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Cover Page Footnote
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What is it? Archaeological Evidence of 19th-Century Agricultural Drainage Systems

Sherene Baugher

Farm drainage was an integral part of the agricultural revolution of the 19th century—a time during which farmers applied scientific practices to increase the productivity of their farms. As archaeologists excavate larger portions of 19th-century farmsteads beyond the immediate area surrounding the farmhouse and barns, they will begin to uncover drainage systems more frequently. How do you know you have located a non-tile drainage system? What can drains actually tell you about the farmer and the farmstead? The goal of this paper is to help colleagues save time when working on farm sites by presenting a reference guide to non-tile drains. The guide provides detailed information and cross-sectional diagrams of numerous drains, including a hollow channel stone drain, over 600 feet (200 m) in length from Ithaca, New York. These diagrams can by used by archaeologists for field identifications of agricultural drainage systems. A case study is also included.

Le drainage agricole était une partie intégrante de la révolution agricole du XIXe siècle—une époque pendant laquelle les fermiers appliquaient des pratiques scientifiques afin d'augmenter la productivité de leurs fermes. Alors que les archéologues fouillent de plus grandes sections des fermes du XIXe siècle en dehors de la superficie immédiate avoisinant la maison de ferme et l'étable, ils commenceront à découvrir plus fréquemment des systèmes de drainage. Comment vous assurer que vous avez découvert un réseau de drainage non formé de tuyaux de céramique ? Qu'est-ce que les drains peuvent nous apprendre à propos du fermier et de la ferme ? Le but de cet article est d'aider les collègues à économiser du temps lorsqu'ils travaillent sur des sites agricoles en leur offrant un manuel de référence sur les drains n'étant pas formés de tuyaux de céramique. Ce manuel fournit des renseignements détaillés ainsi que des schémas en coupe de nombreux drains—y compris un drain creux à canalisation fait en pierre. Ce drain, mesurant plus de 600 pieds de longueur (200 m), est situé à Ithaca, New York. Ces schémas peuvent être utilisés par les archéologues sur le terrain afin d'identifier les réseaux de drainage agricole. Une étude de cas est aussi comprise.

Introduction

Why should archaeologists care about drainage? Field drainage was one of the more popular progressive farming methods used during the agricultural revolution of the 19th century. Archaeologists working at 19th-century farmsteads are likely to uncover agricultural drainage systems whenever they excavate in the fields that lie beyond the areas surrounding the farmhouses and barns. While it is fairly easy for anyone to recognize a tile drain, the other varieties of drains are not easily identified, especially when encountered in a shovel test or in a small excavation unit. Tile drainage was the most expensive and labor intensive system. Until the development and availability of mechanical ditching devices in the late 19th century and the commercial production (in the US) of tiles, tile drainage remained too costly for most farmers. As a result, numerous 19th-century farmers chose other types of drainage systems. These non-tile drains are the primary focus of this article.

There are three major categories of agricultural drains: open drains; closed drains; and hollow channel drains. Within each of these categories there are numerous variations. Each system required different amounts of time, labor, and materials. The labor needed to maintain the drains was another factor that farmers had to consider. Each category also had varying degrees of success both in the short and long term.

One of the goals of this article is to help colleagues save time when working on 19th-century farm sites. This article provides cross-sectional diagrams of numerous variations in the different types of agricultural drains, including a 600 ft. (200 m) drain excavated in the Finger Lakes Region of Central New York. The drawings of non-tile drains are based on a compilation of data from both primary and secondary sources. Because many of these sources are not readily available, this article provides a condensed reference guide to non-tile drains. These diagrams can by used by archaeologists for easy field identifications of agricultural drainage systems.

Beyond just scientific data, drains can provide the archaeologist with information about the farmer and the farmstead. Investigating agricultural drainage systems yields insights into the economic status and technological knowledge of individual farmers. The 19th-century farmer had to balance time, labor, materials, and maintenance costs against the potential benefits of draining specific fields. But first he had to be knowledgeable about the science and technology of drainage. How did the farmer obtain the latest information about these agricultural technological advances? What role did 19th-century agricultural societies and agricultural journals play in promoting these scientific advances? This paper discusses these topics with the goal of providing a broader context in which archaeologists can place their specific farmstead.

Dissemination of Information: Agricultural Societies and Journals

The "average" farmer had many ways to learn about scientific and technological advances in farming such as new drainage systems. Certainly they could learn by observing the practices of their neighbors, but if their neighbors were traditionalists they would have to turn elsewhere for information on innovative farming practices. Agricultural societies and farm journals both played an important role in disseminating the latest scientific information and promoting specific technology and innovative ideas. Access to this information, however, may have been limited by a person's socioeconomic class.

By 1800, there were agricultural societies in Boston, Charleston (South Carolina), Hallowell (Maine), New York, Philadelphia, and in Middlesex County, Massachusetts, but these early societies were for "learned men" not "practical working farmers" (Bidwell and Falconer 1925: 184). These societies reached a limited, well-educated, affluent audience through their educational journals and meetings (Danhof 1969: 60). They also promoted new technologies without regard to its cost effectiveness primarily because its affluent members were people who "could afford unprofitable experiments" (Marti 1980: 37). Agricultural societies promoted scientific farming by providing agricultural premiums to those farmers who increased the productivity of their lands and improved the quality of their crops. However, the societies did not take into account the costs of these improvements (Bidwell and Falconer 1925: 192). Even though these early societies tried to foster agricultural change, including the use of drainage, "they were remarkedly ineffective" (McClelland 1997: 208). Therefore, archaeological discovery of evidence of scientific farming practices in the 18th and early-19th century would suggest that the farmer was both literate and affluent.

By the mid-19th century, some of these state-funded societies had disappeared while others had transformed themselves from small, elite memberships to larger organizations serving economically more diverse groups. With the decline in state aid to county agricultural societies in the years between 1822 and 1832, most of these early societies disappeared (Bidwell and Falconer 1925: 189–190). Furthermore, the economic panic of 1837 brought financial devastation to many farmers (Parkerson 1995: 15). Between 1841 and 1857, there was a slow rebuilding of the agricultural societies, but this time the membership of the state and local groups included farmers from a wider socioeconomic range (Bidwell and Falconer 1925: 317–318). New countywide societies helped create among farmers "a new feeling of their importance as an economic group" (Bidwell and Falconer 1925: 193). The societies also organized state and county fairs to provide a showcase for new technologies. The fairs held competitions (with financial prizes), with crop and animal competitions being the most important categories (Danhof 1969: 62). Premiums were again offered for improvements in cultivation, but now they included criteria to determine the actual costs of the improvements (New York State Agricultural Society 1842: 22). Unlike the state and county agricultural societies, meetings of local agricultural societies (often held in a member's house) provided a more relaxed and informal opportunity for farmers to exchange information and debate the merits of different new techniques (Demaree 1941: 44–45).

