Addendum to:
Thomas Sheperd Gristmill
Shepherdstown
Jefferson County
West Virginia

HAER No. WV-5

HAER
WVA,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED 8" x 10" DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD

Thomas Shepherd's Grist Mill

HAER No. WV-5

Location:	Shepherdstown, West Virginia UTM: 18.258890.4368410 Quad: Shepherdstown
Date of Construction:	c. 1739
Present Owner:	Ira Glackens
Significance:	An example of an early 18th century grist mill which continued to meet local and regional needs into the 20th century. Modifications of its machinery kept pace with innovations in milling technology until economic factors led to its decline.
Historian:	Dennis M. Zembala, 1975

INTRODUCTION

The evolution of milling in western societies, and particularly in the United States, is representative of the growth of mechanization in general. Grain milling was one of the first instances in which an agricultural people harnessed the power of falling water. In primitive frontier communities the miller and, occasionally, the blacksmith were the only two individuals possessing specialized skills and using water-powered machinery. As these communities began to produce a surplus of grain, the income from small merchant mills helped to balance the cost of goods brought into the community. Towns such as Buffalo, Chicago, and Minneapolis developed into large cities on the basis of their flour milling, packing, and shipping functions. The growth of eastern cities created a constant demand for flour and other foodstuffs and provided incentives for millers to adopt more efficient techniques. The development of the railroads facilitated internal communication, and such techniques were quickly disseminated. During the late 19th century, mills in most grain-producing regions were quick to modernize to increase their output. Eventually, the transportation revolution allowed a few companies to take advantage of the economies of scale and eliminate smaller operations. Milling became more concentrated in urban areas with greater access to capital and markets. As a result, the history of flour milling in a particular town is often a revealing look at the relationship between the social, economic, and technological aspects of American urban and local history.

HISTORY

The original mill on this site was erected by Thomas Shepherd sometime between 1734 and 1739 and was probably the first of its kind in the Valley of Virginia. A native of western Maryland, Shepherd settled in the area in 1732, when it was still a wilderness. In 1734 he received a grant of 222 acres of land from Virginia's Governor William Gooch. [1] From that time until his death in 1776, Shepherd's career was intimately linked to the development of Jefferson County and to the patterns of settlement of the Shenandoah Valley as a whole.

The date of the first settlement at what is now Shepherdstown has never been adequately established, but the records of the Philadelphia Presbyterian Synod reveal a letter of 1719 requesting that a minister be sent to "Potomack, in Virginia." This reference, together with the fact that the site of Shepherdstown was near a natural ford in the Potomac River, leads us to believe that the settlers from Pennsylvania and Maryland entered the Valley of Virginia here sometime during the period 1715-1720. [2] These settlements were tenuous at best, and it is likely that many pioneers continued to live in more populated areas north of

the river, traveling once or twice a year to work on their homesteads. In 1722, settlement began in earnest when Governor Spotswood of Virginia succeeded in negotiating a treaty witb the Iroquois Indians. At first, settlement was hindered by the conflicting claims of promoters for priority of grants. Lord Fairfax, in particular, trying to extend the intent of the "Northern Neck" grant to the region west of the Blue Ridge Mountains, created much confusion among early settlers as to what was and what was not available land. The litigation of the suit filed by Fairfax's agents in 1736 took over 50 years and was finally settled in 1786, after the principals had long been dead. In spite of legal problems, settlement proceeded rather rapidly after the treaty of 1722. The difficulty of communication between the Tidewater and the Trans-Allegheny settlements made a person's physical presence the major condition of ownership. In fact, the presence of the settlers alone gave the land what value it had. Even Fairfax recognized this, and in 1738 he granted some settlers titles to their holdings after they threatened to abandon their farms and move west.

