices were mostly restricted to proprietary manors and was actively curtailed by the proprietor's rangers (Lemon 1972: 57, 87). It is unlikely that those households reflected in probate inventories had escaped from paying the annual quit-rent. Quit-rents were replaced by other taxes in 1799 (Fletcher 1950:16).

The acreage subject to quit rent was estimated using Lemon (1972:88-89) and Ball's (1973:123) analysis of Chester County tax lists which suggests that the large, 500 acre holdings of the 17th century had been subdivided to 245 acres by the end of the first decade of the 18th century. Parcel size fell throughout the century until an average holding was about

140 acres by 1764, and 125 acres between 1782 and 1791 (Table 28). In addition to quit-rents, Pennsylvanians also paid local taxes. An estimation of those taxes is difficult because the taxes weren't collected every year, records are incomplete and varied in terms of the kind of property that were taxed. The costs of quit-rents were adjusted upwards by 25-percent as a conservative estimate of the value of grain sold in order to pay those taxes.

Table 28. Quit Rent and Tax Values Used in Allen-Glennie Gross Yield Measure of Chester County, Pennsylvania Inventories, 1713-1789.

	Mean Acres	Total Taxes (£)	Wheat q/p (£)	Meslin q/p (£)	Rye q/p (£)	Indian corn q/p (£)	Oats q/p (£)
1713-1719	245	0.20	0.16	0.01	--	0.01	0.01
1720-1729	220	0.14	0.12	0.01	--	--	--
1730-1739	200	0.25	0.18	0.04	0.01	0.01	0.01
1740-1749	180	0.20	0.12	0.06	0.01	0.01	0.01
1750-1759	160	0.19	0.11	0.04	0.01	0.02	--
1760-1769	140	0.17	0.08	0.05	0.02	0.02	0.01
1770-1779	130	0.16	0.08	0.04	0.02	0.02	0.01
1780-1789	125	0.15	0.05	0.02	0.02	0.05	0.01

Rates for cutting and binding, hauling and threshing were recorded in the executors' accounts and household account books (CC W&A 2386, 3724; Clemens and Simler 1988:118-119, 132-133). Wheat was threshed for 0.0125£ and 0.015£ per bushel in 1768-1769, and 0.025£ per bushel in 1767, 1785 and 1793. Rye was threshed for 0.015£ per bushel in 1785 and barley was threshed for 0.0125£ in 1769. Based on these data, threshing rates were 0.025£ per bushel was used for wheat and meslin, 0.015£ per bushel for rye and 0.0125£ per bushel for barley and the other minor crops.

Reaping and carting rates are not readily available and were usually expressed in terms of a day's wage rather than by acre. The administrator of Anne Walker's Vincent estate paid male reapers 0.125£/day and a female binder 0.100£/day (CC W&A 3724). Assuming that they cut and bound an acre a day, a reasonable figure would be 0.225£/acre. In David Shultze's journal (Berky 1952, 1953) he and his servants spent as much time bringing the crop in, as they did reaping. So the same value of 0.225£/acre was used to reflect the labor of the workmen and the team.

The application of the Allen-Glennie's Gross Yield Measure to wheat in Chester County inventories suggests that yeomen enjoyed returns between almost nothing above the seed sow and 20 bushels per acre (Figure 41). On average, yields tended to be between six and nine bushels per acre (Table 29). Albeit sparse, the data for inter-cropped wheat and rye indicates yields were generally more than wheat alone, but less than rye alone. Where the gross yields of wheat decreased throughout the century, those of rye increased. Because of relatively small sample sizes, the yields of small grains such as barley, oats, and Indian corn were highly variable most accurate in the aggregate. There was insufficient data to make reliable estimates of the yields of buckwheat. The results of the gross yield estimates offers an explanation of the large variability of the estimates of 18th century production (see Table 28). The reports of yields differed so greatly because the actual yields were also highly variable.

The Chester County yields do not compare favorably with estimations drawn from British inventories. There is continuity between Chester County's earliest gross yields and Glennie's (1991) late 17th century estimates from Hampshire County in southern England (:273). However, Chester County yields are less than half those of their contemporaries in Norfolk, Suffolk, and Lincolnshire Counties in eastern Britain (Overton 1991:302-303).

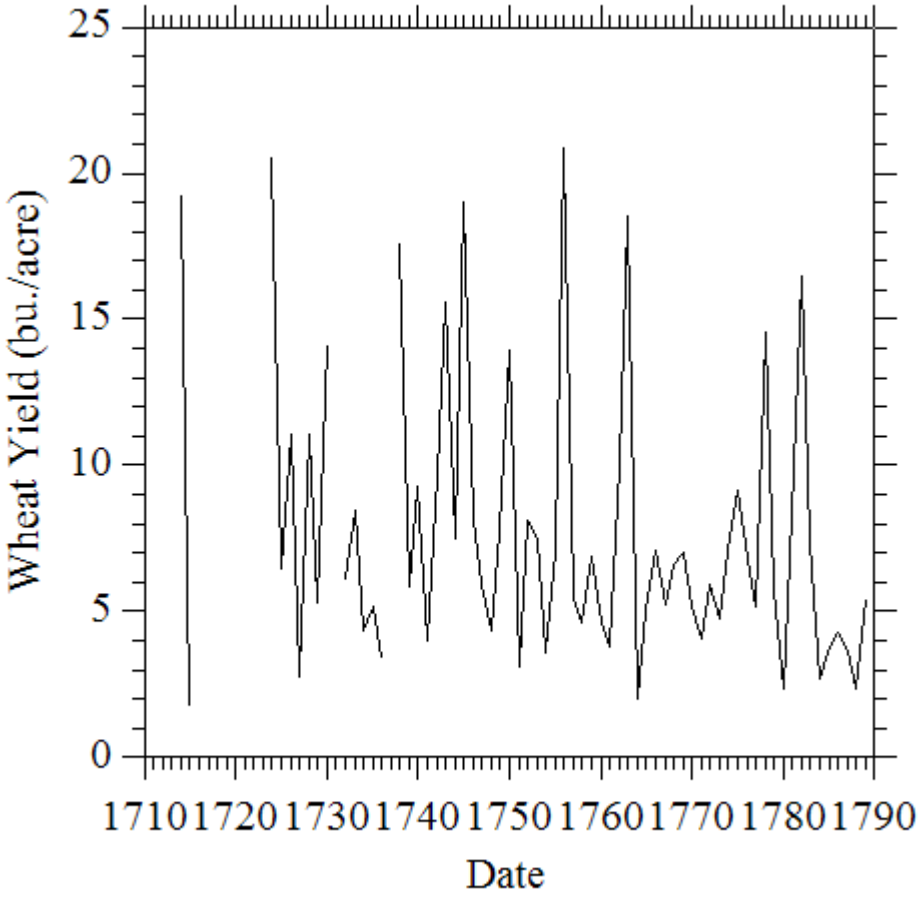

Figure 41. Gross Wheat Yields by Allen-Glennie Gross Yield Measure of Chester County, Pennsylvania Inventories, 1713-1789 (by harvest year).

Table 29. Mean Yields (bushels/acre) by Decade from Allen-Glennie Gross Yield Measure of Chester County, Pennsylvania Inventories, 1713-1789.

	Wheat	"Meslin"	Rye	Barley	Oats	Indian corn
1713-1719	10.47	--	--	--	--	--
1720-1729	8.22	12.20	8.64	--	4.20	--
1730-1739	8.13	--	6.62	--	5.47	4.71
1740-1749	9.12	--	4.99	6.47	42.04	12.37
1750-1759	8.10	4.16	6.86	12.40	24.80	6.41
1760-1769	7.00	--	6.63	--	9.74	--
1770-1779	6.84	6.91	6.86	3.56	9.26	7.15
1780-1789	5.67	--	13.52	--	4.70	14.73
	7.62	7.76	7.98	7.48	15.44	9.07

Chester County yields were more in keeping with those of pre-enclosure Britain (Campbell 1991:171). The low yields are especially surprising when considering the high productivity of American wheat farmers in the 19th century (Clark 1991a:213). Not only were farmers in East Anglia enjoying higher yields, but their returns on grain sown were on an upward trajectory whereas those of American yeomen were waning.

An underlying cause of that difference was the differing relations of production in the two places. In eastern Britain land was expensive but wages were relatively low. Cheap labor subsidized capital improvements which were geared toward maximizing per acre outputs. In the American colonies, the conditions were the opposite. Land was cheap and encouraged every laborer to become his own master. Yeomen avoided all capital improvements and relied on natural fallows and shifting cultivation to regenerate land fertility. Even Chester County's gentlemen put their hands to agriculture. The low yields in Chester County were the result of labor-saving, risk reducing practices carried out on large tracts of land.

CHAPTER 8

LIVESTOCK

Chattel

It is an ugly fact that in the 18th century Chester County chattel included not only livestock, but also slaves, servants, and apprentices whose values were appraised and recorded as an asset of the estate. Laborers will be discussed in a later chapter. What follows is a discussion of livestock which typically included horses, bovines, sheep, swine, and bees (Table 30). In rare instances yeomen also kept captive populations of wild ducks, geese, turkeys and white-tailed deer. Goats, chickens and ponies were available, but the residents of Chester County had little use for them.

Table 30. Livestock in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample (%)	Value (£)	£ Per Head	Estimated Herd or Flock (%)
Horses	2,289 (82)	61,253 (42)	6.82	8,981 (14)
Cattle	2,461 (88)	61,435 (42)	3.13	19,628 (30)
Swine	1,731 (62)	7,738 (05)	0.63	12,283 (19)
Sheep	1,675 (60)	10,093 (07)	0.44	22,939 (35)
Bees	432 (15)	6 63 (00)	--	--
Fowl	99 (04)	85 (00)	0.08	1,063 (02)
	2,798 (100)	145,049 (100)		64,894 (100)

Eighteenth-century Pennsylvanians had little interest in developing breeds of animals. Yeomen controlled the sires of their live stock by castrating most stallions and bulls, but otherwise reproduction was left to unfold naturally as their herds grazed in fields, wood and meadow. Some exceptional horses were offered at stud, but there wasn't a movement toward establishing breeds with particular characteristics. From Chester County appraisers' descriptions and secondary histories, it appears that yeomen made use of a common stock which was ancestral to those animals brought by Swedes and Finnish settlers in the 17th century and a animals purchased from adjacent British colonies (Fletcher 1950:174-176, 186-187). Since animals were left to run free for much of the year, the environment selected animals which were fit the region. The result was hearty animals, but they were often not the most productive.

Horses (Equus caballus)

In 18th century Chester County horses were a primary means of transportation, agricultural power and an emblem of status. By ancient practice, the eldest son or some other designee inherited the head of the household's clothes, horse and saddle separately from any other division of the estate. The horse and clothes represent the yeoman's status above the peasantry and eligibility to rise to the rank of squire. It was common for appraisers to value these items as a single item, or specify which horse was the decedent's. For example, the appraisers of William David, a Vincent tailor, valued "his horses all Except his riding hors" at 41£ (CC W&A 1112). In some cases the horses were inventoried individually, the deceased's would be the only animal valued with a set of harness.

Since it was so common for appraisers to include the head of household's horse as part of a lot to pass to his successor, the decedent's horse was left out from the value of livestock, but include it in the valuation of the total inventory. What results is an estimation of working horses. Typically, only some widows, day laborers and other persons of modest means failed to pass on a horse in this manner. As a result, the average size of herds in Table 31 can be increased by one to represent all the horses on a typical plantation. In total, working horses were about as numerous as swine, but possessed a total value well above all other classes of farm animal.

Table 31. Working Horses in Chester County, Pennsylvania Inventories, 1713-1789.

	With Livestock	With Horses (%)	Mean Herd (£)	Mean Head (£)	Mean Herd	Carriages
1713-1719	63	53 (84)	16.20	3.74	4.33	--
1720-1729	188	168 (89)	20.23	4.22	4.79	--
1730-1739	245	221 (90)	19.36	3.79	5.11	1
1740-1749	458	394 (86)	20.85	4.74	4.40	1
1750-1759	378	303 (80)	21.74	4.87	4.46	6
1760-1769	498	403 (81)	24.29	6.55	3.71	12
1770-1779	484	387 (80)	39.69	11.15	3.56	24
1780-1789	488	360 (74)	35.76	9.24	3.87	39
	2798	2289 (82)	26.81	6.82	3.93	82

Horses were ridden, raced, pulled plows, harrows, carts, wagons, carriages and were used to trod grain to break the husk. In his history of Pennsylvania agriculture, Stevenson Whitcomb Fletcher (1950) asserted that horses were not an "important farm animal in Pennsylvania until after 1790" (:196). However, a comparison of the numbers of oxen and plows indicates that nine out of 10 plows were pulled by horses (Table 32). Some yeomen

sought to reduce their costs by sharing animals. William Kirk of Darby's inventory included "Interest in partnership of a Mare" (CC W&A 1249). Others used horses as a display of status. Wealthier yeoman, artisans and gentlemen used four-horse teams to pull their carriages. The earliest carriage appeared in the 1731 inventory of David Lloyd, a gentleman of Chester Town (CC W&A 394). The popularity of carriages grew quickly and they became relatively common after 1760. However, most Chester County yeoman rode horses or used a cart or wagon.

Table 32. Owners of Cart or Wagon, Plows and Oxen in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	Cart or Wagon (%)	Plows (%)	Cart or Wagon to Plow	Oxen (%)
1713-1719	75	21 (28)	24 (32)	0.9:1	1 (01)
1720-1729	206	54 (26)	61 (30)	0.9:1	9 (04)
1730-1739	291	85 (29)	112 (38)	0.8:1	20 (07)
1740-1749	560	174 (31)	247 (44)	0.7:1	20 (04)
1750-1759	482	181 (38)	213 (44)	0.9:1	23 (05)
1760-1769	648	240 (37)	301 (46)	0.8:1	28 (04)
1770-1779	609	302 (50)	304 (50)	1.0:1	49 (08)
1780-1789	680	310 (46)	303 (45)	1.0:1	41 (06)
	3551	1367 (38)	1565 (44)	0.9:1	191 (05)

Most inventoried equines were working horses. The appraisers of Whiteland yeoman Joseph Francis' 1762 estate recognized that his mare was "a Good Tiller" and was believed to have been with colt. She was valued at 50-percent above his other horses (CC W&A 2039). Those few animals described as race horses also received high appraisals. At his death in 1748, yeoman William Young of Londongrove was in possession of a colt which was a "natural pacer" and valued at nearly twice that of an adult (CC W&A 1103). A Radnor

innkeeper, Michael Stadleman passed in 1777 in possession of a pony in addition to his two horses and a mare (CC W&A 3185, CC Tavern Petitions 27-78). His pony was the only one of its kind in the sample of inventories and may have served as a curiosity for his patrons.

Horses were described by their color and markings, sometimes by name, and by the member of the household with whom the horse was most commonly associated. A typical household possessed a herd of five which included four adults and a foal or yearling. Prior to 1750 there was a strong preference for males, indicating a desire for plowing strength over reproduction (Table 33). However, between 1750 and 1780 Chester County residents preferred the reproductive benefits of mares, and after that date the sexes were found in equal numbers. Foals and yearlings appeared in higher frequencies after 1770. When viewed in the context of falling herd size, this suggests that yeomen were increasingly playing the grazier and sold their mature animals to the urban market and raising young as replacements.

Table 33. Sex and Age Grades of Horses and Bovines in Chester County, Pennsylvania Inventories, 1713-1789.

	Horses (%)	Mares (%)	Yearlings Foals (%)	Oxen (%)	Bulls & Steers (%)	Heifers & Cows (%)	Calves (%)
1713-1719	52	30	18	1	6	73	22
1720-1729	52	30	18	2	7	65	26
1730-1739	44	36	20	2	6	62	29
1740-1749	43	39	18	1	8	67	24
1750-1759	37	41	22	2	6	69	23
1760-1769	38	44	18	2	7	69	22
1770-1779	36	41	23	3	7	71	19
1780-1789	37	38	25	3	8	71	18
	40	39	21	2	7	69	20

Cattle (Bos taurus)

The typical Chester County yeoman kept a herd of eight bovines of which six were cows or heifers, one a calf, and about half would possess either a bull, steer, or team of oxen (Table 34). By way of clarification, heifers are adult females who have yet to calve. Steers are neutered bulls who are typically fattened for meat. Oxen are bulls which are chosen for strength and trained to draw plows, carts, sledges, and log carriages. The majority of the cattle population was female, suggesting a strong interest in dairy. However, males were typically slaughtered for beef at the time that females were beginning to produce milk. Cattle were a close second to sheep in number and about equal to the value of working horses. Approximately, one in 10 households with cattle possessed only a single milk cow.

Table 34. Bovines in Chester County, Pennsylvania Inventories, 1713-1789.

	With Livestock	With Cattle (%)	Mean Herd (£)	Mean Head (£)	Mean Herd
1713-1719	63	48 (76)	14. 59	2.28	6.40
1720-1729	188	147 (78)	17. 51	2.04	8.58
1730-1739	245	213 (87)	19. 72	2.04	9.67
1740-1749	458	395 (86)	19. 77	2.11	9.37
1750-1759	378	329 (87)	19. 71	2.44	8.08
1760-1769	498	439 (88)	25. 52	2.99	8.54
1770-1779	484	445 (92)	33. 24	4.48	7.42
1780-1789	488	445 (93)	30. 72	4.22	7.28
	2798	2461 (88)	24. 96	3.13	7.92

The frequent mention of cheese presses and butter churns indicates that dairy products were a regular part of household production, but it was somewhat rare for dairy products to have been produced in marketable quantities. Peter Sherman of Pikeland's September 1778

inventory included 3£ 6s. for milk he had provided Washington Hall, a hospital constructed by the Constitutional Congress near the site of the Valley Forge encampment (CC W&A 3135). Less than one in 10 households produced cheese in quantity, but those who did typically had 150 lbs. on hand at any one time (Table 35). Cheese was made throughout the century, but was produced in the greatest quantities in the 1740s and 1750s.

Table 35. Cheese in Chester County, Pennsylvania Inventories, 1713-1789.

	Cattle Owners	Cheese Makers (%)	Cheese Mean (£)	Cheese £/lbs.	Cheese Mean lbs.
1713-1719	48	1 (02)	1.25	0.01	125
1720-1729	147	1 (01)	0.30	--	--
1730-1739	213	9 (04)	1.71	0.02	50
1740-1749	395	29 (07)	10.54	0.02	527
1750-1759	329	15 (05)	4.27	0.01	427
1760-1769	439	27 (06)	2.79	0.03	93
1770-1779	445	38 (09)	2.82	0.03	94
1780-1789	445	17 (04)	3.32	0.04	83
	2461	137 (06)	4.57	0.03	152

Butter was made in marketable quantities between 1750 and 1790, with the greatest quantities being produced in the 1760s and 1770s (Table 36). As Joan M. Jensen's research has revealed, dairy products formed an important form of domestic production in the late 18th and 19th centuries (1986:80-113; 1988:813-829) and Michael Kennedy's (2000) work with merchants accounts indicates that butter was second only to wheat in sales to Pennsylvania retailers (:600-603). Although, dairy production was controlled by women, marketable quantities of cheese and butter were not any more common in women-headed households.

Table 36. Butter in Chester County, Pennsylvania Inventories, 1713-1789.

	Cattle Owners	Butter Makers (%)	Butter Mean (£)	Butter £/lbs.	Butter Mean lbs.
1713-1719	48	--	--	--	--
1720-1729	147	--	--	--	--
1730-1739	213	--	--	--	--
1740-1749	395	--	--	--	--
1750-1759	329	5 (02)	1.85	--	--
1760-1769	439	9 (02)	1.06	0.02	53
1770-1779	445	10 (02)	4.45	0.03	148
1780-1789	445	3 (01)	1.38	--	--
	2461	27 (01)	2.50	0.03	83

As with most Chester County animals, there were no recognized breeds of cattle and most were described by color, markings, sex and age. The cattle raised in the 18th century were replaced in the 19th century by "improved" breeds, many of which are now extremely rare. Chester County appraisers described cattle's markings as red, black, pied and dun. Differently colored cattle were often part of the same herd and probably represent variation within a single breeding population. Peter Kalm was assured by a number of residents that Pennsylvania cattle were primarily descended from Swedish stock with a few contributions from New England (Benson 1937:75, 717).

Artist representations of livestock from 18th century Pennsylvania are few. In the early 19th century Edward Hicks painted his memories of his Bucks County childhood home (see Ford 1952 for a review of Hick's work). Several of the cattle pictured in the work entitled "The Residence of David Twining 1787" have the mottled pattern and medial white line of a breed commonly known as a "Lineback." Hicks was certain to have been familiar with the livestock of his childhood home, but his works also paid homage to elements from other

works. Nevertheless, Linebacks resembling Twinning's animals appear in his numerous versions of "The Peaceable Kingdom," Noah's Arc" and "Grave of William Penn." Lineback cattle also appear prominently in his mid-nineteenth century landscapes of the Hillborn and Cornell Farms. Appraisers descriptions and contemporary art suggests that the modern Lineback may be similar in appearance to the landrace cattle of colonial Pennsylvania, but that hypothesis requires further testing.

Chester County agrarians weren't adverse to experimenting with other breeds, but none made a significant impact until the following century. New Garden yeoman William Richards' 1773 inventory included a "Dutch Cow" whose value was nearly twice that of other cows (CC W&A 2814). Peter Kalm reported that some Pennsylvanians had acquired young American buffalo (*Bos bison*) and cross-bread them with their beef cattle (Benson 1937:110). However, no beefalo where listed within any Chester County probates.

A sign of things to come was contained in the 1783 inventory of Robert Wilson Esquire of East Nottingham. At the time of his death, Wilson was raising a "Fat Ox" equal in value to his yoke of working oxen. The practice was to grow in future decades and result in what Fletcher (1950) has called the "Fat Cattle Craze" where animals were overfed for many years until they grew to colossal size. At its peak in 1821, the "Pennsylvania Against the World" fair concluded a four-day exposition with the slaughter of the gigantic animals and parade of the meat through the city (:181-182).

Swine (Sus scrofa)

An unchanging staple of Chester County yeoman diet was pork and bacon. The average hog-owner had a herd of seven, usually composed of a boar, a few sows, and pigs

(Table 37). Swine were turned out to fend for themselves like Nathaniel Grubb, Esquire of Willistown whose animals were "wild in the woods" in 1760 (CC W&A 1891). Peter Kalm explained that swine "went about in great herds in the oak woods where they fed upon the acorns which fell in great abundance" (Benson 1937:87). At least one Pennsylvanian had used meals of Indian corn to teach his hogs to return home at the blowing of a conch shell (Fletcher 1950:187). In Edward Hicks' painting of David Twining's 1787 plantation, the pigs were depicted with a patchy black and white pattern similar to a Bentheim Black Pied swine common to northern Germany. Earlier observers describe a thinner, more generalized animal and Twinning's animals may have been recent introductions.

Table 37. Swine in Chester County, Pennsylvania Inventories, 1713-1789.

	Livestock Owners	Swine Owners (%)	Mean Herd (£)	Mean Head (£)	Mean Herd
1713-1719	63	14 (22)	3.48	0.38	9.16
1720-1729	188	48 (26)	2.26	0.31	7.29
1730-1739	245	84 (34)	2.83	0.43	6.58
1740-1749	458	182 (40)	2.98	0.42	7.10
1750-1759	378	182 (48)	3.47	0.46	7.54
1760-1769	498	248 (50)	4.21	0.54	7.80
1770-1779	484	304 (63)	5.78	0.81	7.14
1780-1789	488	294 (60)	6.56	0.86	7.63
	2798	1356 (49)	4.47	0.63	7.10

Swine ran free for most of the year, but some Chester County yeoman penned their animals in the summer in order to fatten them for slaughter in early winter. John Maxwell of Tredyffrin's October 1760 inventory included "8 swine Penned up for feeding." Maxwell's hogs must have been impressive since they were each valued at four times more than an

average animal. In June of 1787, yeoman James William's Sadsbury estate included seven head at the farm and six "out in the woods" (CC W&A 3334, 3876). William's penned animals may have been young since they were valued at only 25-percent of his free range animals. A comparison of herd size by month suggests that animals were most commonly slaughtered in July and December (Table 38). The typical household butchered two or three swine a year.

Table 38. Swine by Month in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	With Swine (%)	Mean Swine (£)	Mean £ Per Head	Mean Herd
January	254	111 (44)	2.98	0.55	5.42
February	269	109 (41)	3.02	0.53	5.70
March	374	193 (52)	3.26	0.49	6.65
April	336	172 (51)	3.28	0.51	6.43
May	326	165 (51)	3.84	0.52	7.38
June	267	133 (50)	4.77	0.57	8.37
July	133	60 (45)	3.97	0.59	6.73
August	271	158 (58)	4.51	0.69	6.54
September	277	138 (50)	5.86	0.78	7.51
October	405	202 (50)	5.46	0.73	7.48
November	331	167 (50)	6.93	0.81	8.56
December	308	123 (40)	4.86	0.76	6.39
	3551	1731 (49)	4.47	0.63	7.10

Fencing was insufficient to keep hogs out of gardens and fields. A British visitor commented that he had seen a hog leap through the rails of fence. Pennsylvania law required that hogs had to be fitted with yokes as a sign of ownership and to prevent them from sliding between fence rails (Fletcher 1950:187-189). Peter Kalm observed the collars in use in the

middle of the century (Benson 1937:87), but Fletcher (1950) suggests that they were rarely used (:189). No hog collars were observed in Chester County inventories.

Sheep (Ovis aries)

Chester County yeomen kept far fewer sheep than their British counterparts, but sheep were the most common animal in the county. A herd typically included 14 animals (Table 39), most of which were females and lambs. Rams were few in number which indicates that males were culled as lambs rather than castrated. Contemporary observers were contemptuous of Chester County sheep. One suggested that they were so thin as to "look surprisingly like goats" and they lost most of their wool as they browsed in the woods (Fletcher 1950:191-192). On the other hand, Chester County inventories indicate that yeomen's approach to their sheep was not completely lackadaisical.

Table 39. Sheep and Wool in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Sheep (%)	Mean Flock (£)	Mean Head (£)	Mean Flock	Mean Wool (£)	Sheared (%)
1713-1719	63	28 (44)	3.95	0.31	12.74	2.96	12 (94)
1720-1729	188	92 (49)	4.60	0.25	18.40	1.95	8 (43)
1730-1739	245	150 (61)	5.46	0.27	20.22	1.29	5 (25)
1740-1749	458	288 (63)	4.69	0.31	15.13	1.49	6 (40)
1750-1759	378	224 (59)	5.19	0.36	14.42	1.38	6 (42)
1760-1769	498	298 (60)	5.95	0.39	15.26	1.23	5 (33)
1770-1779	484	305 (63)	7.74	0.57	13.58	2.02	8 (59)
1780-1789	488	290 (59)	7.22	0.65	11.11	1.47	6 (54)
	2798	1675 ((60)	6.03	0.44	13.70	1.58	6 (44)

Westtown yeoman Thomas Mercer's February 1758 inventory included "nine Shorn Sheep on ye wheat at 5 sh. Each" (CC W&A 1701). The sheep were not in the field of winter grain by accident. It was a common practice to fold livestock on fields in the late winter. Typically, annual grasses had not yet emerged, and the exposed wheat sprouts were not sufficiently stiff to allow the sheep to pull up the roots. The sprouts would otherwise be eaten by deer and as long as the roots remained intact, the plant would recover. The practice did little harm to the crop and the grazing animals added manure.