Agricultural journals were another important source of information for the 19th-century farmer. By the 1830s, the agricultural press had become firmly established (McMurry 1997: viii). In 1819, there were only two farm journals, *The American Farmer* and *Plough Boy*, but by 1834, there were fifteen (Marti 1980: 29–30). The agricultural journals disseminated information on the agricultural revolution and by mid-century they relied on trained scientists, often associated with colleges, to provide information on innovations in science and technology (Marti 1980: 28; Ruffin 1851: 91). The United States journals provided information on techniques used regionally, nationally, and occasionally internationally with the primary focus on Canadian rather than European practices. The farm journals not only provided advice to the readers but also served as a forum for lively discussion and debate about the new technologies and practices, including agricultural drainage.

Historian Sally McMurry (1997: viii) notes "the power of the agricultural journals as both influences [on] and reflectors of rural culture." In her analysis of the farm journal, *The Cultivator*, McMurry (1989) found that the people who subscribed to the journal represented a wide range of socioeconomic backgrounds and included both male and female readers. Historian William Gilmore (1989: 354) has noted that by 1835 reading had become "a necessity of life" in rural New England, and he added that by the late 1820s perhaps 80% of the farmers (both men and women) had some degree of literacy. This literacy rate is in marked contrast to low literacy rate for urban areas. The result is that rural people could gain exposure to new ideas through reading, especially reading the farm journals. In 1838, the farm journals reached as many as 100,000 readers and by 1860 circulation had risen to an estimated 250,000 (Demaree 1941: 17).

McMurry (1989: 17) adds the cautionary note that even though data on new technologies were available in the farm journals, farmers were selective about "what advice they chose to heed." Other authors in writing about the 19th-century agricultural press also note the conservative nature of farmers and the time lag between the introduction of new techniques in the press and the widespread adoption of these techniques (Bidwell and Falconer 1925; Danhof 1969; Hedrick 1933; Marti 1980). It is important for archaeologists to remember this resistance to change among farmers. Simply because a new technology was available, such as tile drainage, did not mean that farmers across the northeast rapidly adopted this technology.

In analyzing an agricultural site, an archaeologist should evaluate what printed information might have been available to the farm family and then compare this to the archaeological data in order to determine what type of technical and economic choices were actually being made by their farmer.

Why Invest in Agricultural Drainage?

Drainage was an integral part of the 19th-century agricultural revolution during which farmers increasingly applied scientific practices to increase the productivity of their farms. However, the idea of improving land by drainage is not a new concept. Marion Weaver (1964: 1) notes that the ancient Egyptians and Babylonians used drainage techniques for water control. The Romans were also well known for their use of agricultural drainage (Weaver 1964: 1–3; French 1860: 24).

In colonial America, sanitary drains were used on some estates and in fortifications. For example, on his rural estate in New York, Sir William Johnson built stone drains to flush water through his privies (Feister 1994). Lois Feister found that Johnson's use of a stone drain for sanitary purposes was a common practice among the colonial elite and that evidence of these drains have been found at Monticello (VA), Drayton Hall (SC), Belair Mansion (MD), Mt. Clair (MD), Kingsmill (VA) and in colonial forts at Fort George (NY) and the Fortress of Louisbourg (Nova Scotia) (Feister 1994: 14).

In addition to sanitary drainage, well-educated, affluent 18th-century farmers experimented with agricultural drainage. However, it was not until the second quarter of the 19th century that farm journals, agricultural societies, and county boards of agriculture were trying to encourage all farmers to invest in land drainage.

> Drained and reclaimed swamps invariably make the richest of land, as they have for uncounted centuries, served as the places in which the spring floods, and the summer rains have deposited their most valuable treasures, and when freed from their super-abundant water are ready to repay four fold the labor bestowed upon them (*The Genesee Farmer* 1837: 169).

The goal was to increase the amount of useable land, thus increasing their crop yields and resulting in a major financial gain for the farmer (Massachusetts Agricultural Society 1819: 127–132; New York State Agricultural Society 1842: 127).

Farmers also believed that draining prevented over saturation of the plant roots and inhibited early freezing (*Ohio Cultivator* 1847: 2). The beneficial effects of draining swampy areas were also emphasized. In 1822, *The American Farmer* (1822: 285) printed the following advice:

> Another point of primary importance in good farming, but in which our country is defective, is the draining of wet and marshy grounds. Much of our best land is not only rendered useless by this neglect, but it often becomes the local cause of sickness and death. If our farmers would annually devote a few days after a harvest to ditching their wet grounds, and divesting them of their bogs and brush, they would greatly improve the beauty and productiveness of their farms and contribute to the health of their neighborhood.

The journals claimed that that the numerous economic and health benefits would outweigh the costs and labor that a farmer would expend in the construction of the drainage system. *The Genesee Farmer* (1836: 129) encouraged farmers to invest in drainage by noting "much of our land might be increased five times in value by an expenditure of less than their present estimated worth."

Farmers were only modestly enthusiastic in their adoption of new drainage methods. In 1839, journalist Isaac Hill (1839: 151) lamented that while drainage was used successfully in England, in his home state of New Hampshire, "draining can hardly be said to be yet introduced in this state." McMurry (1997: viii) notes that the actual farming practices of journal subscribers "show that they followed the journals' advice selectively, blending experience with novelty in such a way as to call into question easy dichotomies." The tremendous variations in the covered drains demonstrate farmers' adaptations to whatever was readily available on the farm, and what they could afford in terms of time, labor, and materials.

Reference Guide for Agricultural Drainage Systems

In America, three types of agricultural drainage have been and continue to be used: open ditches; covered drains; and hollow channel drains (including tile drains). Sectional drawings of drains are provided as a visual reference guide for archaeologists. Drains tiles (FIG. 1) came in four basic forms, "horse-shoed" (arched tiles with no closed bottom), round, oval, or "sole tiles" (round or oval tiles with an attached flat base). Non-tile drains could be made of large stones, small pebbles, brick, wood, branches, turf, straw, or any combination. Because of the tremendous diversity in non-tile drains, it would be misleading to provide only a couple of examples as if they accurately represented all non–tile drains. The visual format that is used in this guide closely follows the 19th-century artistic style and rendition used in agricultural journals. The shape used for the diagrams suggests what an archaeologist would see in a profile.

The drawings are based on data from primary and secondary sources. Nineteenth-century agricultural journals and 19th-and early–20th-century books provided many drawings of drains. In addition, Marion Weaver drew cross-sections of non-tile drains in his book, *History of Tile Drainage* and provided detailed descriptions from 19th-century sources for each non-tile drain drawing. Most of his data was from agricultural society archives, including meeting notes, lectures, and letters. I took Weaver's drawings, which were not

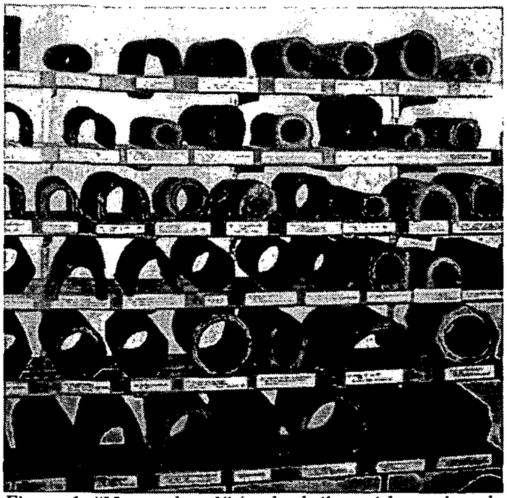


Figure 1. "Horse-shoed" (arched tiles with no closed bottom), round, oval, or "sole tiles" (round or oval tiles with an attached flat base) are pictured here. The drains tiles are on display in the Mike Weaver Drain Tile Museum on East Lake Road in the Town of Fayette, New York. Photo: Sherene Baugher.

sorted by category or type, plus the sectional drawings that I found in various 19th-century agricultural journals and books and combined all of them into visuals for the three categories of non-tile drains. Landscape architect Alyson Taylor then took my data and created the sectional drawings for this guide. In addition to the visuals, the guide provides key information that an archaeologist should know about drainage systems.

