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AND THE
GREENBANK MILL
New Castle County, Delaware

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This publication is,

In recognition of the 150th anniversary of the forming of the
Wilmington & Western Rail Road company in 1869,
And dedicated to the memory of HRCV founder,

Thomas Clarence Marshall, Jr.

February 20, 1924 ~ February 12, 2019

Educator, Humanitarian, Philanthropist, Preservationist

"The best thing to make in life, is to make a difference!"

Tom & Ruth Marshall at Auburn Heights

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Note Regarding the 2019 2nd Edition

This document was digitally scanned to high resolution images from a copy contained in the Historic Red Clay Valley Archive collection. Optical character recognition was performed and the document transferred to Microsoft WORD for editing.

Editing involved formatting for letter-size pages (the original monograph was printed in a 6" x 9" page size). As a result, the page numbers in this document do not match the page numbers of the originally published monograph. To improve readability, the font size has been increased over what was originally used for the printed monograph. The author's original numbered footnote references are unchanged.

HRCV has elected to build on the author's work with this reissue. Spelling and grammar have changed in the fifty years since this manuscript was originally presented. Where applicable, spelling and grammar changes have been made to bring the text in align with current grammar and spellings. Lettered footnotes refer the reader to new information as well as the original spelling and grammar references at the back of the manuscript.

New facts have been uncovered as well as other relevant information related to the author's original content. Any new facts and information included are printed as part of the letter footnotes at the rear of the monograph. Original photos and drawings have been updated, where possible, with the originals referenced by letter footnote at the end of the monograph.

This monograph is being released by HRCV in recognition of the 150th anniversary of the Delaware Legislature's Act revising the identity of the Delaware & Chester County Railroad to the Wilmington & Western Rail Road (Laws of the State of Delaware, Volume 13, Chapter 491; March 10, 1869). With this change of corporate identity and a new slate of highly-regarded Delawareans in control of the enterprise, progress on the new railroad progressed rapidly. On October 19, 1872 their efforts were rewarded with the railroad's first day of operation.

Robert E. Wilhelm, Jr., Editor, 2019

Historic Red Clay Valley, Inc., is a non-profit organization engaged in promoting interest in the social and economic history of the Red Clay Creek Valley.

INTRODUCTION

A rural and agricultural economy, such as America's in the 18th century, fostered few manufactures and those largely extractive. Among these, those gristmills built to convert grains into flour, were perhaps the most important.[A] Certain it is that, by the time of American independence, most readily available mill seats[B] were already occupied by either merchant or custom flouring mills. It was therefore necessary, during the period between the rise of American manufactures and the wide adoption of steam power, for the newer manufactories to be erected within or on the sites of former gristmills.

Two such mill sites were at Greenbank and Faulkland in New Castle County, Delaware. Both operated as gristmills before 1800, but soon after, were expanded to produce a surprising range of products. By the end of the 19th century both were reduced once more to grinding grain for the local trade. Tales of the Rise and Fall of anything always instruct in some manner and those following, it is hoped, will not be exceptions to this rule. The admonition that man should know himself extends outward to include his surroundings and backward to include his past – for together, environment and heredity make man much of what he is.

I am grateful to the Eleutherian Mills-Hagley Foundation, the Historic Red Clay Valley, Inc., Mrs. Eldred B. Hoiriis, and Mr. C. A. Weslager, all of whom helped make this study possible.

June 1, 1964
Cleveland, Ohio

THE FAULKLAND SPICE MILL

For the better part of a century, the millseat at Faulkland, Delaware, on the Red Clay Creek, was the scene of one or another important manufactory. In 1785 Oliver Evans[C], the "American Watt," made it the site of his first automatic flour mill – an innovation which soon became standard over the United States and remained so for 100 years. Then, in 1828, Evans' mill was converted into one for the manufacture of spices from all around the world. This manufactory was the only one of its kind in the State of Delaware and, for many years, the leading spice mill in the nation.

The interested traveler may view the site of the Fell spice mill by turning north on Faulkland Road between the Lancaster Pike and Price's Corner. The road descends into the Red Clay valley, crossing the stream over a modern bridge considerably less handsome than the one built in 1813 which is replaced. After passing the millsite, the road then climbs again to the high land at Brandywine Springs.

Little is known about the early life of Oliver Evans. The years between his birth on September 13, 1755, and his majority, are filled only with those peculiar myths which cluster about the biographies of famous men. Stories of little Oliver studying late into the night by the light of flickering wood chips tells us more about Victorian virtue than an actual life. That he received a good education we may be sure, and about 1771, when he was 16, he became apprenticed to a wheelwright, no doubt in his native village of Newport, Delaware.[1]

Instead of pursuing the trade for which he was trained, Oliver Evans, with his younger brother Joseph, moved to Nine Bridge, on the Eastern Shore of Maryland, and opened a general store. His prospects were such that in 1783 he could marry Sarah Tomlinson, the daughter of a local farmer, but already his real expectations lay in the direction of invention rather than commerce. He was thinking seriously of several improvements in the manufacture of flour and had purchased in 1782[D], with his brothers John and Theophilus, about 400 acres of land along Red Clay Creek from their father Charles Evans.[E]

Oliver Evans' five separate inventions for the improved operation of flour mills – the hopper boy, elevator, descender, conveyer, and drill – taken together, revolutionized the conduct of this ancient manufacture. The common practice at that time was to carry a bag of grain to the second floor of a mill. Here it was emptied into a hopper from which it fell through a chute into the mill-stone hopper on the first floor. The freshly ground flour fell through another chute into the cellar where it was collected in open tubs and hoisted up into the third-floor loft. On this level the flour was dumped out onto the floor, raked about until it was dry and cool, then pushed through a hole in the floor through which it fell, by way of another chute, into the boulter on the floor below. The revolving silk cylinder of the boulter separated the bran and dirt from the various grades of flour, each of which was then barreled for transport. Although this was the best available process of flour manufacture, it suffered from three major drawbacks: (1) the large amount of manual

[1] - Unless otherwise attributed, the following information on Oliver Evans is taken from Greville and Dorothy Bathe, Oliver Evans: *A Chronicle of Early American Engineering* (Philadelphia, 1935), passim.

labor involved was grueling and expensive; (2) a considerable amount of material was wasted at each step in the operation; and (3) the quality of the flour was never what it should have been since, as Evans put it, "people did not even then like to eat dirt, if they could see it."[2]

Under Evans' plan, these three drawbacks were greatly lessened by mechanical contrivances designed and arranged in such a way that the power of the water wheel, heretofore used primarily to turn the stones, provided an automatic and uniform drive to the entire process. In Evans' mill, an elevator (buckets moving on an endless belt inside a closed chute) carried the grain to the second floor and dumped it into the hopper above the millstones. Gravity carried the grain down to the stones on the first floor and the moist, warm flour from the stones to the cellar. Another elevator carried the flour to the third floor where it emptied into the hopper boy. This simple device consisted of two long arms set with teeth which, when it slowly revolved, stirred the flour within an area of the floor enclosed for that purpose. The flour then fell to the boulter below and thence into waiting barrels. Thus, the miller had only to empty the grain sacks and cover the barrels: the rest was automatic. (See Figure 1)

The elevator and hopper boy were the most commonly adopted and indeed, indispensable, parts of Evans' improvements, but the other three were sometimes used as well. These consisted of (1) the descender; an endless belt set at a slope upon which material could ride downward, (2) the conveyor; a screw made of sheet iron on a wooden core shaft, (3) and the drill; which was essentially an elevator for moving materials horizontally rather than vertically.F

In order to demonstrate the usefulness of his new processes, Oliver Evans, with his brothers, began to build a new flour mill incorporating his principles along the Red Clay.[3] David Nivin, of Newark, was taken in to operate the store at Nine Bridge, and Oliver moved either to the Red Clay mill itself or to a house in Wilmington. The new mill was in operation by 1785 and Evans busied himself with grinding grain for local farmers at 18 shillings a wagon load. The smooth operation of business was interrupted only on occasion, as when Evans had to advertise for the return of an apprentice boy who, though he "did Obtain of me a written permission to visit his Mother," had been gone more than 40 days and was presumed to have run away.[4]

The prime object of the mill however, that of serving as a showcase for Evans' improvements, was being accomplished only in part. Although five local millers testified publicly in 1787 to the usefulness of his inventions, and at least one of them had installed the equipment in his own mill, acceptance was slow. The Brandywine millers, in particular, were reluctant to convert their mills and their conservatism, tied as it was to a national reputation for excellence, tended to put a brake on adoptions.

Evans sent agents and went himself about the country, but to little advantage. Millers either denied the practicability of the scheme or adopted it while contending that it was no

[2] - Quoted in *ibid.*, p. 12
[3] - There may have been a small mill on the property as early as 1742. *Ibid.*, p. 13.
[4] - *Delaware Gazette* (Wilmington), April 12, 1785

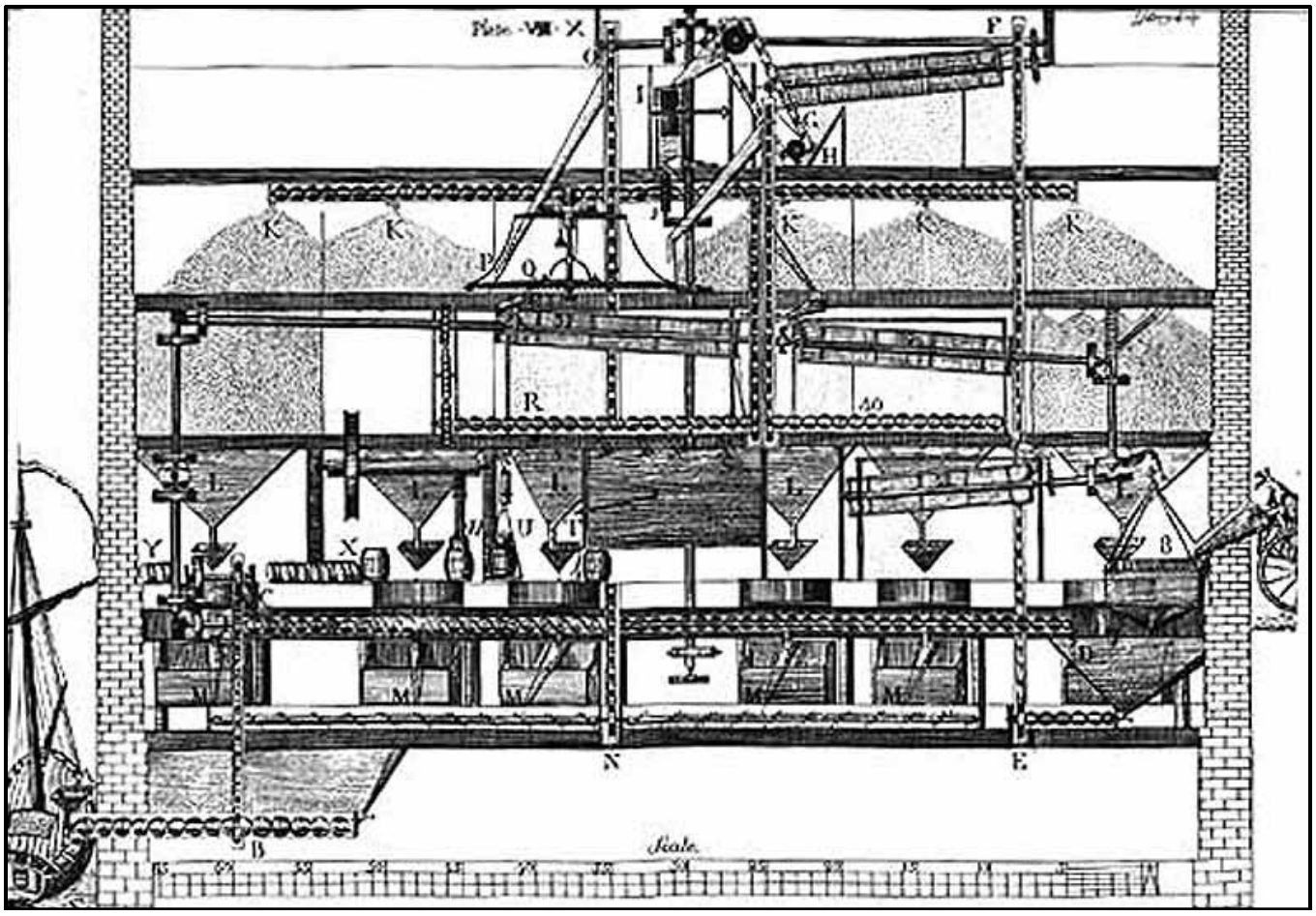


Figure 1

Oliver Evans' automatic flour-milling machinery, similar to that installed in his Red Clay Creek mill. (From Oliver Evans, *The Young Mill-Wright's & Miller's Guide* (Octoraro, 1807), plate X.) [G]

new invention and Evans deserved no fee. In 1790, he had a model built of his new mill and put it on display at his Wilmington home, but again to little avail.[5] Two years later, partly no doubt to enjoy the more philosophical atmosphere of America's first city, he moved to Philadelphia.[6] At age 37 he was ready to stake his small capital and growing mechanical talents on a career of invention and manufacture.[7]

For reasons either personal or financial, the Evans' brothers Red Clay enterprise had come to grief a short time before Oliver Evans moved to Philadelphia. The Sheriff of New Castle County[H] exposed the mill to public sale and it was purchased by David Nivin on May 26, 1792.[8] It is possible that Nivin acted with Evans as a silent partner in this purchase, although of this we cannot be certain. Within a short time Nivin divided his responsibility by selling a third of the mill to Charles Anderson; a practice that was common enough before incorporation laws were liberalized.