Yeomen valued sheep for their meat and skins. There was no international market for American wool. In order to protect its own wool industry, Britain had forbidden her colonies to export wool or wool products (Fletcher 1950:192). For most of the century yeomen did not bother to shear all their sheep. An estimate of the numbers of shorn sheep can be found in the inventory of farmer William Porter of Oxford. The wool from each of his five sheep was appraised at 0.25£ (CC W&A 3325). Applying that single instance as an estimate of the value of wool in general, provides a tentative estimate of the typical number of sheep shorn in each decade. The quantities of wool in probate inventories dating before 1720 indicate that nearly all sheep were shorn. However, the value and quantity of wool in probate inventories dropped sharply after the 1720s and remained relatively low until 1770. The rise in flock size in the 1730s and 1740s was concurrent with a drop in the amount of wool in Chester County inventories. After 1770, the size of flocks increased as households used more wool. However, only about 60-percent of shorn wool was used within the household.

Chester County sheep were most valuable in March, suggesting that in that month they had a fullest coat of wool and were shorn in early spring (Table 40). With the birth of lambs in

the late spring, flock sizes increased in April and May. Four or five animals were culled from the typical herd in June, and two more were taken in November.

Table 40. Sheep by Month in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	With Sheep (%)	Mean Sheep (£)	Mean £ Per Head	Mean Flock
January	254	114 (45)	5.57	0.43	12.95
February	269	106 (39)	4.89	0.41	11.92
March	374	171 (46)	8.71	0.77	11.31
April	336	160 (48)	6.75	0.43	15.70
May	326	175 (54)	7.29	0.40	18.23
June	267	141 (53)	6.89	0.42	16.40
July	133	64 (48)	4.57	0.34	13.44
August	271	146 (54)	5.54	0.38	14.58
September	277	130 (47)	5.43	0.40	13.58
October	405	180 (44)	4.89	0.35	13.97
November	331	171 (52)	4.98	0.43	11.58
December	308	117 (38)	4.98	0.43	11.58
	3551	1675 (47)	6.03	0.44	13.70

In his depictions of early 19th century Pennsylvania and biblical scenes, Edward Hicks consistently painted white bodied sheep with light brown faces and legs. The rams were hroned and deep chested and the ewes were polled. That description approximates the appearance of Hill Radnor sheep common to Wales. It is possible that Pennsylvania's 18th century stock was primarily descended from those introduced by Welsh colonists who were some of the first purchasers of land in the Pennsylvania colony. However, that suggestion should be seen as a working hypotheses rather than a conclusion.

Perhaps in an effort to foster demand for American wool, some Chester County residents sought to introduce new varieties of sheep. Smuggling British sheep carried the

punishment of death (Fletcher 1950:193), but the risks must not have been that great. At the time of his death in 1769, yeoman William Seal of Birmingham was in the possession of rights to “half of an English Ram” whose total value was 1£ (CC W&A 2526). The animal appraised at only twice the value of a typical sheep. A truly valuable animal was a “One Brown Sheep with a white face" which had belonged to Alexander Lockhart of Concord in 1785 inventory. Lockhart’s sheep was valued at 3£ 15s. an amount greater than the appraisement of his nine other sheep (CC W&A 3725). That description matches a White-faced Woodland sheep common to the hills of Yorkshire, but such an identification is quite speculative. The sheep could also have been within the natural variation of the Chester County flocks and merely exceptional for the reversal of its coloration.

One last animal of note was held by Major Dick Archibald of Lower Chichester (CC W&A 3371). His 1782 inventory included a single goat. In common application, the line between goats and sheep is blurry, and the animal may have been one of several varieties of Caribbean sheep. It was the only goat listed in Chester County inventories and was valued at more than three times the typical value of a sheep.

Bees (Apis mellifera)

Beehives were commonly woven from rye grass to form a skip or a hollowed log called a gum. The inventory data agrees with Fletcher’s (1950) argument that honey was readily available from feral hives descended from bees imported by 17th settlers (:407). The first beehives didn’t appear in a Chester County inventory until 1726 and then the practice remained relatively uncommon until the 1740s (Table 41). Marketable quantities of honey was first listed a 1753 inventory, but it never became particularly common commodity. Those few

who did accumulate honey may have done so in order to brew metheglin, a honey wine which was produced during the same period (see Table 19). Beeswax appears in marketable quantities in the 1740s and was most common in the 1760s and 1770s. Beekeeping grew steadily throughout the century and by 1770 one in four yeomen had one or more hives.

Table 41. Bee Products in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Bees (%)	Mean Hives (£)	With Honey (%)	Mean Honey (£)	With Wax (%)	Mean Wax (£)
1713-1719	63	--	--	--	--	--	--
1720-1729	188	1 (01)	0.50	--	--	--	--
1730-1739	245	13 (05)	1.01	--	--	--	--
1740-1749	458	40 (09)	0.94	--	--	4 (10)	0.87
1750-1759	378	37 (10)	1.52	1 (03)	1.60	1 (03)	0.55
1760-1769	498	98 (20)	1.26	1 (01)	0.96	5 (13)	0.46
1770-1779	484	128 (26)	1.69	3 (02)	1.83	14 (11)	0.74
1780-1789	488	115 (24)	1.88	6 (05)	0.65	7 (06)	0.99
	2798	432 (15)	1.53	11 (03)	1.09	31 (07)	0.76

Fowl

As important as chickens (*Gallus gallus*) were in the 19th century farmyards and 20th century industrialized butcheries, Chester County yeoman kept almost none (Table 42). Only seven chickens were located in decedent's inventories, and all of them in the 1776 inventory of John Kelley of Darby (CC W&A 3027). Admittedly, most barnyard fowl may have been of such low value that appraisers overlooked them or regarded them as food for the household. However, appraisers commonly inventoried things of smaller value. Edward Hick's painting of David Twining's residence in 1787 portrays chickens in addition to a Guinea Fowl and a pair

of turkeys. Chickens were certainly available. A number of hen houses appeared in advertisements of land sales in the *Pennsylvania Gazette,* but they were predominantly attached to city lots. Michael Kennedy's (2000) study of sales to 18th century Pennsylvania mills and ironworks found that chickens represented only 2-percent of trades involving livestock (:600). In the first three quarters of the 18th century, chickens appear to have been part of the urban ecology, but not the rural.

Table 42. Fowl in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Fowl (%)	With Geese (%)	With Ducks (%)	With Turkeys (%)	With Chickens (%)	Misc. Fowl (%)
1713-1719	63	--	--	--	--	--	--
1720-1729	188	3 (02)	3 (100)	--	--	--	--
1730-1739	245	5 (02)	3 (60)	--	--	--	2 (40)
1740-1749	458	12 (03)	7 (58)	--	--	--	5 (42)
1750-1759	378	9 (02)	5 (56)	--	--	--	4 (44)
1760-1769	498	26 (05)	13 (50)	2 (08)	2 (08)	--	9 (35)
1770-1779	484	24 (05)	19 (79)	1 (04)	3 (13)	--	1 (04)
1780-1789	488	20 (04)	17 (85)	--	1 (05)	1 (05)	1 (05)
	2798	99 (04)	67 (68)	3 (03)	6 (06)	1 (01)	22 (22)

Chester County yeoman tended to keep ducks, geese and turkeys. As Peter Kalm observed at mid-century, the birds were not a reproducing population but wild animals which had survived the hunt and were clipped to prevent flight (Benson 1937:111-112). It appears likely that for the first half of the century, Chester County yeoman relied on wild sources for eggs. An increasing number of fowl after 1760 may mark the adoption of domestic varieties of geese and turkeys. An average flock numbered about 11 geese and six turkeys, far more that would be expected of hunted birds. On the other hand, the typical flock of ducks included only

two or three birds which are unlikely to be a viable breeding stock. In addition, five inventories authored between 1776 and 1784 included pigeon nets (CC W&A 3012, 3099, 3139, 3584, 3621). During Peter Kalm's time in Pennsylvania, enormous flocks of migratory pigeons passed through southeastern Pennsylvania in early March (Benson 1937:252) and provided a seasonal food.

White-Tailed Deer (Odocoileus virginianus)

Two Chester County inventories included white-tailed deer, a wild species of cervid native to North America. Joseph Wilson of West Fallowfield had "a tame deer" when he passed in 1751 (CC W&A 1396). James Hayes of East Fallowfield's 1758 inventory included "a tame Dear herd" valued at 7£ (CC W&A 1706). Pennsylvanians had always hunted deer, but it wasn't until the middle of the century when deer were found in inventories. Events like the harsh winter of 1740-1741 which drove deer to feed beside yeoman's livestock (*Pennsylvania Gazette* I:4352, Hazard 1828 2:24) may have been an impetus for these incomplete experiments with White-Tail domestication.

Fishing

An important resource was shad collected during their spring spawns up the Schuylkill and Susquehanna Rivers. In the 17th century, Swedes and Finns fished the waterways in the southeastern portion of the county (Benson 1937:710), a practice which was continued into the late 18th century. The 1781 inventory of yeoman Morton Morton of Ridley listed nearly 60£ of fishing equipment which included four canoes and 66 fathoms of shad and herring seines and nets (CC W&A 3317). The primary sites of collection were the riverside townships,

but barrels of preserved fish were sold into the interior of the county. Marketable quantities of preserved fish were listed in 25 inventories authored between 1738 and 1788. On average, the fish were valued at 17s. (0.85£) and in the possession of yeomen, merchants, artisans and gentlemen alike.

Meat, Tallow, Leather and Train Oil

Four important side products of livestock were meat, tallow, leather and train oil. Marketable quantities of pork or beef were listed in 423 inventories and represented the products of butchering of their own animals which were then salted, smoked or pickled to preserve them (Table 43). It was common for households to use more than one method of preservation. The 1771 inventory of yeoman and stonemason Henry Thompson included both "beef Drying & in Pickle" (CC W&A 2660). Marketable quantities were produced in the largest average quantities in the 1730s and remained an important product throughout the century.

Appraisers usually gave meat a value below the wholesale market price which ranged from 30£ to more than 93£ for a 200 lbs. barrel of beef or pork. Universally, pork drew the higher price at market (Bezanson, Gray and Hussey 1935:422) and in inventories. For example, in the 1752 inventory of George Nicklin of Concord, his 107.5 lbs of bacon were valued at 4d./lb. but his 98 lbs. of dried beef was appraised at only 3d./lb. (CC W&A 1425). In keeping with the cycle of butchering, meat appeared in the largest quantities in inventories authored in March and November (Table 44). Overall, the appraised value of meat was highest in the winter and lowest in fall.

Table 43. Meat and Tallow in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Meat (%)	Meat £/lb.	Mean lbs. Meat	With Tallow (%)	Tallow £/lb.	Mean lbs. Tallow
1713-1719	63	1 (02)	- -	--	--	--	--
1720-1729	188	1 (01)	- -	--	--	--	--
1730-1739	245	19 (08)	0.02	382	7 (03)	0.03	30
1740-1749	458	61 (13)	0.02	194	16 (03)	0.02	37
1750-1759	378	39 (10)	0.02	235	15 (04)	0.03	26
1760-1769	498	87 (17)	0.02	164	35 (07)	0.03	27
1770-1779	484	120 (25)	0.03	147	45 (09)	0.05	13
1780-1789	488	95 (19)	0.03	207	45 (09)	0.03	44
	2798	423 (15)	0.03	155	163 (06)	0.04	23

Table 44. Preserved Meat by Month in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	With Meat (%)	Mean £	Mean £/lbs.	Mean lbs.
January	254	47 (19)	6.63	0.04	166
February	269	52 (19)	4.17	0.03	139
March	374	68 (18)	5.56	0.02	278
April	336	58 (17)	4.20	0.03	140
May	326	47 (14)	4.92	0.03	164
June	267	43 (16)	5.64	0.03	188
July	133	10 (08)	4.15	0.03	138
August	271	13 (05)	2.80	0.02	140
September	277	11 (04)	1.92	0.03	64
October	405	13 (03)	1.48	0.03	49
November	331	20 (06)	3.69	0.01	369
December	308	41 (13)	3.84	0.02	192
	3551	423 (12)	4.66	0.03	155

Many households kept a barrel or box in which they had collected fat to be rendered into tallow and used to make candle wax and soap. Once processed, tallow was valued higher than the meat itself. Although tallow would be collected in large amounts, Chester County

yeomen didn't produce marketable quantities of candles and soap. The quantity of tallow was only sufficient to satisfy household consumption or was sold directly to urban chandlers.

Leather was a valuable commodity and pound for pound was appraised higher than meat, butter or cheese (Table 45). In keeping with the rise in the numbers of horses, cattle and swine, Chester County households possessed increasing amounts of unprocessed hides and cured leather. The bulk of the material was in the hands of tanners whose inventories began in 1730s and were marked by the presence of large quantities of tree bark and lime used to treat the hides.

Table 45. Leather and Train Oil in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Leather (%)	Mean Leather £/lb.	Mean lbs.	With Train Oil (%)	Train Oil £/ Barrel
1713-1719	63	1 (02)	0.08	21	--	--
1720-1729	188	16 (09)	0.07	16	--	--
1730-1739	245	19 (08)	--	2 86	--	--
1740-1749	458	55 (12)	0.08	1 10	--	--
1750-1759	378	49 (13)	0.07	424	2 (01)	3.00
1760-1769	498	180 (36)	0.05	2 52	2 (00)	--
1770-1779	484	181 (37)	0.16	1 16	6 (01)	--
1780-1789	488	86 (18)	0.04	230	5 (01)	4.70
	2798	432 (15)	0.08	185	15 (03)	3.85

Another animal byproduct was train oil produced by the rendering of whale blubber and animal brains. Although whales occasionally swam up the Delaware and a 1750 Marlborough estate included a large quantity of "Wheale Bone" (CC W&A 1338), the brains of livestock were probably the main source of train oil. Yeoman William Crabb of

Chichester's "Oil House" had train oil and "Head Matter" valued in 1770 at more than 150£ (CC W&A 2555). Most others had only a barrel or two and were almost universally tanners who used it to treat leather. Some was used to lubricate machinery, such as in the case of yeoman Thomas Evans of Edgmont who apparently used it on the wheels of his carriage before he passed in 1787 (CC W&A 3829).

Fodder

A critical resource for Chester County's growing animal herds was fodder such as hay, clover, oats, and "Indian fodder" made by topping stalks of Indian corn. Hay cut from sown grasses and other fodder crops were only mentioned occasionally (Tables 46 and 47). Hay was commonly stacked in the field, barns, rafters of cowhouse sand stables, or placed in a hay houses variously described as a barrack, rick or cock. Most hay was cut from meadows and fallow fields. The wetland grasses were regarded as the best as the grasses from fallow fields tended to be course and weedy. However, fallow fields sometimes contained volunteer cereals like the "oats in the fallow field" which had belonged to Joseph Brown of Goshen when he passed in 1785 (CC W&A 3715). Straw from wheat and rye were not commonly listed as fodder, but the prevalence of cutting boxes means that they could have been made palatable to livestock.

Quantities of stored hay are difficult to estimate since appraisers often used qualitative descriptions such as a small quantity, sundry parcels, small or large stack, wagon load, a barrack, half a cock, part of a rick, a mow, or merely a reference to the field in which it was located. The few quantitative measures suggest that the value of hay was mercurial. The appraisers of yeoman William McCay's Chichester estate listed "two Tun of Hay" at 3£ per

ton in October of 1765 (CC W&A 2238). At the time of her death in October of 1769, Jane Culbertson of Kennett had "twenty five hundred [lbs.] of hay at 15d. per Hd" or 1.25 tons of hay valued at about 1.25£ per ton (CC W&A 2520). In 1782 the appraisers of the goods of Tredyffrin's John Cloyd valued his 14.5 tons of "First Crop" hay at 5£ per ton and his 3.5 tons of "Second Crop" hay at 4£ per ton (CC W&A 3422).

Table 46. Fodder in Chester County, Pennsylvania Inventories, 1713-1789.

	With Stock	With Hay (%)	Hay Mean Value £	"Indian" Fodder (%)	With Clover (%)	With Timothy (%)	With Turnips (%)
1713-1719	63	2 (03)	2.75	--	--	--	--
1720-1729	188	15 (08)	5.34	1 (01)	--	--	--
1730-1739	245	33 (13)	4.52	--	2 (01)	1 (00)	1 (00)
1740-1749	458	121 (26)	6.07	8 (02)	--	4 (01)	8 (02)
1750-1759	378	122 (32)	7.31	5 (01)	3 (01)	2 (01)	7 (02)
1760-1769	498	183 (37)	10.69	13 (03)	9 (02)	2 (00)	12 (02)
1770-1779	484	175 (36)	12.25	11 (02)	6 (01)	5 (01)	8 (02)
1780-1789	488	198 (41)	13.39	5 (01)	5 (01)	4 (01)	6 (01)
	2798	849 (30)	10.14	43 (02)	25 (01)	18 (01)	42 (02)

First and second crop refers to two times a year that yeomen cut hay. The first was in June and July, before or after the harvest of winter grain, and then it was cut again in late fall. The second cutting was usually not as good as the first. East Nantmeal yeoman James Guest's first crop of hay was valued at six times his second crop (CC W&A 3400). Nevertheless, a second harvest could make an important contribution to winter stores. Cloyd's second crop of hay added approximately 25-percent to his hay stores. In only five instances was uncut hay valued in terms of acreage (CC W&A 982, 1396, 1503, 1869, 2023). The value of uncut hay

ranged from the low of 0.25£ per acre in July of 1746 to 1.18£ per acre in July of 1760. On average hay was valued at about 0.50£ per acre.

Table 47. Fodder by Month in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	With Hay	Hay Mean Value £	With Indian Fodder	Indian Fodder Mean Value
January	254	65 (26)	10.56	4 (09)	0.67
February	269	56 (21)	4.86	2 (05)	0.32
March	374	42 (11)	5.76	1 (02)	0.50
April	336	26 (08)	3.34	--	--
May	326	6 (02)	1.94	--	--
June	267	15 (06)	6.87	1 (02)	0.50
July	133	28 (21)	9.01	--	--
August	271	110 (41)	7.74	--	--
September	277	112 (40)	10.99	2 (05)	1.69
October	405	154 (38)	12.36	12 (28)	0.81
November	331	130 (39)	14.84	11 (26)	0.90
December	308	105 (34)	9.92	12 (28)	0.56
	3551	849 (24)	10.14	43 (100)	0.76

Yeomen augmented their hay stores with "Indian fodder" made by topping maize stalks in September. Peter Kalm described the process:

> [The Indian corn] stalks had been cut somewhat below the ear, dried and put in narrow stacks, in order to keep them as food for cattle in winter. The lower part of the stalk had likewise leaves, but as they commonly dry of themselves the people do not like to feed the cattle with them, all their flavor being lost. But the upper ones are cut while they are yet green (Benson 1937:84).

The use of Indian fodder was relatively rare with its highest frequency of use in the 1760s, a pattern which was not commensurate with the increased number of households planting the crop or with its growth as an important grain in the 1780s (see Table 21). The purpose of Indian fodder appears to have been a method of keeping a larger number of animals. Those

yeomen who made use of Indian fodder had 40-percent less hay than average, but a third again as many cattle.

Some yeomen sought to improve their wild annual grasses with clover or timothy grass. Appraisers made no distinction concerning the variety of clover used in Chester County. White or Dutch clover (*Trifolium repens*) was introduced to eastern North America in the 17th century and it quickly became naturalized and spread in advance of settlement. White clover continues to grow in the county without assistance. Red clover (*Trifolium pratense*) was prized by agricultural reformers for its superior ability to rejuvenate depleted soils, but required regular seeding. Clover had played an important role in the Dutch and British agricultural revolutions, and it was popular with early 19th century American farmers, but Chester County yeomen only dabbled in it. Appraisers tended to give clover hay only a middling value. Those who did grow clover were attempting to maximize their livestock. On average, clover growers had one-third again as much hay as the typical farm and cattle herds about twice the size of others.

The use of clover had been known for centuries. Pennsylvanians like John Bartram and William Logan had followed Jared Eliot's recommendation and experimented with red clover (Fletcher 1950:130-132). Eliot was informed by Samuel Hartlib's 1651 *Samuel Hartlib His Legacie: or An Enlargement of the Discourse of Husbandry used in Brabant and Flanders* (Eliot 1934:42, 59, 79) who plagiarized Richard Weston's circa 1645 manuscript *A Discours of Husbandrie used in Brabant and Flanders* which chronicled his observations in the United Provinces or what is now called the Netherlands (Prothero 1961:108-126, 477; Michell 1974:160-161).

While most European reformers recognized that clover was an excellent fodder, and would produce prodigiously if dressed with plaster, lime, burnt shell, or chalk, not all were sure about the durability of the practice. In his 1508 *Rei Rusticae libri quatuor*, Conrad Heresbach cautioned against continued use of chalk. As it was translated in 1577 by Barnaby Googe, Heresbach warned that challk "brings the grounde to be starke nought, whereby the common people have a speache, that grounde enriched with chalke makes a riche father and a beggerly sonne" (Prothero 1961:99-100, 474). In short, Herebach charges that the benefits of clover and plaster do not last.

Timothy grass (*Phleum pratense* a.k.a. Herd's grass, Cattail grass) was a favored product of reforming gentlemen. Timothy produces more abundantly than the native annual grasses, but the field must be periodically re-seeded. The grass first appears as "thimmey & Clover seeds" in the 1738 inventory of John Evans of West Nottingham (CC W&A 630). Timothy grass was readily available, but was never very popular and never grew beyond one in a hundred inventories. Those few who did plant timothy grass had 15-percent greater hay reserves and kept herds which were 25-percent larger than the average yeoman.

Turnips (*Brassica rapa*) are an old European domesticate which was introduced to the Delaware Valley by Swedes and Finns in the 17th century (Benson 1937:260, 268). The root was a garden product for many years, but in 1733 they appeared in large quantities in the inventory of John Turner of Middletown (CC W&A 481). In 18th century Britain, agricultural reformers advocated turnips as a fodder crop for intensive cattle production. However, the quantities in early Chester County inventories were quite small, and appear to have been for human consumption. For example, John Turner's turnips included only four bushels. Greater quantities were found in later inventories.

Three inventories dating between 1777 and 1784 included 15 to 50 bushels of turnips (CC W&A 3205, 3526, 3630). These households may have been experimenting with the methods of the "new" British agriculture as they were touted in the contemporary writings of Arthur Young. At the time of his death in 1783, yeoman Isaac Pearson of Darby was in possession of 50 bushels of turnips and he had accumulated a large quantities of animal manure valued at 1£ 10s. (CC W&A 3526). His was the only Chester County inventory which contained a valuation for dung. British agriculturalists had recommended feeding turnips to cattle and sheep. However, Pearson's had no sheep, only four cattle, and three working horses. His herds were quite typical except for his 14 swine, a number which was twice others of the same period. The two other households also included higher than average numbers of swine and they also may have been maximizing production of pork and manure.

The quantities of Indian fodder, clover, timothy and turnips indicate that it was a rare yeoman who wasn't satisfied with the natural hay from meadows and fallow fields. Those who did use fodder crops did so in order to keep a higher than average number of animals. Those who cut Indian fodder appear to have been motivated by a deficiency of hay. Timothy grass was a way of bolstering the supply of hay by 15-percent and to support 25-percent more cattle. Whereas the use of clover doubled the returns of timothy. A fact which undoubtably accounts for its later popularity. For the most part turnips were a garden crop which may have been sold in local markets and used as hog fodder. Chester County yeomen had access and the skills necessary to implement the fodder crop technologies of the British agricultural revolution, but only those very few who desired to keep more than the usual number of animals adopted them.

CHAPTER 9

LABOR

The Agricultural Cycle

The quantities of crops in Chester County inventories and contemporary accounts (Berky 1952, 1953; Bezanson, Gray and Hussey 1935) reveal that yeomen worked in a flexible cycle of production that began with: (1) building and repairing fences in February; (2) ploughing and sowing spring crops of wheat and rye in March, flax and hemp in April, and summer crops of Indian corn and oats in May; (3) clearing new land in April and May; (4) planting buckwheat, cutting hay and pulling flax in June and July; (5) harvesting winter wheat, rye and oats in late June, July and August; (6) plowing and sowing the next winter crop of wheat and rye in August and September; (7) cutting a second crop of hay in August; (8) mowing buckwheat and harvesting Indian corn in September and October; (9) harvesting spring grains in October and November; and (10) thresh grain from October through February.

The cycle of production was demanding, but produced steadily throughout the summer and fall. As Peter Kalm observed:

> Many aged Swedes and Englishmen... said that they could not remember any crop so bad as to make the people suffer in the least, much less that anybody had starved to death while they were in America... the chief thing is the great variety of grain. The people sow different kinds, at different times and seasons, and though one crop turns out bad, yet another succeeds... There is hardly a month from May to October or November, inclusive, in which the people do

> not reap some kind of cereal, or gather some kind of fruit. It would indeed be a very great misfortune if a bad crop should happen; for here, as in many other places, they lay up no stores, and are contented with living from hand to mouth as the saying goes" (Benson 1937:285-286).

Kalm appears to have seen the insides of few barns. Rather than living "hand to mouth," inventories reveal that significant quantities of grain were kept year-round. Not only were there household stores but also grain and flour at local mills and, in a worse case scenario, the warehouses of Philadelphia merchants.

The cycle of rural production was also flexible. Yeomen did not plant every crop every year, and could vary the kind and quantity of product in response to perceptions of the prevailing weather pattern, market demand, labor pool, and personal choice. A yeoman who enjoyed a bountiful or late harvest could put off planting wheat and rye until the spring. The crop had to compete with spring weeds and was slower to mature (Fletcher 1950:144), but left time to get in the previous harvest. Labor was a persistent limitation on the amount of sown land.

Labor was widely recognized to be one-half of the costs of production. When Samuel Smith passed in October of 1784, he was in possession of fields sown by a tenant. The appraisers of his estate recognized an agreement to split the proceeds equally:

> To Wheat in the Ground Computed 37 Acres at 20/[shillings] per acre One half of the Grain to be Deliver'd Clear of Expense in the Bushel -------- 37/0/0
>
> To Rye in the Ground Computed at 18 Acres at 15/[shillings] p[er] acre to be Deliver'd as above ---------- 13/10/0 (CC W&A 3628)

Production costs included reaping, binding, hauling, threshing and cleaning. The same arrangement was stipulated in 1780 for Job Vernon's fields in the same township. In this case, Vernon was the tenant and his share was expressed as "Grain in the Ground the one half to be

Delivered the Landlord in the Bushel Clear of all Incumbrance at 17/6 per acre" (CC W&A 4009).

Sources of Labor

The core of the yeoman's labor was himself and the members of his household which often included servants and slaves. Mnay yeomen also hired day laborers and cottagers. Cottagers were typically men, often with families, who were provided wages, a small house and other benefits in return for a promise to work a specified number of days. Day laborers had no such contracts. They supplied their own lodgings and were free to sell their labor as they saw fit. Day laborers were usually men, but women also hired on for domestic labor and fieldwork at harvest time. Indentured servants were bound for a number of years in return for passage to the colonies, room and board, and sometimes a small salary or bonus upon completion of their term of service.