Open Ditch Drains

The open ditch drain was the simplest, cheapest type of drain because it was simply an open trench. Examples of the open ditch drain are still visible in rural areas and can even be seen next to roads to channel storm water in suburban residential subdivisions. By the 1830s, open ditch draining of meadows and swampy areas had become common in New England (Danhof 1969: 255). *The Genesee Farmer* (1837: 168) noted in 1837 that while open ditch drains were inexpensive to build, they were very expensive to maintain. Open ditches were not only less durable but they also obstructed access to the farmland, and "cut up the farm land and thus interfere with cultivation" (Hatch and Haselwood 1906: 65).

Covered Drains

The covered drain was a variation on the open ditch. While covered drains were undoubtedly used during the colonial period, the first known mention of the usefulness of covered drains is in 1790, by Samuel Deane in his book, *The New England Farmer, or Georgical Dictionary*. Deane (1790: 72) wrote that covered drains are useful on wet uplands. From 1830 to 1860, farm journals enthusiastically encouraged draining agricultural lands but the journals varied in their support of specific drainage systems and sometimes offered contradictory advice.

This variety in journal advice can even be seen in the journals' discussions of depth of the drains. For example, the journals usually recommended a 3ft (1 m) deep trench for covered drains. Occasionally an author would state that "a depth of about two feet may be sufficient" depending on the soil conditions (Munn 1855: 42). The difference in depth (two feet versus three feet) would make an enormous difference in terms of the amount of time and labor needed to dig a long trench especially if the ground was rocky or had a high clay content. In 1861, John Klippart (1861: 261) believed that drains needed to be at a depth of three feet to avoid movement due to frost and plow damage. In addition, if drains were too close to the surface, the weight of cattle or horses and carriages going over the drains could damage the drains. Klippart (1861: 261) noted that on New England farms, miles of drains laid at a depth of two feet (60 cm) were packed with solid earth after several years of service and were no longer functioning.

Once the trenches for covered drains were dug, the trenches were ideally filled with stones. However, brush, wood, bones, and straw could be and were used, even though they were less efficient (*The Genesee Farmer* 1837: 31). Figure 2 provides some examples (in cross section) of what archaeologists can expect to find if they excavate a covered ditch drain. *The Farmer's Monthly Visitor* (1841: 75) noted that while the easiest way to fill up a covered drain was simply to "dump stones in," they recommended placing the stones in by hand and leaving some openings between

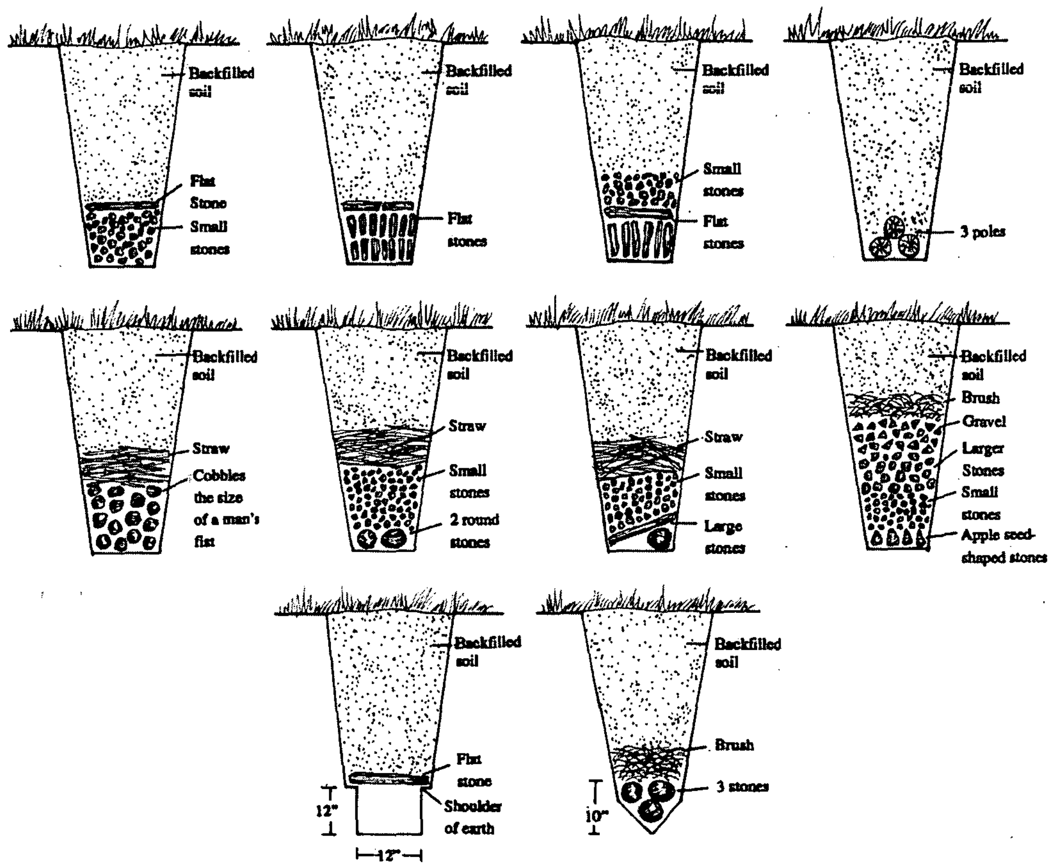


Figure 2. Sectional drawings of covered drains. Drawing by Alyson Taylor based on drawings from Klippart (1861: 257) and Weaver (1964: 38, 40, 42, and 45).

the stones. *The Farmer's Monthly Visitor* (1841: 75) added that the stones should be covered with sod or straw because they believed that the sod would create a barrier to prevent the backfilled dirt from clogging the stone drain (FIG. 3). Sometimes hemlock and pine branches were cut and placed at an angle in a trench (FIG. 4). *The Genesee Farmer* (1837: 168) noted that branch-filled drains were the best drains for porous soil or quicksand, and added that because the soil was constantly wet the branches would not decay. Trenches filled with logs rather than stones (FIG. 5) were often used to drain peat lands (Hays 1910: 228–229).