Patterns of settlement were largely determined by the desire for ethnic and cultural exclusiveness. According to most accounts, the major participants in this migration were English, Scotch-Irish, and German. These settlers were religious dissenters, more similar in orientation to the Puritans of New England than to the Anglicans of the Southern colonies--in this case, Virginia. Most of them came from eastern Pennsylvania, where they seem to have had problems of religious and cultural differences with the dominant groups. Consequently, their removal to the Valley of Virginia appears to have been motivated, at least covertly, by a desire to preserve these traditions in self-sufficient communities. At first these communities were segregated along ethnic and religious lines, as, for example, with the Quakers at Smithfield and the German Reformed at Masamutten. While settlement of the valley was generally of the dispersed type, towns such as these gradually formed around the community's church. The religious focus was reinforced by the threat of Indian predation and later by the development of critical economic functions such as milling, tanning, and blacksmithing. During the second half of the 18th century, some towns in the valley began to shed their exclusive character in favor of a more varied cultural composition. This was particularly true of places like Winchester and Shepherdstown, which were located on the major routes up the valley. Such towns became trading centers and later developed industries based on processing the valley's products. Religious and ethnic affiliations were relegated to the sphere of private life as town size and a more transient population prevented the hegemony of any one group. Shepherdstown was, at different times, an example of both types.

The original settlement near Pack Horse was primarily German, and the town was called Mecklenburg. By the time Thomas Shepherd built his mill in the late 1730's, the population was mixed. [3] Stability came with the increase in the population of the valley and attracted

promoters and developers with the lure of secure investment. The growth of marketing and manufacturing in a town like Shepherdstown tended to obscure ethnic and religious differences and promote amalgamation. By the Revolutionary War, Shepherdstown was the site of a pottery, a gun works, and several gristmills (two of which were owned by Thomas Shepherd). Although some religious and ethnic distinctions remained, such enterprises tended toward the creation of a town culture whose participants often had more in common with one another than they had with their coreligionists on the farm. Shepherd's career spans a period in which the town was being transformed from a small group of German-American settlers to an important market and commercial center. [4] Shepherd was typical of the farmer-promoter-businessman who played an important role in the transformation of many self-sufficient frontier towns into thriving regional centers of commerce.*

In this context, the career of Thomas Shepherd takes on added significance. When Shepherd arrived at Mecklenburg, it was most likely a small group of houses grouped together for protection from the Indians. Nearby, Pack Horse Ford was a point where what would eventually become the Philadelphia Wagon Road crossed the Potomac into the Valley of Virginia. Shepherd began to farm the 222 acres of his 1734 grant. The area was already the scene of speculation, and Shepherd was the third person to claim title to the tract, acquiring it from Hans Joist Hite. Soon after, he laid out 50 acres of this land as a town and began distributing lots to the settlers. These lots were distributed for a price of 5 pounds and a ground rent of 5 shillings per year, the transfer of title to be contingent on the erection of a "dwelling house 20 feet long and 17 feet wide with a stone or brick chimney to the same." [6] This process proceeded gradually during the next three decades until 1764, when the town was formally incorporated. On this date, 51 of the 98 lots were sold outright and the ground rent discontinued. Sometime between 1734 and 1739, when it first appeared in the Court Journals of Frederick County, Virginia, Shepherd built the first mill on the present site. In the meantime, Shepherd had increased his holdings in the area. In 1751, he secured a grant of 457 adjacent acres from Lord Fairfax. In 1762, he sold 151 acres of this land to Captain Richard Morgan and bought 50 acres of Morgan's land adjacent to the town. The latter he cut up into lots and sold. [7] When Thomas Shepherd died in 1776, he passed on to his heirs several large and valuable farms surrounding what was fast becoming a booming town. Finally, Shepherd's farming and speculative interests led him to engage in several commercial and manufacturing enterprises. His will of record dated August 20, 1776, at Martinsburg, shows that he eventually added a sawmill and a second gristmill to meet the demand created by a growing agriculture in the area. [8] In 1765, Shepherd applied for and received a charter from the Virginia legislature to operate a ferry connecting his lands on both

* In 1790, Shepherdstown was able to raise over $20,000 in cash to support its bid as a site for the location of the new National Capital.

sides of the river. The original pack horse trail had by this time become the Philadelphia Wagon Road, and provision was needed for the transport of coaches and wagons. Shepherd's charter was rescinded the following year when the legislature was apprised that Shepherd had been preceded by Thomas Swearingen's ferry, which crossed the river just north of Shepherd's. [9] By 1776, Shepherd's holdings were indicative of the most important functions in the town: agriculture, lumbering, milling, and transportation.