In 18th century Pennsylvania there were well-established spheres of engendered labor. For much of the year, men worked in the barn and field, while women worked primarily in the house and yard (Soderlund 1997:81-82). The spheres converged during the harvest when women and children stacked and bundled the grain as it was cut by reapers. There were exceptions. In 1782, 17-year-old Rosina Shultze of Montgomery County took over the operation of her father's fields. No task was too much for her and she even plowed the fields, an arduous task which some yeomen hired out. David Shultze's work as a surveyor made for frequent absences from home. Having no brothers and an unpleasant experience with manservants, Rosina and her sisters turned their hands to making fences, mowing oats and

buckwheat, pulling flax, threshing, harrowing, and they joined the gangs of reapers who moved from field to field harvesting grain (Berky 1953:122-215).

Benjamin Rush (1789), a prominent Philadelphia physician, had commented that Dutch women regularly worked in the fields beside their men. The observation carries the implication that other women did not. Rosina Shultze was certainly a hard-working Dutch woman, but Rush's ethnic characterizations have not held up to scrutiny (Lemon 1966:467-496). Rosina Shultze was probably the exception rather than the rule, and few yeomen allowed their daughters to become plowmen. Women performed all the domestic labor and important tasks at harvest, but for everyday field labor most yeomen turned to servitude, slavery and apprentices.

The large middle class of Chester County was supported by an underclass of bound laborers. Of the 3551 sampled inventories, 648 or about one in five included valuations for people bound to the deceased (see Table 7). Servants represented 63-percent of the 1165 bound persons in the sampled inventories, 401 slaves represented another 34-percent, and the remainder included 35 apprentices (3-percent).

Peter Kalm explained the preference for servants as a desire to minimize the risks associated with the high purchase price of slaves (Benson 1934:205; *c.f.* Tully 1973:286). Lucy Simler (1986) has argued that slavery was less common in Pennsylvania because grain production cannot maximize bound labor in the same way as southern plantation crops (:562). However, that view overlooks the ways in which Pennsylvania yeomen's diversified approach to agriculture spread labor throughout the year. Darold D. Wax (1962) makes the case that wartime conscription of servants drove masters to the slave market (:256, *c.f.* Wax 1983:40; Salinger 1987:57-60). As Wax notes, in 1756 a Philadelphia merchant named Thomas Willing

complained that "all importations of white servants is ruined by enlisting them, and we must make more general use of Slaves" (Wax 1962 in Nash 1973:230). His collection of the fragmentary merchant records indicates that slave importations increased throughout the period that servants were conscripted.

Wax's hypothesis has been strengthened by Gary R. Nash's (1973) analysis of Philadelphia burial records which reflect a concurrent rise in slave populations. Nash also draws attention to Benjamin Franklin's warning to the Commander of British forces that his continued conscription of servants might kill the trade. Franklin forecasted that masters would be unwilling to pay the expense of importation if they had to bear the risk of losing both the servant's labor and the difference between purchase price and government reimbursement (:223-256). The Chester County probate data provide an opportunity to see whether this same shift from servant to slave labor occurred in the rural counties.

Wage Laborers

An often elusive portion of the labor pool, a picture of Chester County wage laborers has been constructed by Simler (1986, 1990) and Clemens and Simler (1988) from tax assessments and surviving labor agreements. A Chester County yeoman who sought to augment his labor could hire day laborers or install tenants on small rental properties. Wage earners were typically local people looking to augment their existing living arrangements with work picked up in other households. Such laborers were most often employed in summer when yeomen were under pressure to bring in the winter crops, plant the next years crop, and bring in the second crop of hay. In June of 1752, July 1759, and July 1768, David Schultze wrote of gangs of nine to 19 reapers who cut and bound his grain (Berky 1952:128, 240;

1953:20). Some of the reapers were neighbors with whom he had a reciprocal labor relations, but others were strangers who were paid in cash.

Women's pay for fieldwork was a matter of negotiation. Sometimes women were paid a rate equal to a man's. In 1775 Sally Whitesides and Rachel Mathers were paid a man's wage for reaping. In the 1786 harvest, Nelly Griffen and Joe Jones received the same rate of pay (Simler 1990:186). This equity was not always the same case. Other times women's pay for field work was much less than a man's. In the late 1780s, the administrator of Anne Walker's Vincent Township estate paid a female hand 1s. per day for reaping, or 25-percent less than a man's wage. In 1792 George Brinton paid John Rock 3s. a day to cut hay and bind wheat, while Rock's wife earned just half of that amount. When Mrs. Rock worked within the Brinton home, her pay was decreased to just 7d. a day, or about one-fifth of her husband's wage in the fields (Clemens and Simler 1988:132-133).

The disparity in wages did not persist inside the house. Men who spun earned the same wages as women (Simler 1990:185). In terms of annual earnings, the low pay for domestic service is somewhat offset by the availability of such work year round. Based on David Shultze's journals (Berky 1952, 1953), and Simler's (1990) estimates concerning the employment of cottagers (:175-176), domestic workers were likely to have a one-third longer earning period than men. However, that does little to close the earnings gap between female and male workers. If Mr. and Mrs. Rock had worked the entire year, he would have received an estimated 30£ while she would have received about half that amount. The low compensation for women's work meant that few women could have established their own independent households.

Cottagers

Cottagers were typically husbandmen with families who sought a level of stability above that of day work. Cottagers typically exchanged their labor for a small house, a garden and wages. Rent and supplies consumed by the cottager and his family were counted against his salary (Clemens and Simler 1988:106-143). Cottagers' labor agreements were not exclusive. As long as they met their obligations to their landlord, they were free to pick up additional work. A cottager who had gained a good reputation often shopped among employers. For example, in 1781 Samuel Scott made an agreement with Edward Darlington of Birmingham that he would reap and mow for a set rate, and pay 4£ a year for a small house, garden plot, and firewood. The following year Scott made a similar arrangement with Caleb Brinton, but gained the privilege of the fruit of an apple tree and the right to keep a hog (Simler 1990:175-176).

Clemens and Simler's (1988) examination of published account books of several Chester County farmers and yeomen indicates that cottagers and day laborers were paid approximately the same rates for the same tasks (:116, 121-122, 138-139). Chester County yeoman George Brinton exchanged cash, goods and services worth roughly 30£ a year for each of his two cottagers (:114-120, 138-139). That amount appears to have been the prevailing annual wage at the end of the century. Yeomen's need for labor was persistent. On his 91-acre plantation, Samuel Swayne required the labor of himself, his wife, and two wage earners who received a total of 13£ 3s. 11d. in 1768 and 1769. If Swayne's labor was valued at 30£, his wife's harvest-time labor at 5 or 6£, the operator of a smallish plantation required approximately 50£ of labor. For the yeoman without adult sons, a cottager would provide most of his annual labor.

Offspring

Other than his own labor, a yeoman's offspring was the most common source of labor. Children were a financial boon to American colonists. As Adam Smith observed in the *Wealth of Nations,* in colonial America:

> Labor is so well rewarded that a numerous family of children, instead of being a burthen is a source of opulence and prosperity to the parents. The labor of each child, before it can leave their house, is computed to be worth a hundred pounds clear gain to them (Smith 1776:23; Netting 1993:71)

Smith's observation is upheld by the Pennsylvania tax code which charged heads of households for servants above the age of fifteen and enslaved children above the age of twelve (Nash 1973:234). These observations indicate that by age 15, offspring's labor had balanced the costs of the their childhood and in the subsequent five years generated 100£ of labor above their room and board.

Adult offspring sometimes delayed their economic independence from their parents in order to engross labor within their father's household and use the proceeds for a dower or to purchase a plantation of their own. Rosina Shultze and her sister Mary were awarded 10£ and 15£ by their father for serving him and his stepmother longer than had any of their sisters (Berky 1953:232). Some young Quakers forestalled economic independence for upwards of 20 years in order to generate sufficient capital for a large "gift." Sons would be given a plantation and daughters a comparable amount of cash. Barry Levy's (1988) examination of inter-generational deeds of Delaware Valley Quakers suggests that parents typically gave gifts worth 200£ between 1710 and 1750, and 226£ between 1750 and 1778. The amount of land given their sons decreased with each generation. However, those amounts were offset by rising land values (Levy 1988:322).

Apprentices

Apprentices typically came from poor families who purchased training and middle class accommodations for their children with the value of the youngster's labor. Most apprentices in Chester County inventories were boys, but they also included four girls (CC W&A 2238, 2487, 2589, 2842). The females were bound to the heads of yeoman and artisan households, but they were probably trained in the domestic arts. Artisans were most likely to accept apprentices (Table 48) and young men learned craft specialties from men like yeoman John Buffington of West Bradford whose 1736 inventory suggests that he was a stone mason (CC W&A 582). At the time of William Ferguson of Chichester's death in 1748, he was training young William Norris to be a tailor. John Maris of Springfield and John Price of East Bradford taught their apprentices to be cordwainers (CC W&A 1121).

Table 48. Apprentices in Chester County, Pennsylvania Inventories, 1713-1789.

	Decedents	Apprentices (% of decedents)	Master's Trades
1713-1719	75	--	--
1720-1729	206	--	--
1730-1739	291	1 (00)	Mason
1740-1749	560	2 (00)	Tailor, Cordwainer
1750-1759	482	5 (01)	Cooper, Cordwainer, Joiner, Smith
1760-1769	648	8 (01)	Cooper (2), Shipwright, Smith
1770-1779	609	8 (01)	Carpenter, Joiner, Tanner (4), Weaver
1780-1789	680	11 (02)	Cooper, Forge Master, Smith, Weaver
	3551	35 (01)	

The masters of several boys had no apparent occupation other than agriculture. It may be that the boys were bound to learn how to cultivate, but that could be learned through hored

labor. The arrangement may have been a way of establishing a legal guardianship which superceded the rights of living parents. A common aspect of the non-artisan masters was their substantial wealth. Their acceptance of wards would have reflected a gentlemanly charitableness. Craftsmen with apprentices also tended to be wealthy. The efficacy by which they conducted their trade may have been attractive to the parents of potential apprentices, and the possession of understudies added to both the craftsman's reputation and his labor pool. Although apprenticeship was an element of the waning artisan's guilds, Chester County decedents took on more apprentices as the century progressed. However, their numbers were never very large.

Servants

Servants in 18th century Chester County included voluntary domestics, orphans, legally-bound indentured servants, and "redemptioners." "Redemptioners" were immigrants who traveled on credit for part or all of their passage (Grubb 1988:583-603). Once they arrived in the British colonies, the friends and family had a few weeks to redeem the traveler before the ship's captain sold them into servitude. The rarest of all bound laborers was the traditional servant of Britain who exchanged voluntary service in return for access to the comforts of a well-to-do household. When the estate of Abraham Vernon of Thornbury was appraised in 1749, his household included:

> "A Servant Girle taken untill she arrives to age of Eighteen Years by a Verbel agreement but never bound. She having at the time about four years and ten months to Serve by the said agreement" (CC W&A 1244).

Since she was not under a legal obligation, the appraisers did not appraise the value of her labor. A more common was servitude as form of fosterage which legally bound the master

with the child. Such as the five-and-half-year-old in the household of John Troake of East Caln. Troake's death in 1737 cut-short his promised care which was to continue until the "orphan child" had reached the age of majority and it fell to the administrator of his estate to find appropriate placement for the child (CC W&A 586). Such fostering arrangements probably account for the dozen servant children in Chester County inventories.

The majority of servants were indentured to a master for an agreed number of years in return for passage to the colonies. As Sharon V. Salinger (1987) has discussed in her study of indentured servitude in colonial Pennsylvania, the American pattern included a number of innovations on traditional service. In Britain, the master was almost as bound to the servant as the servant was to the master. Those in British service typically made oral agreements which were subject to annual renewal. Dutiful servants could shop for the best terms of service and could expect a level of treatment codified by centuries of practice. American masters needed strong legal protections to keep their servants from seeking their fortunes elsewhere. Service agreements were written, legal contracts which could be bought and sold and an expressed legal code replaced the interpersonal relations between a master and servant. The American legal code barred servants from having sexual relations, marrying without their master's consent, or purchasing liquor. Masters could expect that their servants would work the whole day and be obedient to his direction. However, masters were precluded from abusive treatment or from needlessly provoking rebellion. Servants could be sold at will, but it was necessary for the servant and two Justices of the Peace to approve sale out of the province ((:2-11, 80-81, 134).

American terms of service were typically for four to seven years, much longer than in Britain. However, some servants contracted for additional benefits such as a promise to learn

trade and language skills and freedom dues in the form of cash, clothing or agricultural implements (Galenson 1981:220-227; Grubb 1985:855-868). Servants were acquired in port cities like London, Bristol, Dublin, Rotterdam and Amsterdam. They were purchased from a shop like any other household good (Heavner 1978:702) or found on the streets awaiting a chance for passage.

Some Chester County residents imported servants directly. The 1741 inventory of James Adams of Londonderry included a consignment of a score of servants he had acquired in Ireland. The trip was a difficult one. Adams and four of the servants died in transit. The administrator of Adams' estate sold the surviving 11 men, five girls and three boys to residents of Chester County. One of the appraisers of Adams' estate, yeoman John Todd of New London, paid 18£ for a manservant whose price suggests that he was unusually skilled. The other servants sold for between 9 and 12£ without a clear difference in price with regard to age or gender (CC W&A 767). Buying directly meant that the purchaser bore the risks of passage on ships that were notoriously overloaded, under-provisioned, and subject to epidemics (Salinger 1987:82-96). Farley Grubb's (1987) analysis of mortality on 14 ships carrying German-speaking immigrants who had arrived at Philadelphia between 1727 and 1775 found that 3.8-percent of passengers died in transit (:570).

The servant population was fueled by immigrants who encountered unexpected difficulties. Passengers often faced additional fees by predatory ship captains, misfortune, and excessive customs fees which gobbled up their traveling money. Those who owed money upon arrival were held on ship. A passenger's friends and relatives had two weeks to satisfy the charges or the passengers would be sold into servitude (Salinger 1987:11, 85-88, 94). Salinger (1987) estimates the costs of the voyage in the early 18th century at 3 or 4£ per

passenger (:76). Whereas Peter Kalm estimated the costs at mid-century at 6 to 8£ sterling (Benson 1937:205) or about 10 to 14£ in Pennsylvania currency (U.S. States Bureau of the Census 1960 Z-357). The difference in the estimates may be whether or not sustenance and fees were included. Farley Grubb's (1988) review of the contracts of redemptioners who arrived after 1770 indicates that those traveling from Britain accrued debts averaging 13£ and those from the German-speaking portions of Europe faced costs of about 22£ (1988:590).

Servants could negotiate to get better terms, but few had good success. Grubb's (1986) analysis of several thousand servant contracts found that less than 1-percent of indentured servants, and just 6-percent of redemptioners, had obligated their masters to provide freedom dues above the prevailing custom. Indentured servants tended to sign their contracts before they embarked, and therefore had little control over their placement. Because they were already in country, a Redemptioner could negotiate directly with potential masters. As a result, one in four were able to extract non-monetary benefits such as education, occupational training, or joint service with a spouse (:409-411).

Once employed, the size of a servant's freedom dues were subject to continued negotiations for continued good service. One such a bonus was carefully recorded by the appraisers of the 1749 estate of Samuel Coates of East Caln. Perhaps at her insistence it was carefully recorded that "Mary a Woomen sarvant having 1 year & 4 mo.^{ths} to serve but is to have a cow when free & freedoms" (CC W&A 1243). Mary's arrangement was probably the exception, rather than rule.

The descriptions of servants in Chester County inventories suggest that servants were drawn predominantly from England and Ireland, but they also included an "Indian Servant man" in the inventory of yeoman Thomas Townsend of Concord (CC W&A 469), and

"Duch," German-speaking people from southwest Germany, northern Switzerland, and the Alsace region of France (Fogleman 1996:16-17). Servants described as "Duch" first appeared in Chester County inventories between 1739 and 1774 (CC W&A 673, 772, 832, 1222, 1583, 2191, 2810). They were part of the second stage of servitude in Pennsylvania which marked a shift from skilled, unmarried English tradesmen to entire families of Dutch, Irish and Scots-Irish agriculturalists. By the end of the century, the last servants in the county were typically the bound offspring of manumitted slaves (Salinger 1987:2-4).

Servants were most commonly employed in Chester County during the first half of the century. In the 1730s and 1740s there was one servant for every three decedents (Table 49). Two-thirds of all masters had just one servant and only 7-percent had more than two. There were exceptions. The 1741 appraisement of James Dawson's West Caln estate included "12 Servants & Redemtioners" (CC W&A 772). The servants formed the bulk of Dawson's estate and he may have been speculating in servants.

Table 49. Servants in Chester County, Pennsylvania Inventories, 1713-1789.

	Inv.	Servants (% Inv.)	Mean Per Holder	Gender % male	Mean Contract in years male - female	Contract Value £/year male - female
1713-1719	75	22.0 (29)	1.7	67	6.0 - 4.0	3.5 - 2.5
1720-1729	206	47.0 (23)	1.3	85	3.4 - 6.2	3.3 - 2.8
1730-1739	291	103.0 (35)	1.5	70	9.6 - 4.6	2.4 - 2.2
1740-1749	560	213.5 (38)	1.9	68	6.8 - 6.6	3.7 - 2.2
1750-1759	482	108.0 (22)	1.3	69	8.2 - 5.8	4.3 - 2.1
1760-1769	648	101.5 (26)	1.4	49	7.2 - 6.6	3.1 - 2.1
1770-1779	609	89.0 (15)	1.5	63	8.4 - 10.6	4.7 - 4.5
1780-1789	680	44.0 (06)	1.3	62	7.6 - 7.2	5.0 - 2.6
	3551	728.5 (21)	1.5	66	7.8 - 6.4	3.8 - 2.4

The contracts of maidservants could be purchased for less than those of men, which indicates that the demand was principally for agricultural labor. Menservants were in the majority throughout most of the 18th century. Inventories authored in the 1720s included about six males to every maid servant. Only in the 1760s were maidservants found in equal numbers and may reflect conscription in during the War of Austrian Succession (1744-1748) and French and Indian War (1754-1763). It was a very real problem for rural masters. Salinger (1987) found that 80-percent of conscripted servants came from the rural counties and most of them had served less than half of their contracts (:106-107).

No appraisers or administrators made mention of a debt from the crown for a conscripted servant. However, a number of masters suspected that their runaways had signed on with military companies or privateers. When Joel Bailey of West Marlborough advertised the 1745 escape of his servant Dennis Crowley, he warned that his man might have boarded a privateer *(Pennsylvania Gazette* I:7115). If true, Bailey was unlikely to retrieve his servant from a ship with a license for plunder.

In 1746, George Taylor of the Warwick Furnace believed that Patrick Linch had run away to join up with Captain Trench's Company (*Pennsylvania Gazette* I:7991). If Linch had enlisted, he did so under an assumed identity. His name does not appear on an enlistment roll made later that same month (Montgomery 1906:8-10). Even if he had found his servant, Taylor faced an uphill battle. It would have taken Taylor himself to pick out Linch from the large numbers of young Irish men who composed the unit. Then he would have had to convince the unit's British officers that he had a valid claim. It was a losing proposition since it was no secret that the military recruited among American servants.

When James Wickrey ran from Swan Boon of Darby in 1749, he also stole Boon's copies of his indenture. Since Wickrey had served on a privateer in the past, Boon was probably correct in suspecting that he had again signed up (*Pennsylvania Gazette* 1:10580). Without documentation, Boon's chance of retrieving Wickrey from the ship was quite small. In 1762, a New Garden Innholder named Nathaniel Ring suspected his servant Edward McSurely was intent on joining a privateer (*Pennsylvania Gazette* 2:28578). The servant was probably successful in his escape. When Ring died in 1766, McSurely was not listed as part of his estate (CC W&A 2338).

If the perceptions of the masters of runaways were accurate, there was a direct loss of servants to military service. Runways were just a small proportion of servants serving in the county. The precipitous drop in servitude in the 1760s was likely the result of the threat of loss, rather than actual runaways. Falling numbers of servants in probate inventories was caused by masters who chose to forego a second servant, rather than those leaving the market altogether. As the practice of servitude in Pennsylvania petered out in the 1770s and 1780s, the preference for men was reasserted. The relatively high value of woman's contracts in the 1770s suggests that supply may have fallen short of demand. However, in the subsequent decade the demand for maidservants was also on the decline.

Although servitude in general was on the wane, interest in men was strong in the context of renewed conscription during the American Revolution (1775-1781). Chester County masters had again suspected that their servants had escaped to join the military. In July of 1776, William Pennell of Middletown advertized that his servant Effingham Howard had been seen in regimental uniform (*Pennsylvania Gazette* 3:59709). Pennell's experience didn't sour his attitude towards servitude. When Pennell died in 1784, his household included

two servant lads (CC W&A 3545). In 1781, Elisha Price believed that Daniel Degan, a veteran of the Continental Army, may have again joined up, or perhaps had made out for his father's place in Maryland (*Pennsylvania Gazette* 3:66189). The advertised runaways and falling numbers of inventoried servants gives truth to Benjamin Franklin's warning that the trade would be ruined by conscription. Although servants remained available after 1740, the numbers employed in Chester County dropped in subsequent decades. Rural Pennsylvanians had lost their ardor for servants long before the source dried up in the early 19th century when rising wealth in America and abroad meant that immigrants could readily fund their passage (Grubb 1994:815-818).

Maidservants' labor contracts were usually shorter and appraised at lower value than mens' (Table 50). If one assumes that the purchase of a servant was independent of their master's death, an average length of the original contracts can be estimated by doubling the remaining periods of service. The inventory data is sparse, but suggests that Chester County servant's contracts were typically about seven years long. Among young servants, those which more than seven years to serve, maidservants were appraised at 25-percent more than young menservants. The value of a maids' labor leveled off as they reached their full productive potential in early adulthood. In the fields, the labor of menservants was quickly valued above that of maids and rose steadily throughout his service. Where maidservants had typically mastered their occupation after a few years of service, menservants underwent a long period of training in which his most valuable year was his last. Assuming equal mental acuity in the genders, mens' long period of training reflected the necessity of full physical maturity in order to carry out a yeoman's tasks.

Table 50. Appraised Values of Servants in Chester County, Pennsylvania Inventories, 1713-1789.

Remaining Time to Serve	Sampled Males	Manservant £/year	Sampled Females	Maidservant £/year
0 - 1 year	7	7.4	6	3.0
1 - 2 years	14	4.5	10	2.4
2 - 3 years	19	4.1	11	2.5
3 - 4 years	9	3.3	6	3.0
4 - 5 years	11	3.6	2	1.9
5 - 6 years	7	3.5	3	2.6
6 - 7 years	4	1.7	4	1.1
more than 7 years	9	0.9	3	1.2
	80	3.8	44	2.4

Servitude was an institution with deep roots in Europe. Many of those who emigrated to serve in the American colonies had a reasonably clear expectation of what they might encounter. Nevertheless, the system was inherently exploitive and there were moments of conflict. Pregnant maidservants often chose to run with the father rather than suffer social stigma and an extension of her contract. Some servants were not well-equipped for rural labor. An unsupervised Chester County manservant leaned into the split of a partially fallen tree in order to finish the cut. When he sawed through one-half of the tree, the split closed on him and he was crushed (*Pennsylvania Gazette* 1:7550). Runaway servants were often described as having a number of new and old wounds from workplace accidents. Where the wounds were commonplace or an instigation for escape is unclear.

The act of bringing a servant into a household also presented a potential danger. David Shultze of Montgomery County had the worst and best of possible experiences. While visiting Rotterdam in 1749, David Shultze's brother-in-law Abraham Beyer of Methacton, contracted with a pair of Swiss beggars for seven-years of service. Once in Pennsylvania, the boys

learned that others had only to serve four years for their passage. One of the boys, Hans Ulrich Seiler, complained that Beyer had taken advantage of the boys and grew recalcitrant. David Shultze took over the boy's contract in an effort to diffuse the situation. However, Shultze's surveying duties took him away from his plantation and it fell to his wife, Anna Rosina to oversee the lad. The change of place didn't improve Seiler's mood. He an Anna Rosina came into conflict and on two occasions she "boxed his ears" with blows with the flat of her palm to sides of his head.

In June of 1750, Anna Rosina, Seiler, a maid named Catharina Eckert and a neighbor were bringing in the first crop of hay. Anna Rosina recommend that Seiler "move a little faster." In English the phrase sounds like a simple request. Among the Dutch, it is a stinging rebuke. Catharina overheard Seiler say "Wait, I'll show you!" once he was outside his mistresses' earshot. That night he crept to Anna Rosina's bed and cut her throat. She bled to death before she could find help and her body was found the next morning. Seiler was caught, tried, and hanged for the murder. Shultze said he was the first Dutchman executed in Pennsylvania (Berky 1952:96-106).

Such conflicts were uncommon. Michael Roudebush served David Schultze for the subsequent five years without incident (Berky 1952:121-180). His replacement, Philip Lahr used his service to cement a relationship with the family. Shultze's skills as surveyor, scribe, and organizer had made him an important figure in the German-speaking community. By time Philip had completed his three years of service, Shultze had married Philip's kinswoman, probably a sister, and he had become a fully invested member of an important family (Berky 1952:181, 222). What one servant had stolen, another had returned.

Slaves

Slavery was never practiced by the majority of inventoried persons. At its height in the 1730s, there was only one slave for every four inventoried households. Throughout most of the 18th century, only one in ten Chester County decedent households held slaves. The average price of adult slaves in Chester County were not substantially different from those in City of Philadelphia inventories (Soderlund 1985:60), indicating that urban and rural people were part of the same slave market. Chester County masters did not drive their slaves, but worked beside them. Half of decedents who held slaves owned only one. Another one-quarter of masters held but two and no one owned more than ten slaves.

Households which included more than three slaves typically included slaves from multiple generations. For example, in 1785 Job Ruston, Esq. of Oxford died in possession of 12 slaves which included Will and Bess, a couple described as "old" and valued at 30£, Pegg "an old wench worse than 0" a cold recognition that she had become a financial liability, and a number of young people who probably included their children. The eldest was a man named Neil, Flora who was 17, Aaron aged 15, Bell about 13 years old, Alice who was 10, Bill who was 4 or 5 years old and a 'young child" named Sophiah (CC W&A 3674). Rushton had once owned more slaves, but George, Isaac and Jim had escaped with the British Army in 1777 (CC Archives Register of Revolutionary War Damages :10). The runaways were probably the core of Ruston's workforce, and of the dozen remaining slaves, only three were working adults. A fact which may have encouraged Ruston to purchase a pair of male servants named Joseph Eapy and John Dickson (CC W&A 3674). Those masters who found themselves with too many slaves, but did not wish to sell them could share them out. At his death in 1748,

Jacob Vernon of Thornsbury had lent the labor of a "mollatto wench" in return for the "Victualls + Cloaths" necessary for her upkeep (CC W&A 1177).

As Jean R. Soderlund (1985) has deftly explained, the institution of slavery was a problem for the large number of Quakers in Chester County and the rest of the Philadelphia Yearly Meeting. As some of the earliest and most successful settlers, Quakers used their new-found wealth to invest in slaves. However, abolitionists waged a century-long campaign which resulted in the manumission of slaves or the expulsion of the slave holders within the Society of Friends (:148-172). The greatest period of manumission in Chester County was in the second half of the 1770s (Nash and Soderlund 1991:58, 66-68). Where abolitionists could not free slaves outright, they fought for protective legislation. By law masters provided a bond recognizing their responsibility to provide perpetual support for their slaves. This guarantee of lifetime care was just a small part of the value of the labor which they had provided their master's household, but it at least provided some personal safety for the infirm. Ruston's Pegg and a woman in the 1748 inventory of John Hendrickson who was described as "Old" and "without leggs" (CC W&A 1127) were secure in the knowledge that they could not be abandoned.