The main advantage of the covered drain over the open ditch drain is that the ground

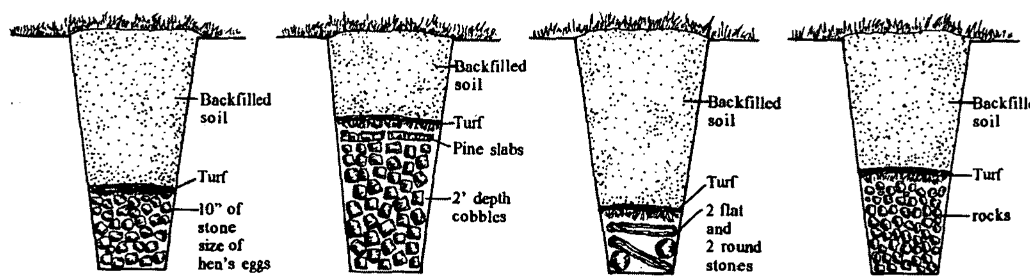


Figure 3. Covered stone drains with inverted turf. Drawings by Alyson Taylor based on material from French (1860: 155), Klippart (1861: 256) and Weaver (1964: 42, 44).

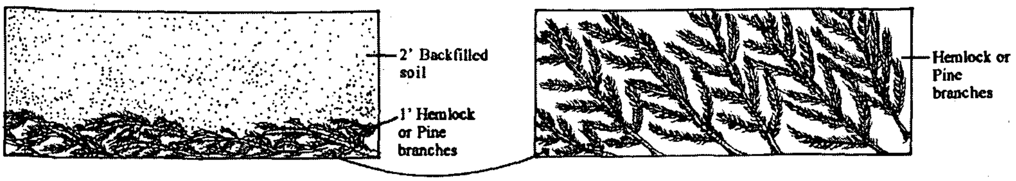


Figure 4. Covered drains with branches. Drawings by Alyson Taylor based on material from Weaver (1964: 322–323).

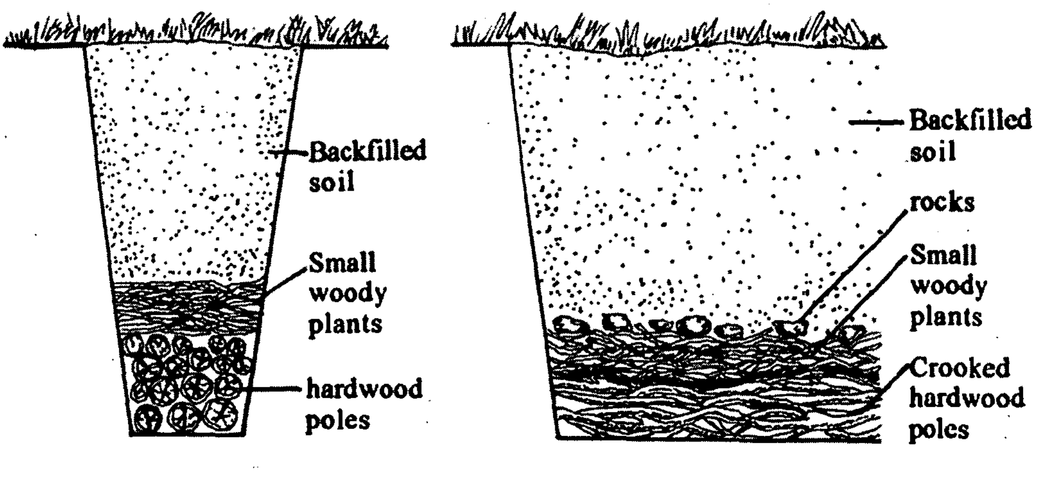
above the covered drain can be used for cultivation (including plowing), for pasturage, or even for a road or pathway, whereas the land for the open ditch could serve only for drainage (Deane 1790: 73). Covered drains, however, were more costly than open ditch drains because of the time and labor involved in digging the trench, collecting the material for the drain, building the drain, and then backfilling the trench.

Hollow Channel Drains

Simple covered drains usually worked for a few years but then became less efficient as dirt accumulated in them and the drains clogged. The most sophisticated method of agricultural drainage, the hollow channel drain, was designed to avoid the weaknesses of the closed drains. The hollow-channel drains were covered drains with channels running the length of the drain. The channels were covered to prevent soil from seeping into the channel and eventually blocking the flow of water. The best hollow channel drains were made from stone or tile. Some farmers, however, used wooden planks as the material to create the pathway (Weaver 1964: 46). Figures 6 and 7 provide some examples in cross section of what an archaeologist can find if they uncovered a hollow channel drain made of stone or wood.

In 1834, the editors of *The Cultivator* told their readers that stone drains were the best type of agricultural drains (Hedrick 1933: 350). Two years later articles in *The Genesee Farmer* (1836: 30) not only stated that hollow channel stone drains were the most desirable type of agricultural drain, but also described how to construct the drains. In 1861, John Klippart (1861: 255) wrote that the ideal hollow channel drain was made of a combination of round cobblestones on the side of the channel with flat stones on the top or roof of the channel. He recommended that inverted sod or straw be placed over the flat stones. Klippart (1861: 251) told his readers that the advantage of using field stones for drains was that it not only saved the farmers money, but that it also

Figure 5. Logs in covered drains. Drawings by Alyson Taylor based on material from Hays (1910: 229).