[5] - *Ibid.*, October 2, 1790.
[6] - Cf. Bathe, p. 28.
[7] – Evans' subsequent career, spent largely in the field of steam technology, is described in Bathe.
[8] - J. Thomas Scharf et al., *History of Delaware*, (Philadelphia, 1888), II, 925.

In 1795[I] Anderson sold his third of the mill to William Foulk. Three years later, on February 24, 1798, the latter purchased the remaining two thirds interest in the mill from David Nivin, and the enterprise entered several decades of relative stability.[9] By the beginning of the 19th century Oliver Evans' equipment was becoming standard in the United States and was even receiving some notice abroad. The original Red Clay mill lost its unique technological advantage becoming indistinguishable from other mills of its type.

But fame was not yet to desert the mill completely. William Foulk died intestate, leaving seven children to share his estate. On May 29, 1824, they sold their father's mill to John Foulk, one of the sons. Within two years the younger Foulk saw the mill once again seized by the Sheriff. It was exposed to public sale and advertised as being "well worth the attention of Manufacturers, either of wool or cotton, as the buildings are substantial and it has the whole water right of Red Clay Creek, which is a never failing stream, and is within five miles of Wilmington, three of Newport,[J] (whence there is a water navigation to Philadelphia), and about fourteen miles from Elkton, so that a communication either to Philadelphia, or Baltimore can be effected with very little expense."[10]

On May 20, 1828, however, before the Sheriff could affect a sale, Foulk himself sold the mill to Jonathan Fell, of Philadelphia, who had first seen and admired the property while on a vacation taking the chalybeate[K] waters at nearby Brandywine Springs.[11] The fame which Philadelphia had stolen from the Red Clay mill it now returned. Although Foulk's name was perpetuated (though transposed) on the map as Faulkland, it was the Fell family which made the old Evans mill famous throughout the nation.

About 1766 John Dixon, an English-born Quaker, established a mustard manufactory in Philadelphia.[12] The modest enterprise prospered at its Front Street location and, when Dixon died in 1810, he was succeeded by Jonathan Fell, Jr., who "purchased the entire stock and utensils belonging to that concern," and promised that "every reasonable exertion will be used to merit a continuance of . . . confidence and custom."[13] The following year, when Fell added the manufacture of chocolate to that of mustard, the enterprise gave every indication of growing even larger.[14]

The technology involved in grinding mustard, chocolate, or any of the other condiments later produced by the Fell mills, was basically like that of grinding wheat or any other type of hard seed. In 1787, one mill near Philadelphia was described as grinding, by water, "chocolate, flour, snuff, hairpowder[L] and mustard."[14a] While the quality and purity of the products may well be questioned, it is clear that there was no great difference in the way they were processed. Horizontal or vertical wheels, turning on a stationary bed, could and did grind everything from cassia seed to gunpowder in early American mills. As

9 - Deed Book E-4, 344-347 (New Castle County Court House, Wilmington, Delaware).

10 - *Delaware Gazette*, January 22, 1828.

11 - Deed Book G-4, 305-308. The connection between the Fell family and Brandywine Springs is admirably traced in C. A. Weslager, *Brandywine Springs* (Wilmington, 1949).

12 - Abraham Ritter, *Philadelphia and Her Merchants* ... (Philadelphia, 1860), p. 174.

13 - *Aurora* (Philadelphia), August 15, 1810.

14 - *Ibid.*, October 3, 1811.

14a - Tench Coxe, *A View of the United States; A Series of Papers Written at Various Times Between the Years 1787 and 1794* (Philadelphia, 1795), p. 39.

specialized production became economically feasible, this basic mechanism was usually modified in detail to fit the processing needs of a particular raw material.

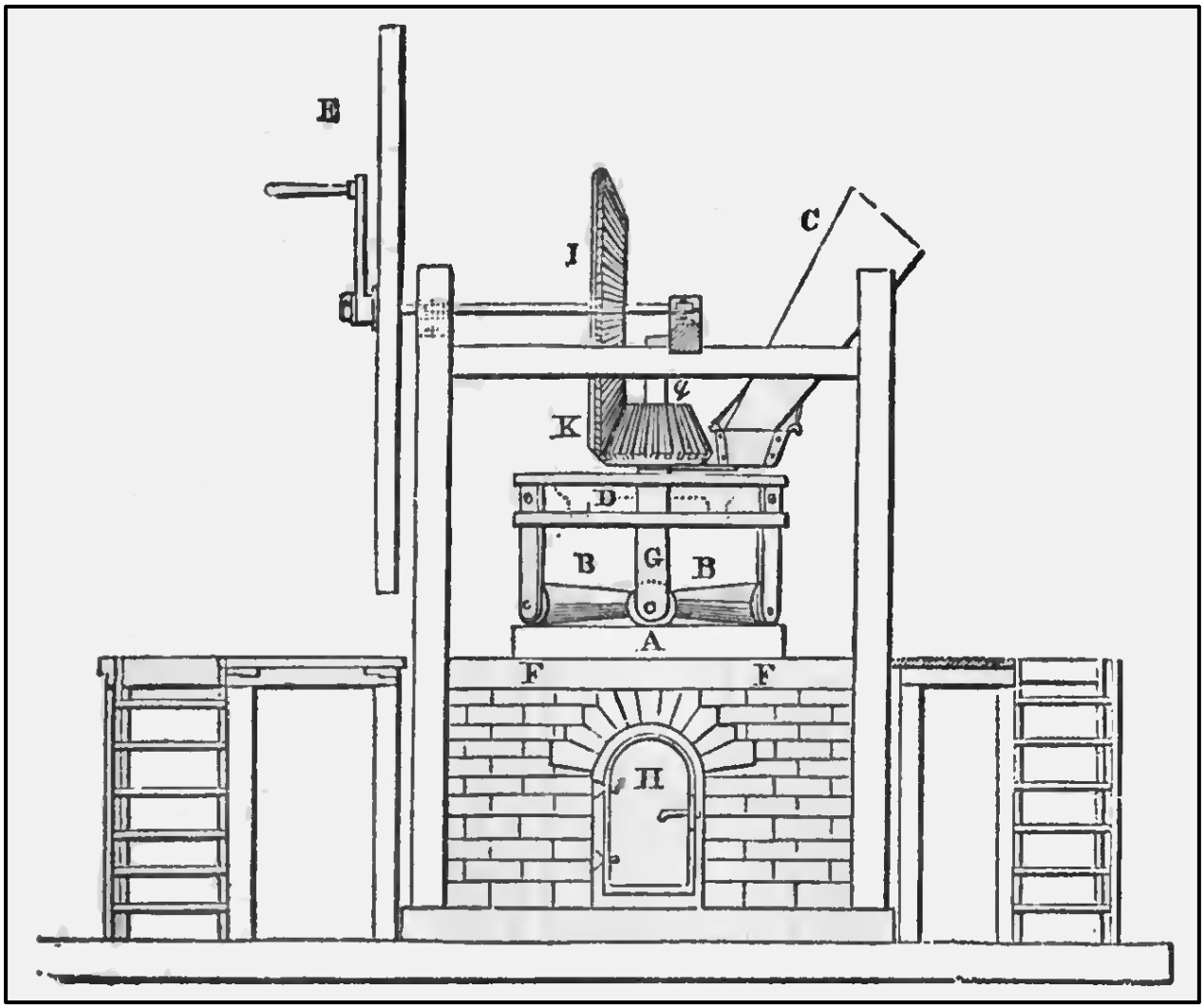


Figure 2

The machinery for a chocolate mill, 1845. Six conical rollers (BB) crushed the beans on a bed of marble (A). (From Andrew Ure, *A Dictionary of Arts, Manufactures, and Mines* . . . (New York, 1845), I, 299.) M

By the early 19th century, for example, it was discovered that the taste of chocolate was improved if it was processed in the following manner. The cacao beans were first cleaned, then roasted in an iron cylinder over a slow fire. When the aroma indicated that this step was completed, the beans were removed, cooled, and freed from their husks by fanning and sifting. The roasted beans were then ground in a special mill (see Figure 2) in which a marble bed stone replaced the more familiar burr stone used in gristmills, and the upper stone was replaced by six conical rollers. The marble bed stone was then heated to about 130° Fahrenheit so the beans could be reduced to a viscous paste. When the beans were sufficiently ground, sugar and vanilla were added and incorporated to sweeten and flavor the chocolate. After grinding, and while still thin enough to flow, the chocolate was poured into molds and allowed to harden.[14b] The recipe, as well as the type of machinery

[14b] - Andrew Ure, *A Dictionary of Arts, Manufactures, and Mines* . . . (New York, 1845), I, 299-300.

used by Fell to make chocolate, have never been uncovered, but were no doubt quite similar to that just described.

As his spice business flourished, Jonathan Fell broadened his interests to include a wide range of philanthropic and commercial activities. At one time or another, for example, he was president of the Philadelphia Society for the Establishment and Support of Charity Schools and the Lehigh Coal and Navigation Company.[15] Fell is sometimes credited with being the first to burn anthracite coal in a parlor grate.[16] This honor, however, is more usually given to Jesse Fell, a nail-maker of Wilkes-Barre who developed such a device in 1808.[17] Even without this particular discovery to his credit, the death of Jonathan Fell on July 15, 1829, closed a career of unusual public and private service.[18]

With the death of the father, the spice business, including both the Philadelphia establishment and the newly acquired mill on the Red Clay, was taken over by the sons of Jonathan. Courtland J. Fell, being the oldest, gave his name to the firm which until its dissolution late in the century was known as C. J. Fell & Brother. The firm was operated as a partnership and ground spices were sent, by 1832, to "most of the seaports of the United States." The water powered mill on the Red Clay, valued that year at $12,000, employed three men, two girls, and "one child," who worked by the hundredweight.[N]

The amount and variety of spices produced was quite large, being refined, in 1832, from 100,000 pounds of cocoa, 800 bushels of mustard seed, 200,000 pounds of race ginger, 50,000 pounds of black pepper, 5,000 pounds of cassia, and 1,000 pounds of other spices.[20] A large part of these raw materials, of course, were necessarily imported, but the mill also advertised locally for barley, indicating that this grain was also among its products.[21]

Another American product consistently encouraged by the Fells was mustard seed. From the time he first took over Dixon's business, Jonathan Fell had advertised that "farmers desirous of growing Mustard, can be furnished with seed of a superior kind by applying as above, and also find a ready market for any they may have to sell."[22] By 1844, most mustard seed was still imported from England, but C. J. Fell & Brother were sanguine in their hope for a larger domestic supply.

On receiving a delivery of 382 bushels of brown mustard seed from J. H. Parmelee of Zanesville, Ohio, the Fells referred to the notorious English Corn Laws then under attack in Parliament, predicting that "the time is not far distant, if not already at hand, when the interests of the American farmers will be best promoted by devoting a portion of their time

15 - *National Gazette* (Philadelphia), July 16, 1829; *United States Gazette* (Philadelphia), January 2, 1826.