The commercial and manufacturing importance of Shepherdstown continued to increase during the early 19th century. Among the early industries were two potteries, an armory for the manufacture of rifles, a cotton factory, a brewery, and a brickyard. In addition, there were three tanneries, two sawmills, and a woolen mill. [10] The nearby Potomac Cement Mills produced much hydraulic mortar used on the locks of the Chesapeake and Ohio Canal from Georgetown to Cumberland. [11] During this period, Shepherd's Mill assumed more than local significance. Although mills proliferated throughout the valley as settlement spread, those in commercial centers like Shepherdstown could cash in on the growing surplus that was beginning to appear. As farming in the valley grew beyond the subsistence level, wheat became the major money crop, and by the end of the Revolutionary War the valley had become an important source of flour for coastal markets from Philadelphia to Alexandria. [12] Virtually from its inception, Shepherd's Mill was a major "merchant" mill, buying grain at local market price and selling flour either locally or in distant markets. It continued to be a profitable venture through the Civil War period, although it gradually became only one of many enterprises as the town increased in size and wealth. It remained in the Shepherd family until 1831, when Thomas Shepherd, Jr., sold it to Jacob and Henry Staub. [13] When the Staubs sold it to Jacob Staley in 1847, it was described as "a large flour mill." [14] It remained in the Staub family until 1888. [15]

During the period from 1870 to 1910, the flour milling industry underwent a major revolution in technology. The state of milling in 1870 was essentially the same as it had been since Oliver Evans' innovations of 1790. [16] Evans was responsible for the automation of the flour mill, which he achieved through a system of conveyors that made the small water-driven mill a one- or two-man operation. From 1790 until the invention of the roller mill in the late 1870's, innovation in flour milling consisted of the elaboration of Evans's designs. Automation made possible the construction of larger mills such as those in Richmond (Hauxall) and Minneapolis, but the grinding process was essentially unchanged. Grain was still ground with stone burrs set close together to produce as much flour as possible in one "run." The product of this grinding was then run through a "bolter," which separated the finer particles (flour) from the coarser (middlings) and the coarser from the chaff (tailings). [17]

In 1879, Edmond La Croix, a French immigrant employed at the Washburn "B" Mill in Minneapolis, began a series of experiments to develop a more efficient purifier for the separation of these products. La Croix, working under conditions of utmost secrecy, built a purifier based on the design of a French machine patented in 1860. Until this time, the middlings had little value and were used to make coarse ship's bread or porridge. The new purifier allowed them to be efficiently separated from the bran and reground. The resulting flour was highly superior for baking bread and was labeled "patent" flour. The desirability of patent flour encouraged the acceptance of the so-called "New Process" milling technique, in which the stones were set high (far apart) to obtain the largest possible amount of middlings. The elaboration of this process led to what is called the "gradual reduction" process, in which the grain might be ground as may as seven or eight times, being run through a purifier after each grinding. Unlike the old process, the object of the first grinding was now to produce as little flour as possible. The stones were set far apart, eliminating, to a large extent, the heat of friction which formerly discolored the flour and reduced its rising ability. [18]