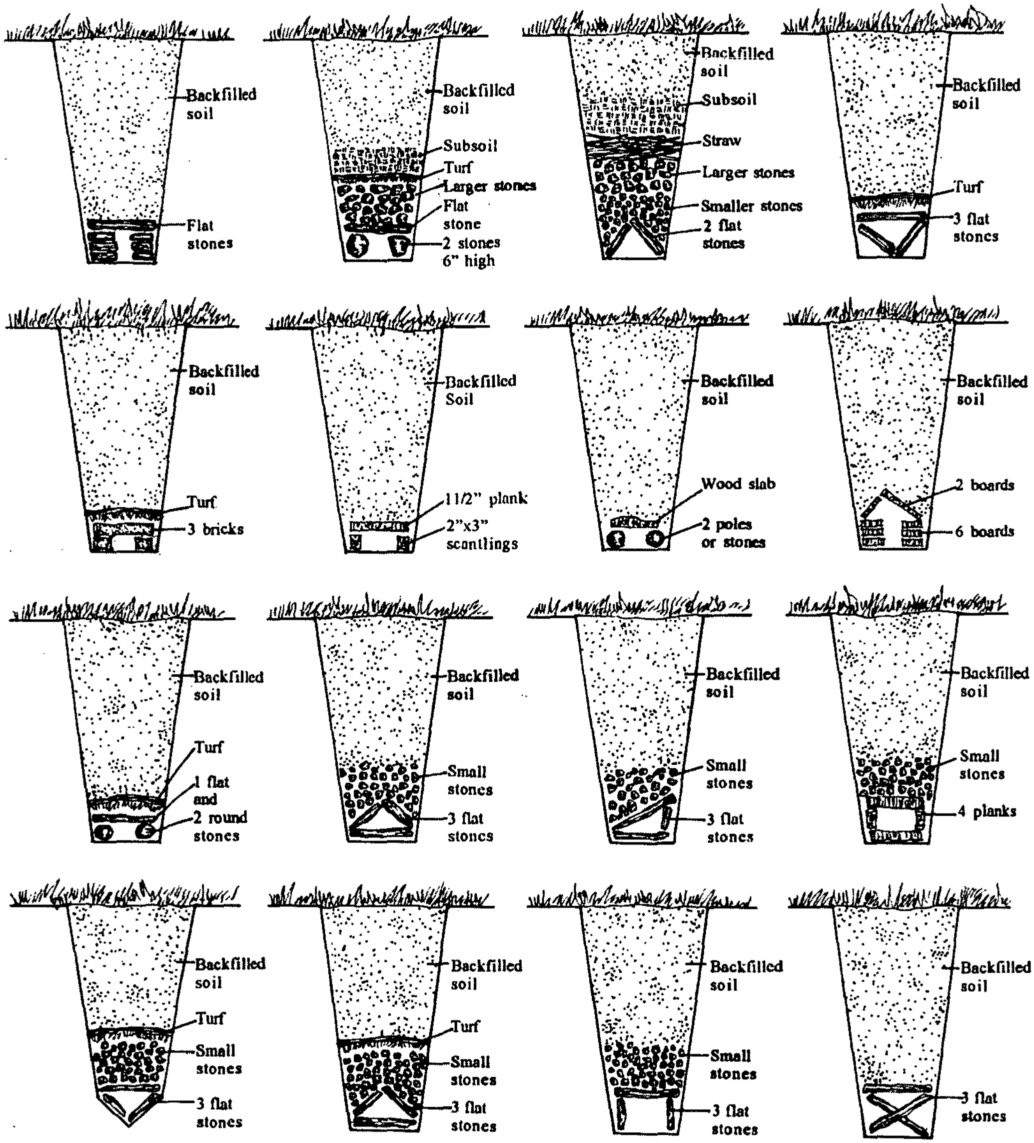


Figure 6. Hollow channel drains with stones, bricks, or wood. Drawings by Alyson Taylor based on material from French (1860: 115, 117), Klippart (1861: 258), Mann (1855: 83) and Weaver (1964: 38, 40, 44 and 45).

cleared their fields of "a great nuisance." Farm journals and agricultural societies noted that in terms of time and labor, hollow channel stone drains were much more expensive to build, but they were also more durable and cheaper to maintain than covered drains.

Tile Drains

In the early 1850s, the journals highlighted the final 19th-century innovation in agricultural drainage —tile drains. Drainage experts consider tile drains to be a variation within the third category of the hollow channel drains. This type of hollow drain combined the simplicity of covered drains along with the durability of the hollow stone channel drains.

John Johnston is recognized as the father of American tile drains (Hoskyns 1854: 273–274). John Johnston, formerly of Scotland, bought a farm near Geneva, New York. In 1835, he

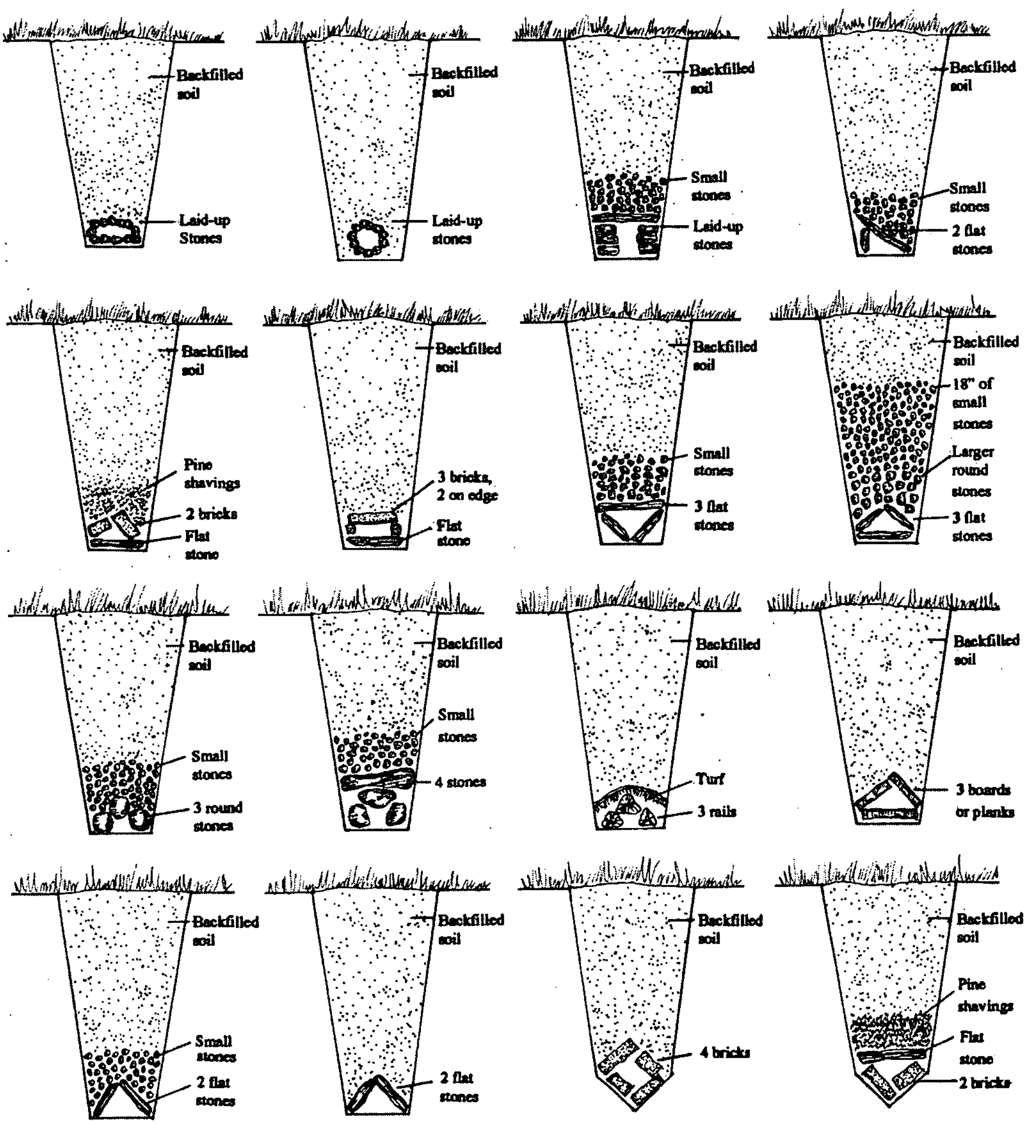


Figure 7. Diverse examples of hollow channel drains. Drawings by Alyson Taylor based on material from Weaver (1964: 38, 42, 44, and 45).

became the first person in America to use Scottish agricultural drain tiles, which had been used successfully in Scotland and England beginning in the early-19th century (Bidwell and Falconer 1925: 318; French 1860: 46, 120–130). Benjamin Wharten produced the first American-made tile in 1838 by using Scottish tiles (bought by Johnston) as his patterns (Geneva Historical Society 1994). Both Johnston and John Delafield (a banker) tried to promote tile drainage (Hedrick 1933: 349). By 1851, Johnston "had laid 16 miles of tile on his own farm" and in 1852, the New York State Agricultural Society awarded Johnston a silver cup for the "best experiments in draining land" (Hedrick 1933: 349). The agricultural press gave "wide publicity to the results of Johnston's experiments and served as a major agent in the popularization of this innovation" (Demaree 1941: 42). By the time Johnston retired he had installed 72 miles (120 km) of tile drainage on his 320-acre farm (Geneva Historical Society 1994)

Although tile drains were more expensive and more labor intensive to install than the stone channel drains, they were regarded as the most effective drains. Tile drains, unlike stone drains, required the purchase of materials (the tiles) and often required services of an experienced drainage engineer to design and construct the tile beds (Hatch and Haselwood 1906: 64). Initially tile drains, using imported tiles, were very expensive, but the tiles John Delafield made in New York State decreased the price (Bidwell and Falconer 1925: 318).