16 - Ritter, p. 174.

17 - Frederick M. Binder, "Anthracite Enters the American Home," *Pennsylvania Magazine of History and Biography*, LXXXII (1958), 86. Binder suggests that Jesse Fell may have been anticipated by Oliver Evans. [*we do not understand the reference to Oliver Evans in Pursell's original footnote reproduced here*]

18 - *Philadelphia Gazette*, July 16, 1829.

19 - *Documents Relative to the Manufactures in the United States* [McLane Report] . . . (Washington, D.C., 1833), II, 715-716.

20 - *Ibid.*

21 - *Delaware State Journal* (Wilmington), March 20, 183 5.

22 - *Aurora*, August 15, 1810.

and land to the raising of many crops which are now imported from countries refusing (except when their own crops fail) the surplus of the American farms, and thus not only raise the prices of their grain crops by diminishing their quantity, but secure to themselves a large amount of money which is annually sent out of the country to purchase these crops".[23]

In answer to charges that the market for mustard seed could be easily glutted, the Fells admitted that "if its culture is gone into with a 'multicaulis' energy, the demand for the manufacture at the present 'infant state' will not be equal to the supply; but if," they added, "on the contrary, the farmers move with their usual caution and prudence, and sow each but a few acres, we think there is no fear of overstocking the market." A growing market was assured, they claimed, because "the manufacture of mustard in this country is yet in its infancy, and has only been undertaken on a large scale since the passage of the tariff[O] giving a protection of 30 per cent. In these two years, such improvements have been made in machinery, and such knowledge obtained, as has enabled the manufacturers to produce an article which commands a preference over any heretofore imported . . . "[24]

The death of Courtland J. Fell in 1848 left the family spice business in the hands of Franklin Fell, his younger brother. The latter was born on May 25, 1814, in a house on Front Street in Philadelphia just a few doors away from his father's new business. He received a liberal education and at 17, two years after the death of his father, he began his commercial career as the youngest boy in the store of Shober, Bunting & Co., dealers in fish and oils.[25] Within 18 months, in recognition of his "faithful labors," he rose to be chief bookkeeper and confidential clerk. The death of Thomas Jenks Fell, junior partner in C. J. Fell & Brother, in 1836, made it desirable that Franklin enter the family business to help his brother Courtland, who then moved to the Red Clay to give personal supervision to the spice manufactory.

Franklin Fell, now in full charge of the Philadelphia store and warehouse, seems to have inherited his father's desire for wider business and philanthropic interests. Besides serving as president of the Seaman's Saving Fund Society, of Philadelphia, he was president for several years of the Buck Mountain Coal Co.[26] Stock in this company, along with some "wildlands in the anthracite region," came to the spice firm when a debtor failed, and Franklin Fell became an expert, as had his father, in "every branch of the mining and selling of coal." In another venture Fell, with a group of associates, engaged in real estate development in the city of Philadelphia, cutting up an old estate on the west side of town into handsome residential units.[27]

When Courtland J. Fell died in 1848, Franklin became the sole partner in the spice business. Dividing his time between Faulkland and Philadelphia, he continued his varied

[23] - Letter of September 28, 1844, from C. J. Fell & Bro., in *Report of the Commissioner of Patents, For the year 1844* (28th Cong., 2d sess.), House Doc. No. 75, p. 327. The Corn Laws, which severely restricted the export of grain to England, were repealed in 1846.

[24] - Letter of October 21, 1844, from C. J. Fell & Bro., in *ibid.*, pp. 327-328.

[25] - This sketch of Franklin Fell's early years is taken from an extensive obituary notice appearing in the *Philadelphia Commercial List* and *Price Current* (supplement edition), October 2, 1875.

[26] - *Delaware Gazette*, July 21, 1857.

[27] - *Philadelphia Commercial List* (supp.), October 2, 1875.

interests in both places and, at the battle of Gettysburg, travelled to that tragic battlefield to volunteer his services to the wounded and dying. He was deeply involved in the affairs of the Episcopal church in Delaware, founding and teaching a Sunday School in his Faulkland home. After his retirement, Fell suspended these many interests long enough to travel extensively throughout the West Indies, the British Isles, and Europe.[28]

Under the direction of Franklin Fell from 1848 to 1867, the spice business grew even farther from its origin as a combination shop and single-horse mill on Front Street. A steam engine appears to have replaced the faithful horse at the Philadelphia mill, and by 1857 the Red Clay mill was running nine pairs of stones to grind the various products of the company. By this date also the firm was making hominy, said to be "so prepared by a new process, that it resists the effects of any climate and keeps sweet and good for years".[29] They also appear to have begun the roasting of coffee at about this same time.[30]

An 1864 price list of the firm states the availability of coffee, chocolate, cocoa, ginger, pepper, cassia, allspice, cloves, brown and yellow mustard, rice flour, barley, hominy, cream tartar, bicarb. soda, sal-AEratus, indigo, split peas, caraway seeds, and mustard seeds. "The manufactured goods," the list asserted, "in packages [are] unsurpassed in beauty and variety of style".[31] The packaging was aided, as early as 1857, by a remarkable machine "propelled by steam, which *weighs* accurately, and packs the Spices neatly in bundles. Its ingenuity and speed," an observer marveled, "are remarkable."[32]

A reporter for the *American Grocer* visited the Fell warehouse in Philadelphia late in 1872 and gained some information on the way in which the firm did business.

> "Introducing himself, the reporter modestly asked to be shown the *modus operandi* of preparing spices for the trade. This was, in part, impossible, as the reporter found that the mills where the spices are ground were located at Brandywine Springs, near Wilmington, Delaware. Also, part of the packing in cans and labelling is done there. The balance is brought in casks to the Philadelphia house, where it undergoes the same operation and is ready for sale. The specialty of this house is pure spices."
>
> "Whatever goes out with their trademark under their name is guaranteed to be in all respects pure and unadulterated. To meet a demand of the trade for lower-priced goods, different grades are made, but in no case, are they ever allowed to bear the name of the firm, that being a guarantee of the

[28] - *Ibid*. Courtland J. Fell likewise had a wide range of interests, serving at one time as president of the Irving Literary Society of Delaware. *Delaware State Journal*, January 3, 1862.

[29] - Edwin L. Freedley, *Philadelphia and its Manufactures . . . in 1857* (Philadelphia, 1858), p. 269. A new kiln for drying the corn for hominy was erected in 1858. *Delaware Gazette*, September 21, 1858. The "single-horse" mill referred to would be one in which a horse, harnessed to the axle of the mill, walked slowly in circles turning the machinery. Such horse mills, being severely limited in the amount of power they could produce, were used instead of water power only in situations where the latter was not available. Until the advent of steam engines, horse and hand power were the only types available in cities.

[30] - *Boyd's Delaware State Directory 1859-60*, p. 210.

[31] - Among C. J. Fell & Bro. papers in possession of Mrs. Eldred B. Hoiriis, of Faulkland, Delaware.

[32] - Freedley, pp. 269-270.

purity of the contents of any package of spices upon which it is found. To those knowing the house, nothing need be said about their way of doing business."

"Others, if such there be, may be interested. A stranger steps in, and asks the price, say, of pure pepper? Do you want pure pepper? is asked, and a price list is handed him. Why, I never paid more than – mentioning a sum less than the cost of pepper before it is ground. The matter is explained to him and the best pepper is offered him that can be had for the price he is willing to pay. Upon this principle, the business is conducted. If a merchant wants pure goods and is willing to pay a fair price for them, he can get them. If lower-priced goods are wanted they will be furnished him, the best that can be had for the money, but they will not be put up under the name of C. J. Fell and Brother over their trademark."

"Packages of their goods are all full net weight, except glass, which are of standard sizes. For hot climates and long voyages, glass packages are always recommended. Space will not permit the telling of half that was seen; the quantities of crude goods; the immense casks of ground spices of all kinds; ginger root imported from Borneo by themselves and of which they have the monopoly; nutmegs eighty to the pound; and much that was new and interesting to the reporter and would be to the trade if space would permit it all to be told. As an instance of what this house turns out, one order, seen by the reporter upon their books, called for 7,500-pounds of ground cassia, 3,000-pounds ground cloves, 2,100-pounds ground nutmegs, and 1,500-pounds ground allspice; 14,100-pounds ground spices in one order."

"The firm are also sole agents for Fox's Philadelphia starch, of which large quantities are handled, and also are sole agents for the United States for Nelson's Gelatine, an article claimed to be superior to any other, either imported or domestic, for the purpose for which it is used."[33]

Franklin Fell retired from mercantile life in 1867, turning the direction of the firm over to his son, William Jenks Fell, and nephew Joseph E. Taylor.[34] That same year the first of a series of disasters struck at the very heart of the enterprise, the grinding mill on Red Clay creek. About 5 o'clock on a Monday evening, September 9, 1867, a small fire was discovered near one of the sets of French burr stones, probably caused by a nail having gotten between the stones. The fire was quickly extinguished and after dark the foreman made a special check for light. None being found, the mill was closed for the night.

About 4 o'clock the next morning flames were discovered bursting through the roof of the mill and the aroused workmen and neighbors, seeing that the mill was lost, concentrated their efforts on trying to save the out-buildings. The foreman's house and box mill, although near the main structure, were protected by a row of Linden trees, and with

[33] - *Every Evening* (Wilmington), October 25, 1872.
[34] - *Philadelphia Commercial List* (supp.), October 2, 1875.

great exertion, the house and box mill were saved. The fire in the main mill, which started early in the morning of the 10th, was still burning late on September 11th. A mill race was diverted to flow through the mill and pipes were laid to throw a stream of water from the creek on the burning wreckage.

The loss was estimated at $26,000, divided between building ($6,000), machinery ($10,000), and merchandise ($10,000), of which there was a large stock in anticipation of the Fall trade. Only $16,000 of the loss was covered by insurance. It was reported that "Messrs. Fell and Brother propose to commence immediately rebuilding the burned mill, and meantime they have rented another mill which they will temporarily fit up for continuing their business. . . . The loss of this mill does not at all effect their business as they have another large one in Philadelphia. . . . "[35]

The fire worked a double disaster. Not only did it weaken the financial position of C. J. Fell & Brother, perhaps fatally, but it also destroyed the mill which had been the scene of Oliver Evans' first experiments. There is no evidence of its exact size and construction when Evans sold it, but a detailed survey made two years before the fire shows it to have been, at that time, three stories high, with an attic and built of stone, 90 by 35 feet.

Attached to the west wall of the mill, and no doubt burned as well, was a two-story stone kiln 15½ feet by 12½ feet, probably added in 1858. The floors of this kiln were of brick; the furnace being located under the first floor and the heat circulated through terra cotta pipes.

Against the north wall of the mill had been a brick building with wrought iron rafters and corrugated, galvanized-iron roof. This building contained a revolving sheet-iron cylinder in which corn was dried and coffee roasted. Adjoining this building, also on the north side, was a small barley and hominy mill.[36] The main mill, and perhaps the smaller attachments, were driven by two large water wheels[P], each 18 feet in diameter and 16 feet wide.[37]

It was two years before the old spice mill was replaced by a new one "much larger and more commodious."[38] (See Figure 3) The spice firm had apparently weathered the storm and could look forward with justifiable optimism to even larger and more efficient operations. The transportation problems gave promise of solution when the long-debated Wilmington and Western Rail Road was finally projected to run up the Red Clay from Wilmington to Landenberg. In September 1869, Franklin Fell was elected a vice president of the line at a festive Harvest Home and Railroad Meeting at Hockessin.[39]

[35] - *Wilmington Daily Commercial*, September 11, 1867. The rented mill may have been the old Reynolds mill (built 1799) located at Milltown on Mill Creek. Scharf, II, 923.

[36] - "Survey of a Stone Mill House & additions thereto . . . ," memorandum written by Franklin Fell, Feb. 21, 1865, transcript owned by C. A. Weslager.

[37] - *Wilmington Daily Commercial*, September 11, 1867.

[38] - *Ibid.*, September 13, 1869.

[39] - *Ibid.*, September 11, 1869. See also Arthur G. Volkman, *The Story of the Wilmington and Western Railroad*, (Wilmington, 1963).