The next step in the milling revolution was the adoption of the Hungarian system of using rollers instead of stones. This innovation was encouraged by the New Process of gradual reduction, where the object was to granulate the grain instead of pulverizing it. In addition to taking up less space, the new roller machines were ideally suited to the production of a large proportion of middlings. In the first reduction, the grain was passed between two cylindrical rollers of chilled iron (early experiments with fluted iron and ceramic rollers proved unsuccessful) and twisted until it cracked, thereby separating interior, starchy portions from the hull (chaff) and the germ. After separation, the former was reground. Each successive purification eliminated more of the undesirable parts and produced flour and middlings. The final result was flour of the highest quality. The first all-roller mill was supposedly that build for C. C. Washburn in Minneapolis in 1878. By the late 1880's, it was the most common system for new mills throughout the country. [19]

The largest impediment to widespread acceptance of the New Process was its increased demand for power. For small mills on country streams, the operation of a bank of roller mills and a number of purifiers, each with its appropriately sized sifting cloth, was out of the question. For this reason, initial acceptance was limited to areas like Minneapolis, which had plentiful supplies of water power. Those less fortunate, however, were quick to develop alternative sources and to take advantage of the new techniques.

The three basic solutions to this problem of increasing horsepower demand were the use of steam as motive force; the use of large iron or steel water wheels; and the replacement of the water wheel by a water

turbine. The selection of one of these depended on the amount of water available and the size of the mill. Where water was scarce or erratic or the anticipated mill was large, steam was the only answer. Where water was plentiful, the most practical solution was either a turbine or a large metal water wheel. The latter was slightly less efficient than a turbine but easier to build, particularly on a large scale (in fact, this gap in efficiency was not, at the time, an established fact; as late as 1924, one miller's handbook included discussions of both). [20] On the other hand, the turbine had certain operating advantages. It would not freeze up in winter, took up less space, and did not require so much gearing to get up speed. [21] In either case, the efficiency of both types was much greater (80%-85%) than that of wooden wheels (60%) and allowed millers in marginal areas to compensate for these new milling machines. For the operator of a merchant or commercial mill, the increased demand for fine "patent" flour made continued operation contingent on this critical increment of power.

Shepherd's Mill is a graphic illustration of the transition which took place in flour milling at the end of the 19th century. The original mill was decidedly smaller than the present structure and probably consists of the southern 43 feet 2 inches. (See HAER drawing of Plan, sheet 2 of 4.) The water wheel was originally located at the northern side of the building, where the two-story addition now stands. The ground floor of this addition conceals the original wheel pit. In its original state, Shepherd's Mill was not unlike the rural gristmills which still survive around the country. After A. S. Reynolds purchased the mill in 1891, it was transformed into a larger, more efficient operation with a daily capacity of 35 barrels of flour. [22] Reynolds installed roller equipment, which was removed sometime after 1947. The third story of tin-clad frame construction was probably added at this time to house additional equipment called for in gradual reduction. While tentative, these conclusions are totally in keeping with the character of the wheel itself and the accounts of local residents. [23]

The 40-foot diameter steel water wheel at Shepherd's Mill is the product of a sophisticated approach to hydraulic engineering (HAER Photo WV-5-5). Built by the Fitz Water Wheel Company of Hanover, Pennsylvania, its design is based on the careful calculation of water supply and mechanical efficiency. Samuel Fitz founded the company in 1840 to produce wooden water wheels and their iron fittings. [24] Originally, the company was probably typical of many small millwright shops. The development of the more scientifically designed metal wheel such as the one at Shepherdstown was due to the efforts of John Fitz, son of the founder. [25] It is not known whether the younger Fitz had any formal engineering training, but he was thoroughly versed in the most recent developments in hydraulics. Together with his practical experience, Fitz used this theoretical basis to build the company into one of the principal suppliers of intermediate-sized water-power plants on the East Coast. [26] By 1829, the company could claim dominance in the

field. In that year, a company brochure noted that

> Fitz Water Wheels form part of the equipment of some of the greatest engineering colleges and universities in the world. They have been adopted by many railroads and by many of the leading engineering firms in this country for use wherever high efficiency and perfect reliability are the essential requirements in a small water power development. [27]

Fitz wheels were being used to power hydroelectric plants, pumping plants, municipal water supply systems, and small manufacturing plants of all kinds.