Legally, slaves were bound for life. However, in Pennsylvania the common practice was to free a slave after a term of service, usually when they had attained 30 or 35 years of age. When John Sharpless Jr. and Thomas Pennell inventoried saddler William Gorsuch's Upper Providence estate in 1744, they made reference to that traditional agreement. There was some disagreement over the time that Gorsuch's man had yet to serve, so the appraisers valued the"Negro man Whose Time is in Dispute" at 20£ "If he Serves According to the Common Course of Negroes" (CC W&A 896). The "common course" for slaves was an

impermanent and reduced form of the rewards yeomen offered their adult children who continued to work for their parents. A period of obedient labor in return for a place of their own. The practice invokes the same mechanism by which yeomen first received freeholds as rewards for skilled and faithful surface to their feudal lords. However, the comparison is superficial since freed slaves were rarely, if ever, allowed to pass those lands to their heirs.

In order to reflect the change in status which accompanied a retirement agreement, appraisers would place a price on a slave's labor rather than their person. In 1749, the appraisers of yeoman Christopher Taylor's Ridley estate valued his older slaves in terms of the remainder of their time "until they attain to 30 years old" (CC W&A 1212). In 1765, yeoman John Painter's man was appraised as "a Negro mans time" in much the same way servants were appraised (CC W&A 2219). When Jonathan Parke of East Bradford, yeoman, died in 1767 he was in the possession of Ruth and Will, and three children named Hannah, Peter and Jesse. The appraisers added to their appraisal "N.B. the above Negroes and Mullatos were appraised untill 30 years of age" (CC W&A 2354).

There are some indications that bound people under the common course were seen as servants rather than slaves. John Mackey, Sr. of West Nantmeal died in possession of a man and woman whose high appraisal indicates that they were enslaved. However, their furniture was described as a "Servant's bed + cloaths" (CC W&A 3892). In the case of the 1780 estate of Valentine Weaver, a Chester Innkeeper, the status of his woman named Violet was sufficiently unclear as to cause the appraisers to admit that they "cannot agree as to a value" (CC W&A 3288). It was the only incidence where appraisers could not come to an agreement over price.

The promise of retirement and continued care were a necessary recourse for keeping slaves from seeking their fortunes elsewhere, or rebelling against their bondage. Since slaves had very little material comfort, there was little a master could take from those who didn;t meet his expectations. Punishment of slaves was a particular problem for Chester County Quakers whose faith discouraged physical violence and even threats of bodily harm was considered unsavory speech (Soderlund 1985:17-26). Strong abolitionist sympathies in the county elevated the customary treatment of enslaved people and those who treated their slaves roughly faced stigma by their peers. Those masters who did not wish to live in a tumultuous household had to buy their slaves' conformity through a promise of a future return of some of the proceeds of their exploited labor. The effect of the "common course" was to first turn slaves into long-serving servants, and then into cottagers whose household represented a potential source of labor. All of which was carried out in the context of a legal responsibility for perpetual care.

Many masters promised their slaves "freedom dues" to be paid at, or in installments throughout their retirement. Some masters provided a small stipend. Others kept their labor available by offering them a small house for life. Sometimes ex-masters were able to collect rent on those houses. Such was the case of "Negroe Peter" who owed Robert Chamberlain of Birmingham half a years rent when he passed in 1786 (CC W&A 3795). John Jacobs, Esq. of West Whiteland recorded in his 1780 will that should Tom and Ishmael agree to work for the family until they had reached the age of 35, each would receive five acres of land and a house (CC W&A 3257). The investment was a significant one. A 1798 Chester County tax roll, indicates that small, secondary houses were valued at approximately 130£. Rent charged cottagers for similar arrangements were valued at approximately 4Ł per year (Clemens and

Simler 1988:138). Tom and Ishmael's property was theirs for life, but could not be rented out or sold. On the other hand, since the house remained within the family, it could not be taken away by a third party. While the land could not be passed on to their children, it provided some security in a world in which they had few legal rights.

In the 1710s the majority of slaves were women who were appraised at values significantly higher than men (Table 51). That period is concurrent with the prevalence of indentured men and Chester County yeoman may have been looking for domestic help to assist with the maintenance of agricultural labor. In the 1720s the enslaved population of Chester County doubled as new masters made purchases of enslaved men. Women retained a value that was on par with men, suggesting that yeomen had continued to desire additional domestic labor.

Table 51. Slaves in Chester County, Pennsylvania Inventories, 1713-1789.

	Inventories	Slaves (% of Inv.)	Mean per Holder	Gender % male	Mean Value £ male - female
1713-1719	75	4.0 (05)	2.0	33	25.0 - 55.0
1720-1729	206	17.0 (08)	1.6	88	26.4 - 26.5
1730-1739	291	67.0 (23)	3.9	31	37.0 - 23.8
1740-1749	560	51.0 (09)	1.6	53	29.6 - 21.0
1750-1759	482	35.0 (07)	1.6	60	33.5 - 33.1
1760-1769	648	75.5 (12)	2.0	63	41.0 - 43.2
1770-1779	609	70.0 (11)	2.1	57	57.5 - 41.0
1780-1789	680	80.0 (12)	2.4	50	43.3 - 44.9
	3551	399.5 (11)	2.1	53	40.1 - 36.9

Chester County yeomen greatly increased their investment in slavery throughout the 1730s. In that decade masters came close to again doubling the number of enslaved people in

their households. The majority of those purchases were women, but the higher value of men indicates that the preponderance of females was a function of supply, rather than demand. That conclusion is supported by a concurrent drop in the value of maidservant contracts.

In a pattern similar to that of menservants, the value of enslaved males climbed above that of females in the 1740s when servant populations were at their highest. As the supply of indentured servants fell in the context of the mid-century wars, the total numbers of slaves in Chester County inventories doubled. However, when viewed in relation to the rising number of households, there was only a small increase in the investment in slavery. Most of the increase was due to purchases by masters who already held a slave.

Despite the efforts of local abolitionists and the liberation of slaves by the British Army during the American Revolution, the proportion of slaves to decedents was held steady between 1760 and 1790. A rising number of slaves per inventory suggests a process of consolidation whereby some masters added additional slaves to their households, as others removed themselves from the practice. Males and female labor was valued equally except in the 1770s when the appraisals of enslaved men rose significantly. That rise may be a reflection of the strain that the war placed on the supply of agricultural labor. Reverend Muhlenberg observed in early August of 1776 that:

> As it is now time that the farmers should be preparing their fields for the sowing of winter crops and the men must go to war, there is much lamentation, and the women and gray old fathers are obliged to complete the gathering of the late harvest and put their hands to the plow (Tappert and Doberstein 1942 2:727).

Once the war had passed, the continued influx of immigrants and the movement of persons to the nations new capital provided increasingly affordable wage laborers.

In conclusion, these data find some agreement with Wax's hypothesis that the conscription of servants into the mid-century wars prompted a shift from servant to slave labor. However, the purchase of slaves was never sufficient to replace a proportional amount of servant labor. The numbers of servants in Chester County inventories took a dramatic downturn in second half of the century and there is substantial evidence to suggest that servants regularly removed themselves in order to serve in the military and on privateers. As Wax and Nash have argued, there was a concurrent increase in slave populations. However, this growth was part of an overall demographic increase and the additional purchases of slaves was never sufficient to replace the proportional number of lost servants. In the long-term both servitude and slavery fell throughout the second half of the century. The need for additional labor never subsided, and as land became in increasingly short supply, yeomen employed an underclass of daylaborers and cottagers.

Labor Exploitation

The rise and fall of the trade in slaves and servants does well to map demographic changes, but it does not explain why servants were preferred to slaves, nor why bound labor should be desired by yeomen who were otherwise hesitant to invest capital. Slaves and servants was an investment fraught with risks of escape, rebellion, death, and disability. Why did yeomen chose servants over slaves? Gary B. Nash (1973) has touched on the beginnings of an answer to this question in a footnote to his "Slaves and Slaveowners in Colonial Philadelphia." He commented that although slaves were more expensive, their labor was cheaper over the long-run (:228 n12). When purchasing bound labor, yeomen were forced to chose between servants and slaves. Servants required smaller up-front investment,

had shorter and therefore less risky contracts, but also had relatively high cost over the course of employment. Slaves had a larger and therefore riskier initial price, but their longer period of service reduced their annual investment. The following section examines each of the ecological conditions of each variety of labor in order to examine the yeoman approach to labor.

A yeoman's labor relations with his offspring, servants, slaves, apprentices, cottagers, and day laborers were framed by a set of traditional practices and responsibilities. The labor relations of bound labor and offspring carried paternal responsibilities of board, clothing, lodging, health care, assumption of their debts, and monetary restitution for their crimes. Prior research offers insight into those costs.

Lemon (1972:155) estimated that legacies to Chester and Lancaster County widows typically provided 8£ per annum of support. The inventories of some Chester County widows made reference to outstanding balances in their support. When Elizabeth Owens of Willistown passed in 1741, she was owed a "yearly income of twelve Bushells of wheat for two years and eight months In John Evan's hands" valued at 6£ 8s. (CC W&A 757). Bettye Hobbs Pruitt (1984) has estimated that the quantities left widows would have provided approximately twice what would need to sustain herself, and argues that widows exchanged the surplus for other necessary goods (:343-348). Since heads of households are responsible for material goods above board, Lemon's estimate fairly represents the annual costs of upkeep for an upper-middle class woman.

Some masters skimped on the upkeep of his servants and slaves. Appraisers occasionally made reference to low-grade goods for the use of their slaves. When he died in 1772, John Kirkpatrick of West Nottingham was in the possession of "12 yards of Coarse

Negro-Cloath at 3/ per yd £1 - 16" which was apparently used to dress “old Negro Will” (CC W&A 2732). However, those incidences were rare and it appears that generally slaves and servants wore similar clothes as others in the household. Similarly, the relatively high valuations of the beds of slaves and servants indicates that bound people were afforded amenities that were not significantly below those of other members of the household.

Farley Grubb (1988) has estimated that in the last three decades of the 18th century, a servant’s food, rent, fuel, and clothing would run his master somewhere between 27£ and 40£ (:588-590). Grubb’s estimates are for the City of Philadelphia where prices for lodging, food and fuel were higher. However, those estimates are enormous sums and exceed the annual compensation of contemporary Chester County laborers and cottagers who commonly supported a family on his wages (Clemens and Simler 1988:114-120, 138-139). Grubb’s (1986) high estimates are informed by economic model which holds that competition and negotiation would remove excess profits from the labor contracts (:408). However, indentured servants were not an independent commodity. In order to be marketable, servant contracts merely had to be cheaper than wage labor and less risky than enslaved labor.

Lemon’s estimate has other supporting evidence. Billy G. Smith (1981) has estimated that an adult Philadelphian had spent a little over 10£ a year on food (:171-172). Susan Klepp (1994) has collected scattered examples of charges paid by Philadelphia masters for the upkeep of laborers. In 1732 the upkeep of a slave woman awaiting sale cost her master 7.4£ in 1762-equivalent money. Between 1759-1761 a Philadelphia slave trader paid 11.1£ for the room and board for each of his three male slaves. In the 1740s two hard-working male slaves at a foundry consumed 8.3£ in victuals. In comparison, free male workers consumed 10.9£ per annum in 1762-money. As Klepp discusses, masters could lower their food costs by hiring

out their slaves for wages or by offering a garden plot (:481-482). However, those things came at the cost of time away from their master's work.

These data suggest that in controlled circumstances, slaves were not provisioned as well as white laborers. However, reduced rations would be a matter of daily negotiation. On a plantation whose chief products were comestibles, pilferage could augment insufficient board. In addition, the hungry could conserve calories by shirking duties. In light of the ability of all laborers to negotiate their daily sustenance and the savings inherent in domestic production, it is likely that a cost of 7.5£ for domestic workers and 10£ for field hands would capture the mean cost of annual upkeep on a Chester County plantation.

Although scattered and non-continuous, these data can be used to model the potential savings heads of households accrued by employing adult household labor rather than wage earners (Figure 42). Offspring who forestall independence provided the greatest savings since their labor came without a purchase price. A son who served until the age of 35 would potentially save his parents 340£. That money would cover the costs of a gift of 200£ of land, livestock, and agricultural implements at the close of his period of service. However, daughters were another matter.

Domestic labor was valued as a necessity for the support of the household unit, but its indirect involvement in the grain market meant that domestic work had few opportunities to generate profit. Over the course of a seventeen year term of service, a daughter employed in domestic work could save her parents nearly 130£ that would otherwise have been spent employing wage laborers. While a significant amount, such savings was a poor match to their brother's inheritance for a similar period of service.

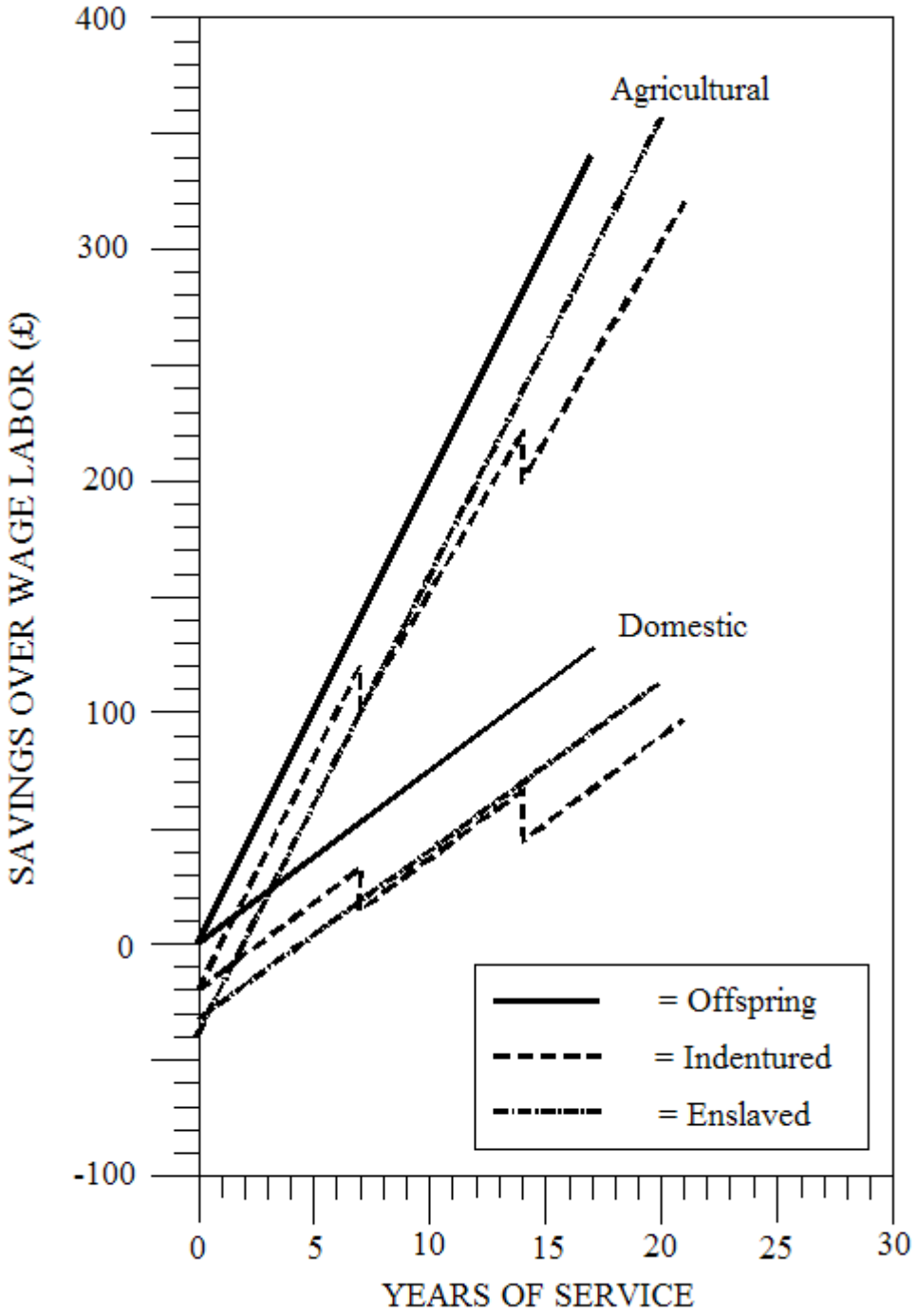

Figure 42. Potential Savings of Employment of Offspring, Indentured Servants and Slaves over Wage Laborers, circa 1765, Chester County, Pennsylvania.

The most expedient method of covering the gap between the perceived economic value of domestic and field work was to reduce the gifts to sons. Undoubtably, many fathers with more sons than daughters chose this path. Although doing so would have reduced the ability of their sons to employ their grandchildren in the same way. A second option was to gift daughters out of the working capital of the parents plantation. However, this would have only been an option after most of the older children had already received their gifts. A third alternative, one that left the parents' holdings intact, was to augment their daughter's legacy with the exploited labor of servants and slaves.

Over the course of labor of several servant contracts, a master could save more than 300£ in agricultural labor and approximately 100£ in domestic labor. The purchase price of a manservant meant that a master must endure a short period of risk when a servants death, infirmity or escape would result in financial loss. However, the market for grain was such that menservants could return the value of their purchase price in the course of a single year. Maidservants came at a greater risk and it was not until they were halfway through a typical term of service before they turned a profit for their masters. Nevertheless, the extra domestic labor was critical if a master was to add field hands to his household.

Servants were a great benefit to their masters in that their freedom dues were small in comparison to other forms of labor. However, their short labor contracts required periodic repurchase and training. Servants were also a flight risk. Between 1728 and 1800, Chester County masters filed notices in the *Pennsylvania Gazette* offering rewards for more than 600 run-away servants. Even in those cases where the servant was captured or returned of their own accord, chances were that their master were short-handed during a critical portion of the agricultural cycle. In the short run the costs of employing servants were below the purchase

price of a slave, but over the course of a number of contracts the savings from the employment of servants fell behind the savings from purchasing slaves.

Slave labor required a large initial investment which resulted in a relatively long period of risk to a master's initial investment. A male slave employed in agriculture was unlikely to turn a profit until the fourth or fifth year of his captivity. Apparently, not all bound people were equally productive. At the time of his death in 1761, yeoman Thomas Brown of Marlborough owned a quarter share of enslaved couple and their baby who were part of a Maryland kinsman's household. The appraisers valued the husband's annual labor above room and board at only 10£ and estimated 4£ for the wife (CC W&A 1953). However, the type of production in which the man was employed was a significant factor in the profit of his work.

Typically, it took as many as a dozen years before enslaved women produced a profit over wage labor, but their children provided future labor. Some enslaved women appear to have had many children, but owing to the depredations of enslavement most chose not to, or were unable to reproduce. As Klepp (1994) has calculated the birth rate among enslaved Philadelphians was below their death rate and approximately 50% higher than whites. Subject to "low fertility, high infant mortality, and the forced outmigration of children" the slave population of Philadelphia was only maintained the through importation of new slaves (:476-477). This pattern appears to hold true for Chester County where there was only one child for every three enslaved women (see Table 7).

If held for the "common course" of twenty years of service, an enslaved agricultural laborer would save his master more than 350£ and a domestic slave presented savings of 100£. After that age, slaves were usually free to work for themselves and may have been of little additional cost to their master. Masters who provided a house for their retired slaves had

the additional cost of a small building, but some would collect rent. Those masters who provide a house for a retired woman spent the majority of her exploited labor. However, by doing so they retain her as a resource for the continued care of her children and as a source of short-term wage labor. In retirement, men took a much smaller share of their exploited labor and provided a source of continued labor.

As seem through a yeoman's labor calculus, his best labor investment is in his own offspring who provide the surest savings over wage laborers. The cost of reproducing the plantation for offspring was substantial, but it was a goal central to yeoman ideology. Servitude had a substantial savings over wage labor, but was hampered by repeated cash payments for contracts and training. Nevertheless, the gains were substantial and there was no expectation of large freedom dues. From a purely financial perspective, servitude provided the highest, short-run economic return to the master. However, that advantage disappeared over the course of repeated purchases. Over the "common course," enslaved persons put to agricultural labor had the highest savings, but the provision of sizeable freedom dues could remove any profit from the labor of enslaved women.

CHAPTER 10

RISK

Class Relations and Environmental Risk

Positioned as they were on the semi-periphery of the world system economy, Chester County yeoman balanced environmental risks of agricultural production with the risks of a global grain market. They suffered the effects of the weather and the market directly. In Britain, those who pursued the gentlemanly occupations minimized their exposure to the selective forces of the environment by employing husbandmen, laborers, and tenants. Rents were rationalized by a potential yield, perceived future market, and carefully-maintained scarcity of land. Landlords had only to gain by implementing agricultural reforms. As actual returns fell short of the promised bounty (Clark 1998:73-102), his tenants bore the direct labor costs through stipulations in their rental agreements, or indirectly through elevated rents. The risks of capital investment were a short-term problem. In the cases of failure, tenants took the brunt of the losses and gentleman had only profit at risk.

In Chester County, those who were called gentlemen were often a wealthier sort of yeomen. As contemporary observers attest, many worked alongside their laborers. Evidence in probate inventories indicates that landlords commonly shared the risks of production and tenants paid rent in the form of a half share of the harvest. Since rural gentlemen were just as tied to a successful harvest as their tenants, it is no wonder that the voice of agricultural

reform emanated from the center of American cities, rather than from the countryside. Chester County gentlemen had nearly the same relations as yeomen whose self-employment and relative self-sufficiency meant that they bore both the costs and benefits of changing weather and market. A fact that predisposed yeomen to long-term strategies which first, preserved the plantation; secondly, reproduced the yeoman; and thirdly was financially rewarding.

The consistent complaints of agricultural reformers indicate that agricultural decisions were informed by a body of knowledge passed from one generation of yeomen to the next. Yeoman were hesitant to stray from that time-tested wisdom. Many children went to school, but they learned agriculture by working alongside the other members of the household. It is both the reception and implementation of this body of knowledge that defined a yeoman. The result was a body of knowledge that was objectively practical, but also subjectively valued perpetuation of the lifestyle. The socially communicated body of knowledge was written into the individual through communal labor and reproduced the yeoman identity in the next generation.

In the aggregate, the aspirations of yeoman households formed a class consciousness which favored long-term reproduction over short-term profits. To that interest, yeoman perpetuated practices which moderated the highs and lows of agricultural production in order to insure continuity of the household. A failed yeoman was one who lost his land and therefore his household. A partial failure was the inability to reproduce a plantation for the next generation. The loss of land meant a social demotion to that of a husbandman or laborer. However, in 18th century Chester County a family had a fighting chances of again achieving yeoman status. It was after all, the "best poor man's country" (Lemon 1972).

Since the goals of yeomen were well above mere subsistence but below easily tracked materialistic displays of social advancement, a proximate measure of acceptable risk is represented by poor crop yields. The measure is incomplete since yields fail to reflect efficiencies of labor which may have produced low returns per unit of land, but resulted in a greater return per unit of labor. Nevertheless, yeomen's ability to maintain and reproduce their household was predicated on the accumulation of market profits and labor savings by the exploitation of bound labor.

Strategies for Reducing Agricultural Risk

Risk is the potential for hindrances to a specific goal. In food production, risk avoidance strategies are implemented to protect against hunger, catastrophic harvest, or economic failure. Producers insure themselves by trading the potential for optimum gain for a reduction in the variance of possible outcomes. Generally, these risks do not include easily foreseen sources of loss. Predictable phenomena are merely a cost of production which can be managed by crop selection, longer fallows, drainage, or turning the parcel over to some other use such as permanent fallow, wood lot or stone quarry. The concern here are the stochastic disasters such as changes in the trend of long-term weather patterns, out-of-season hailstorms, or the path of a marching army. There are four fundamental tactics for managing risk (Winterhalder, Lu and Tucker 1999:339). In terms of agricultural production, cultivators can manage risk by spreading potential loss over (1) space, by scattering cropped fields; (2) time, by cadence of planting or storage; (3) products, through diversification; and (4) producers, by pooling labor and friendly barter.

Yeoman constructed their risk-reducing strategies as a modification of the risk-adverse strategies of their peasant forerunners who operated the unenclosed fields of European manors. Deirdre N. McCloskey (1972, 1975a, 1975b, 1976, 1989, 1991) has championed the view that the inefficiencies of the open-field system were a rational response by peasants to minimize risks to household sustainability. McCloskey's view rests on Marc Bloch's (1966) argument that scattered plots within French open fields were a prophylactic against localized natural or human disasters (:55, 233). The view is one widely supported in studies of smallholder agriculture by historians, anthropologists and economists (see McCloskey 1976:126-128, 165n, 1989:11-12, 34-36; Bentley 1987:31-67; and Goland 1993:318, 327-328 for literature reviews).

McCloskey (1972) has argued that the efficiencies of enclosure must be viewed in the light of the costs of financing land acquisitions, legal fees, fencing, and a lack of improved crop yields on enclosed land (:19-32). She also maintains that many of the perceived inefficiencies of open fields have been exaggerated. The time required to move equipment between scattered plots was not as large as imagined, and critics have ignored the peasant land market which allowed consolidation when they deemed it necessary. Balks between plots were not necessarily a waste of arable land, but provided fodder, room for drains, and places to pile fieldstones. Livestock breeding was not uncontrolled, but subject to personal and village-level selections concerning the quality, type and number of animals grazed in the commons (1975a:78-87, 100-101). One of McCloskey's most persuasive arguments is her review of durable systems of fragmented fields and collective decision-making by agrarians from Ireland to Indonesia (1975a:90-92, 1989:10-12, 34-36).

In a study undertaken with John Nash (1984), McCloskey argues that the open field practices were more economically rational than other varieties of insurance. The authors calculate that even short-term loans came at interest well above the inefficiencies of open fields. Long-term storage of wheat was beyond the means of most peasants since its' costs were equal to approximately one-third of the grains' market value (:174-187). That is not to mention the Corn Laws beginning in the mid-16th century which had made it illegal to excessively profit from the sale of stored grain (Prothero 1961:253-274, 490-499). As a result, husbandmen were much better off spreading risk across space by scattering fields, than spreading risk across time through storage.

McCloskey's analysis of yields and rents spanning the 13th through 19th centuries revealed that by resisting consolidation, a typical Midland husbandman with scattered holdings traded 10-percent of potential income in order to halve his chance of a catastrophic loss in each generation (1976:132-165; 1989:5-51). However, it is important to note that the practice did not forestall disasters to the village as a whole. As a corporate entity, the manor suffered both the disaster and the open-field inefficiencies (Yelling 1982:412). Scattering acted to spread the risk to a number of households, and thereby diluted its effects on any one. The result was a form of crop insurance that was concurrent with a period of colder and unpredictable weather (McCloskey 1991a:352).

Common Hazards in Chester County

Probate inventories and contemporary observers suggest that Chester County yeomen faced a number of unpredictable environmental hazards. Pennsylvania's mercurial climate was certainly one of them. However, yeomen appear to have been diligent about not letting their

crops suffer in hot summers. It was in just two cases where appraisers noted desiccated crops. Marple yeoman William Philips' spring 1738 inventory included "Dry wheat + oats" (CC W&A 623). Unfortunately, there is no surviving climatological data for the 1737 growing season.