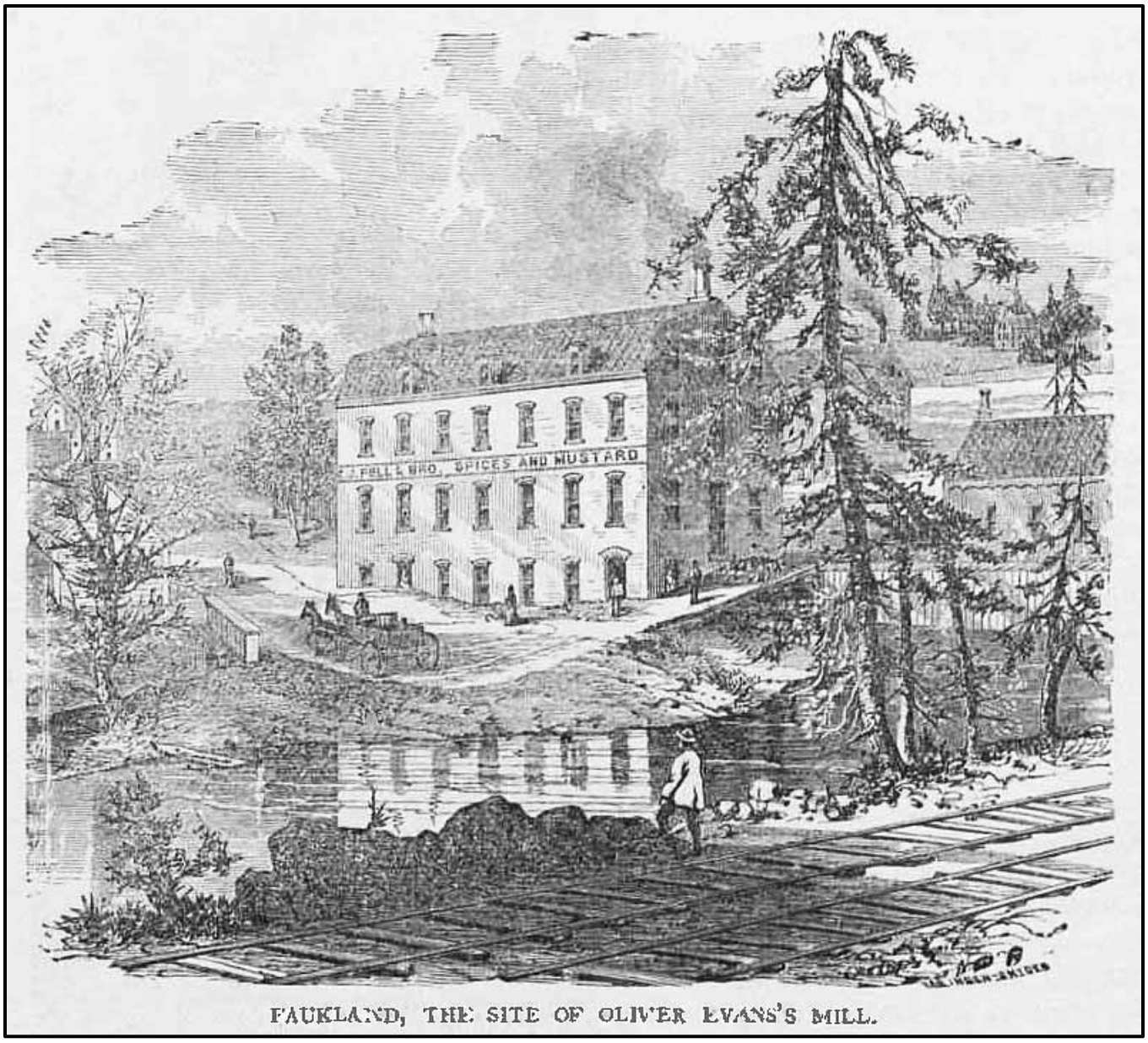


Figure 3
The Fell Spice Mill at Faulkland, 1873. (From a woodcut by Van Ingen, in "Wilmington and Its Industries," *Lippincott's Magazine*, XI (April, 1873), 369-388.) Q

Fell was an ardent supporter of the new line, but his enthusiasm did not handicap him in bargaining with the railroad company. He was able to extract a promise on their part to build a "neat and substantial depot building" at Faulkland, at which no alcoholic beverages were to be sold or used. Furthermore, all trains were to stop at the station.[40] Ground was formally broken for the road on July 8, 1871, the ceremony being held at Faulkland.[41] The railroad was opened officially on October 19, 1872, and the Reverend George A. Latimer took the occasion to read to the assembled crowd an "interesting

[40] - Weslager, pp. 63-64.

[41] - *Proceedings of the Third Annual Meeting of the Stock holders of the Wilmington and Western Railroad Company, Held . . . January 8th, 1872*, (Wilmington, 1872), p. 6.

biographical sketch" of Oliver Evans.[42] The opening of a post office at Faulkland a month later, on November 22, 1872, further improved the business facilities of the spice mill.[43] The Faulkland mill had less than two years to enjoy these new advantages before another disaster struck, this one fatal to the whole enterprise.

At one o'clock in the morning of March 17, 1874, fire was again discovered in the main spice mill. As before, it spread with such rapidity that efforts were concentrated on saving the out buildings. Speculation attributed the fire to either spontaneous combustion or an overturned stove in the mill office, but the point was never settled with certainty.[44] By late afternoon the mill was still burning and the Fells sent into Wilmington for a steam powered fire wagon. A Delaware steamer was sent out at about 5:30 in the afternoon, but when only a mile and a half from the mill, became bogged down in mud. It took until nearly midnight to dig the engine out, so it returned to town along with several fire hoses lent by the Water Witch Company.[45]

The loss from this second fire was figured at $33,000, of which all but $5,000 was covered by insurance.[46] By the beginning of April the rubbish was removed from the burnt mill, and the turbine wheels removed to "the adjoining building" where "the spices and mustard mill will be running by the 10th of May."[47] It was announced in August that the large mill was to be rebuilt, but notice was taken of the fact that "the matter of paying the insurance money is yet to be settled."[48]

The crowning calamity was only a year away. On July 10, 1875, Franklin Fell died. His only son, William Jenks Fell, inherited not only his father's fortune, estimated initially at $100,000, but also a firm that had little chance of survival.[49] Early the following year Fell offered for sale or rent a "large stone building in the village of Newport, with steam engine, boiler, shafting and large lot. . . . The property," he promised, "is well suited for a large manufacturing enterprise."[50] This building, known as the Franklin Mills, had been used for years by C. J. Fell & Brother to grind their own brand of self-rising flour.[51] At the same time he advertised, for rent only, "a second power grist and merchant flour mill; machinery all new and of most approved description" at Faulkland.[52] This was no doubt the same secondary mill pressed into service after the fire of 1874.

There can be no doubt that the fires of 1867 and 1874 severely undermined the position of C. J. Fell & Brother. The estate of Franklin Fell became a source of both bitter contention and considerable confusion between William Jenks Fell, the original trustee,

42 - *Every Evening*, October 21, 1872. [*see added footnote "C"]*
43 - Harvey Cochran Bounds, *A Postal History of Delaware* (Newark, 1938), p. 95.
44 - *Every Evening*, March 17, 1874.
45 - *Ibid.*, March 18, 1874.
46 - *Ibid.*, March 21, 1874.
47 - *Ibid.*, April 2, 1874.
48 - *Ibid.*, August 31, 1874.
49 - *Ibid.*, August 25, 1875.
50 - *Ibid.*, January 15, 1876.
51 - *Wilmington Daily Commercial*, December 23, 1869. Using this flour, bread could be made without yeast, thus preserving "the nutritious qualities of the grain" and allowing dyspeptics to use it when freshly baked.
52 - *Every Evening*, January 15, 1876.

and a Philadelphia trust company. The combination of situations conspired, early in 1878, to force C. J. Fell & Brother to suspend. William Jenks Fell and Joseph E. Taylor (Fell's cousin) explained to a meeting of creditors that the total liabilities of the firm amounted to only $173,112, while its assets came to $228,096. A committee of creditors took these figures under advisement but one of their number, with a claim of $600, "sued out a warrant before Magistrate Smith," charging Fell and Taylor with "conspiring to cheat and defraud." Constable Trefts was waiting after the creditors' meeting and both members of the firm suffered the humiliation of arrest upon adjournment.[53] The creditors met again the following month and decided to dissolve the firm.[54]

The spice mill on the Red Clay was leased to J. M. Purvis & Co., of Philadelphia, who soon had reason to regret their action. On October 30, 1878, the mill was for the third time utterly destroyed by fire. The flames, it was reported, had "every advantage" and the site of the mill presented "nothing but a mass of ruins." The mill had cost $50,000 four years before and, perhaps indicating that its periodic burnings were becoming notorious, insurance had been written in small amounts by 12 different companies located in France, Scotland, England, and Canada, as well as in Delaware, Pennsylvania, Connecticut, and New Jersey. The press suggested that the fire might have been "the work of an incendiary," but it was also charged that the Purvis company was negligent in attending to a small fire discovered the previous afternoon in a set of stones grinding cassia.[55]

This fiery end to the history of spice milling on the Red Clay did not lift the incubus [*nightmares*] of failure from the shoulders of William Jenks Fell. The Pennsylvania Supreme Court ruled in 1882 that he must pay rent to the assignees of C. J. Fell & Brother for the three pieces of commercial property that remained to him from the old firm: a store at 120 South Fourth Street in Philadelphia, the Franklin Mills at Newport, and the small gristmill at Faulkland. Rent on all three was in arrears.[56] In 1884 an attempt was made to "RENT – THE GRIST MILL WITH ALL the water power at Faulkland, with quite a large custom: also, the house and stabling for two horses, also two houses and yards, one with garden and stable."[57]

As late as 1894, however, the *Delaware State Directory* carried the listing: "Faulkland: Fell, W. J., flour mill."[58] Thus after more than a century of continuous use the Faulkland millsite was once again what it had been when Oliver Evans came to the Red Clay – the scene of grist milling for local custom.

The demise of the Fell spice manufactory antedated by only a few years a remarkable rise in the consumption of spices in the United States. Previous to 1883 there had been

[53] - *Ibid.*, February 11, 1878. The two were released on bond and ordered to stand trial. The facts of the case, as reported in the press, make it clear that Taylor was alleged to have cashed a check which he knew to be worthless, on the account of the firm. Fell, as an associate in the firm, was also held accountable. *Ibid.*, February 12, 1878.

[54] - *Ibid.*, March 4, 1878.

[55] - *Ibid.*, October 30, 1878; memo dated February 13, 1879, in C. J. Fell & Brother waste book no. 18, pp. 26-27, in possession of Mrs. Hoiriis.

[56] - *Every Evening*, May 9, 1882.

[57] - *Ibid.*, February 15, 1884.

[58] - *Delaware State Directory for 1894-95*, p. 116.

some modest tariff on unground spices entering the country, but it amounted to only about five cents a pound on such staples as pepper and cloves. When unground spices were added to the free list in that year, however, domestic consumption (assumed from import figures) began to rise sharply. Pepper for example went from 6,973,000 pounds in 1883 to 12,712,000 pounds just five years later.[59]

With this growing market for spices, it is not difficult to imagine that the fate of C. J. Fell & Brother might have been different. The firm's downfall was brought about by a number of circumstances among which the three fires were no doubt the most damaging. Another factor must surely have been the relative isolation of the Red Clay Creek from the main arteries of commerce. Philadelphia had always been the real home of the enterprise as well as of many of the personal and other business interests of the family. And one cannot but notice that, although C. J. Fell & Brothers Company was incorporated by the State of Delaware in 1871, it remained to the end a family business.[60] Jonathan Fell had given four sons to the enterprise while Franklin Fell had only one. It is no discredit to William Jenks Fell that the burden proved too great.

[59] - David A. Wells, *Recent Economic Changes* (New York, 1896), pp. 384-385.
[60] - *Laws of Delaware*, XIV, 299.