The 1928 brochure illustrates the scientific character of hydraulic engineering by the turn of the century. This document is a concise explanation of the mathematical and experimental basis of the Fitz designs and of the company's advocacy of water wheels as opposed to turbines. The water wheel vs. turbine debate occupied the mainstream of controversy among wheelwrights and hydraulic engineers from about 1840 until the 1880's. By 1890, careful experiments had determined the relative merits of each. The Fitz brochure claimed that a well-designed wheel was superior in efficiency to a small turbine under conditions of variable water supply. [28] Since the angle of its fins is fixed and calculated to a particular pressure, a turbine depends on a constant head of water to achieve maximum efficiency. A larger head of water does not increase its power, while a smaller head drastically diminishes its efficiency. [29] In addition, the water passing between the fins and the housing yields no effort at all, and this clearance increases with use. The Fitz brochure cites scientific studies performed by the U.S. Geological Survey (1906) to prove that, even under ideal conditions of constant head, turbines failed to yield the available energy. [30] Consequently, the turbine's ideal location was one where the available head was large and constant, as, for example, where a dam and reservoir were practical.

The Fitz Overshoot Water Wheel was far more useful than turbines on streams of extremely variable flow. It design was carefully calculated to squeeze as much energy as possible out of the available water. Unlike the more traditional wooden overshot wheel, the Fitz wheel utilized the pressure of the water's head as well as its weight. A "forebay" or surge tank near the end of the penstock created a small head so that the water struck the wheel under pressure instead of merely falling on it. To take advantage of this pressure, the penstock chute was constructed so that the water struck the buckets before they reached the crown. [31] (See HAER drawing of East Elevation, sheet 3 of 4.) The buckets themselves were shaped to extract the maximum moment from the force of the jet tangent to the crown of the wheel. [32] (WV-5-6.) This curvature also meant that the wheel made maximum use of the water's weight by holding it in the bucket almost to the level of the tailrace.

With a design such as this, the structure of a specific wheel had to be carefully adjusted to suit the particular conditions of each site. The 1928 brochure included detailed instructions to prospective clients for calculating the available power of their water sources. These included the measurement of fall and techniques of stream gauging. [33] The company also went on to suggest the various means of power transmission suitable to the customer's needs. To harness the power of its wheels, Fitz also manufactured custom-made segment gears (both external--as at Shepherdstown--and internal) and spur master wheels out of its own formula for cast semi-steel. [34] Segment gears and wheel were pre-assembled in the company's shops, and bolt holes were drilled to insure accurate fit. Sections were then numbered, disassembled, and shipped to the customer with assembly instructions and blueprints. A patented locking device was used on the nuts of all split gears. [35] The company provided the services of a skilled millwright when requested.

The 40-foot Fitz wheel at Shepherdstown was originally located about 150 feet downstream, where its original piers may still be seen. (WV-5-1, WV-5-7.) Water was carried from upstream in an elevated sluice supported by a timber trestle. Power was transmitted back to the mill by a circular loop of cable ("endless wire") which entered the mill through a door in the east elevation. (WV-5-2.) The amount of water available was not great (90 cubic feet per minute), and the downstream location allowed that to be used to greater advantage. When U. S. Martin bought the mill in 1905, he improved the layout by moving the wheel to its present location at the side of the mill itself. [36] (WV-5-8.) A two-story dock covered the drive wheels and allowed the miller convenient access to the wheel and water supply. [37]