In August of 1780, the appraisers of the 1780 Coventry estate of Thomas Hockley had noted that some of his wheat was "damaged" (CC W&A 3277). No doubt the cause was excessively dry weather. David Shultze of Montgomery County had noted that the "long drought and hot weather" in August 1780 had done "great damage to the garden" (Berky 1953:124). A thermometer in Philadelphia hit a high of 95°F after fluctuating between 80 and 93° for "many weeks" (Benjamin Rush in Hazard 1828 2:151-152). Reverend Muhlenberg complained of a drought in "May and half of June" and August heat which he variously described as "almost unbearable," "scorching," "so intense that one could hardly breathe," "oppressive," "intolerably hot again," "extraordinary," "astonishingly hot" and observed that the 'dry, burnt out earth has been panting" for rain (Tappert and Doberstein 1942 2:338-345).

Damp crops were also a concern, but again yeomen appear to have been expert at keeping their grain in good condition. Only in a few cases did Chester County appraisers mention grain damaged by moisture. Joseph Kirk, an Upper Darby tailor died in November of 1773 in the possession of "Part of a small mow of Mildewed wheat" (CC W&A 2802). A mow is a stack of grain which hasn't been cut from the straw. The mildew must have formed in the stack since that summer which was "a prodigious dry time" stopping mills and river barges (Bezanson, Gray and Hussey 1935:64, 48, 161) and it was followed by an exceptionally dry autumn (see Figure 13). The mildew didn't appear to affect the value of the grain. It was appraised at slightly above that year's average price per bushel. The higher value

of the grain may mean that it wasn't Kirk's carelessness which allowed his wheat to mildew, but a desire to preserve what moisture remained in the grain. The following spring, yeoman Thomas Hartt of East Caln had sent 20 bushels of "Light Wheat" from that same 1773 harvest to his local mill (CC W&A 2850). Despite being at the peak time of year, Hartt's wheat was valued less than Kirk's mildewed grain.

These few instances suggest that the quality of grain was not only a matter of its treatment in the field, but also in the barn. As a result one cannot make too strong predictions concerning the pre-harvest climate based on stored grain. For example, John Kelley's "badly mildewed" wheat in his December 1776 inventory (CC W&A 3027) was partially the result of a late harvest, but also a lack of field labor during the early days of the American Revolution (Tappert and Doberstein 2:728).

What doesn't appear to have been a problem for Chester County yeomen was spoilage due to lodging. Lodged grain is that which was bent or fallen over by irregular growth or physical damage. The reclining head of grain was sheltered by its neighbors and closer to the ground which retarded its growth and left the plant more susceptible to pests and disease. Common causes of lodging was storm damage, soils which were too rich in nitrogen, and warm and dry springs which caused the head to mature ahead of its stalk (Fletcher 1950:144; Beuerlein and Lipps 2001:1). A common preventative measure was thin seeding which preserved the distance between plants. No lodged crops were mentioned by Chester County appraisers which suggests that their low seeding rates (Myers 1912:228n1, 264; Davies 1983:320-321) were successful in countering its effects. A second preventative measure was to exhaust new land with other crops. A turn-of-the-19th century observer reported that new

land in the Western part of the state was first planted in hemp or Indian corn in order to prepare the soil for wheat (Mease 1808:260 in Fletcher 1950:144).

A persistent problem were fungal, bacterial and insect infestations. As James T. Lemon (1972) has noted, colonial agriculture suffered from "[r]ust, mildew, 'black blast,' 'scab,' 'field lice,' locusts or grasshoppers, 'fly weavil,' and possibly by 1787 the 'Hessian fly'" (:176). Widow Martha Woodward of West Bradford's April 1754 inventory included six bushels of the previous year's wheat which had become "Wevely" during storage (CC W&A 1573). Despite the presence of weevils, the wheat retained its full value and was the only inventory to mention pests. Although, the absence of some common crops and contemporary accounts indicate other problematic bugs.

Inventories contain few peas because yeomen had nearly given up on combating the pea beetle (*Bruchus pisorum*). The beetle had discouraged early Swedish-speaking colonists from growing peas and frustrated the efforts of later generations to introduce other varieties (Benson 1937:91-93; 335-336). Peas only appeared in the inventories of yeomen Josiah Hearn and Roger Ball who passed in 1731 and 1736 respectively (CC W&A 389, 577). Peter Kalm suggest that the pea beetle went unabated because colonists had suppressed the blackbird (*Gracula quiscula*) population out of concerns that it ate seed corn (Benson 1937:91-93). However, the pea beetle persisted even after the bounties for birds were dropped in the early part of the century (Fletcher 1950:74-75).

Much has been written about the "Hessian" or Wheat Fly (*Mayetiola destructor*). The fly laid its eggs in the crooks of the a young plant. As hatching larvae fed upon the plant, the weakened stem caused the grain to lodge. A widespread infestation often caused a failure of the whole field. The fly infested the Delaware Valley in the late 1780s, and was a persistent

problem in the 19th century *(Pennsylvania Gazette* 3-8478; Fletcher 1950:147-148, 1955:141-142; Hunter 2006:236-262). As Philip J. Pauly (2002) writes, the name "Hessian" is a tongue-in-cheek reference to the ability of the fly to devastate a field in the same way that British mercenaries stripped American households. Beyond the name, the coincidence of the British occupation of New York and the earliest observations has lead to the suspicion that insect had arrived in fodder carried on British ships (:485). There are still many unresolved questions concerning the insect's origins, but the current best guess is that it originated in the Middle East, reached southern Europe in the 18th century and emigrated to the British colonies during the Revolutionary war (:500).

As James T. Lemon has stated, danger of the Hessian Fly to Pennsylvania agriculture is "not clearcut" and is only clearly reported to the east, in Bucks County (1972:273n134). Brooke Hunter's (2006) valuable research chronicles the pests movement through southeastern Pennsylvania in 1787, 1788 and 1789. The pest damaged New Castle and Kent County, Delaware wheat plantations in the 1790s (:242-256), but Chester County remained untouched. No Chester County appraiser made reference to fly-damaged grain and no contemporary observer made mention of a the fly in the county.

Wheat yields in the 1780s were at an all-time low, but they had been falling for decades. It is possible that Chester County yeomen's practices were resistant to the worse effects of the pest. The immediate plowing of the field in preparation for the crop plowed under the stubble which housed the flies' eggs. Shifting cultivation meant that there were buffers of natural grass between fields. A significant barrier to a bug that was a poor flyer (Hunter 2006:242). In addition, Hunter's (2006) review of export records suggest that the worse of the Hessian fly infestation occurred after 1794 (:257), or after the passing of the

yeoman class. It may be possible that the Hessian fly was a local pest, but was suppressed by the practices of shifting cultivation. In any event, the timing of the Hessian fly infestations indicate that it was a problem associated with the emerging agricultural revolution techniques rather than yeomen's practices.

One of the problems that was most widely discussed by18th century reformers was the wheat "blast"or "black stem rust." Blast was a fungus particularly damaging to wheat and found in the northern colonies. It was eventually controlled by the removal of barberry plants which hosted the fungus between planting seasons (Fletcher 1950:146-147; 1955:141-142). No Chester County inventory specifically mentioned the blast as a source of damage to a crop. Thin seeding did much to allow grain to dry quickly and helped to prevent the growth of fungi and mildew. However, both were noted in Chester County grain. Fungal infections interrupted the life-cycle of the plant by barring complete fertilization. The result was that wheat produced "cheat." In 1775, yeoman William Reese of Willistown was appraised for eight bushels of cheat (CC W&A 2903). Its exceptionally low value of 10d. per bushel indicates that the appraisers considered it nothing better than animal feed. William Woodward, a West Bradford carpenter, also lost wheat to cheat in 1789 (CC W&A 4062). Being sown with a complementary grain saved some of the crop's value, and Woodward's "Rye & Cheat" was valued at 2 sh. 6d. per bushel.

Years of drought slowed the growth of Indian corn and produced small, malformed kernels they called "nubbins." Indian corn was grown in very low quantities until the end of the 18th century, but it was not uncommon for appraisers to note stunted ears. Nubbins first appeared in the 1758 inventory of yeoman Edmund Dougherty of London Britain (CC W&A 1742). Subsequently, Indian corn nubbins were found in inventories authored in the fall of

1763 and 1766, spring and fall of 1767, spring 1775, and the fall of 1783 (CC W&A 2096, 2310, 2370, 2390, 2905, 3527). These crops match the dry summers in 1761-1763, 1766, 1774, and 1782 (see Figure 15). In proportion to total production, Indian corn nubbins appear with more regularity than cheat. However, nubbins still only represent less than one in 100 appraisals of Indian corn indicating that despite its persistence, overall loses were low.

In addition to the environmental problems, yeomen suffered from human encroachments. During the war of American Independence, Chester County was occupied by both the British and Continental forces. If one was lucky, British paymasters paid for what they took in gold coins. No doubt a guilty boon to a yeoman with chests of rapidly depreciating Continental money. The Ridley yeoman John Knowles' estate included 135.50£ of "Cash in gold paid by the British Commissary" for "forage + Cattle" taken from his estate "between the time of decease & Appraisement" in January 1778 (CC W&A 3138). Many were not compensated, and more than 500 Chester County residents filed claims for damages (CC Archives Register of Revolutionary War Damages).

As British forces marched through Chester County in September 1777 and encamped in Tredyffrin Township, they foraged from houses and fields. When General Howe's forces encamped for three days on the plantation of Samuel Havard near Valley Forge they removed 540£ worth of goods which included everything from the window curtains to a quarter-acre of turnips (CC Register of Revolutionary War Damages :189-191). Soon after the British left, Havard and his neighbors became the hosts of the Continental Army's winter encampment in 1777-1778. Others had similar experiences. Frederick Engle of Chester first lost 100 bushels of oats to three regiments of British Light Dragoons, and then gave up 40 bushels of wheat and two tons of a hay to Continental forces (CC W&A 3129). Yeoman John Beaber of

Tredyffrin fled to Berks County with most of his moveable property. However, in his absence he lost 20 acres of wheat to encamped Continentals (CC W&A 3262).

With the exception of peas, none of the hazards which Chester County yeomen faced appear to have been insurmountable. Unpredictable weather, pests, and fungus were ameliorated by invoking strategies which reduced the variance of yields at the cost of maximum potential yields. Even the ravages of war were not suffered alone. Those who were not paid with gold by the old government, were eventually compensated by the new one. Despite the direct impact of the war, those effected taped social networks, rebuilt their plantations, and replaced what was lost. The following reviews those strategies.

Yeoman's Environmental Risk Minimizing Strategies

Yeoman practices had formed in the open fields of manorial Europe, but they had passed through the bottleneck of enclosure and relocation in the colonies. Their holdings were fenced and legally recognized as private property. The decisions concerning the type and timing of crops were at the discretion of the head of household or a designated manager. Nevertheless, labor was often cooperative, planting was conducted in consultation with others, and one's cultivation was the subject of public scrutiny and comment. With the exception of the few specialists like graziers and husbandmen, differences between plantations were expressed as matters of quantity rather than basic strategy. Yeomen generally operated from the same body of inherited knowledge which encouraged the minimization of environmental risks by scattering fields, shifting cultivation between fields, crop diversity and inter-cropping. Without exception, agricultural reformers had viewed these practices with disdain and viewed them as the cause, rather than insurance against poor yields. However,

Chester County yeomen were continuing a set of practices that had proven their worthiness over the course of generations and of all people, they were most invested in their continued efficacy.

Field Scattering: Spreading Risk Over Space

Early Chester County yeomen had probably scattered their fields in order to cultivate the best and clearest lands. For the first third of the century, Chester County plantations were from one-quarter to one-half the size of a British village (Lemon 1972:88-89; Ball 1973:123; McCloskey 1989:5-6) which gave yeomen ample choices for optimizing field locations. The effect was an emulation of the fragmentation of open fields, but without interspersed neighbors. The fields of medieval husbandmen had long-standing boundaries which were recorded in several kinds of documents. McCloskey's (1975a) survey of plot ownership had found that those working in open fields typically operated 12 scattered clusters of plots, of which one-third lay fallow in any particular year (:116). Unfortunately, there are no similar documents for the locations of the fields of Chester County yeomen. When authoring inventories appraisers were primarily interested in the value rather than location of a growing crop. However, in rare instances appraisers made reference to particular fields.

When Alexander Gibson and Joseph Adams appraised John Hall of Fallowfield's 1747 estate, they valued the "2 fare fels rie and whet of 15 shelengs per ekers and ye ner fel of whet at 7 shelengs and six pence per eker" ["two far fields of rye and wheat at 15s. per acre, and the near field of wheat at 7s. 6d. per acre] (CC W&A 1081). Although the three fields were part of the same plantation, the two distant fields of wheat and lower-value rye were appraised at a value of nearly twice that of the field composed entirely of wheat. By splitting his three

fields, Hall had protected two fields from the misfortune which struck the third. In 1755, Samuel Shanks of West Nottingham died in possession of two, four-acre fields of wheat. One was appropriately priced at 1£ per acre, but the other had a poor value of 4s. per acre (CC W&A 1578). Shank saved 40-percent of the value of his wheat crop by splitting the two fields. The value of yeoman Vernon Thomas of East Marlborough's "west" and "east" fields of wheat differed by 5s. an acre in 1760 (CC W&A 1870) and thereby he preserved one-eighth of the crop.

As Yelling (1982:412) has argued, the scattering plots on open fields reduced the risk to individual households, but not the village. A peasant's scattered fields may mean that he suffers only a portion of a localized disaster, but his neighbors are effected by the rest. As a result, scattering doesn't change the yield of the village as a whole. The Chester County fields were not only scattered, but also discontinuous. Buffer areas of old fields and wild lands absorbed the damage of localized disasters. Thus yeoman's shifting cultivation not only protected the individual household but also the community as a whole.

In the early part of the century, yeomen's holdings were large and well dispersed. They were unlikely to have suffered from the drop in the collective yields experienced in the open fields. However, as size of the typical holding was subdivided there would have been an increase in the proximity of neighbors' fields. As a result, the risks of neighbors being struck by the same disaster increased. This may have had an effect on the average total yields which fell slowly throughout the second half of the century (see Table 28). Concurrent with those falling yields was a drop in average holding size from 500 acres at the beginning of the century to 245 acres in 1710, about 140 acres in 1764, and 125 acres between 1782 and 1791 (Lemon 1972:88-89; Ball 1973:123). The increase in the collective risk from localized disasters was

likely to have been part of a suite of effects that accompanied land subdivision in the second half of the century.

Shifting Cultivation: Spreading Risk Over Time

Peter Kalm hit on the crux of the matter when he observed that the "easy method" of agriculture which Delaware Valley yeoman learned from Native Americans had "spoiled" them for the methods he had observed in Britain (Benson 1937:308). Yeomen introduced European domesticates and plow cultivation, but their method of shifting cultivation followed the Native American precedents. Pennsylvania yeoman did not replenish their land with hauled manure, lime, or fallow crops, but relied on natural fallows and opened another field.

Yeomen spaced out the heavy labor of opening new land which meant that every yeoman had a mix of new, mature and old fields. The differing characteristics of these lands provided diverse settings for the confrontation of environmental hazards. For example, in an excessively wet year thinly sown grain on new land would do best because the nutrients and precipitation would produce large and well-formed plants. In a year of moderate rain, the best yields would come from densely sown grain on mature fields where there was a balance between precipitation and available nutrients. A year of early drought would be best withstood by an old field crop whose low level of nutrients would attenuate growth until summer rains. This model is born out by Chester County inventories which indicate that the appraised value of old and new land crops were dependent on available precipitation.

Chester County appraisers made regular mention of "new" and "old" fields. The earliest was a March 1764 inventory of yeoman Samuel Brisbin of East Nottingham. His estate included 12 acres of "Old Land Wheat" which was valued at a little more than one-third

of the going rate (CC W&A 2133). That spring was moderately wet and would have been best for mature lands (see Figure 14). On New Year's Eve 1769, yeoman William Aston of West Nantmeal's crop of "New Land Wheat" was valued at third less than his other wheat (CC W&A 2542). That year had been one of the driest on record (see Figure 9) and its low valuation may have reflected that continued drought would have been best withstood by his old fields. George Smith of Goshen's May 1778 inventory included a field of "New Land" wheat that was valued at twice that of his "Old Land" wheat (CC W&A 3463). The spring had been somewhat dry, but turned wet in early summer (see Figures 14 and 15) which allowed the grain to take few advantage of the new fields.

To the dismay of agricultural reformers, yeomen habitually replanted grains on the same field without rotation or intervening fallow crops. The members of the Philadelphia Society for Promoting Agriculture found such methods "unproductive" (Logan 1791:167; Fletcher 1976:19-20). However, direct cropping may have preserved easily threshed grain. As a normal course of the harvest, the cutting, bundling and stacking of sheaves shook loose ripe grain which was left in the field. The grains most likely to be lost were those which had a loose hull and a brittle *rachis*, the central stem of the head to which grains were attached. The loss of those seeds from the next year's crop meant that there was a selection for increased kernel retention with each generation. The long-term result would have been the production of grain which was increasingly difficult to thresh. British peasants had preserved easy-threshing grain by laboriously gleaning the fields after harvest. By re-cropping the same field, Pennsylvania yeoman avoided that labor, sowed the next winter crop in a timely manner, and threshed only a few bushels because the field needed only a little additional seed.

Crop Diversification and Inter-cropping: Spreading Risks over Product

Collectively Chester County cultivators produced more total wheat as the 18th century progressed. However, those quantities were the result of an increasing numbers of producers rather than a tightening focus on the market. Running counter to pure economic benefit, Chester County yeomen grew less and less wheat and invested in rye, Indian corn and flax (Table 52 and see Table 27 for flax). The decline of wheat was brought about by a drop in the both the proportion of growers choosing wheat and the individual quantities sown (see Table 15). An ameliorating influence in the downward trend was a substantial amount of wheat which was inter-cropped with rye (meslin) between 1740 and 1770.

Table 52. Acreage of Grain Per Grain Producer in Chester County, Pennsylvania Inventories, 1713-1789 *(N.B.* italics designate estimated values based on sparse data**).**

	Wheat (%)	**Meslin (%)**	**Rye (%)**	**Indian Corn (%)**	**Barley (%)**	**Oats (%)**	**Buck-wheat (%)**
1713-1719	16.8 (81)	*0.9 (05)*	0.2 (01)	*0.7 (03)*	*0.5 (02)*	*1.2 (06)*	*0.4 (01)*
1720-1729	14.2 (88)	0.8 (05)	0.4 (02)	*0.0 (00)*	*0.2 (01)*	0.5 (03)	*0.0 (00)*
1730-1739	14.3 (73)	2.8 (14)	0.7 (03)	0.8 (04)	*0.2 (01)*	0.9 (05)	*0.0 (00)*
1740-1749	13.5 (60)	6.2 (28)	1.1 (05)	0.8 (04)	0.1 (00)	0.7 (03)	*0.0 (00)*
1750-1759	15.0 (60)	5.6 (22)	1.3 (05)	2.4 (10)	0.1 (00)	0.6 (02)	*0.1 (00)*
1760-1769	10.6 (46)	7.0 (31)	2.1 (09)	2.2 (10)	*0.1 (00)*	0.7 (03)	0.2 (01)
1770-1779	10.6 (50)	4.6 (22)	2.7 (13)	2.0 (10)	0.1 (00)	0.9 (04)	*0.3 (01)*
1780-1789	9.6 (34)	3.6 (13)	3.0 (11)	9.6 (34)	*0.1 (00)*	2.2 (08)	*0.4 (01)*
	15.2 (63)	3.9 (16)	1.4 (06)	2.3 (10)	0.2 (01)	1.0 (04)	0.3 (01)

As Bruce Horwith (1985) has outlined, inter-cropping's potential benefits include (1) companion compensation, (2) differential use of resources, (3) soil preservation, and (4) resistance to pests (:286-291). Wheat and rye are complementary in that their range of optimal

climates overlap, but not completely. Rye is more resistant to cooler weather and lighter soils. Since it is fast growing, rye serves to shelter wheat, out-competes low weeds, and preserves topsoil from erosion. Wheat makes better use of warm weather and has a higher market price. When inter-cropped, short-falls like unpredictable weather or low soil nutrients are made up by rye, while the most favorable conditions are exploited by wheat. The maximum potential yields of each are exchanged for a potentially higher minimum yield. Thereby, inter-cropping reduced the risk of an inadequate harvest and a poor return on invested labor. Nevertheless, the addition of inter-cropped wheat was insufficient to counter the overall decline in wheat production. If one includes one-half of the mixed wheat and rye, the gross acreage of wheat dropped steadily from about 90-percent of all grain in the 1720s, 70-percent at mid-century, and 40-percent in the 1780s.

Chester County yeoman inter-cropped rye in fields of standing Indian corn, but in much smaller quantities than wheat and rye. Seventeenth-century European colonists had eagerly adopted the Native America practice of growing Indian corn, beans and squashes on hills of hoed soil (Bidwell and Falconer 1925:10-12). A local modification was to sow a winter crop of rye between the hills of maize (:92). Hilling persisted into the 19th century as the means of growing Indian corn (Fletcher 1955:122-123). However, the growing of Indian corn all but disappeared in the 1720s and rye was only rarely grown in that decade (see Table 25). Contemporary observation and inventory data suggest that the practice was revived in the late 1730s and practiced until the early 1780s.

Inventories containing rye and Indian fodder were almost exclusively drawn from estates in the southwestern townships which bordered Maryland. At mid-century Peter Kalm witnessed the practice during a trip to New Jersey:

> The corn is planted as usual in squares, in little hills, so that there is a space of five feet and six inches between each hill, in both directions. From each of these little hills [that we saw] three or four stalks had come up, which were not yet cut for the cattle... In some places the ground between the corn is plowed and rye sown in it, so that when the corn is cut the rye remains upon the field (Benson 1937:89).

Colonists sped the creation of hills by using plows to pile furrows into a checkerboard of overlapping furrows. A dark-colored cornbread made from "rye and Injun" was common in New England, and may have also been made in the southwestern part of Chester County (Bidwell and Falconer 1925:96; Fletcher 1950:151).

Inter-cropping rye and Indian corn provided several benefits. In September, when the Indian corn had matured but was not yet ready to harvest, yeomen topped and bladed the stalks for fodder. Blading the stalks did no harm to the plant and opened the aisles between the rows of hills. The creation and maintenance of the hills cleared the ground of weeds which allowed the sowing of rye without much further preparation (Fletcher 1950:148-151). Importantly, the practice allowed the planting of a winter crop at the optimum time of year without having to wait until the Indian corn had fully matured. Rye sown in late winter or spring was less resistant to pests and more susceptible to adverse weather (Bidwell and Falconer 1925:12-14, 93-97).

Yeomen began diversifying their grain production in the 1730s and their crops became increasingly diverse throughout the century. The impetus does not appear to be the market price of wheat, which had not changed significantly in the decades before or after that date. As Bezanson, Gray and Hussey (1935) have demonstrated, the underlying tendency of the prices of wheat, flour and bread at Philadelphia was "practically horizontal" between 1720 and 1744. However, after that date prices moved "rapidly upward" until 1749, when the turned"moderately upward" and finally "still more rapidly upward between 1764 and 1775

(:9-55). Despite the upward direction of the prices of wheat products, individual Chester County yeomen grew less and less of it.

The retraction of the yeomen from the wheat market it is a bit of mystery. Many agricultural reformers had suggested that shifting cultivation was unsustainable. Native Americans had constructed the practice in the context of low populations, few land constraints, and with limited market involvement. However, Chester County yeomen worked in the context of rapidly falling parcel size, increasing population, and a market hungry for bread. In 1796, Thomas Cheyney of Thornbury described what he called the "old" and "new" practices in Chester County. The prior practice had been to plant the same field for three or four years in a row before it would be left to a natural fallow. He and his neighbors had "followed this old way until we could scarcely raise our bread and seed" (Futhey and Cope 1881:339). While Cheyney may have somewhat exaggerated the case, Chester County inventories confirm that average wheat yields fell throughout the second half of the 18th century (see Table 28).

A common explanation for falling yields was to blame soil exhaustion. Kunkle (1959:116) argues that damage to Chester County's soils began with the Native American practice of burning of underbrush which left the topsoil unprotected. Gentlemen reformers had warned about the dangers soil exhaustion since the 15th century (Prothero 1961:64) and that concern has been reflected in the work of British agricultural historians (Postan 1966:548-632). The view that traditional, low-yield agricultural practices depleted the soil was carried over to American agricultural history. Warren C. Scoville (1953) found statements concerning the wastefulness of prior practices in more than half of a dozen or so mid-20th century textbooks (:178). While popular, that explanation for falling yields was not broadly supported.

One of the few regional studies was Avery Odele Craven's (1926) study of Virginia and Maryland. Craven argued that soil exhaustion in Virginia and Maryland was due to a continuation of harmful practices formed in the tobacco plantations of the 17th century (:24). His assertion that "ignorance and habit" were significant factors in the continuation of these practices (:162) reminds the reader that his analysis rests solely on the observations of agricultural reformers. In any event, Chester County yeomen grew no cotton and almost no tobacco. Only 68 of 3551 sampled inventories (2-percent) included tobacco. Of those, only one in five possessed more than 1£ worth, indicating that it was mostly purchased from the southern colonies. Only the 1788 inventory of Thomas Speakman of Goshen included a patch of local tobacco (CC W&A 3963).

Other researchers have come to question soil exhaustion as an explanation for agricultural change. British researchers have persuasively point to long-running agricultural experiments at Rothamsted Research, Harpenden, Hertfordshire, England which have demonstrated that low, but sustainable yields of wheat are possible without the use of fertilizer (Lennard 1922; Usher 1923:385-411; Long 1979:459-469; Clark 1996:61-84). The view has American advocates who similarly point to long-term experiments with continuous cropping of Indian corn in Ohio and Illinois which found a threshold of low, sustainable yields without fertilizer (Slater and Green 1933; Salter, Lewis and Slipher 1926; Odell, Melsted and Walker1984; Whitney 1994:240). As Gordon Whitney (1994) has argued, the lesson to be carried away is that exhaustion is not permanent and can be revered through fallows or fertilizers. He notes that the perceived exhausted farms of the old colonies had no lack of buyers in later centuries (:239-241).

In Pennsylvania, the evidence for soil depletion is fairly circumstantial. Fletcher (1950) mentioned an early Bucks County yeomen's concern with wheat harvests which he interpreted as an early sign of depleted soils. Unfortunately, their complaints were not referenced and Fletcher's source has remained elusive. Fletcher's next bit of evidence is a 1791 letter to President George Washington wherein Judge Richard Peters of Philadelphia reported that average yields were a little more than 10 bushels, but in some places wheat yields were as low as six bushels an acre (:124-126, 145). Fletcher takes this as confirmation of a progression of the soil depletion throughout the century.

The accuracy of Peter's yield estimate is born out by the quantities of grain probate inventories, but that doesn't necessarily have to be a result of a linear and unavoidable depletion of the soils by shifting agriculture. Instead, falling yields should be seen as yeomen's expectations of production running ahead of the natural cycle of soil rejuvenation. Grain yields per acre are not only a measure of soil fertility, but also reflect seeding rates, time of planting, climate, and decisions of when to break new land. The quantities of grain and livestock in Chester County inventories allows an examination of whether or not shifting cultivation was a likely cause of falling wheat yields in the second half of the 18th century.

Were Chester County Soils Being Exhausted?