Figure A
Faulkland, October 18, 1895, from the Charles S. Philips Collection, Chester County Historical Society. Faulkland Station extreme center left with Fells Spice Mills. William Jenks Fell mansion on knoll with Baltimore & Ohio westbound freight train at station. [R]

THE GREENBANK MILL

While the origins of the Faulkland mill are still uncertain, those of the mill at Greenbank are lost in myth.[S] The story persists that a "Swedes' Mill," built of logs and used for grinding flour, was erected on the property of John Anderson (Stalcop) sometime after 1677.[61] The property was purchased by Robert Philips from Empson Bird in 1773 and remained in his family for over a century.[62] Two anecdotes remain from the early years of Philips' proprietorship, both of which are romantic but undocumented. The first has it that soldiers from George Washington's army, retreating toward the Brandywine, stole baked goods from the large clay oven located in the garden behind the mill. We are informed that "the matter was reported to General Washington, who caused a guard to be placed around the oven".[63] The second tale, hallowed by frequent repetition, is that Oliver Evans here installed his first automatic miller and invited the Quaker millers of Brandywine to view its marvelous operation. "When the capitalists entered," we are assured, "they found the mills running in full blast and not a person could be found in the building. A search was instituted for the operator and Evans was finally discovered in a hay field a quarter of a mile away busy with the harvest".[64]

The ownership of the mill in the 19th century is more certainly established and quickly told. In June of 1819 two of Robert Philips' neighbors, Thomas Latimer and William Murdock, entered a claim against him for a debt of $6,977. Sheriff of the County, John Moody, seized Philips' "land on Red Clay Creek & Merchant Mill, Saw Mill & Factory, five tenant houses etc." This property remained unsold until December 2, 1830, when Robert's son, John C. Philips, was declared the highest bidder at public auction and the property was sold to him for $6,300.[65] The consummation of a sale after so many years was no doubt called forth by the fact that Robert Philips died during the winter of 1828-29.[66]

John C. Philips, who was described as a Merchant Miller, retained possession of the property until March 24, 1852, when the title passed to his two sons, William G. and Isaac D. Philips.[67] These two owned the mill for nearly a quarter of a century. Then William G. Philips, in his 59th year and "suffering for some time with malarial fever," died intestate on October 12, 1876, leaving a widow and two children.[68] Acting on a petition by Isaac D. Philips, the Chancellor of the State of Delaware decided that the property could not be divided and Benjamin Nields, of Wilmington, was appointed trustee. Nields then proceeded to sell the entire property to Philips for the sum of $15,000.[69] On August 27,

[61] - Henry C. Conrad, *History of the State of Delaware from the Earliest Settlements to the Year 1907* (Wilmington, 1908), II, 484; Scharf, II, 924; Jeanette Eckman, *Delaware, A Guide to the First State* (New York, 1955), pp. 451-452.

[62] - Scharf, II, 924. His family name is sometimes spelled Phillips. Deed Book C-2, 113 records the purchase from Empson.

[63] - *Every Evening*, October 31, 1891.

[64] - *Ibid.*

[65] - Deed Book M-4, 130-132.

[66] - *Delaware Gazette*, June 9, 1829.

[67] - Deed Book K-6, 77-79. Cf., MS. will of John C. Philips, April 15, 1854, in Delaware State Archives, Dover, Delaware.

[68] - *Every Evening*, October 13, 1876 and October 14, 1876.

[69] - Deed Book G-14, 345-349.

1888, Philips sold the property to James[T] and Ellis M. Clark.[70] The following year Ellis M. Clark sold his half to James.[71] After the long Philips' tenure on the property, it seemed now to turn over with distressing frequency. Exactly four months after buying his brother Ellis' half of the mill, James Clark sold him back the whole enterprise.[72]

The new tenant of the property had little luck with his operations. On March 16, 1891, Ellis Clark sold the mill to Joseph W. H. Watson, of Newport, in trust for $50, to be resold in an effort to pay off the former's bills.[73] In November, Watson was able to sell the mill for $3,321 to Harman McDonald, of Unionville in Chester County.[74] After McDonald died, his widow sold the mill finally to John Lynn of Elsmere.[75] In this century, the mill and property continued to change hands, but in 1964 Historic Red Clay Valley, Inc.,[U] became the owner, and plans are under way for its restoration as an historic site.

The years between America's two wars with England were apparently uneventful ones at Philips' mill. Oliver Evans' machinery was installed at some point, either in advance of, or to keep up with, competition. It was not until the War of 1812, however, that any real change took place in the Greenbank enterprise. On February 27, 1811, an advertisement appeared in the Wilmington newspaper *American Watchman*, signed by John R. Philips and announcing that he "WANTED, immediately, a PERSON who is skilled in the management of SHEEP, and would be fond of taking care of a flock."

Cut off from the woolen mills of a war-torn Europe, American manufacturers were already turning to local producers of wool for the raw material with which to make a fortune in a newly protected market. Since merino sheep produced the very best wool for manufacture, and since the common country breed of American sheep were little suited to this purpose, competitive bidding drove the price of merino sheep to fantastic heights by the summer of 1810.[76] Although the Merino Mania, as it was called, subsided somewhat after 1810, prices remained high as long as the war kept British woolens off the American market, and native American manufacturers on a high crest of prosperity.

In deciding to invest some capital in the woolen manufactory, Philips was following the same path taken by such New Castle County entrepreneurs as E. I. DuPont, Peter Bauduy, William Young, and others.[77] It was a decision not to be taken lightly, especially by a Quaker miller with no sheep, no factory, no workmen, and (so far as we know) no knowledge of the business.

The flock of merino sheep was in existence at least by the second month of 1811. It was probably at about the same time that Philips tore down the old "Swedes" mill which stood

[70] - Deed Book G-14, 350-355.
[71] - Deed Book R-14, 459-465.
[72] - Deed Book T-14, 495-499.
[73] - Deed Book G-15, 422-429.
[74] - Deed Book N-15, 425. The *Every Evening* of October 30, 1891, announced the result of the public auction, but garbled the name of the purchaser.
[75] - Deed Book N-18, 165-171.
[76] - See the author's "E. I. DuPont and the Merino Mania in Delaware 1805-1815," *Agricultural History*, XXXVI (April, 1962), 91-100.
[77] - *Ibid.*, and the author's "Peter Bauduy and His Shepherd's Dog, 1814: A Note," *Delaware History*, X (Oct., 1962), 181-184.

next to his merchant mill, and built on its site a structure to house the new operation.[78] Named the Madison Factory after James Madison, the President of the United States and a lifelong advocate of American manufactures, the new structure made a handsome appearance. Built of field stone, the new factory was 45 feet long, 25 feet wide, and three stories high, making it nearly as large as the adjoining gristmill (50' x 39').[79]

Provided now with his own source of raw material and a factory in which to process it, Philips was faced with the problem of finding workmen, a problem which over the years, probably caused him more trouble than any other. During the summer of 1812 he advertised that he "Wanted, Immediately, several apprentices from twelve to seventeen years of age, to the woolen manufacturing business." Playing upon paternal concern, he pointed out that "from the high wages paid to manufacturers [i.e., workmen], parents will only be consulting the interest of their children, by placing them in a situation to acquire a knowledge of this important branch of our own growing manufactures, and as the manufactory now establishing will be upon the most new and improved principles, apprentices will have an opportunity offered them to become masters of this useful art."[80]

Once having acquired workmen, it was not always easy to keep them. The Delaware state legislature had passed an act, on January 26, 1811, exempting "every artificer or workman" employed in a water-powered mill making "woolen yarn, woolen cloth," or certain other specified products, from all "militia fines and forfeitures."[81] Seventeen months later the United States went to war with Great Britain and despite the clear intention of the law to exempt factory workers from service, one of Philips' weavers eventually was called to duty in a Delaware militia company. Explaining that the man, John Rigby, was "poor in pocket but proud in principle," John R. Philips employed the legal counsel of no less a personage than Louis McLane[V] to discover whether the workman was bound to serve.[82]

Housing was a problem so far from any town. The Philips advertised that they had "Several houses to let." Since these were at a premium, they stipulated that "none need apply but such as are acquainted with some branch of the woolen manufacturing business and are willing to accommodate boarders, or have large families of children who wish employ in the factory."[83] Children represented only one end of the spectrum of Philips' needs. At the other he needed "a person qualified to take charge of the milling, dressing, dyeing and finishing of Superfine Cloths."[84]

Labor unrest complicated operations at Madison Factory. The sudden multiplication of woolen mills created a shortage of workmen and, despite passage of a state law prohibiting manufacturers from any other "State, Republic, Kingdom or Empire " from attempting to "contract with, entice, or persuade or endeavor to seduce or encourage any artificer " of the

78 - *Every Evening*, October 31, 1891.
79 - *American Watchman* (Wilmington), January 11, 1822.
80 - *Ibid.*, August 12, 1812.
81 - *Laws of Delaware*, IV, 398.
82 - John R. Phillips to Louis McLane, July 20, 1813, in War of 1812 folder (Historical Society of Delaware, Wilmington, Delaware).
83 - *American Watchman*, March 6, 1813.
84 - *Ibid.*, May 4, 1813. For weavers, see *ibid.*, October 9, 1813.

state, employed in certain key industries, it happened.[85] This demand no doubt added to that restlessness and independent behavior of some workmen which manifested itself in both individual and group acts of defiance. In November, 1814, the Philips were forced to offer a $40 reward for the return of William Guthrey, an apprentice boy who "absconded without any cause whatever."[86] Earlier that same year they had announced with great sarcasm that "a few of our weavers, through ignorance, mistaking impudence for independence and licentiousness for liberty, have been the cause of our losing not only what we were willing to part with (themselves) but also a number of the opposite, character. Weavers of moral and industrious habits," they concluded, "will receive good encouragement, permanent berths and the best of materials and attendance".[87]

Even without the necessity of replacing disaffected workmen, procuring new men continued to be a problem. In March, 1814, the factory called for "several families who have a number of children who could be employed in a factory. Such families," the advertisement continued, "will be furnished with convenient accommodations." In July, the Philips advertised for a "good woolen dyer, who understands his business," and "three or four single laboring men, who would be willing to engage for two years to labor in the finishing department."[88]

One elaborate solution concocted by the Philips to solve their labor problems involved training their own hands, and paying them in graduated installments. "The subscribers," they wrote,[89]

> "wishing to engage a number of hands, for the various departments of their Woolen Manufactory, take this method of informing their laboring fellow citizens, or rather those who are not mechanics, that they will take hands into the finishing, carding, spinning and weaving departments, for the term of two years, and will give them a proper knowledge of those branches of the Woolen Manufactory, and liberal wages. They would take, immediately, six hands to learn the weaving business. Those from twenty to thirty-five years of age would be preferred. The terms will be one hundred and fifty dollars per year, with boarding and lodging, in the following payments: for the first six months, forty dollars: the second, sixty, the third, eighty, and the last one hundred and twenty dollars – and by the twentieth of the ensuing March, six more, upon the above terms – Two or three young women would be taken to spin for the same length of time, the wages two dollars per week, their boarding and lodging found them. Boys from eight to eighteen years of age will be taken apprentices."

The business organization of the Madison Factory is far from clear. Although Robert and John R. Philips were both actively engaged in the enterprise, certain parts of the process seem to have been let out to small firms on a temporary basis. In March, 1815, for example, John R. Philips announced that he had "taken into partnership John M. Butler and Charles Briggs, experienced workmen in the fulling, dying, and finishing department

85 - *Laws of Delaware*, IV, 399-400. For violations, see advertisement of Lanvale Factory, near Baltimore, for weavers, in *American Watchman*, August 10, 1814.

86 - *American Watchman*, December 3, 1814.

87 - *Ibid.*, February 19, 1814.

88 - *Ibid.*, March 23, 1814, and July 2, 1814.