In summary, the significance of Shepherd's Mill is that it remains a symbol of several aspects of local, regional, and national development. As probably the first mill in the Valley of Virginia, it shows the critical function of milling in frontier culture. In its relation to the history of Shepherdstown, it sheds light on the rise of major market towns and their cross-cultural nature. The 40-foot steel water wheel and other modernizations of the 1890's reflect technological changes on a national scale and the way in which towns like Shepherdstown reacted to them. A company such as Fitz used a modern, scientific approach to increase the efficiency of small water powers and allow such a mill to meet the growing demand for power for new machinery. Millers such as A. S. Reynolds and those who followed him bore little resemblance to their predecessors. Their knowledge of contemporary developments in hydraulics reflects the general revolution in communication which took place at the turn of the century. Advances in transportation increased geographical mobility and the availability of books, papers, and catalogues, thereby making these techniques available to the rural entrepreneur. The transportation revolution, however, was also responsible for the eventual demise of much rural industry. Shepherd's Mill, then known as Thompson and Carter, suspended operations in 1939. [38]

By that time, transportation facilities had increased to the point where large firms could control regional or national markets. Small firms with limited production were simply forced to close their doors in face of such powerful competition. Shepherd's Mill was too large to exist as merely a local supplier and not large enough to compete in a broader market where economy of scale meant the difference between survival and extinction. This phenomenon affected most of the town's industries in a similar fashion, and Shepherdstown reverted to its earlier function as a residential and commercial center catering to the needs of the surrounding farms and the local college.

Footnotes

1. A. D. Kenamond, Prominent Men of Shepherdstown, 1762-1972 (No place, 1963), p. 11.
2. Millard K. Bushong, Historic Jefferson County (Boyce, Virginia, 1972), pp. 11-12.
3. Ibid., pp. 43-49.
4. Ibid., p. 88.
5. Clifford S. Musser, Two Hundred Years' History of Shepherdstown (Shepherdstown, West Virginia, 1931), p. 6.
6. Ibid., p. 11.
7. Ibid., pp. 11-12.
8. Kenamond, pp. 11-13.
9. Musser, pp. 12-13.
10. J. E. Norris, History of the Lower Shenandoah Valley, 2nd ed. (Berryville, Virginia, 1972), p. 387.
11. Ibid.
12. O. C. Stine and Silas Starry, "The Shepherd Grist Mill," unpubl. manuscript courtesy of E. L. Kemp, Department of Civil Engineering, West Virginia University (Morgantown, no date), p. 3.
13. Jefferson County Clerk's Office, Will Book 1, p. 61; Deed Book 16, p. 386.
14. Jefferson County Clerk's Office, Deed Book, Vol. 29, p. 68.
15. Stine and Starry, p. 4.
16. Oliver Evans, The Young Mill-Wright and Miller's Guide (New York, 1972 [1790]).
17. Ibid., pp. 255-283.
18. Charles B. Kuhlman, The Development of the Flour Milling Industry in the United States (Boston, 1929), p. 120.
19. Ibid., p. 122.

20. R. J. Abernathy, Practical Hints on Mill Building (Moline, Illinois, 1880), pp. 93-101; B. W. Dedrick, Practical Milling (Chicago, 1924), pp. 451-470.

21. Fitz Water Wheel Co., "Fitz Steel Overshoot Water Wheels," Bull. 70 (Hanover, Pennsylvania, 1928), p. 27.

22. Stine & Starry, p. 6.

23. Abernathy, p. 93; Stine & Starry, p. 5; Jefferson County Clerk's Office, Deed Book W, p. 197.

24. Fitz Water Wheel Co., Bull. 70, p. 3.

25. Ibid.

26. Ibid. Note the diversity of the company's numerous installations.

27. Ibid., p. 9.

28. Ibid., pp. 24-29.

29. Ibid., pp. 24-25.

30. Ibid., p. 25; Robert E. Horton, "Turbine Water Wheel Tests," U.S. Geological Survey Water Supply & Irrigation Paper, No. 180, p. 22.

31. Ibid., p. 32.

32. Ibid.

33. Ibid., pp. 62-67.

34. Ibid., pp. 52-54.

35. Ibid., pp. 54-55.

36. Stine & Starry, p. 5.

37. Fitz Water Wheel Co. Bull. 70, p. 27.

38. Stine & Starry, p. 6.