The critical factor in the shifting cultivation practiced in colonial Pennsylvania was a balance of arable acreage with fallow land for grazing livestock. The valuations of grain in inventories indicates that Chester County yeomen typically planted between 15 and 30 acres of grain each year (Table 53). That quantity of arable land was very similar to that which was worked by a "full virgater," a well-employed husbandman of manorial Britain (McCloskey

1989:6). Prior to 1750, yeomen sowed approximately 18 acres of wheat and rye, an acre of Indian corn, and another of barley, buckwheat or oats. Over the course of the subsequent three decades, yeomen made some modest additions of two more acres of wheat and rye and a second acre of Indian corn. In the 1780s, a typical yeoman planted about four fewer acres of wheat and rye, 10 acres of Indian corn, and three acres of summer crops. Although the cultivation of wheat dropped in the later part of the century, overall production was increased by a greater investment of labor in high-yielding Indian corn and oats. As a result, Chester County yeomen increased the total output of grain, but that took place in the context of falling yields which meant a decreasing return on labor.

Table 53. Typical Grain Output Estimated from Chester County, Pennsylvania Inventories, 1713-1789.

	Wheat & Rye		Indian Corn		Barley, Oats & Buckwheat		All Grain	
	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels
1713-1719	18	180	1	10	2	10	21	200
1720-1729	15	120	0	0	1	5	16	125
1730-1739	18	145	1	10	1	5	20	160
1740-1749	20	160	1	10	1	5	22	175
1750-1759	21	165	2	20	1	5	24	190
1760-1769	18	125	2	20	1	5	21	150
1770-1779	20	140	2	20	1	10	23	170
1780-1789	16	110	10	100	3	30	29	240
	18	145	2	24	1	9	22	175

The output of an average inventoried household is well below the hypothetical annual production that James T. Lemon's (1972) drew from Chester and Lancaster tax assessments and a patchwork of contemporary observations (:265). Lemon estimated that after 1760, a

Lancaster or Chester County household produced 80 bushels of wheat, 25 bu. rye, 60 bu. of oats, 30 bu. of barley, 30 bu. of buckwheat, and 120 bu. of oats (:155-156). The estimated 345 bushels of grain is nearly twice that indicated by probate inventories. The main point of disagreement is an underestimation of wheat and rye, and an over-estimation of the lesser grains.

Lemon's hypothetical farm produced grain in keeping with quantities common to probate inventories, but does not consider that not every grain was sown each year. Wheat and rye were grown regularly, but the lesser grains like barley, buckwheat and oats were only grown by a minority of producers in any particular year. The values used in Lemon's model accurately captures the size of any one particular crop, but does not reflect an average over the course of several years. The low estimation of wheat and rye production may have resulted from Lemon's source which recorded winter grain in the fields, but not spring crops of the same grain. These short-comings may have escaped notice because his relatively high estimate of yield (see Table 27) masked much of the underestimation.

The production of grain was an important market product for Chester County yeomen, but it was livestock which required the greatest quantity of land. Yeomen cut hay and grew oats and Indian corn to counter the shortages in winter, but for most of the year livestock grazed on fallow fields. In the early part of the century, a typical yeoman's livestock required a little less than 50 acres of grass (Table 54). That quantity of grazing land could have provided by a field shift after only three, four or five years of grain production (Table 55). That rotation was easily carried out within the large plantations of the first part of the century and allowed a long period of restorative fallow.

Table 54. Fodder Requirements per Producer in Chester County, Pennsylvania Inventories, 1713-1789.

	Horses	Cattle	Swine	Sheep	Livestock Units*	Grass Acres+
1713-1719	4.6	4.9	2.0	5.6	10.7	48
1720-1729	5.3	6.7	1.9	9.0	15.9	72
1730-1739	5.6	8.4	2.2	12.3	18.8	85
1740-1749	4.8	8.1	2.8	9.5	17.2	77
1750-1759	4.6	7.0	3.6	8.5	15.6	70
1760-1769	4.0	7.5	3.9	9.2	13.6	61
1770-1779	3.8	6.8	4.5	8.6	12.7	57
1780-1789	3.9	6.8	4.6	6.6	12.5	56
	4.6	7.0	3.2	8.7	15.6	70

* 1 Horse = 1 Bovine = 5 Swine = 7 Sheep.
+ on soils of median fertility and grazed twice (Kunkle 1959:13-18).

Table 55. Minimum and Maximum Fallows Necessary for Livestock and Grain in Chester County, Pennsylvania Inventories, 1713-1789.

	Acres*	Grain Acres	Grass Acres	Cleared Acres (%)	Minimum Years Fallow to Arable for Grass+	Maximum Years Fallow to Arable for Grain
1713-1719	185	21	48	69 (37)	3.3 : 1	8.8 : 1
1720-1729	165	16	72	88 (53)	5.5 : 1	10.3 : 1
1730-1739	145	20	85	105 (72)	5.3 : 1	7.3 : 1
1740-1749	135	22	77	99 (73)	4.5 : 1	6.1 : 1
1750-1759	120	24	70	94 (78)	3.9 : 1	5.0 : 1
1760-1769	105	21	61	82 (78)	3.9 : 1	5.0 : 1
1770-1779	100	23	57	80 (80)	3.5 : 1	4.3 : 1
1780-1789	95	29	56	85 (89)	2.9 : 1	3.3 : 1
	130	22	70	88 (68)	4.1 : 1	6.3 : 1

* Excludes 25-percent of land in wood, waste and buildings (Ball 1973:136-138).
+ includes one additional year for the establishment of grass on old fields.

In a system of shifting fields the length of fallow is constrained by the fodder requirements of livestock and the acreage in grain. These two needs represent the minimum and maximum length of fallow available to yeomen. For example, in the 1730s a typical grain producer raised 20 acres of grain and kept livestock which required about 85 acres of grass from fallowed land. In total these fields took up less than three-quarters of the typical holding of 145 arable acres and was therefore easily managed. The minimum length of fallow can be estimated by the ratio of land in grass (85 acres) and land in grain (20 acres) and adding an additional year for the grasses to take root (4.3 + 1 = 5.3 years). In the 1730s a yeoman who turned his arable fields over to fallow every 5.3 years would have sufficient grazing land for his livestock. The maximum length of fallow can be estimated by comparing the total arable land (145 acres) and the size of all the grain fields (20 acre). Because of the size of his landholding, the longest fallow that a typical yeoman in the 1730s could carry out was about seven years. With such long fallows there was little danger of soil exhaustion. However, in subsequent decades, falling parcel size reduced available grazing land and forced yeomen to chose between livestock and grain.

Despite making reductions in the size of their herds in the 1750s and 1760s, Chester County yeoman's grain and animals still required more than 80-percent of cleared land. The cutting of herd size was a costly choice which ran counter to the increasing production of dairy products for local markets (see Tables 33 and 34) and the rising price of meat and dairy (Bezanson, Gray and Hussey 1935:96-116, 422-424). Yeomen made up for those losses by increasing acreage under cultivation in the 1770s and 1780s. Much of the increase was in fodder crops of Indian corn and oats, but the effect was to close the gap between the

minimum and maximum length of fallows and shorten the time in which natural fallows could rejuvenate retired grain fields.

In each decade after 1730, falling parcel size squeezed natural fallows such that the amount required for graze land approached that which allowed for soil rejuvenation. The point at which fallows were no longer sufficient to replenish the soil appears to have been the 1750s when fields were allowed five years of natural fallow and the typical plantation included about 150 total acres. Because of the length of natural fallows, the downturn in wheat yields was not fully felt until the 1760s. As parcel size fell in the 1770s yeomen reduced their herds and increased fodder production, but both the length of fallow and wheat yields continued to fall. In the 1780s, the demands of grass and grain had nearly converged and increasingly forced yeomen into a rotation of three to four years.

The ratio of three or four years of fallow to one of grain agrees with Squire Thomas Cheyney's 1791 observation concerning the "old" way of agriculture in Chester County. Cheyney believed it was the source of falling yields. However, that ratio of crop and fallow was more than the 2:1 course of wheat-barley-fallow which was traditional to the open-field system of manorial Britain (McCloskey 1975a:76). Despite these conditions, the Pennsylvania yeoman's confidence in natural fallows to regenerate the land was strong. In the 1770s, a Pennsylvania yeoman from near Durham, in Northampton County (now Lehigh County) assured the anonymous author of *American Husbandry* that he had profitably direct-cropped a field with a variety of grains for 14 consecutive growing seasons. He then allowed the field to rest for seven years before it was again to be cultivated (Carmen 1939:122-123; *c.f.* Fletcher 1950:128). Without a doubt, the Durham example was an extreme case involving new land.

However, it is noteworthy that his course preserves the medieval ratio of two to one ratio between crop and fallow.

While it is clear that subdivision had placed pressures on Chester County yeomen to decrease rotations and reduce herd sizes. However, it doesn't necessarily indicate that it was impossible for yeomen to continue their traditional practices. Shifting cultivation was best carried out on plantations of 150 acres with approximately 25 acres of grain and 15 livestock units. However, in the 1770s and 1780s, parcel size had stabilized at about 125 acres and wheat yields were about 6 or 7 bushels per acre. Albeit these yields were not what they had once been, they suggests a condition of stabilization rather than of collapse.

CHAPTER 11

MARKET

The Colonial Market

Immanuel Wallerstein (1974, 1980, 1989) places the American colonies on the "semi-periphery" of the emerging world-system economy(1980:75-120). Having supplanted many of the colonial aspirations of the Netherlands, Britain and France grappled for dominance of the American colonies. The material base of their power was agricultural production. It was an enterprise in which they were equally proficient (1980:65,81-90; *c.f.* Grantham 1991), but demand for foodstuffs in Europe exceeded supply (Wallertein 1989:206). Producers in rural Pennsylvania were part of a network of trade in which their wheat was traded for wine, salt and fruit from Southern Europe and shipments of English manufactured goods (Wallerstein 1980:237-238).

George David Rappaport (1996:xi-xii) has described the economy of 18th century Pennsylvania as "non-capitalist" and "associational," noting that it lacked the particular class structures and hierarchical institutions of modern capitalism. He argues that the social norms and values were motivated by membership in voluntary societies rather than an external market. This conclusion rests uneasily with Marx who places the origins of capitalism as concomitant with the 15th century enclosure which created a peasant proletariat alienated from arable land (Giddens 1971:31). However, Weber (1930, 1998) offers a potential middle

ground, and argues that American colonials were "rational" capitalists who rejected the traditional capitalism of feudal Europe and produced as a form of religious practice (:47-78). A Weberian history works best in early industrial New England, but Pennsylvanians similarly straddled the fence between traditional production and the world market.

Historians of colonial America are split in their characterization of the American attitude toward the market. James T. Lemon (1972, 1980) has argued that colonials were not "single-minded maximizing materialists." Nevertheless, they were "ready in spirit to conquer the limitless continent, to subdue the land" (:xv). Lemon typifies the prevailing ethos as "liberal individualism" or what would be described today as a "libertarian" political view. A position he sees as antithetical to the "industrialized, bureaucratized, and urbanized scene" of the 20th century which lacks the social stability and opportunities of the colonial period (:228). Lemon argues that the colonial society was stabilized by the "safety valve" of the nearby frontier. Risks to liberal individualism, such as the finite quantity of land, were evaded by out-migration which preserved the material base of the prevailing ethic. In his view, the paragons for this entrepreneurial spirit were local men of wealth and social stature (1980:690, 696).

James A. Henretta (1978; 1980) agrees that out-migration was fostered by was young, landless people who "moved to newly settled communities not as yeomen but as aspirants to that status" (1978:8). However, he suggests that the persistence of the liberal individualist ideal is incongruous with Lemon's recognition of the growth of tenancy toward the end of the 18th century (1978:5-6; Lemon 1972:94). Henretta argues that market-oriented agriculturalists were the exceptions to a *mentalité* which was "traditional" in the sense that it was well-established. He argues that the viewpoint was an "historically distinct social and economic system" divorced from the peasant classes of Europe. Nevertheless, colonists valued peasant's

concerns with the "yearly subsistence and the long-run financial security" of a "lineal" family unit which provided security for the older generations (1978:6, 19; 1980:696).

For all of Henretta's assertions concerning the shortcomings of Lemon's focus on the individual, his attention to lineage perpetuation is the same phenomena at a household scale. As T. H. Breen (1982) has pointed out, what is needed is an "analytic framework capable of dealing with both dimensions of rural life" (:246). An answer to that dilemma has been provided by Mildred Campbell's (1942) often under-appreciated volume *The British Yeoman* which serves to connect colonial agrarians with the class formation of their European forerunners. As she describes, the perpetuation of the household in agriculture is a defining value of the yeoman class and throughout their history the yeoman class has walked along the fence between security and market participation.

The colonist's own differentiation of "yeoman" from "farmer" reveals an important analytical tool for examining changing market attenuation and reformation of the labor structure. For example, Henretta is concerned that increasing tenancy is an overlooked sign of increasing entrepreneurship. However, yeomen have long accepted well-to-do tenants into their ranks (M. Campbell 1942:148-149). The difference between yeomen and farmers is a determined by the terms of the lease, not the institution itself. Yeomen often turned to tenancy as a solution to a short-term solution to an excess of labor. Both Lemon's "liberal individual" who looks for market advantage and Henretta's "lineal" family who seek continuity are well-entrenched aspects of the yeoman class ideology. Whether one is concerned with the yeoman strategies of the 15th or 20th centuries, the yeoman strategy is a risk-adverse approach to the market with the expressed goal of reproducing a new generation of agriculturalist (M. Campbell 1942; Kulikoff 1989, 1992, 2000; Salamon 1985, 1995; Bartlett 1987; Davis-Brown

and Salamon 1987). Yeomen encompass both Lemon's hopeful entrepreneurs and Henretta's cautious traditionalists.

Yeomen's Market Relations

Pennsylvania yeomen were at considerable risk when it came to their relations to the market. Wheat was lucrative, but strong overseas demand meant that it was one of the few Pennsylvania goods that merchants chose to export. The long distance between colonial ports meant that producers had limited ability to diversify their customer base. Rural producers could gain intelligence concerning the international market through newspapers and letters from friends and family, but they could only react to changes in the market. Market policies were established by the distant Lords of Trade who represented the interests of their trading companies. The geographic breath of the emerging world-system market meant that price was unpredictably affected by distant weather patterns and the incessant wrangling between the colonial powers. When Chester County yeomen entered the global market, they did so at a disadvantage. Unable to diversify the geography of their grain sails and with a limited number of cash crops, yeomen sought to alleviate risks by market abstention, occupational diversity within the household, and by reinvesting their profits locally.

Market Abstention: Spreading Risk over Product

Chester County yeomen did not withhold themselves from the wheat market because they were unaware of the prevailing price. Merchants' prices were published in Philadelphia newspapers and a comparison of inventory valuations of wheat and market price at Philadelphia suggests that appraisers tended to be very well informed (Figure 43). The

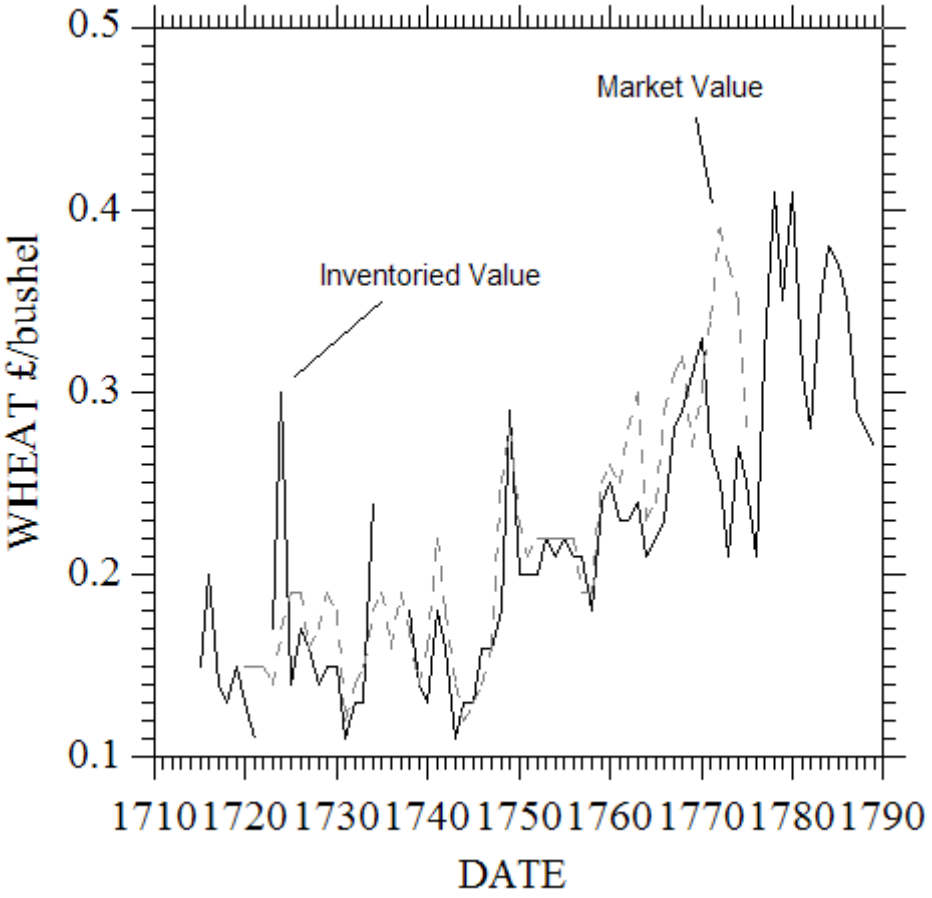

Figure 43. Mean Annual Chester County Inventoried Value and Philadelphia Market Price of Wheat, 1713-1789 (Wheat price: Bezanson, Gray and Hussey 1935:422).

difference between appraised and market price averaged about 7-percent, indicating that yeomen were attuned to the market and that the costs of moving grain from barn to merchant's warehouse were not substantial. Despite a better road system and mature networks of trade, Mark Overton (1980) found a 15-percent difference between East Anglia inventories and market price in nearby London (:207).

A difference in the value of the wheat in the yeoman's barn and at market was the costs of threshing and hauling the grain. On average, wheat in the sheaf was appraised at 4-percent less than the value of threshed wheat. The costs may have been somewhat higher if wage labor was employed. In 1785 the administrator of the estate of Anne Walker of Vincent paid a workman 0.025£ per bushel to have her wheat threshed (CC W&A 3724). That amount represented 7-percent of the mean appraisal of a bushel of wheat in that year. Another source of savings for American yeomen over British farmers was the widespread use of animals to tread the gain. Chester County yeomen had little use for flails which were listed in only three of 2012 inventories containing grain (CC W&A 2728, 3216, 3680). Although, flails were merely two staves married by straps of leather and had little value, appraisers regularly inventoried items of less value. At the very least, they would have been mentioned as part of a parcel of utensils.

The hauling of the grain to market represented the remainder of the difference between barn and market. There were as many owners of carts and wagons as there were owners of plows (see Table 16) and many rural producers took their own goods to market. Others hired a neighbor. When he passed in 1776, yeoman William Barr of West Nantmeal was owed 1£ 7s. by Robert Carson for hauling ten casks of flour the 40 miles to the town of Chester (CC W&A 3003). That trip across the entire width of the county added 0.03£, or 14-percent to the

cost of each bushel of wheat. On average, goods would be hauled only half that distance, and indicates that the costs of hauling were nearly equal to that of threshing. However, that is for overland travel. Chester County is cut and bound by numerous navigable rivers which flowed toward the ports at Chester and Philadelphia. In most cases rural goods were carried by flatboat or shallop at less cost. It may be that Carlson had to pay Barr for hauling his grain overland because of the drought of 1775 which had robbed mills of water (Bezanson, Gray and Hussey 1935:51) had probably had also hindered navigation.

The comparison of appraised value and market price of wheat suggests that there were three periods of varying accuracy of appraiser's wheat valuations. On average, the appraisals made between 1720 and 1745 were within 4-percent of the market price, but appraisers tended to overestimate the market's volatility. Such heightened perceptions of risk may have contributed to the yeomen's diversification of grain products during that same period. The valuations made between 1746 and 1759 agree most closely with market price. They vary by only 3-percent and with a narrow range of deviations. That level of agreement suggests a period of low uncertainty, and yeomen left the percentage of wheat grown unchanged during the 1740s and 1750s. The 1760s and 1770s witnessed the greatest variance between appraisers estimates and the market price. On average, they disagreed by 13-percent of the price and was market by relatively long periods of substantial disagreement. The low values applied by appraisers to wheat may indicate that there were concerns with the trade. No doubt the failure of the Continental currency caused unease, but that speaks only to the latter part of the trend. This period of a lack of surety in the wheat market may have encouraged the authors of probate records to increasingly establish the decedents' yeoman credentials (see Figures 2 and 3).

The quantities of grains in Chester County inventories indicate that yeomen most vigorously chased the wheat market in the 1720s (see Tables 51 and 52). However, the market in the first half of the century had the undesirable characteristics of being both chaotic and without significant improvement. After 1730, Chester County yeomen began a more sustaining strategy by growing more rye and Indian corn. The poor price of wheat may be sufficient to explain the diversification of grains. However, as the price of wheat climbed throughout the second half of the century (Bezanson 1935:9-55), Chester County yeomen continued to diversify their grain crops. During the unprecedented high wheat prices of the 1780s, Chester County yeomen eschewed maximization and lowered the mean output of wheat and rye. After having maintained a consistent average output for seven decades, yeomen produced one-third less wheat and rye. Most of that decrease was due to a movement away from wheat. Rye production grew throughout the century, but wheat had fallen from about 90-percent of all grain grown, to about 40-percent in the 1780s.

These data suggest that Chester County yeomen were very attentive to changes of wheat price. However, they used that knowledge to abstain from the market during times of price unpredictability. During a period of uncertainty prior to 1745, yeomen retreated from the wheat market and produced more grain that was consumed locally. During the short period of relative stability, in the late 1740s and 1750s, yeomen maintained a consistent level of wheat production. Even when falling yields after 1760 required them to place additional land under cultivation. However, the 1770s was marked by decreasing yields and periods when appraisers valuations of Chester County grain ran substantially below the market price. Despite the relatively high price of grain, these data indicate that yeomen were facing significant challenges in maintaining a predictable wheat harvest. This period of trouble was followed by

a decade in which wheat was grown in smaller quantities by fewer producers and as many yeomen raised Indian corn as sowed wheat.

Occupational Diversity: Spreading Risk Over Product

Agriculture was the business of 18th century Chester County and even schoolmasters swung a scythe at harvest (see Table 9). However, many households diversified their production by carrying out a non-agricultural trade. Duane E. Ball (1976) argued that the growth of manufacturing trades worked to retard the subdivision of agricultural holdings (:630), but the growth of manufacturing in the 18th century is difficult to track. The authors of probates provided descriptions of the trades of some decedents and others can be inferred from the tools and products in their inventories. The contents of an inventory provide a more complete record than descriptions of trades. For example, only 43 decedents were described as blacksmiths, farriers, wheelwrights or some other kind of ironworker. However, 155 inventories included forges and other smithing equipment owned by heads of households described as yeomen, innkeepers, a saddler, a tailor and a widow. The descriptions suggest that the equipment was not always used by the decedent themselves, but still represented an industry of the household. An additional concern are those retired craftsmen who passed on their tools to others. Half of decedents described as ironworkers were no longer in possession of the tools of their trade. However, by comparing the proportion of ironworkers who no longer possess their tools (51-percent) by the number of decedents with inventoried tools (155), the total number of ironworking households can be estimated (Table 56).

Table 56. Manufacturing Trades in Chester County, Pennsylvania Probates, 1713-1789.

	Identified by Description	Identified by Goods	Tradesmen without Goods (%)	Estimated Frequency (%)
Textiles	50	264	22 (44)	380 (21)
Ironworking	43	155	22 (51)	234 (13)
Woodworking	30	116	27 (90)	220 (12)
Coopering	19	125	10 (53)	239 (13)
Milling	15	10	--	25 (01)
Tanning	14	36	3 (21)	44 (03)
Construction	13	14	11 (85)	259 (15)
Shipbuilding	6	1	--	7 (00)
Medical	9	18	8 (89)	34 (02)
Sawyering	1	198	0 (<1)	198 (11)
Paper making	1	4	1 (100)	8 (00)
Baking	1	1	1 (100)	2 (00)
Whitesmith	1	1	1 (100)	2 (00)
Distiller	--	88	--	88 (05)
Surveyor	--	21	--	21 (01)
Quarrying	--	20	--	20 (01)
Wagonmaker	--	1	--	1 (00)
Clockmaker	--	1	--	1 (00)
	203	1073	--	1783 (100)

A comparison of those decedents associated with a particular economic endeavor and the contents of their inventories suggests that probate descriptions capture only about one in 10 tradesmen engaged in non-agricultural production. These descriptions are the best source for identifying persons engaged in relatively high-profile jobs such as milling and shipbuilding. However, inventoried tools are the best indicators of very common trades like woodworking and construction and the only evidence for distillers, surveyors and quarrymen. However, inventoried goods are poor identifiers of tailors, shoemakers, gardeners, and colliers since their tools are common to most households.

One-quarter of all inventories included goods which suggested a practitioner of at least one manufacturing trade (Table 57). When compared with the number of persons described in a trade, but without tools, these data suggest that about 4 in 10 households derived income from trades other than agricultural and domestic production. Diversification into non-agricultural trades became well established in the 1730, and remained at a similar level throughout the rest of the century. That pattern indicates that there was little growth in rural manufacturing throughout the 18th century. Rather these trades were established as a means of support for agriculture and as a third source of income beyond agriculture and domestic production.

Table 57. Tools and Goods Representing Non-Agricultural Trades in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	One Trade (%)	Two Trades (%)	Three to Five Trades (%)	Estates with Trades
1713-1719	75	3 (04)	--	1 (01)	4 (05)
1720-1729	206	26 (13)	3 (01)	2 (01)	31 (15)
1730-1739	291	59 (20)	6 (02)	1 (00)	66 (23)
1740-1749	560	106 (19)	13 (02)	5 (01)	124 (22)
1750-1759	482	105 (22)	17 (04)	4 (01)	126 (26)
1760-1769	648	119 (18)	32 (05)	10 (06)	161 (25)
1770-1779	609	145 (24)	32 (05)	12 (02)	189 (31)
1780-1789	680	140 (21)	40 (06)	8 (01)	188 (28)
	3551	703 (20)	143 (04)	43 (01)	889 (25)

Social Banking: Spreading Risk Over Producers

Behind the simplicity of inventory valuations was a dazzlingly complex system of international coinage, divers colonial and state paper monies, merchant's endorsements,

personal ledgers, business accounts, personal bonds, and debts remembered and forgotten (see McCusker 1978:175-188). Much of the exchanges were small, day-to-day bartering of goods based on a mutually agreed value set by traditional equivalences, current market and social relations. A credit might run over the course of months or years with only occasional reconciliation. Much like one's credit rating today, one's ability to assume debt was a function of reputation gained through past activity.

Each head of household kept track of these accounts in a ledger which tracked agreed price, goods exchanged and payment history. For example, David Thomas and Jonathan Pugh preserved a page from the ledger of John James of Coventry when they made his inventory (CC W&A 3261). James was probably a partner in one of Coventry's iron foundries since his ledger recorded sales of bar and rod iron. These ledgers were an economic tool for working around a chronic lack of minted currency in colonial America. Socially, they served to create complex networks of debtors and creditors which presented a safety net in times of need and a means of acquiring status as a person of means.