89 - *Ibid.*, November 5, 1814.

of his Woolen Manufactory, [which] will in future be conducted under the firm of John M. Butler, and Co. The department being provided with every necessary labor saving machinery," the new firm planned to handle both the product of the factory and any homemade cloth that was brought to the premises for finishing.[90] By the end of 1817, a firm made up of Joseph Sykes, Thomas Stead, Richard Kay, and John Brown was operating all or a part of the factory on some kind of arrangement with Philips.[91]

In February, 1815, news of the signing of a peace treaty with England reached New York: a costly and humiliating war was over, but so were the days of almost certain profit for manufacturers operating in a protected market. British goods began almost immediately to flood the American market and many factories of marginal profit were closed about the country. Late in 1815 Robert and John R. Philips began to liquidate some of the capital they had tied up in the Madison Factory. First to go was the flock of merinos which they proposed to "sell, or let on shares, from one hundred and fifty to two hundred merino Ewes, 1-2 and 3-4 breed; they are of the importations of Chancellor Livingston, from the national farm of France [*at Rambouillet*]." Perhaps this sale was also a response to the fact that John R. Phillips, son of Robert, and perhaps the person initially responsible for the woolen business, was selling his "Farming Utensils" at the same time, with the intention of "removing from the state."[92]

We cannot be sure whether John R. Philips did in fact leave the state at this time. At the end of 1817 an unsigned advertisement in a Wilmington newspaper declared that "a person well acquainted with the keeping of Accounts, a practical Woolen Cloth Manufacturer, and [who] can produce incontestable evidence of his integrity and attention to business, will be received as a partner in a concern of extensive country business." Applications were directed to the Madison Factory."[93] The writer of the advertisement appears to have been John R. Philips for, a few months later, he published the news that he was "intending in March next to engage in the Woolen business, and desirous of extending his capital," and therefore was offering his farm in Mill Creek Hundred at public sale.[94]

Soon after re-establishing himself in the woolen business, the younger Philips gave a good account of his operations: [95]

> TO THE PUBLIC. You were partially, and but partially informed by me, as early as February last, in a private Circular, that I was about to put into operation in the ensuing March, the Woolen Establishment belonging to my Father, known by the name of Madison Factory, near Newport, Delaware, in concern with a certain Firth Barber, from Yorkshire, England – and for reasons stated in that Circular (now made public) I offered the Establishment in the line of Manufacturing the Wool of others at stipulated prices. Mr. Barber having been called to England early in

[90] - *Delaware Gazette*, March 14, 1815.

[91] - *American Watchman*, December 31, 1817. The occasion of the announcement was the withdrawal of Samuel Dixon from the firm.

[92] - *Delaware Gazette*, October 5, 1815.

[93] - *American Watchman*, December 31, 1817.

[94] - *Ibid.*, March 14, 1818.

[95] - *Ibid.*, August 26, 1818.

> March – (at the recommendation of Isaac Bannister, esquire, the partner of Mr. Young, on the Brandywine, whose goods have so justly acquired a celebrity over all others manufactured in this country) we have since had in our employ a Mr. John Aldridge, as principal, likewise from England, who, from his qualifications, is now taken into concern – the Firm will therefore hereafter be ROBERT PHILLIPS, SON, and CO., to whom, such as may be pleased to favor us with our attention, will make their address. The Establishment is now and has been since the date mentioned, in operation, all the hands experienced workmen and lately from Europe, and we pledge ourselves to the public, that no Goods will be suffered to leave the establishment, without receiving that entire finish the materials entitle them to. Country cloths will be taken in to finish, and will be done, in a style superior to any that have appeared from our common country fulling and finishing mills. To those immediately in this neighborhood who brought goods to the firm at this establishment for finish, we wish unequivocally to state, that should they see proper to furnish us with their custom, their goods shall be finished to their entire satisfaction, notwithstanding the charge so illiberally made against the Country Spinner, that the threat has no medium, but is "either too small or too thick." Our prices for broad cloths will be from two dollars to two dollars and seventy-five cents per yard with the addition of fifty for blue; on Broad Cloths, Narrow Cloths, Cassimers, Satinetts, etc., in proportion. For any further information, the character of the Firm only excepted, we would refer the public to our Circular, which will accompany this address in the Easton [Maryland] paper, and those of Wilmington [Delaware] – Should it not be thought presumption we would assure the Store Keepers in the Peninsula, that it would be to their interest to take in wool from their customer for store goods and have it manufactured in preference to the purchase of their Woolen Goods.

Philips' second fling at woolen manufacture appears to have been unsatisfactory. By March of 1819 he was determined to leave Delaware, with his family, for "the Mississippi, state of Illinois," and once again put all his property up for sale.[96] From this point onward his father, Robert Philips, operated the several enterprises as best he could. Early in 1822 he advertised the premises "FOR SALE, OR TO RENT, or a partner would be taken in the concern." The description which followed was notable both for the exactitude of information it contained and for evidence it gave that Philips was open to almost any suggestion as to its operation:[97]

> "About 7 acres of land on both sides of Red Clay creek, about 4½ miles from Wilmington, and 2 from Newport, New Castle County, whereon is erected a large mill house, 50 feet long and 39 wide, 3 stories high, with an addition on one side of 45 feet long and 25 wide, 3 stories high, and at one end an addition of 28 feet long and 24 wide, one and a half story high, with 2 large sheds, and a shear shop. There are 2 water wheels, and water sufficient to drive them at all times (or nearly so) to run five feet stones powerfully. There is likewise a saw mill, and sufficient water (exclusive of what is necessary for the grist mills) to drive it eight or nine months in the year. One water wheel in the mill is now employed in a woolen establishment,

96 - *Delaware Gazette*, March 27, 1819.
97 - *American Watchman*, January 11, 1822.

which is carried on pretty extensively; the other wheel in the milling business. There is house room (by evacuating the grist mill machinery, etc.) sufficient for two thousand cotton spindles, with all the machinery necessary for them, besides the woolen establishment, and water sufficient for both establishments. There is a large, tight dam, a short head and tail race, with twelve feet head and fall, a large stone mansion house and kitchen, 2 stories high, cellared under the whole, a good frame barn, with stabling under it, and six tenements for families to live in. It is a healthy neighborhood and handsomely situated. More land can be had convenient."

In 1828 the whole premises, gristmill, saw mill, and factory, were again available for sale or rent.[98]

Robert Philips died during the winter of 1828-29, and possession of the mills passed into the hands of his son, John C. Philips. In 1852 John's sons, William G. and Isaac D. Philips took over. It appears to have been operated only as a gristmill, under the proprietorship of yet another son, Calvin Philips. This son moved to Philadelphia and I. D. Philips was called to active participation in the firm. It was under the supervision of the latter that the new enterprise of manufacturing spokes, felloes, and general bentware was undertaken.[99]

Touring the United States in the mid-nineteenth century, Sir Joseph Whitworth noted with astonishment that "every man in America who is able to keep his [own] wagon is free to do so, unfettered and unquestioned, consequently their use is so general that it may be said to be almost universal. Their manufacture is one of great importance, and supports a vast number of wheelwrights and artisans of that class, who from the nature of their employment attain great skill and aptitude, enabling them to turn their hands to almost any variety of work, and rendering them a most useful and important class."[100]

In the years after the Civil War the manufacture had grown so in Wilmington that it was called "the queen city for carriages." There were reportedly operating, within the borough in 1872, twenty firms making carriages, and employing 35 proprietors, 625 journeymen, 189 apprentices, and 14 clerks.[101] It was to serve this already growing trade that Wm. G. Philips & Bro. was formed in 1851.

The processes by which hubs, spokes, and felloes were manufactured for the carriage trade were complex and highly mechanized. "To make the hub, from a green log," for example, it was required that one "saw a block, bore out the heart, turn it in the lathe, paint the ends, dry it from 1 to 2 years, bore it with a tapering pod auger, on the Mandrel turn it into a hub which is then coated with permanent wood filling and again laid away 6 months to 1 year to harden."

98 - *Delaware Gazette*, February 26, 1828. Philips made special note of the fact that the factory contained "every necessary for carrying it [the woolen manufacture] on, from the sheep's back to the man's back."

99 - *Every Evening*, October 31, 1891.

100 - Joseph Whitworth, "New York Industrial Exhibition, 1853. Official Report, "*Miscellaneous Papers on Mechanical Subjects* (London, 1858), pp. 129-130.

101 - Wilmington and Its Industries," *Harkness' Magazine*, Volume I (1872-3), 132. W

"For spokes," it was necessary to "cut down a straight tree, saw and split it into pieces a little larger than spokes which season for 1 year. 500 to 800 pieces per day are turned into rough spokes in a complicated machine by a skilled mechanic, rough tenoned, sand-belted and put away in the dry-room for a long time." In attaching the spokes to the hub, they were "faced, tapered, throated out, coarse-sand-belted, fine-sand-belted, tenons reduced and cornered, warmed, glued and driven into the hub with all force at the rate of 6 to 7 sets per day. The outer ends are sawed off to equal length, and round-tenoned with a hollow auger."

In making and placing felloes, "green logs are sawed into planks and these into strips, which are steamed, bent to semi-circular shape and seasoned for 1 or 2 years. The felloe is then placed on the outer ends of the spokes already driven. Its length, and places for spoke holes being marked, it is sawed off at the ends and the holes bored. Both inner corners are rounded off by once passing it through the machine. It is then rough sand-belted, fine sand-belted and the ends bored into which are driven dowel pins. A strong man drives on the felloes and saws off the protruding ends of the spokes. The 'Backing Off' machine turns the wheel perfectly square on the tread, and exactly round in circumference except in two places at the end of the felloes which, when the tire is shrunk on, are pressed in and bound so tightly that the rim is as stiff there as anywhere, perfectly round, and slightly dished." By the time a wheel was finished, the material had "passed through 32 machines, many of which were ingeniously made, and 36 different processes."[102]

William G. Philips & Co. did not limit itself to making parts for carriage and wagon wheels. Among other products, it made wooden forks which were disposed of "to the farmers in the vicinity who call at their establishment."[103] At the 1874 Industrial Fair in Wilmington, the company displayed various of its products, including "the firm's celebrated folding camp chair, probably the best in the world, together with folding stools, step ladders, felloes for wheels, croquet mallets, &c."[104] A letterhead of the firm dating from the 1870's also lists "Carpenter and Ship Turnings, Scroll and Circular Sawing, House Brackets " as being among the products of the mill. At about this same time the firm name was changed to J. P. Wells & Co., the company being John C. Philips, son of Isaac D. Philips, and the enterprise was moved to occupy a part of the D. H. Kent & Co. building in Wilmington.[105]

John P. Wells was the undoing of this part of Philips enterprises. One day in the spring of 1879 it was discovered that he had "left the city, ostensibly to attend a funeral in Baltimore and has not returned." The spoke and felloe factory was closed by Sheriff Pyle at the insistence of creditors representing a debt estimated at $15,000 to $20,000. "Much sympathy" was expressed for Philips who was left to bear the brunt of the debts. A former partner (a Mr. Carver) reportedly lost $1,200 and an otherwise unidentified "lady living on King Street" lost $1,000. Furthermore, it was reported that rumors were current to the effect that Wells had "forged the name of Isaac Phillips, his partner's father, to notes amounting to $3,000; and his protracted absence is taken as corroborative evidence of the

[102] - *Ibid.*, I (1872-3), 131, 132. The processes described were those in use in Wilmington at that time.
[103] - *Delaware Gazette*, September 21, 1858.
[104] - *Every Evening*, October 26, 1874.
[105] - Letterhead preserved in Isaac D. Philips & Son, ledger (1877-83), p. 107 (Historical Society of DE.)

truth of this charge."[106] Philips' bentware business, like the Fell spice enterprise, came to an ignoble end.

The demise of the spoke and felloe business did not mean the end to activity at the Greenbank mill. The gristmill, which had antedated and at least partially financed the woolen and bentware ventures, continued to operate in what we must presume was a satisfactory manner. In 1872, the newly completed Wilmington and Western Rail Road[X] brought improved transportation facilities to the mill and, in fact, the first way freight carried by the road was a shipment of four kegs of nails from D. H. Kent & Co., delivered at Greenbank station.[107] The firm of I. D. Philips & Son, which operated the mill, also maintained a store at 115 East Fourth Street in Wilmington.[108] In 1883 the mill was taken over by the newly incorporated Diamond Milling Co., and thereafter meetings were held at the mill in Greenbank, under the supervision of John C. Philips, Secretary of the Corporation.[109]

These various reorganizations and improvements were important in themselves, but also were indicative of the fact that the Greenbank mill, like the others on Red Clay Creek and, in fact, all over the United States, were now operating in a national economy. During the 18th century the mill had been located in the center of the great wheat-growing region of the country. A man and his son were able to grind flour for the local custom and perhaps a bit more, purchased outright, to be sold in nearby Philadelphia for the international trade. By the late 19th century the wheat-growing region of America lay far to the west on the bonanza farms beyond the Mississippi. It was in fact a new kind of wheat being grown, harder of grain and best crushed with the new Hungarian roller process. In the late 1870's and early '80's, the ledger books of Isaac D. Philips and Son carried entries such as "415 bushels white wheat from grain dealers in Kalamazoo, Mich." and "1 car of yellow Corn shipped to I. D. Philips from Peoria, Ill."[110] Speaking of local flour mills in 1901, the Wilmington Board of Trade Journal remarked that "the roller process has either converted . . . or put them out of business."[111] In fact, neither of these applied to the Greenbank mill and it continued to grind wheat between the traditional stones. Its failure to convert, however, was a tacit admission that the mill was giving up any hope of large-scale operations. It marked the beginning of the end.