Farmers debated the major financial costs of tile drains versus the advantages. In the agricultural journals there are letters from farmers complaining about the cost of tile drains. In 1889, George Waring, Jr. (1889: 337) published a book on land drainage and found that while stone drains were cheaper to build, they required more maintenance over time because of their propensity to become obstructed with dirt that seeped in around the edges of the irregular stone whereas, the solid "dirt tight" sides of tile drains "will, practically, last for ever." In the early-20th century, Hatch and Haselwood (1906: 64) recommended tile drainage even though initial labor and construction costs were significantly higher.

Even though agricultural journals promoted tile drains over stone drains, farmers did not only always accept the advice. While tile drainage was used extensively in England during the 19th century, it did not prove to be as popular in New York. Data from the New York State Agricultural Society in 1862 show that tile drains were not nearly as popular as stone drains. For example, in Tompkins County, New York less than 4 percent were tile drains (Weaver 1964: 229). Weaver (1964: 229) estimated that in 1864 in New York State there was 6,060 miles of tile drain out of the total 26,630 miles of drains, including open ditch drains. Therefore, tile drains comprised less than one quarter (22%) of the agricultural drains in New York State. In other states the proportions probably varied. Weaver (1964: 6) notes that in America tile drainage has had cycles of popularity:

> More possibly, leadership, or lack of it, may have been the cause. The American John Johnston and his disciples gave an impetus to tile drainage that carried it along until after the Civil War. The lack of leadership, an economic change, or both gave a downturn. The second decade of the twentieth century again gave us leadership.

Therefore, if archaeologists uncover tile drainage on a mid-to-late 19th-century site, it could indicate both the use of innovative, scientific farming practices by the farmers, and the work of a farmer with enough spare capital to invest in this costly land reclamation.

Case Study: The Fisher Farm

This case study focuses on the archaeological excavation of two drainage systems on the Fisher Farm site. The site is located in the Town of Ithaca, within Tompkins County in New York State (FIG. 8). Tompkins County is located within the Finger Lakes area of Central New York. The project parcel is in Inlet Valley, 2.2 miles southwest of downtown Ithaca.

The Fisher farm project was one part of a larger, multi-year archaeological project between Cornell University and the Town of Ithaca (1993–1996). Our goal was to determine if the project parcel contained any significant archaeological sites (Baugher and Quinn 1995, 1996). The farm was owned for over 40 years by the Fisher family (1831–1867) and 75 years by the Pearson family (1867–1942) making it possible to link stratified historic deposits to known occupants of the farm in the 19th and early-20th centuries. This case study, however, focuses on agricultural land use and drainage systems and is not a discussion of the domestic assemblages associated with the farm families.

Fisher Farm Drainage

Cornell archaeologists excavated two mid-19th-century drainage systems at the Fisher farm. Agricultural drains were built to handle a variety of problems including storm water management, channeling normal spring run

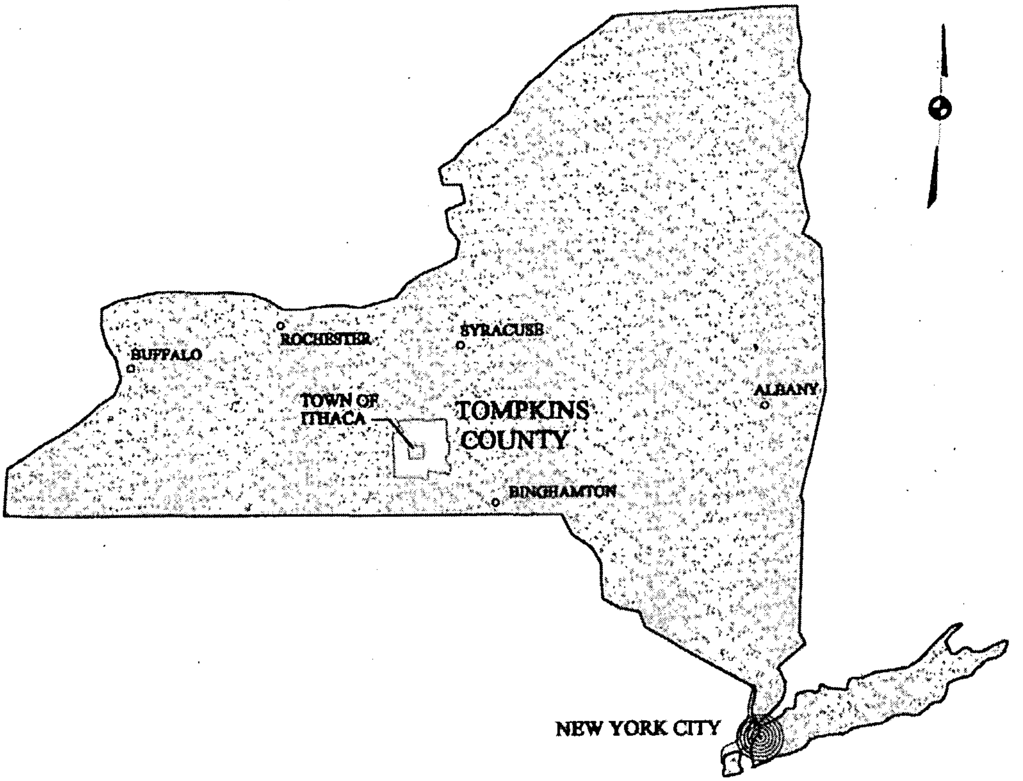


Figure 8. Map of New York state showing the location of Ithaca. Map by George Frantz.

off, reclaiming wetlands, draining soggy low-lying sections of the fields, and eliminating mosquito-breeding ponds. On the 150-acre Fisher farm there were no marshes or swamps but on the lowest land, a 29-acre farm field excavated by Cornell students, there were drainage problems.

Fisher farm drainage systems were unearthed in the 29-acre agricultural field surrounding the farmhouse. This parcel was bordered on three sides by streams, and the town road formed the fourth side (FIG. 9). The soils were silty and clay deposits were found near the streams. The rolling field contained two ridges and some very noticeable low-lying areas.

The first drainage system was uncovered at the base of one of the two ridges with the farmhouse located on the flat top of the ridge (FIG. 10). The drain's builder's trench contained a variety of mid-19th-century artifacts, including cut nails, fragments of window glass, bottle glass, undecorated creamware, undecorated pearlware, handpainted whiteware, flow blue, undecorated whiteware, salt glazed stoneware, and redware flower pot fragments. In addition, there were fragments of coal, slag, charcoal, and partially burnt wood. The artifacts were scattered over the archaeologically excavated length (450 ft or 150 m) of the drain's trench. The artifacts date to the mid-19th century, during the time when the Fisher family would have owned the property. The other drainage system was located at a low point in the middle of the 29-acre field, about a mile from the house, and contained absolutely no artifacts in the builder's trench. As a result, the date of its construction could not be determined.