Much to the frustration of gentlemen reformers, yeomen did not reinvest their profits into capital improvements. Instead yeomen addressed two class goals at once by letting out their profits in bonds. In a system which might be best described as "social banking," yeomen who had accumulated significant profits or who sought to put an offspring's inheritance "to work," would let out funds to a reliable member of the community. Very often this person was a younger kinsman or someone else who was well-known by the lender.

A common use of borrowed funds was to set oneself up in agriculture. The bonds were legally binding, but relied on the industry of the borrower to generate sufficient income to pay back the lender. A prospective borrower was not judged merely by relatedness or

ability to make repayment, but also their adherence to social expectations of deportment and career path. It was likely that borrowers were also judged by race, gender, religion and social position, but it was common for yeomen to lend small amounts of money to persons outside their social circle. In order to protect themselves, the lender of large sums would often make the purchase of land or improvement and then place it with the borrower on bond. In that way should the borrower default, the property would revert to the lender. The result of this system was a tight-knit network of older and younger yeoman linked by mutual benefit. Lending money was a means by which successful yeomen gained social stature, collected interest, and furthered the class goal of reproducing yeoman households.

The amount of money involved in social banking was substantial. Loans account for two-thirds of all wealth in 18th century Chester County inventories (Table 58). These sums were recorded as bills requesting payment, bonds detailing the legal conditions of a loan, a personal note promising payment, or book accounts for small sums. Social banking continued even after the new United States government offered interest accruing certificates and the First Bank of North America was established in Philadelphia and opened to the public in 1782 (Rappaport 1996:137-158). No Chester County decedent had an account there, but in 1787 yeoman Samuel Jones of Tredyffrin possessed a note for a little over 26£ drawn on the Bank of Delaware in nearby Wilmington (CC W&A 3869). The institution had just opened its doors the prior year (Munroe 1984:106).

The costs of the system were bad loans which were sometimes described by administrators as "dubious." Common causes were the death of the borrower, insolvency, or removal to another state. However, the investment of the majority of a household's wealth in other households meant that even potentially catastrophic losses like house fires or war-time

looting were survivable. For example, although British troops took everything from curtains to turnips from Samuel Havard's Tredyffrin house in 1777, he and his unmarried sisters were able to tap social networks and maintain their household for the rest of their lives (CC W&A 5512).

Table 58. Social Banking in Chester County, Pennsylvania Inventories, 1713-1789.

	Sample	Lenders (%)	Mean Inventory £	Mean Credits (%)	Loan Office
1713-1719	75	46 (61)	145	42 (29)	--
1720-1729	206	130 (63)	160	59 (37)	--
1730-1739	291	201 (69)	191	66 (35)	--
1740-1749	560	417 (74)	208	81 (39)	--
1750-1759	482	356 (74)	239	104 (44)	--
1760-1769	648	467 (72)	335	181 (54)	--
1770-1779	609	419 (69)	382	164 (43)	--
1780-1789	680	441 (65)	405	186 (46)	21 (03)
	3551	2477 (70)	297	133 (45)	--

CHAPTER 12

FARMERS

Historical Ecology and Multidimensional Analyses

Having marshaled the historical, climatological, geographical, material, social, agricultural and strategical evidence relevant to the perpetuation of American yeomen, it comes time to sort it all out. A particular problem for studies in historical ecology is the stochastic risks of reconciling multiple lines of evidence (Crumley 1994:1-16). It is rarely the case that a researcher has sufficient evidence to establish causality outside the historical continuity of a single line of evidence. For example, it is a biological certainty that a long period of drought lowers yields of unirrigated wheat. It is also a truism that agriculturalists depend on good crop yields to make their living. Within economic theory, one can be pretty certain that repeated crop failures will encourage agriculturalists to seek more advantageous lands or instigate a change in their methods. Lastly in terms of social formation, a class of producers without membership does not continue. However, the relationships between these lines of evidence are less sure. How long a drought is required to drop yields sufficiently to drive enough producers away from a region or set of practices in order to prompt a reordering of class identity?

A solution is to examine the historical trajectories and interrelationships of relevant ecological factors over a period of time. This is carried out in a three step process wherein one

must identify likely ecological factors, then examine their historical trends and relationships, and lastly, these must be interpreted in a way that provides a plausible set of motivations of ecological change. The choice of factors is aided by Crumley's (1994) recognition that landscape is the product of the historical relations of human and environment. This observation narrows the choice of relevant factors to those things which potentially shape landscape such as climate, biotic communities, geology, hydrology, soils, and human actions.

Historical and Ecological Trends in 18th Century Chester County

The data relevant to the material basis of the American yeomen in Pennsylvania includes reconstructions of climate, wealth, landholding, grain, livestock, bound labor, practice, market and growth of manufacturing in Chester County (Table 59). The spring, summer, autumn and winter temperatures (A, B, C and D) and rainfall (E, F, G and H) were drawn from Lansing, Yu and Huang's (1968) reconstruction of Philadelphia-region weather. The value of all estates (I) included every inventory with a class descriptor and yeoman estates (J) is a subset of that sample. The frequency of probated persons who are identified as yeomen (K) is based on those decedents with a class identifier wether male or female. Landholding (L) is a estimate of the mean acreage held based on samples by Chester County historians. The frequency of wheat producers (M) and Indian corn (O) are percentages of grain producers who grew those crops. Acreage in wheat (N), Indian Corn (P), acreage of all grain (Q), and wheat yields (R) are drawn from the inventory data. Livestock units (S) are the average herd size reduced to equivalents for size. Bound laborers (T) is the number of slaves, servants, or apprentices in an average household. Inter-cropped (U) is the proportion of total wheat and rye acreage which was sown together. The minimum and maximum fallows (V and W) define

Table 59. Ecological and Historical Trends in Chester County, Pennsylvania Inventories and Climate Data, 1713-1789 (Factor letter is keyed to Figure 44).

	1713-1719	1720-1729	1730-1739	1740-1749	1750-1759	1760-1769	1770-1779	1780-1789
A. Spring Temp. (°F)	--	--	55.8	54.7	53.3	52.1	51.3	52.3
B. Summer Temp. (°F)	--	--	74.7	74.6	73.4	73.2	72.5	75.0
C. Autumn Temp. (°F)	--	--	55.7	56.0	56.4	55.3	56.2	55.9
D. Winter Temp. (°F)	--	--	35.4	31.5	36.8	36.4	37.0	31.3
E. Spring Rain (In.)	--	--	11.0	10.8	10.0	9.7	9.4	10.6
F. Summer Rain (In.)	--	--	13.4	12.3	13.5	12.1	12.4	12.6
G. Autumn Rain (In.)	--	--	9.7	9.4	9.3	9.3	9.3	10.1
H. Winter Rain (In.)	--	--	9.1	9.0	8.7	8.2	7.8	9.0
I. All Estates (10£)	17.1	21.8	21.1	24.3	27.7	36.8	36.9	49.9
J. Yeoman Est. (10£)	20.5	18.3	22.3	24.1	28.6	30.5	34.0	48.8
K. Yeoman Class (%)	49.0	62.0	63.0	52.0	61.0	68.0	66.0	48.0
L. Land held (10 acres)	18.5	16.5	14.5	13.5	12.0	10.5	10.0	9.5
M. Wheat Prod.(%)	72.0	62.0	56.0	62.0	60.0	59.0	68.0	65.0
N. Wheat acreage	16.8	14.2	14.3	13.5	15.0	10.6	10.6	9.6
O. Indian Corn Producers (%)	16.0	1.0	19.0	22.0	27.0	37.0	41.0	48.0
P. Indian Corn Acres	0.0	0.0	4.3	3.6	8.9	6.0	4.8	19.9
Q. All Grain acreage	20.7	16.1	19.7	22.4	25.1	21.2	21.2	28.8
R. Wheat yields (bu/a)	10.5	8.2	8.1	9.1	8.1	7.0	6.8	5.7
S. Livestock units	10.7	15.9	18.8	17.2	15.6	13.6	12.7	12.5
T. Bound Labor (/10 households)	3.5	3.1	4.8	4.8	3.1	2.9	2.7	2.0
U. Inter-cropped (%)	5.0	5.0	14.0	28.0	22.0	31.0	22.0	13.0
V. Min. Fallow (year)	3.3	5.5	5.3	4.5	3.9	3.9	3.5	2.9
W. Max. Fallow (year)	8.8	10.3	7.3	6.1	5.0	5.0	4.3	3.3
X. Social Banking (%)	29.0	37.0	35.0	39.0	44.0	54.0	43.0	46.0
Y. Wheat (£/10bu)	--	1.7	1.6	1.8	2.2	2.8	3.4	3.9
Z. Manufacturers (%)	5.0	15.0	23.0	22.0	26.0	25.0	31.0	28.0

the range of years which a field may be left to natural grasses and the browsing of livestock. Social banking (X) is the percentage of estates that were put out on loan and represents the prevalence of working capital. Wheat price (Y) is its advertised value at Philadelphia from the work of Bezanson, Gray and Hussey (1935:422) and Bezanson (1951:339-341). The

frequency of manufacturers (Z) is the estimated numbers of decedent households engaged in non-agricultural production.

In the interest of increased readability, the data were normalized to the mean of the 1750s (Table 60). The environmental factors, percentage of wheat producers, and the lending of money remained relatively stable throughout the century. The increasing trends are those which are financial. Chester County residents left larger average estates which may have been buoyed by high wheat prices, larger fields, although not of wheat, and increased interest in the manufacturing trades. Those trends which fell in the second half of the century concerned production. The size of herds, arable land held, length of fallow, wheat yields, acreage in wheat, numbers of bound laborers, and the practice of inter-cropping grain all fell during the second half of the century. Practitioners of shifting agriculture faced increasing constraints by subdivision, but such pressures were not an impediment to an increase in their fortunes.

Principal Component Analysis of Yeoman Ecology

The trends expressed in Table 60 establish a basic pattern of rising finances and falling productivity, but a principal component analysis (PCA) provides a means of examining the inner relationships between the ecological variables (see Chapter 5 for further discussion of PCA). Principal components were calculated from data spanning the period between 1730 and 1790 (Figures 44 and 45). Since the data are at multiple scales, the components were calculated from correlation matrices. The first two principal components reflect particularly strong patterns, especially when considering the large number of factors, and explains 80-percent of the variance in the data (Table 61).

Table 60. Indices of Ecological and Historical Trends in Chester County, Pennsylvania Inventories and Climate Data, 1713-1789 and Normalized to the 1750s Mean.

	1713-1719	1720-1729	1730-1739	1740-1749	1750-1759	1760-1769	1770-1779	1780-1789
Increasing Trends								
P. Indian Corn Acreage	0	0	48	40	100	67	54	224
O. Indian Corn Prod.	59	4	70	81	100	137	152	178
Y. Wheat Market	--	77	73	82	100	127	155	177
I. All Classed Estates	62	79	76	88	100	133	133	180
J. Yeoman Estates	72	64	78	84	100	107	119	171
Q. All Grain Acreage	82	64	78	89	100	84	84	115
Z. Manufacturers	19	58	88	85	100	104	119	108
Stable Trends								
G. Autumn Rain	--	--	104	101	100	100	100	108
M. Wheat Producers	120	103	93	103	100	98	113	108
C. Autumn Temp.	--	--	110	108	100	97	94	106
X. Social Banking	66	84	80	89	100	123	98	105
H. Winter Rain	--	--	105	103	100	94	90	103
A. Spring Temp.	--	--	102	102	100	100	99	102
B. Summer Temp.	--	--	99	99	100	98	100	99
E. Spring Rain	--	--	105	103	100	98	96	98
F. Summer Rain	--	--	99	110	100	90	92	93
Falling Trends								
D. Winter Temperature	--	--	94	86	100	99	101	85
S. Livestock Units	69	102	121	110	100	87	81	80
L. Landholding	154	138	121	113	100	88	83	79
K. Yeoman Class	80	102	103	85	100	111	108	79
V. Minimum Fallow	85	141	136	128	100	100	90	74
R. Wheat Yields	130	101	100	112	100	86	84	70
W. Maximum Fallow	176	206	146	122	100	100	86	66
T. Bound Laborers	113	100	155	155	100	94	87	65
N. Acreage in Wheat	112	95	95	90	100	71	71	64
U. Inter-cropped	23	23	64	127	100	141	100	59

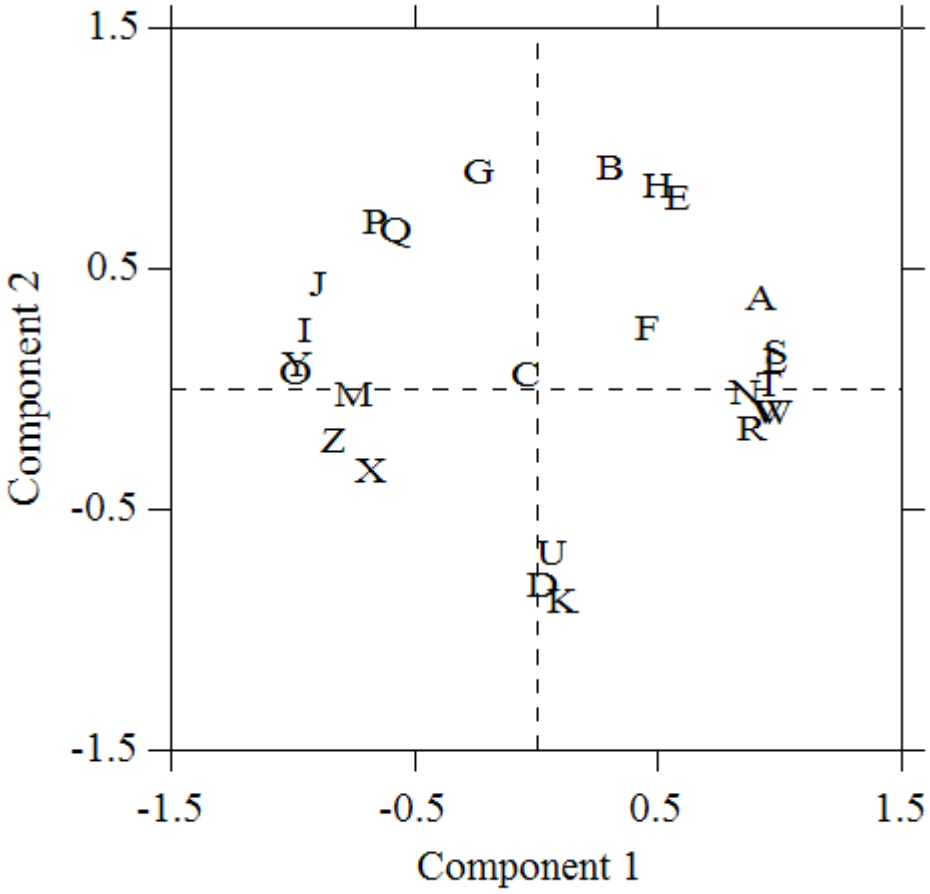

Figure 44. Scores of a Principal Component Analysis of Ecological Factors of Yeoman Production, Chester County, Pennsylvania, 1730-1790.

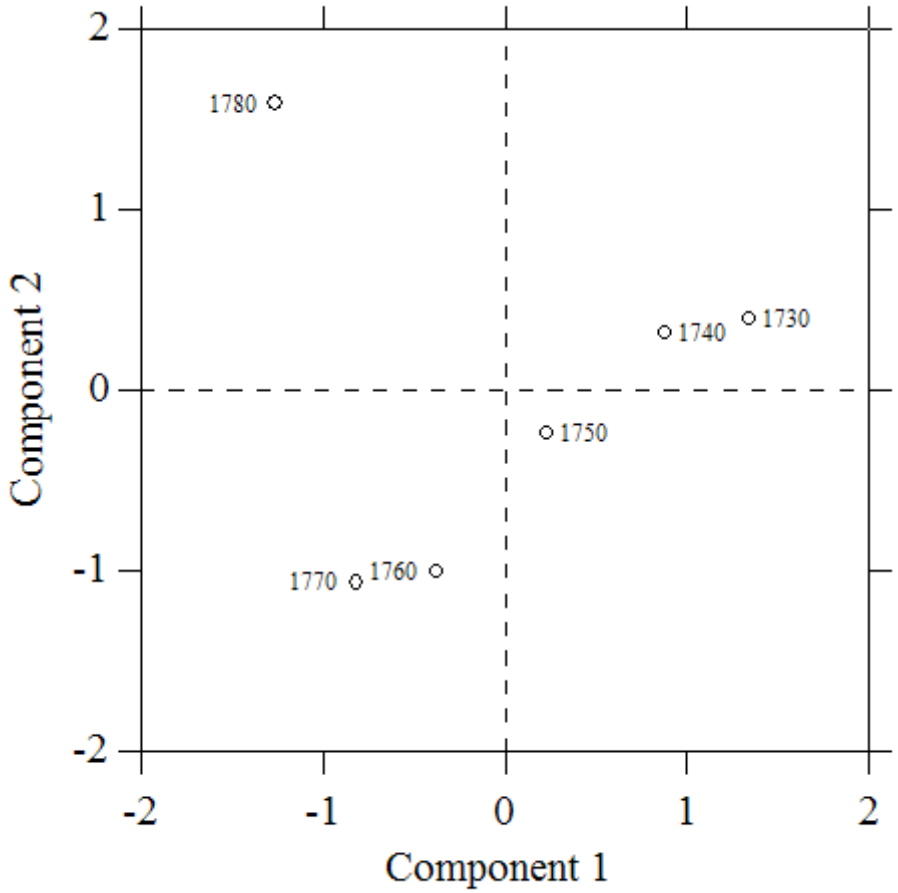

Figure 45. Loadings of a Principal Component Analysis of Ecological Factors of Yeoman Production, Chester County, Pennsylvania, 1730-1780.

Table 61. Principal Component Loadings of Factors in Yeoman Ecology, Chester County, Pennsylvania 1730-1790.

Component	1	2	3	4
A. Spring Temperatures	**0.92**	0.37	-0.02	0.06
B. Summer Temperatures	0.32	**0.92**	-0.24	0.02
C. Autumn Temperatures	-0.04	0.06	**0.87**	-0.48
D. Winter Temperatures	0.03	**-0.82**	0.35	0.44
E. Spring Rain	0.58	**0.79**	-0.15	0.01
F. Summer Rain	0.46	0.25	**0.71**	0.41
G. Autumn Rain	-0.24	**0.90**	-0.06	0.30
H. Winter Rain	0.51	**0.84**	-0.05	0.01
I. All Estates	**-0.96**	0.24	-0.15	0.08
J. Yeoman Estates	**-0.90**	0.43	0.02	0.06
K. Yeoman Class	0.11	**-0.88**	0.03	0.45
L. Landholding	**0.99**	0.11	0.03	-0.01
M. Wheat Producers	**-0.74**	-0.02	0.24	-0.49
N. Wheat Acreage	**0.86**	-0.02	0.41	-0.07
O. Indian Corn Producers	**-0.99**	0.06	-0.08	0.07
P. Indian Corn Acreage	**-0.66**	**0.69**	0.08	0.15
Q. All Grain Acreage	-0.58	**0.66**	0.20	-0.17
R. Wheat Yields	**0.89**	-0.17	0.04	-0.40
S. Livestock Units	**0.99**	0.15	0.04	0.04
T. Bound Labor	**0.96**	-0.02	-0.13	-0.15
U. Inter-cropping	0.07	**-0.68**	-0.48	0.46
V. Minimum Fallow	**0.96**	-0.10	-0.09	0.17
W. Maximum Fallow	**0.97**	-0.10	-0.10	0.14
X. Social Banking	**-0.68**	-0.34	-0.43	0.12
Y. Wheat Market	**-0.98**	0.10	0.00	0.05
Z. Manufacturing	**-0.83**	-0.22	0.44	0.07
Variance explained	14.26	6.51	2.41	1.67
Percent of variance	54.84	25.06	9.26	6.43

The first component describes an inverse relationship between declining factors of production and increasing wealth. Spring temperatures (A), landholding (L), acreage and yields of wheat (N and R), herd size (S), bound labor (T), and length of fallow (V and W) fell, as there were corresponding increases in the value of estates (I and J), market price of wheat

(Y), number of producers and acreage in Indian corn (O and P), money lending (X), and manufacturing trades (Z). The relationship is counter-intuitive since it would be expected that yeomen fortunes would fall with the size of herds, numbers of bound laborers, and grain yields. The complexity of this relationship may lie at the heart of both the gentleman's misunderstanding of yeoman's adherence to shifting cultivation. However, the demand for American foodstuffs was such that producers were profitable despite their increasing labor inefficiencies caused by cool springs and diminishing land holdings.

The critical environmental factor was spring temperatures. The increasingly late springs made bound labor less useful by discouraging the planting of spring wheat and suppressing yields by shortening the growing season. As locals had observed, the increasingly cold springs inhibited the growth of natural grasses. Yeomen reacted by keeping smaller herds. The reduction in productive power was accompanied by the subdivision of agricultural lands which necessitated a shortening of regenerative fallows. Although manufacturing was carried out in support of agriculture, its historical trajectory follows the growth of wealth rather than the decline of farm productivity. That pattern suggests that as rural demand for manufactured goods lessened, yeomen with trades continued to value a diversified approach and were probably supplying those on their way to the new frontier.

The relationship between finances and production described by the first component followed a regular and steady movement from high-yields, long-fallows, and low market prices to lower-yields, shorter-fallows, and higher market prices (Figure 46). Peter Kalm may have been correct when he observed that the favorable environmental conditions in the Delaware Valley encouraged colonists to continue Native American's shifting cultivation. However, it was a strong market which increased profitability as yeomen subdivided their

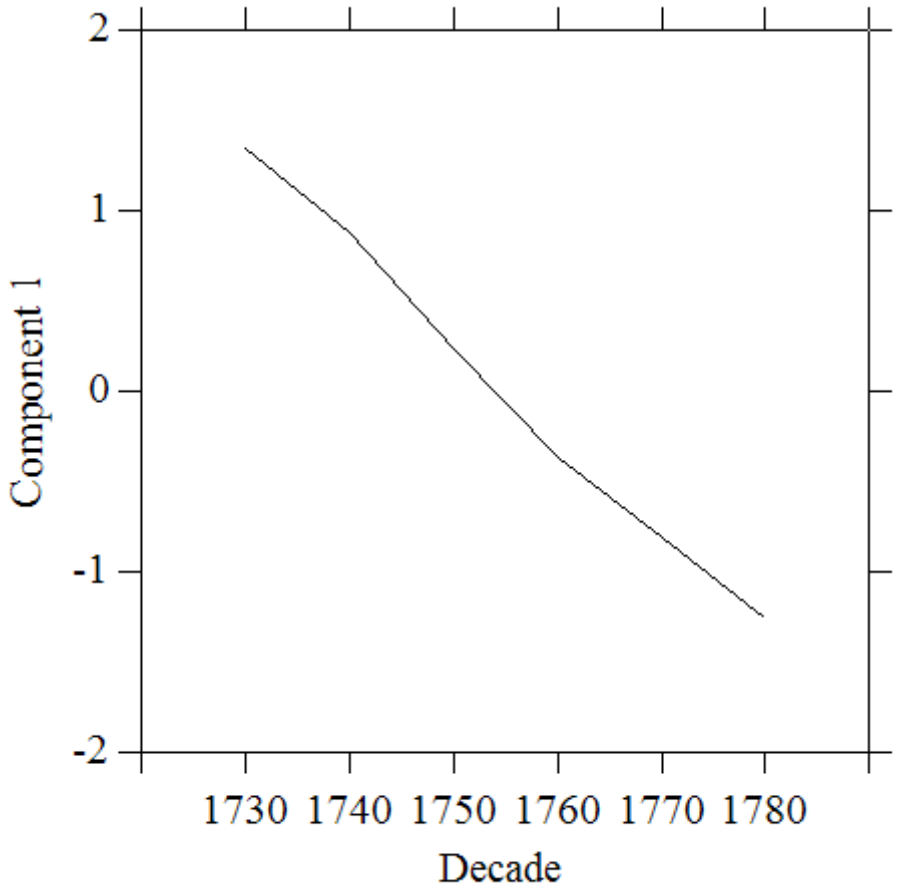

Figure 46. Trajectory of the First Component of the Ecological Factors of Yeoman Production, Chester County, Pennsylvania, 1730-1790 (*N.B.* The downward trend represents increasing wealth).

plantations to provide offspring with land. In the face of persistent immigration and indigenous population growth, reinvestment of profits through socially negotiated loans, and a prevailing morale which valued land ownership, the yeomen of Chester County expanded rapidly occupy the entire county and seek land on the frontier.

The second principal component describes an inverse relationship between summer temperature, precipitation and summer grains, and the size of the yeoman class and prevalence of their risk-management strategies. Yeomen increasingly inter-cropped wheat and rye as summer temperatures fell (B) and springs, autumns, and winters became drier (E, G and H). The factor analysis indicates that yeomen mix-cropped their winter grains as a means of ameliorating the effects of cool summers and a lack of rain. The hardiness of rye was probably the most desired attribute. However, rye's ability to grow quickly meant that it was able to make use of late summer rains. The rye's well-formed root system absorbed and retained water throughout the winter and slowed the dessication of slower growing wheat. The sheltering rye plant continued to keep the wheat moist, and slowed its growth such that it was less likely to ripen too soon and produce light grain.

Yeomen also divorced themselves from a wheat market that they had found increasingly unpredictable, and planted more Indian corn and other summer grains (P and O). Between 1730 and 1760 the second principal component reflects an environmental shift toward cooler summers and wetter autumns and increased inter-cropping as a means of managing the effects of the changing weather (Figure 47). After 1760 the local weather pattern reversed and began a movement toward warmer summers and dryer autumns.

These findings give little credence to the critics complaints that yeomen were unchanging in their practices. Yeomen resorted to traditional practices of inter-cropping and

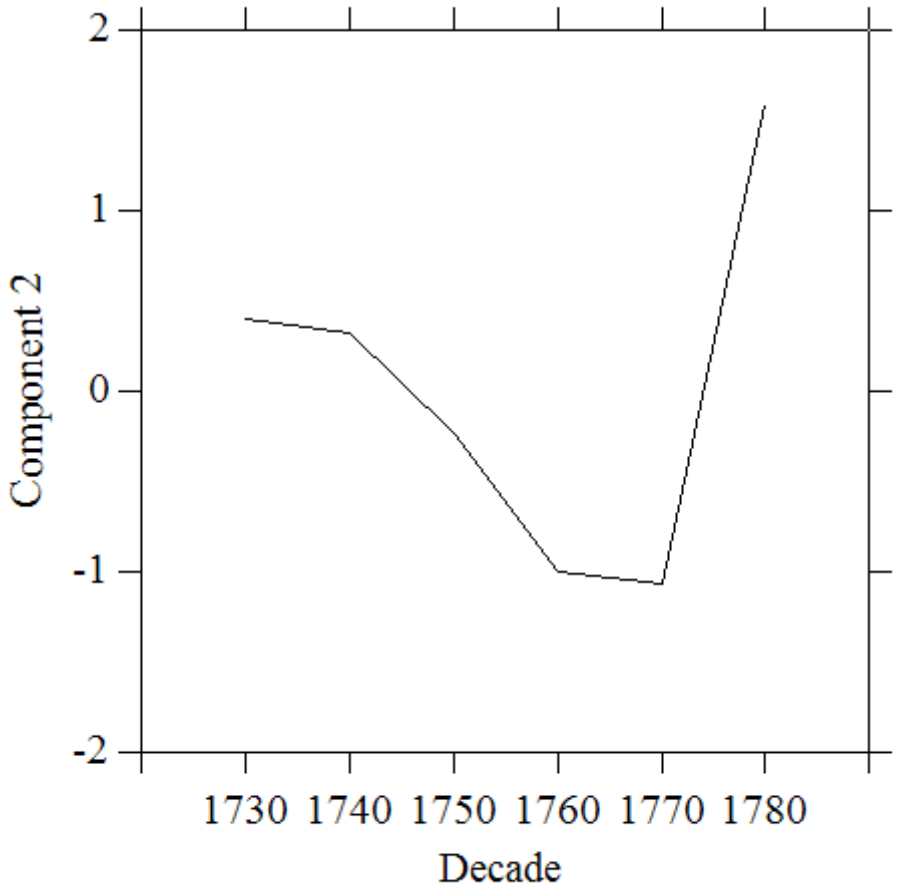

Figure 47. Trajectory of Second Principal Component of the Ecological Factors of Yeoman Production, Chester County, Pennsylvania, 1730-1790 (*N.B.* Downward trend represents growth of yeoman class).

diversifying grains. However, they did so as a calculated response to changing weather patterns by adopting and then abandoning inter-cropping, moving away from wheat production, and shifting from predominantly winter to summer grains. The ranks of the yeoman class rose and fell with these practices, indicating not only that they found them a practical solution, but that they were the material representation of the class ideology. In addition to being defined by their status of owner-operator, yeomen were advocates of low-risk production.