The histories of the mills at Faulkland and Greenbank show that similarity which one would expect from their common origin and close proximity. Both had their origin in the days when New Castle County was within the "Bread Basket"[Y] of the young nation. As this center moved away during the nineteenth century, and as the demand for domestic goods of a wide variety increased, these mills, already old, were converted to new uses. A society once rural and agricultural was already becoming urban and industrial, and along

106 - *Every Evening*, April 5, 1879. I have been unable to discover the eventual outcome of this case. In all fairness to Mr. Wells it must be pointed out that newspaper rumors are not sufficient to prove guilt.

107 - *Ibid.*, October 21, 1872.

108 - See their advertisement in *ibid.*, March 23, 1880.

109 - Laws of *Delaware*, XVII, 586; John G. Philips, mill accounts, p. 37 (Chester County Historical Society, West Chester, Pennsylvania). For a later reorganization, see the *Morning News* (Wilmington), January 1, 1891.

110 - Isaac D. Philips & Son, ledger (1877-83), pp. 191, 46 (Historical Soc. of Delaware).

111 - *Wilmington Board of Trade Journal*, III (August, 1901), 15.

with this change came new demands for new products. For the better part of a century, two small mills along a little-known stream in Delaware could make unique and not unimportant contributions to a regional economy. Then, with the rise of a truly national economy, this contribution was thwarted, to a large degree, by market conditions beyond the control and perhaps beyond the understanding of local entrepreneurs. Yet provincial as they were in so many ways, the mills, and the families associated with them, showed through their histories many of the social traits of their local community and at the same time reflected in miniature the forces of war, depression, and prosperity which influenced the nation as a whole.

Figure 4

The Greenbank Mill, purchased in 1964 by Historic Red Clay Valley, Inc., and operated by the tenant miller, J. Roy Magargal. (Photo courtesy W. E. Grant, Sr.)

APPENDIX

Two Interviews with the Late Edward M. Philips

(Edward M. Philips, who died in 1962 at the age of 92, was born July 9, 1869 at Greenbank, Delaware where members of his family operated the mill for four generations. Mr. Philips was a coal merchant in Wilmington and a member of the Wilmington Friends Meeting where he served as treasurer for several years. In 1956, and again in 1960, C. A. Weslager interviewed Mr. Philips to obtain historical information, and the following notes Mr. Weslager made on the two occasions contain interesting information relative to the Philips family and the Greenbank Mill.)

AUGUST 30, 1956

Visited Mr. Philips, who is now retired, at his home at 1805 N. Monroe Street, Wilmington. He is aged 87, but his mind is clear as a bell. He is a gentle, charming, soft-spoken man. I also met Mrs. Philips, the former Bertha Cranston, daughter of John Cranston, who lived in Newport before her marriage. I queried Mr. Philips about the spelling of his name, and he said that his branch of the family was unique because they used only one "l."

He said there was an old Swedish log house on Robert Philips' land at Greenbank near the old "Swedes Mill." Robert Philips raised his family in this log dwelling, but in 1794 he built a stone house. Mr. Philips remembers his father later tearing down the log cabin for timber. As a boy, he used to play in it. It had a second floor with stairs going up in the center of the room. There was a brick oven outside where the family baked bread. During the Revolution, the colonial soldiers came and stole the bread. The officers placed an armed guard at the oven to protect it. Mr. Philips remembers Washington's earthen fortifications along Red Clay Creek as a boy.

Mr. Philips said he was one of the eight sons of Isaac Dixon Philips. The others were John, Will, Horace, Albert, Calvin, Charles, and James.

Mr. Philips was the sixth son and the only one surviving. In 1907, the sons had a reunion and he showed me a photograph of them. For the occasion, he wrote a poem called "Greenbank", relating to their childhood and the old mill on the family property.

He said that his grand-uncle, Robert Philips, first operated the original mill, which was built by Swedes. The earliest miller lived in the log house.

Mr. Philips' eyes lighted up as he talked over his childhood, and he chuckled over several anecdotes. He used "thee" when he addressed me.

JANUARY 23, 1960

Visited Mr. Philips again at his home. He said he was approaching his 91st birthday. Although he was noticeably feebler than when I last visited him, his mind was still sound, however he had difficulty, he said, with his memory.

He told me that his grandfather, John C. Philips, operated the mill at Ashland. He married Albina Gregg whose family lived in the old brick house still standing there. Mr. Philips said the bricks for the house came from England and were hauled by team from Wilmington or Newport.

John C. Philips was evidently a son of James, although Mr. Philips was not clear on this point. John C. Philips' sons were William Gregg Philips, Isaac Dixon Philips, (Mr. Philips' father) and Calvin Philips. John C. Philips was a brother to Robert Philips who bought the mill at Greenbank.

The mill at Greenbank was temporarily operated by Calvin Philips after John C. Philips' death. In 1854, Isaac Dixon Philips married, and shortly after he took over the grist mill at Greenbank and operated it. His brother, William Gregg Philips, went into partnership with him, and William became interested in expanding the operation to include a saw mill. During Mr. Philips' boyhood the grist mill at Greenbank was a turbine mill, but the saw mill had a large overshot wheel.

Adjacent to the grist mill the partners built what they called a "wood mill." There they installed water-powered machinery for wood working. Wilmington was a carriage center, and there was a big demand for wheel spokes which were made in the mill. They also made "peach ladders" (evidently a form of step-ladder).[Z] Mr. Philips said that his uncle, William Gregg Philips, invented this ladder and collected royalties on his patent.

William Gregg Philips built a new house on the Newport Gap Pike[AA] near Red Clay Creek on a high, grassy bank. He called his residence "Greenbank," and the name later was used for the community.

As a boy, Mr. Philips remembers the Fell Spice Mill, stating there was both a grist and spice mill there, but the latter was larger. He remembers a big fire which burned down the mill. He said that the Faulkland Post Office was in the spice mill.

Mr. Philips said that as a boy he went to school at Marshallton along with other children living in the area of Greenbank. He said the teacher taught them to sing their geography so they could remember the state capitals. He still recalled part of the song, which went something like this:

> Maine, Augusta, on the Kennebeck River,
> Massachusetts, Boston, on Boston Bay,
> Delaware, Dover, on Jones's Creek, etc., etc.

He clearly remembers when the Philips sold the Greenbank Mill, either in 1888 or 1891, he wasn't sure which. He thinks the buyer was James Clark, who worked in the Marshallton Iron Rolling Mill, owned by John Bringhurst. (In *The Richardsons of Delaware*, Wilmington, 1957, p. 98, I pointed out that John R. Bringhurst in 1874 bought a share in the C & J Marshall Rolling Mill at Marshallton, and eventually acquired complete ownership).

Clark had acquired capital from the development of an iron process, according to Mr. Philips, and he put his money in the Philips Mill. But he didn't know anything about "feed" and lost money operating the mill. Darlington Flynn had a mortgage on the property, and he was forced to take over the mill from Clark. (J. Roy Magargal, present tenant at the Greenbank Mill, told me that around 1925 to 1930, Darlington Flynn bought the mill property consisting of 27 acres at sheriff's sale for $25,000, and after his death his heirs sold the mill.)

Mr. Philips said his maternal grandfather was John Commons, a blacksmith living near Kennett, whose health forced him to give up his trade, and he bought a farm near Centreville, Delaware. Mr. Philips often stayed there as a boy. The property was later bought by the Vicmeade Hunt Club, however, John Commons sold it to a man named Press who operated a snuff mill on Red Clay Creek (*Scharf 2:886* states that J. L. Press succeeded William Press as manager of the Garrett's lower snuff mills.)

Mr. Philips said that John Flynn's farm was adjacent to the Philips' property at Greenbank. John Flynn was Darlington Flynn's grandfather. John Flynn had two sons, Thomas and Isaac.

John Flynn hired Mr. Philips to "drop corn" (planting corn in rows) for 25¢ per day. But he was so frugal he didn't provide lunch and Mr. Philips, as a boy, had to go home to get his lunch.

After John Flynn's wife's death, his daughter Ann Catherine kept house for him. He was adamant about allowing young men to visit the house, and it was widely known that no one could get a date with her. Charlie Newlin, and in Mr. Philips' words a "sporty boy", who was a neighboring bachelor, had a fine team of horses. He spent time at Groome's Store in Newport, and sitting around the cracker barrel and pot-bellied stove, the conversation turned to Ann Catherine Flynn.

Charlie said, "It's good sleighing time, and I'm going to take Ann Catherine for a ride." His cronies ridiculed him, saying it couldn't be done, because of her father, and Charlie finally bet $5 he could take Ann Catherine for a sleigh ride.

The next day Charlie courageously drove his team and sleigh up to John Flynn's back porch. "I've come to take Ann Catherine for a ride," he said when John came to the door. Instead of the anger he expected, John Flynn replied, "Charlie, I'll have to go in and ask her if she is willing."

Time passed, and finally Ann Catherine and her father came out of the house. Her father put her in the *back seat* of the sleigh! He climbed into the front seat beside Charlie. They proceeded with their sleigh ride through Newport, passing Groome's Store. Thus, Charlie won his bet. Mr. Philips said this incident was "the talk of the town."

Mr. Philips had a flock of 20 chickens at Greenbank when he was a boy. He sold the eggs for 12¢ a dozen. When the Wilmington dealers raised their egg prices he raised his to 15¢ a dozen. He said his rural customers greeted him with "holy horror."

By saving egg money he was able to buy a bicycle, one with a big wheel in front. He rode it down the road and encountered John Flynn approaching him from the opposite direction in a buggy on his way to the Greenbank Mill. John Flynn leaped down and seized his horse's reins. “Is thy horse afraid,” said Mr. Philips. “No,” was the reply, “but I am, and I can't understand why Isaac Philips would allow his son to ride such an unholy contraption!”

Once several of the Philips' cows got through a hole in the fence separating the property from John Flynn's pasture. At night, they missed the cows and finally located them in the Flynn barn – all milked. “Thy cows grazed in our pasture,” John Flynn told Mr. Philips' father, “it is only right we should have the milk.”

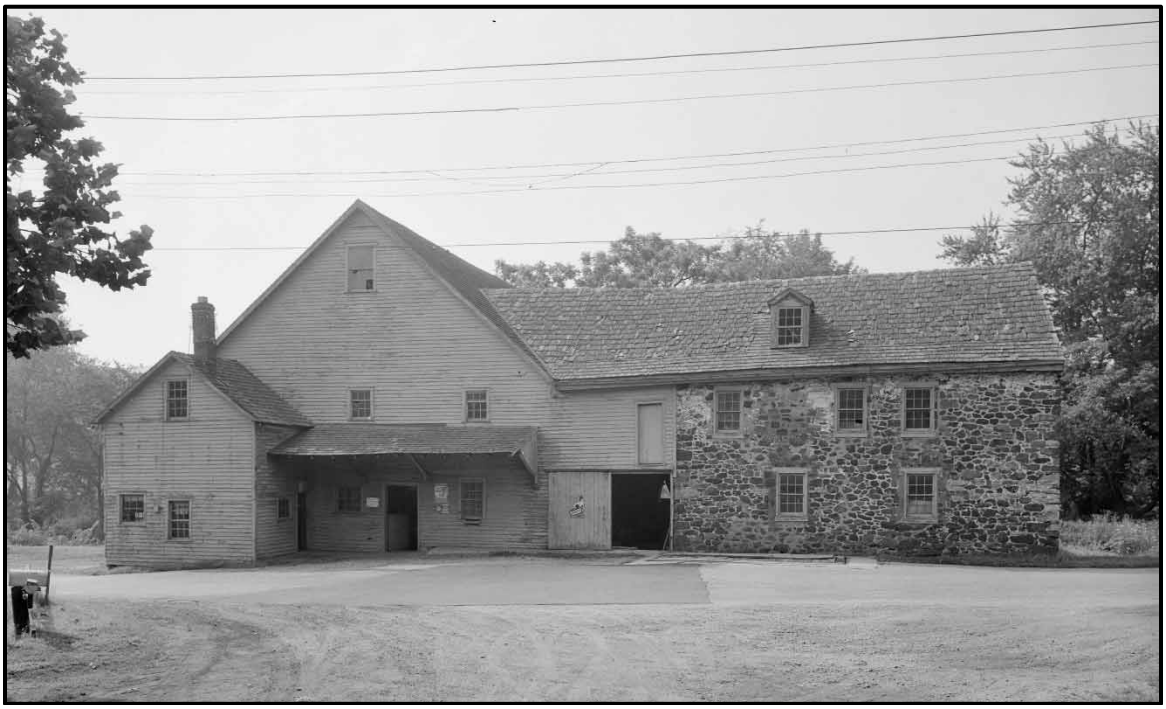
The flour ground at the Philips Mill at Greenbank was called “White Lily” and “White Rose,” according to Mr. Philips. (I asked Roy Magargal about this, and he said he had heard about these brands, but had been told that both came from the same bin).