The serpentine drainage system near the house was a hollow channel stone drain (FIG. 11). The top of the stone drain was approximately three feet (1 m) below current grade. This depth conforms to the 19th-century recommended ideal depth for hollow channel drains. The drain was 18 inches (45 cm) in

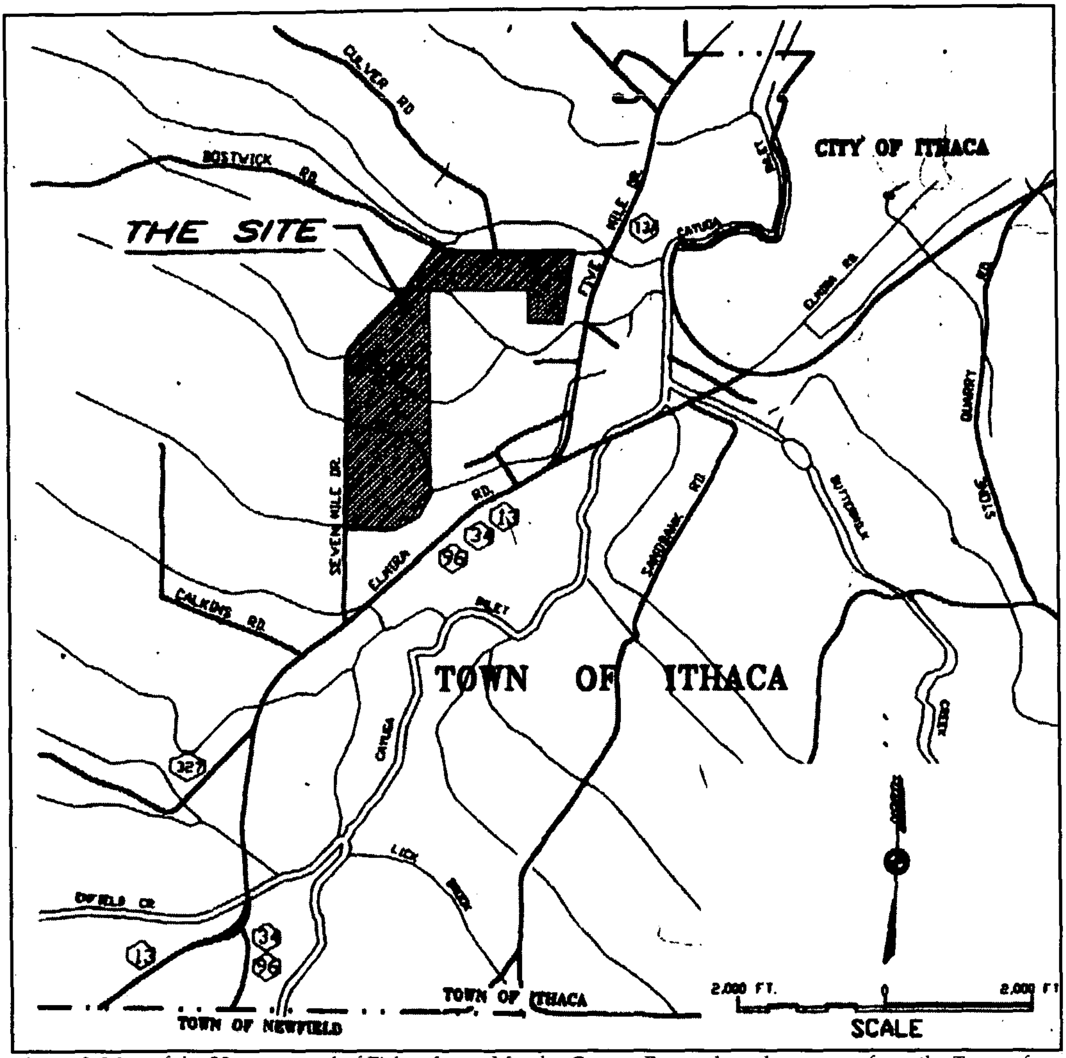


Figure 9. Map of the 29-acre parcel of Fisher farm. Map by George Frantz, based on a map from the Town of Ithaca Planning Department.

width with a 7 inch (18 cm) channel (FIG. 12). The average height of the feature was 10 inches (25 cm). The structure contained round fieldstones on the sides with flat fieldstones forming the "roof" or top of the channel (FIG. 13).

After uncovering 40 feet (12 m), the fairly straight fieldstone drain began to take a series of serpentine turns that did not lead directly to a nearby stream. Instead the drainage system followed along the base of a ridge and then eventually emptied into a stream at the southern edge of the field. In 1855, B. Munn (1855: 36–37) describes this exact method (used on the Fisher farm) of running a long drain along the base of a hill and eventually terminating the drain at a brook or stream.

The stone hollow channel drain appeared to be well built and reflected a lot of time and labor. The flat stones and cobbles used in the drain were probably procured from a farm field about one mile (1.67 km) away. Amazingly after all these years, the drainage channel was still partially opened. The drain still functioned, although minimally, and during heavy spring and summer rains the land above the drain was muddy, but not waterlogged.

Figure 10. Students are excavating the plow zone in the location where the hollow channel drain was found. The farmhouse was located on high ground to the upper left. Photograph by Sherene Baugher.

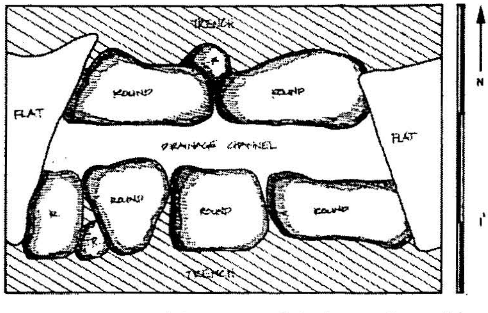


Figure 12. View of the exposed drainage channel in a Fisher farm hollow channel stone drain. Drawing by Jason Thompson.

In a low-lying area in the middle of a 25-acre field we uncovered a second drainage system. The second drainage system was different from the hollow channel drain because it lacked a drainage channel. It was simply a closed drain filled with rocks and bricks (FIG 14). We excavated almost 25 feet (7.6 m) of the drain, and we mapped, photographed, and completed measured drawings of the system (FIG 15). The trench for the closed drain was approximately 2 ft (61 cm) wide at the base. It contained two to three layers of large rocks and bricks. The pattern of bricks, rocks, and number of layers was not consistent and overall it did not appear to be as carefully built as the hollow channel drain. This closed drain ran a fairly direct course from the lowest section in the center of the 29-acre field to a nearby stream.

Running parallel to but directly above the drain and sometimes almost touching the top of the stone drain was a shallower and narrower trench; this trench also contained no artifacts. This trench was only found directly above the drain and in no other area. This second trench probably had been dug to remove debris that was blocking or impeding the flow of water through the drain. By the 1990s, the drain was no longer functioning, and during heavy rains pools of water formed in this low-lying area of the farm field.