The first and second component embrace the dual nature of the American yeoman. On one hand, they were producers for foreign wheat markets who reinvested their profits in order to continue the practice by reproducing their plantations for their offspring. The result was the an unavoidable subdivision of land holdings and the an erosion of the ability of natural fallows to replenish the soil. Throughout the century the pattern of falling parcel size, shorter fallow and lower yields. However, a point of systemic failure was not reached in the 18th century, and a strong market price for wheat more than compensated for increasing labor inefficiencies of shifting cultivation on small parcels of land. On the other hand, yeomen played it safe. They revived low-risk strategies such as inter-cropping and abstention from the wheat market through a diversification of grains in order to minimize the worst effects of an unfavorable climate. These strategies reduced the maximum potential yields but provided protections against a catastrophic loss which would deprive them of their land holdings and remove them from the ranks of the yeomanry. It was the pursuit of these low-risk strategies in the second principal component which separated yeomen from farmers.

These trends suggest that although wheat yields were low, the market was high. At the same time that the pressures of subdivision were first being felt, the summer and autumn weather had taken a turn for the better and was improving. The effects of falling parcel size and continued cold springs were very real. The 1760s was a period of adjustment concurrent with an inability of appraisers to accurately follow the swings in the market. At the same time yeomen ranks were swelled by those of the lower-middle and upper-middle classes (Figures 2 , 3 and 31, Table 10) who sought to gain official documentation of their social position in probate records.

The Revolutionary war was a time of significant disruption and material loss as Chester County provisioned both sides of the conflict. However, yeomen persisted and quickly recovered from the war, and it was not until after the decade after American Independence that the yeomen transformed themselves into American farmers. These data suggest that Chester County yeomen were not forced from their traditional practices by bad fortune, pestilence, exhausted soils or impoverishment. The class was a victim of its own success. The county had been fully occupied, and their offspring faced the choice of seeking land elsewhere or becoming farmers working rented land with hired help.

The yeoman class did not have to pass. Their British fore-bearers had persisted for centuries on modest parcels by keeping their herds small, rotations tight, and expectations low. However, they did so under the pressures of first feudal militarism and then merchantilist laws which had barred them from directly engaging in the market. The American Revolution had removed a layer of governmental rule and with it the legal supports of trading monopolies. American yeomen stood at an historical conjunction. To the east lay a newly opened global market hungry for Pennsylvania grain. To the west was a frontier promising

land for subsequent generations. Young yeomen were faced with a critical decision to continue their traditional practices by chasing the frontier, or stay and make capital improvements in order to chase the market. A continuation of shifting cultivation on relatively small parcels merely forestalled the inevitable as there still would be no land for the next generation. The next generation chose opportunity over security.

Yeomen weren't forced into the role of farmers. They chased it eagerly and set out to be the best farmers in the country. The next generation of Chester County agrarians saw themselves as broken from the past and rejected nearly every aspect of the old agriculture. They introduced new breeds of grain and animals, invented farm machinery, and published periodicals with agricultural advice. The emotion of the day was conveyed in the 1778 will of John Lang of West Caln who described himself as a "Farmer" in "this independent and free state of Pennsylvania" (CC W&A 3132).

The Rise of Farming

The potential for the transformation had always been there. Agricultural historians' characterizations of yeomen as lacking the capacity for change was undeserved. Yeomen eagerly adopted practices which decreased risk and saved inputs of labor. Early in the century yeomen focused primarily on the wheat market and kept relatively large herds. It was only in later decades that they found that they were better served by increasing crop diversity and keeping fewer animals. Labor-saving devices were highly valued. Most eagerly adopted treading rather than threshing with a flail. Chester County yeomen quickly adopted the use of a "Dutch fan," an enclosed winnowing machine which blew the chaff from treaded grain. Researchers have suggested that they were first introduced as early as 1750 (Fletcher

1950:102) or 1731 (Lemon 1966:487). However, yeoman John Blunstone of Darby was using one as early as 1723 (CC W&A 166). Chester County's own Anthony Acker of Vincent Township reported in 1770 that he had manufactured 1660 Dutch fans (Lemon 1966:487 n81; CC W&A 3078). At least 250 Chester County yeomen invested the price of cow into the purchase of one of these fans.

Yeomen were open to change and some found use for Timothy grass, clover and turnips (see Table 46). In 1781 Robert Gilmore of New London died in possession of a rake used to sow clover and by 1760, Aston blacksmith John Carter had built a turnip planter (CC W&A 3290, 1868). Yeoman Isaac Pearson of Darby possessed a drill plow and was an early adopter of turnips and a large quantity of dung (CC W&A 3526). These few rural reformers would soon have auspicious allies, although there would be no consultation between practical farmers and urban reformers.

The Philadelphia Society for Promoting Agriculture

In 1785, an austere collection of gentlemen-reformers collected themselves into the Philadelphia Society for Promoting Agriculture (Fletcher 1976). The membership was drawn from the city's elite and included five signers of the Declaration of the Independence and seven members of the American Philosophical Society. The organizations' founders included prominent politicians, lawyers, physicians, merchants and military officers, but no full-time agriculturalists (:12-15). Richard Peters, a founding member and later president of the Agricultural Society, argued that a lack of direct involvement in agriculture was an asset:

> The founders of the Society were not biased by any selfish motives, for few of them had any direct interest in the subject. Their objects were purely patriotic and calculated to serve the interests of the Husbandman without any prospect

> of emolument, or even fame, accruing to themselves (Richard Peters in Fletcher 1976:9).

The patriotic and scholarly tone of the organization must have been aided by the society's use of Carpenters' Hall, the site of the first Continental Congress and meeting place of the Library Company of Philadelphia and American Philosophical Society. Benjamin Franklin was nominated to the society and General George Washington attended an early meeting. In 1788, the year before he was elected to the Presidency, Washington spoke to role gentlemen played in agricultural reform:

> Experiments must be made and the practice (of such of them as are useful) must be introduced by gentlemen who have leisure and abilities to devise and wherewithal to hazard something. The common farmer will not depart from the old road 'till the new one is made so plain and easy that he is sure it cannot be mistaken, and that it will lead him directly to his object. It is right perhaps it shd be so, for new ways are thorny and require time for amelioration (Bridgeman 1962:576).

It was unlikely that the society would be infiltrated by working agrarians. The rules of the Agricultural Society limited membership to those who lived within 10 miles of Philadelphia. While this rule recognized the practicalities of meeting in the city, it forestalled any potential participation by rural agrarians. The only exceptions to the rule were honorary members, but they were all men of distinction (:15-16).

In the passage above, Richard Peters said "few of them" because he considered himself a "practical farmer" since he oversaw the managers of the fields at his Philadelphia estate (Fletcher 1976:14). Other members' experience was at a theoretical level. The first president of the society, John Beale Bordley (1784) published A *Summary View of the Courses of Crops in the Husbandry of England & Maryland* wherein he argued for the replacement of Marylander's traditional course of Indian corn, wheat and natural fallow with Arthur Young's (1771) "Norfolk improved Course." The Norfolk method made use of turnips as a fallow crop

between wheat and barley (Bordley 1784:12). Bordley proposed a new course which included clover, potatoes, and peas. His calculations showed promise, but he himself had not put them to practice. His confidence in its efficacy was a reflection of his faith in Arthur Young. As Bordley put it, Young's "Collection of undoubted *Facts*, have chiefly convinced me that those improved Courses are practicable" (:16-21).

In a 1793 personal letter, Thomas Jefferson referred to George Logan, another founding member of the Agricultural Society, as "the best farmer in Pennsylvania, both in theory and Practice." Although a lawyer and politician, George Logan conducted various agricultural experiments at his family manse (Fletcher 1976:14-17). Logan's grandfather James Logan had published papers on experiments with Indian corn in Europe. His father William Logan and his father's cousin George Read of Burlington, New Jersey, had corresponded with Jared Eliot and demonstrated a knowledge of practical agriculture and an interest agricultural experimentation (Eliot 1934:228-234; Tolles 1951, 1953, 1956). Logan was clearly the most knowledgeable member of the society, but his research would go largely unacknowledged.

In a 1785 public address that was widely distributed by flier and publication, the Agricultural Society spelled out their concern with the "very imperfect state of American Husbandry" in comparison with Europe, a fact that is "too well known to be controverted." They suggested that over the course of the previous 50 years, England had advanced its agriculture whereas the Americans had "remained stationary" (Fletcher 1976:19). Having established two poles of comparison, the Society summarized the central faults of the local agriculture:

> *American method*: Unproductive fallows precede crops; after crops, the land is generally given up for a number of years to weeds and poor natural grasses

> until it shall come into heart again, the husbandman in the meantime employing his labours upon his other fields in succession.
>
> *English Method*: A field when broken up, is manured with all the husbandman's forces and what is called a fallow crop taken off, such a crop as requires the use of the plough or the hoe, as in turnips, potatoes, beans &c. The land is then laid down in some kind of grain and clover, the last continuing sometimes two or three years, which is succeeded by wheat upon a single ploughing. This course, or rotation of crops, is then renewed in the same order, the land never being idle or resting, as it is called (Fletcher 1976:19-20).

The "English Method" quoted by the society was not the common course practiced throughout Britain, but Young's four-course particular to the East Anglian counties adjacent to London.

The Agricultural Society encouraged experimentation through medals and cash prizes. Awards were offered for the best methods for: (1) a course of crops emulating the "English mode of farming;" (2) reclaiming manure from penned cattle; (3) protecting wheat roots from heaving frost; (4) raising penned hogs; (5) recovering worn out lands with common manures; (6) trench plowing; (7) planting clover; (8) collecting the greatest quantity and quality manure in a single year; (9) protection against wheat-fly, pea-bug and corn chinch-bug; (10) comparing broadcast, drill or machine sown wheat; (11) producing vegetable feed for milk cows; (12) raising thorn hedges in clay soils; (13) locust tree fences; (14) raising cattle for beef, milk and draft; (15) speed and efficiency of horses or oxen as draft animals; (16) repair for gullied land; and (17) making cheese of the same quality as English Cheshire (Fletcher 1976:21-23).

Many of these practices were things that yeomen had already tried and rejected. The general theme was a close intermixing of the arable and livestock spheres of agriculture. The goal is to replace long natural fallows with fodder crops which livestock would convert into manure. The first hurdle was the development of a series of crops which would be both

profitable and sustain consistent yields. The difference's in environment and market mean that Pennsylvanians could not adopt the course in Norfolk, but had to develop one of their own. Bordley's (1784) untested, course recommended three years of clover, followed by wheat, potatoes, Indian corn, peas and barley. The potatoes, Indian corn and peas were meant as fodder crops.

An issue on the Agricultural Society's list of problems was pea beetles (*Bruchus pisi*) which Kalm had noted had been a problem since the mid-century (Benson 1937:91-93, 213). Also conspicuously missing from Bordley's course was rye, a staple 18th century crop which remained an important into the next century (Bidwell and Falconer 1941:353-356). A second hurdle was the Society's failure to acknowledge the significant increase in required labor. Yeomen had used natural fallows which required no effort. Fodder crops had to be planted and harvested, penned animals had to be fed and mucked, and the collected manure had to be hauled and spread in the fields.

A complicating factor to the Agricultural Society's search for a new course of crops was the political fractures in early Federal society. George Logan, the most practical of the group had become disaffected with the other members, in particular John Beale Bordley. Logan's wife related that the underlying cause of the dispute was the "dilettantish character and political conservatism" of many of his fellow members (Fletcher 1976:17-19). As a stanch Anti-Federalist, Logan stood in political opposition to most of the other board members. His collected essays in support of Anti-Federalism was published in 1793 under the title "*Letters Addressed to the Yeomanry of the United States*." The essays won him few friends among his peers, and unfortunately most of his intended audience had already abandoned the cause.

In his dissatisfaction, Logan launched a parallel organization centered in rural Philadelphia County, and which only accepted farming members. No doubt Bordley and the society took notice of Logan's competing organization, but Logan remained an active participant in the Society. Dissension came to head in 1790 when the committee chaired by Bordley denied Logan the top premium for his course of crops. In Logan's (1791) mind the "improved system of English husbandry, solely consists in substituting a crop of clover, in the place of an unproductive fallow" (:167). The Agricultural Society's committee felt that his experiments "do not altogether come up to the Object of the Society, which is to procure a Sett of Experiments of a Course of Crops agreeable to the English Method of Farming," although they did seek permission to publish Logan's essay (Fletcher 1976:17-19). A sticking point may have been the belief by some in the society that the English Method improves soil fertility without need of additional manure (Anonymous 1792:90). Logan (1791) published his essay independently, but left it addressed to the Society. Logan wasn't the first to fail to live up to Arthur Young's promises.

The loss of the prize was unjust. Logan's (1791) experiments were thorough and comprehensive. He established fourteen experimental plots in which he planted over the course of seven years on land he judged to be "very much exhausted." Logan tested combinations of English grass, turnips, potatoes, pumpkins and clover with wheat, rye, barley, buckwheat, oats and flax. He sought to discover which course produced the greatest number of profitable crops, largest quantity of fodder for wintering cattle, lasted without manure, and "may afford the farmer and his family the most constant employ" (:163-166).

Logan's experiments lead him to reject all the fodder crops except small quantities of English grass, clover and potatoes. Potatoes played an important role in Logan's course. He

fed them to hogs, he had "long been in the practice of making potatoes a principal food for my horses and cattle" and he fed boiled potatoes to sheep (:167). Logan found that potatoes mixed with Indian fodder were more fattening than oats. His recommended season cycle consisted of begin with the planting of flax, Indian corn and potatoes in April and May. In June the first mow of hay was collected. Barley and then wheat were harvested in July. Late summer was spent sowing buckwheat and grass, followed by a second cutting of hay, and the sowing of barley and wheat. The winter is spent threshing grain (:167). In other words, Logan's experiments recommended that the only change to be made in the yeoman's traditional agricultural cycle was to replace oats and natural grass with clover and potatoes. No doubt his stock got fat on potatoes, but it wasn't a healthy long-term solution.

Commenting anonymously on Logan's experiments, "A Farmer" (1792) backed Logan's assertion that his course was "agreeable to the new and most approved mode of English husbandry," but he was concerned that the course would produce much manure. By his experience, no course could produce enough manure to fertilize more than 1/9th of one's fields (:89-91). The implication was that farmers needed external sources of fertilizer. Despite his poor reception, Logan had made an important step toward demonstrating the impracticality of Young's course in the United States.

Logan's society of practical farmers was short lived, but the Agricultural Society had similar problems. In 1823 Richard Peters repeated a familiar complaint:

> The task of the founders was difficult, for their influence among practical farmers was neutralized by almost unconquerable prejudice. Few farmers believed that those who did not follow the plough could possibly advise or direct the tillers of the soil (Fletcher 1976:30).

Despite the slow adoption of the Agricultural Society's ideas, there began to be movement as Arthur Young energetically published volume after volume which were eagerly consumed by

American Gentlemen. Pamela Horne (1982) has dubbed him "the propagandist" because of his unceasing devotion to establishing England as the showcase of modern agriculture. Young and President Washington shared letters concerning their common concerns and goals. In 1791 Washington wrote to share a complaint common to both countries:

> The aim of farmers in this country, if they can be called farmer, is, not to make the most they can from the land, which is, or has been cheap, but the most of the labour, which is dear; the consequence of which has been, much ground has been scratched over an none cultivated or improved as it ought to have been... (Bridgman 1962:573).

Washington's dim view was shared by others who came to see resistance to agricultural reform as a lack of patriotism.

A Philadelphia manufacturer named Trench Coxe (1794) saw little good in local agriculture, but in his writings is evidence of a changed rhetoric. The call was no longer for a reform of practice, but a hopeful release from unpatriotic laziness. Coxe's list of complaints was expansive and included everything from soil depletion to insufficient beekeeping. In Coxe's eyes the flour could be whiter, barns and fences in better repair, more sugar maples tapped, fallen trees turned to potash, and an increase in cottage industries (:358). Coxe appealed to the Federalist rhetoric of the day:

> It is a fact very painful to observe, and unpleasant to represent, but it is indubitably true, that *farming* in the grain states, their great best business... is, too generally speaking, the least understood, or the least economically and attentively pursued, of any of the occupations which engage the citizens of the United States. It is acknowledged, however with satisfaction, that great changes have been lately made, and that the energy, spirit of improvement, and economy, which have been recently displayed, promise the regular and rapid melioration of the agricultural system. All other things have taken a course of great improvement — and it cannot be apprehended that the yeomanry of the United States will permit themselves to be exceeded by any of their brethren, in the most valuable of characteristic of good citizens — usefulness in their proper sphere (Coxe 1794:359, italics his).

As Coxe notes, the last two decades of the 18th century witnessed a fundamental change in American agriculture. As the offspring of colonial British yeoman became the farmers of the 19th century Early Republic, their agriculture changed with them. Where in previous centuries yeomen had resisted noble guidance, legal predation, religious inspiration, political rhetoric, scientific experimentation, and ocular demonstration, it was reasonably low-risk economic opportunity within the context of improving weather which convinced yeomen to pursue new methods.

The Agricultural Revolution in Chester County

By the end of the century the agricultural reform movement had reached a critical mass, and affected change in Pennsylvania's rural counties to "clover and plaster" cultivation. In 1796 Thomas Cheyney, Esquire of Thornbury, Chester County reported that "Our land is mostly good, but we have dropt our old method of farming." Although Cheyney aligned himself with the reform movement, his course of crops contained no potatoes, and he had still found use for rye and oats. In March and April he sowed spring crops of barley, oats and flax on dunged land that had previously held Indian corn. In the middle of May he planted Indian corn and broke up some "tough land" for buckwheat sown in mid-July. Cheyney reported that in late July he began his harvest of flax, barley and oats. Once the field was cleared he planted wheat in August and rye in September. The following March, he sowed a watered meadow in red clover with a subsequent dressing of calcium carbonate such as gypsum plaster, lime, chalk, or burnt shell (Futhey and Cope 1881:339). The principle difference from the earlier method was the addition of clover and lime, and his use of manure to fertilize the now larger crop of Indian corn.

Cheyney said that this new rotation allowed him to keep more animals. The applications of manure and lime and this rotation made the ground more "mellow," easier to work, and presented "no danger of wearing out the land, which many foolishly imagined" (Futhey and Cope 1881:339). After decades of dalliance with clover, the new agriculture had finally taken hold. As Stevenson Whitcomb Fletcher (1950) describes, clover and plaster husbandry spread quickly. Many farmers used it as a replacement for manure. In a 1792 letter to the Agricultural Society Jonathan Roberts of Chester County remarked that he wouldn't bother to haul manure "as a gift" since clover and plaster provided all that was necessary (:138-139). However, there were some early rumblings of trouble with practice.

In 1795 John Adams found that the early 17th century folk wisdom noted by Heresbach had been updated by German-speaking Americans who held that "Lime makes the Father rich, but the grandson poor, – i.e., exhausts the land" (Butterfield 1961 3:225; Lemon 1972:173). Despite the persistent warnings, the use of lime continued to grow. By 1809 Joshua Gilpin of Chester County wrote "Lime is a great article in the Valley"and they produced it in large quantities. There was an undercurrent of criticism beneath the excitement over the increased yields. In 1825 an anonymous writer warned that unless clover and plaster is accompanied by animal manure the "continued application of these substances is so far from enriching the soil that it hastens the sterility of it" (:136). One Chester County farmer asserted in 1838:

> The improvement which has been effected within the last twenty years in several of the eastern counties of Pennsylvania (and especially in Chester) is almost incredible. And the whole is mainly attributable to the regular and judicious use of lime (:136).

While Fletcher (1950) finds it a bit of an overstatement since it was also a time of high prices, the revived technology of clover and plaster answered Jared Eliot's call for an agricultural rediscovery, and began the break down the received yeoman's opposition to capital

investment. By time lime and clover had run its course in the second half of the 19th century (Fletcher 1955:104-107), no yeomen remained in the county.

The agricultural revolution in Chester County brought higher yields, but at a great cost. In the middle of the 19th century "C.B." of Birmingham Township calculated that he spent more time and money on hauling and spreading manure and lime than on his grain (Darlington and Spangler 1853 3:89). The farmer produced an impressive 18 bushels of wheat on an acre, but his expenses meant that he made only $1.50 above what he would have earned through interest. Such an amount was the same level of profit as a yeoman producing 7.7 bushels of wheat on an acre. Such yields were the rule prior to 1760, and not uncommon afterwards.

There was little improvement in the second half of the 19th century. In 1879 Chester County farmers still enjoyed 18 bushel yields, but as whole Pennsylvania farmers produced only 13.5 bushels per acre (Brewer 1883:202-203). The yields may have been lower because those in the western counties were still practicing yeomen-like risk-adverse strategies.

Fletcher (1950) calls the concomitant revolution in animal husbandry, the "Fat Cattle Craze." Gentlemen farmers demonstrated the efficacy of their reforms by producing super-sized beef cattle. The traditional multi-purpose cattle which provided beef, milk and traction were condemned by reformers as "scimitar-ribbed, flat-sided, lubberly, big-legged... expensive masses of unimportant bone." The Pennsylvania Society for Improving the Breed of Cattle was formed in 1809 and offered a bounty to the farmer who imported an English bull of a milk producing breed and offered him for stud. By 1821, the "Fat Cattle Craze" had become a grand spectacle. The enormous animals were brought to Philadelphia, placed on exhibit, butchered, and their meat paraded through the city (:175-182). Efficacy of agricultural

production was no longer a calculation of the ecological balance of labor and profit, but a performance of abundance without regard to quality or expense.

The Agricultural Society also offered bounties for large beeves, but some had thought the practice was uneconomical. Bordley complained that the huge animals were the result of the inbreeding of English cattle until the "beef produced became so course as to be almost uneatable" (Fletcher 1950:182). James Mease condemned the practice as counter to the goals of the new agriculture:

> A number of large-framed oxen with capacious bodies, some of them eight or nine years old, are selected and after the fullest allowance of the finest pasture... are put up in the winter and fed at regular hours with as much Indian corn meal, ground oats, potatoes, pumpkins and hay as they can possibly digest, until they groan from the opposition they suffer... From one to even four years of this treatment are required... Let me ask how any of these observations will 'improve the breed of cattle'? Did any of these crammed beasts leave their progeny behind them?... Plain reason and sound sense dictate that what we require is a breed that will soonest furnish the greatest quantity of good meat at the least expense" (:182).

The changes in the traditional agriculture were comprehensive, and included the adoption and development of specialized animal breeds, imported fertilizers, new designs of farm implements, and the eventual development of mechanized reapers and threshers (McClelland 1997). Chester County farmers would help lead the way with the invention of increasingly practical farm machinery and as authors and publishers of agricultural literature. The sons and grandsons of Chester County yeomen had found a public voice, but they spoke as advocates of agricultural reform.

APPENDIX A:

FREQUENCIES OF INVENTORIES BY MONTH AND YEAR

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12-1713 :	12-1719 :	12-1725 :	12-1731 :
01-1714 :	01-1720 :	01-1726 :	01-1732 :
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APPENDIX B:

COLONIAL AMERICAN WEIGHTS AND MEASURES

Grain in General
2 dozens sheaves = 1 bushel sheaves
2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
1 quarter = 8 bushels
1 wey, ton or load = 40 bushels
1 last = 80 bushels

Wheat
1 bushel wheat seed = 60 lbs. (54-60 lbs.)
= 58.75 lbs. wheat meal
= 44.4 lbs. wheat flour
= 12.4 lbs. wheat bran
= 58.5 lbs. wheat bread
1 4d. loaf wheat bread = 1.5 lbs.
1 12d. loaf wheat bread = 6.6 lbs.
1 sack flour = 100 lbs.
1 barrel flour = 196 lbs.
1 short ton flour = 1,480 lbs.
1 bushel bran = 20 lbs.
1 short ton wheat = 2,000 lbs.

1 bushel spelt seed = 40 lbs.

Rye
1 bushel rye seed = 56 lbs. (54-56 lbs.)
= 52.75 lbs. rye meal
= 30.9 lbs. rye flour
= 21.1 lbs. rye bran
= 41.0 lbs. rye bread

Barley
1 bushel barley seed = 50 lbs. (46-50 lbs.)
= 48 lbs. barley meal
= 39.25 lbs. barley flour
= 8.5 lbs. barley bran
= 58.25 lbs. barley bread
1 bushel barley flour = 26 lbs.
1 bushel barley malt = 34 lbs.

Buckwheat
1 bushel buckwheat = 48 lbs. (42-52 lbs.)

Indian Corn (maize)
1 bushel Indian corn, wet ears = 112 lbs.
1 bushel Indian corn, dry ears = 70 lbs.
1 bushel Indian corn seed = 56 lbs.
1 bushel Indian corn meal = 50 lbs.
1 bushel oats = 32 lbs. (26-38 lbs.)
= 20.3 lbs. oat flour

Fruit, Fiber and Fodder
1 bushel clover seed = 60 lbs. (60-64 lbs.)
1 bushel flax seed = 56 lbs.
1 bushel timothy grass = 45 lbs. (42-60 lbs.)
1 bushel hemp seed = 44 lbs.
1 bushel potatoes = 60 lbs. (50-60 lbs.)
1 bushel apples = 48 lbs. (44-50 lbs.)
1 bushel basket apples = 40 lbs.
1 bushel apples, dried = 25 lbs. (24-28 lbs.)

Potables
1 firkin beer or cider = 8 gallons
1 barrel beer or cider = 32 gallons
1 hogshead beer or cider = 48 gallons
1 anchor wine = 10 gallons
1 barrel wine = 31.5 gallons
1 tierce wine = 42 gallons
1 hogshead wine = 63 gallons
1 pipe wine = 126 gallons

Dry Goods
hundred weight (cwt) = 100 lbs.
long hundred weight = 112 lbs.
1 barrel meat = 31.5 gallons = 200 lbs.

Currency
1 pound (£.) = 20 shillings (s.)
1 shilling (s.) = 12 pence (d.)

Land
1 link = 0.66 foot
100 links = 1 chain
1 rod or pole= 16.5 feet
1 chain = 4 rods or poles = 66 feet
80 chains = 1 linear mile
1 perch = 1 square rod = 1 square pole
1 acre = 160 perches
1 mile square = 640 acres

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