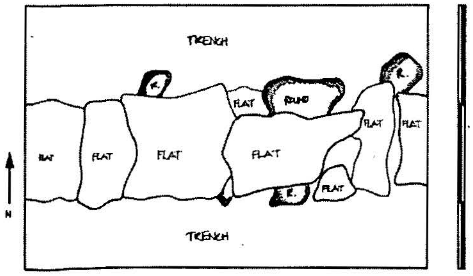


Figure 11. Plan view of a hollow channel drain at the Fisher farm site. Drawing by Jason Thompson.

Fisher Farm and Success of Land Reclamation

The Fisher family probably had access to a variety of information on drainage to guide their choices. *The Genesee Farmer*, a publication from Rochester, New York, was available throughout central New York. Other farm journals were published in New York State such as, *The Cultivator* (Albany), *The American Agriculturalist*, (New York City) and Moore's *Rural New-Yorker* (Rochester). In addition, farm journals from other states as well as books may have been available in Ithaca in the mid-19th century. Tompkins County (where the Fisher farm is located) had an active agri-

Figure 13. Photograph showing a cross-sectional view of a hollow channel drain on the Fisher farm. Photograph by Sherene Baugher.

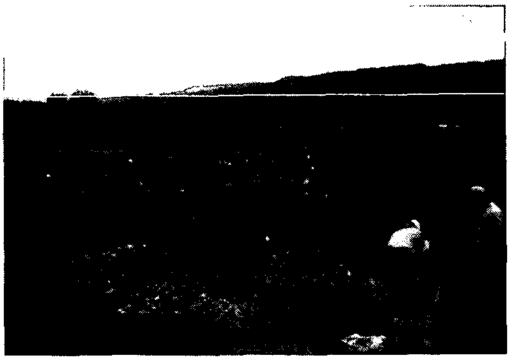


Figure 14. Students shovel testing in the low-lying area of the 29-acre parcel. Photograph by Sherene Baugher.

cultural society. It is probable that the Fisher family had access to information about drainage systems by attending the meetings of the local agricultural society, seeing exhibits at the county fair held in Ithaca (2 miles, or 3.3 km from the Fisher farm), and/or discussing the technology with knowledgeable neighbors.

In terms of drainage systems, the Fisher family accepted and used 19th-century scientific practices for the reclamation of farmland. If both drain systems were built by the Fisher family, then we see evidence of them experimenting with two different systems. In 1862, the New York State Agricultural Society published drainage statistics by county; in Tompkins County there were 124,391 rods of agricultural drains of which 103,298 rods were stone drains (Weaver 1964: 229). The records do not indicate if the stone drains were hollow channel drains, covered drains, or both. In either case, both of the Fisher farm drainage systems used stones, the preferred material for Tompkins County. Actually the use of stones in Tompkins County is not surprising since a glacial terminal moraine is located in the southern section of the county, and has left the county with very rocky soil. The Fisher family seems to have been, in terms of drainage systems, right in the middle of adapting to new farm practices.

Figure 15. The covered drain found on Fisher farm. Photograph by Sherene Baugher.

From 1831 until 1865, John Fisher slowly added more usable acreage to his farm both through some small land purchases and improving the existing land. In the 1850 Federal Agricultural Census, the Fisher farm had 115 acres of land, of which 75 were improved acres and 40 acres were unimproved. In the Town of Ithaca, the average value of other farms of comparable size was $4,811; the Fisher farm's value ($3,000) was less than this average. The Fisher family reclaimed unusable land through drainage and the census records show a continual increase in the amount of cultivated land. By the 1860 Federal Agricultural Census, the farm had 150 acres of which 123 acres were improved and only 27 acres were unimproved. According to the census, in only 10 years (1850–1860), with the addition of only 35 more total acres (from 115 acres to 150 acres) the value of the farm jumped from $3,000 to $9,000. It is also important to note that by 1860 the farm had an additional 48 improved acres (from 75 acres in 1850 to 123 acres in 1860). In 1860, farms of comparable size had an average value of $5,028 compared to Fisher farm's value of $9,000. Table 1 shows the difference in crops and animals on the farm between 1850 and 1860. The productivity of the farm was probably related to innovative agricultural practices including the use of drainage systems. The time and cost invested in land reclaiming drainage systems appears to have paid off in the increasing productivity of this farm.

Conclusion

There was tremendous diversity in the physical form of the 19th-century agricultural drains. While the more modern and expensive tile drains are easily recognizable as drains, many non-tile drains look like the shallow remnants of a fieldstone foundation. To prevent archaeologists from unnecessary excavation to determine the size of these "wall–like" features, the reference guide provides useful sectional diagrams (based on data from 19th-century primary sources) of what archaeologists might find if they unearth part of an agricultural drainage system. The goal of this article was not to inspire archaeologists to go out and excavate entire drainage systems, which are just as labor intensive to excavate, as they were to build! Rather, I hope that by discussing one case study and illustrating the tremendous variations that exist in drainage systems, this article will enable archaeologists to simply and quickly document whether they have a drainage system, and only use a small cross-section to identify the type of drain.

Drainage systems were a component of the 19th-century scientific revolution in American agriculture. The investment of time and money in a drainage system could vary from very modest to quite expensive, especially if a tile drainage system was used. The farmer was also pulled in two directions—that of conformity and tradition versus innovation and change using new scientific principles. The agricultural journals note how difficult it was to get farmers to adopt any type of drainage. Agricultural historians have noted that even in the early-20th century, it was still difficult to convince farmers to spend the money to invest in tile drains. Clearly the invention of a new farm technology, such as tile drains, did not imply rapid acceptance. On the contrary, there was a noticeable time lag between the introduction of new techniques and the widespread adoption of these ideas.

Table 1. Agricultural Census Data, 1850 and 1860

Animals	*1850*	*1860*
Horses	2	5
Milch cows	4	9
Other Cattle	3	12
Sheep	30	31
Pigs	12	20
Value of livestock (US$)	295	1,100
Wool (lbs.)	90	120
Butter(lbs.)	400	1,200
Crops (bushels)		
Wheat	200	370
Corn	200	807
Oats	300	750
Potatoes	24	100
Hay (tons)	25	11
Barley	0	60
Tobacco	0	500
Value of Orchard (US$)	0	200
Value of Farm	3,000	9,000

For the farmer, the use of agricultural drainage was not only a monetary investment but also involved a mindset change in how the farmer saw his involvement in the agricultural landscape. Each farm family had to decide to what extent they were going to use scientific principles and technology to alter, control, and transform their landscape.

To what extent did agricultural societies encourage farmers to break with the traditional mindset and be innovative? For the middle class English-American Fisher family, the presence of an active agricultural society in Ithaca may have made a difference. Living in a community in which other farmers were willing to experiment and seeing the financial rewards from those innovations may have helped the Fisher family break with the old traditions of farming.

In the end, though, data on water management and drainage systems are one piece in a larger puzzle. The drainage information should be used in combination with other data from the whole farm site in order to obtain a better understanding of how the farmer was using scientific practices in order to improve the land and increase the productivity of the farm. Archaeologists also need to investigate whether there were differences among ethnic and religious groups in their willingness to use innovative technology to alter their landscape or whether was it simply a matter of economics and affordability. Once we have a better understanding of a specific farm, then the farm needs to be placed in a broader context of trends within the community, county, state and region.

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