After leaving Greenbank, Mr. Philips lived briefly on Puget Sound, also in Philadelphia and Milwaukee. In the latter town, he had German friends named the Strohmeirs, who took him to parties and other social gatherings. They couldn't understand why he would never drink beer. He told them he had been raised a Quaker at the Greenbank Mill, and had never tasted alcohol in any form. He didn't have any idea what beer tasted like and he never tried it. After returning to Philadelphia he joined the Quaker Meeting there, and the first Friend who visited him was Isaac Clothier of the family who founded the Strawbridge & Clothier Department Store.

Mr. Philips told me he had three sons then living, Edward Jr., William, and John.

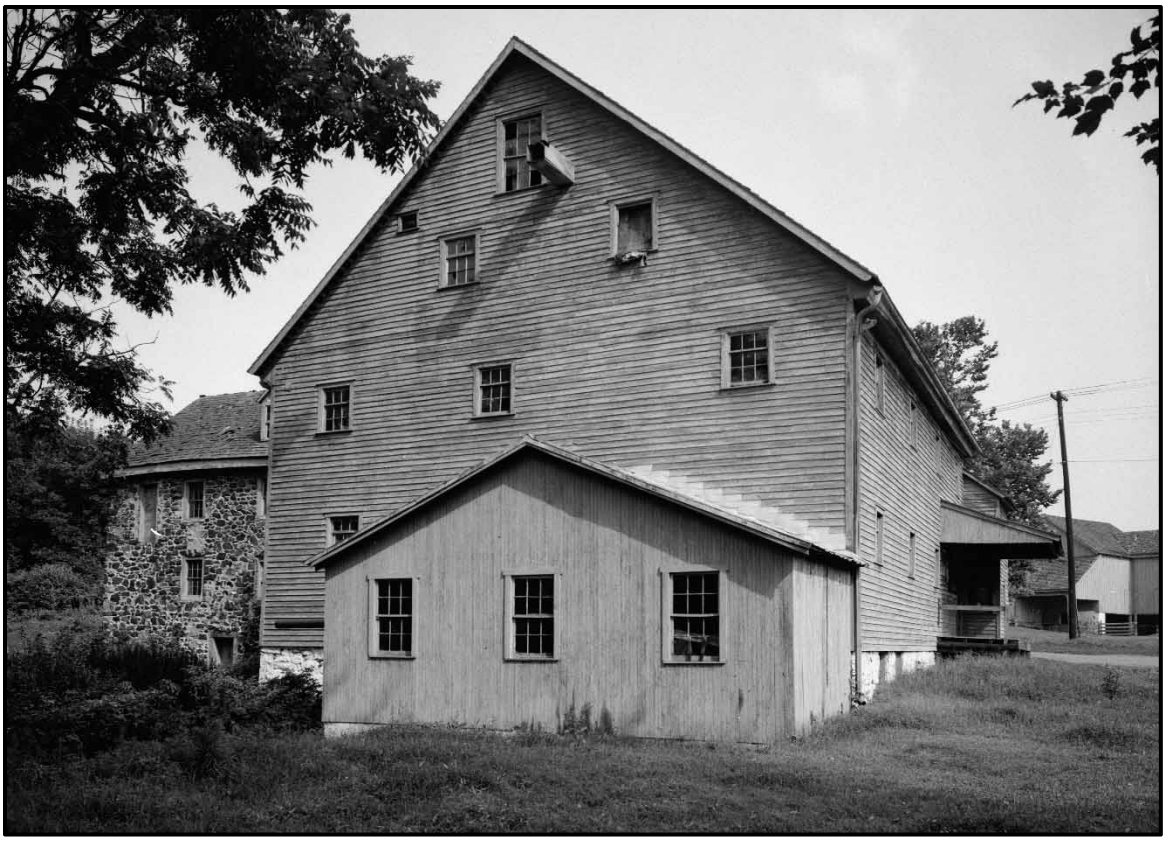
GREENBANK MILL PHOTOS [cc]

Greenbank Mill photos from the July 1965 Historic American Buildings Survey done for the National Park Service. The report is available from the Library of Congress as HABS ID: DEL-164. The photographs were taken in 1958.



Northwest view, grist mill (left), factory addition (right, stone)

Northeast view, two-story grist mill

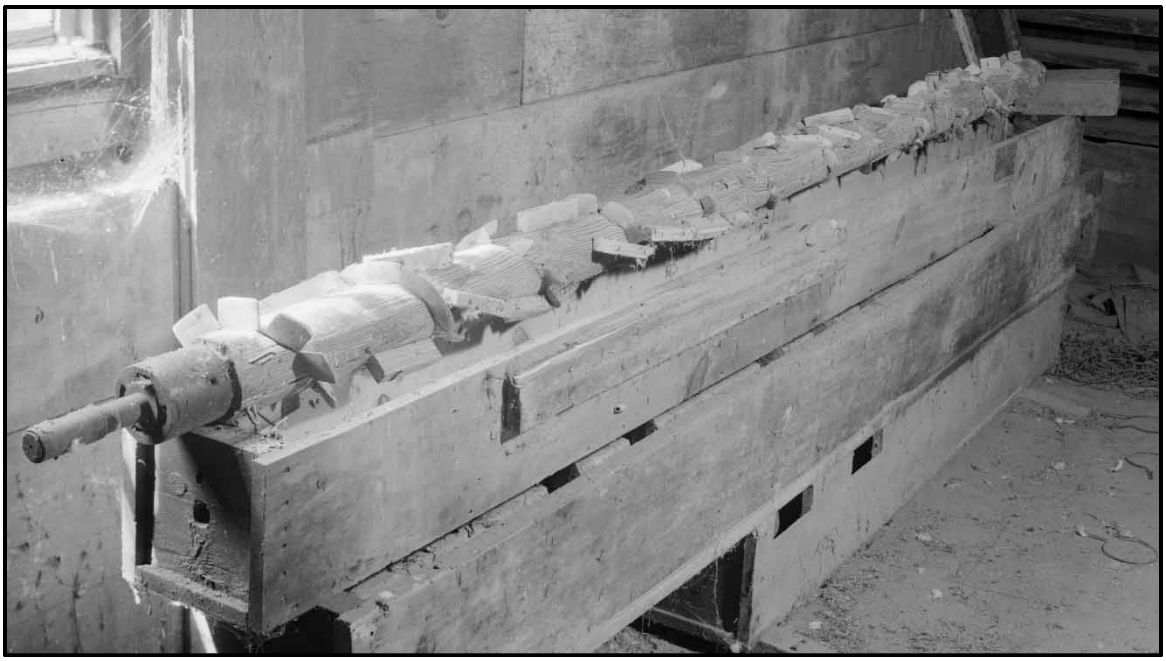


Southeast view, grist mill foreground

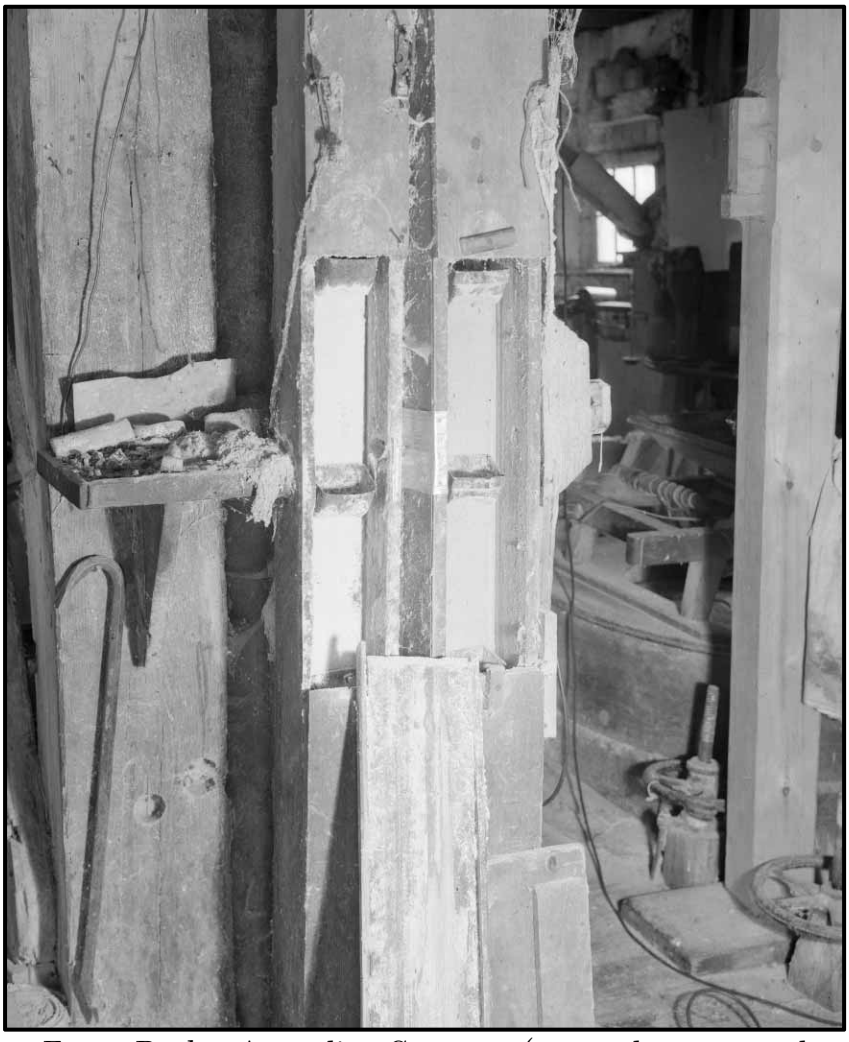
Southeast view, factory mill (left, stone), grist mill (right)

Southwest view, factory mill (left, stone), grist mill (right)

Turbine wheel pit (left, right rear), Evan's bucket elevator (right, foreground)



Archimedean Screw Conveyor on top of wooden duct box



Evans Bucket Ascending Conveyor (access door removed

OLIVER EVANS MILLING EQUIPMENT [DD]
ABBOTT'S MILL – SUSSEX COUNTY, DE

The Faulkland, DE mill where Oliver Evans of Newport, DE developed and patented his automated milling equipment no longer survives. History records that after Evans left the mill for Philadelphia in the early 1790s, the facility passed through several owners including William Foulk who owned and operated it until 1828. After Foulk sold the mill to Jonathan Fell, it is unknown how much of the original Evan's milling equipment remained when Fell began the milling of mustard and other spices at Faulkland. In any event, whatever Evans' milling equipment remained was turned to ashes on September 10, 1867 as the first of several devastating fires gutted large sections of the Evans' mill.

Greenbank Mill was established in the later quarter of the 1600s. In 1773 the mill was purchased by Robert Philips. The mill remained in the Philips family for more than 100 years. At some point in the latter 1700s, Evans automatic milling equipment was installed at Greenbank Mill. That equipment would remain at the mill and near daily operation until an arson fire on August 18, 1969 consumed Greenbank mill and most of the contents including any original Oliver Evans milling equipment.

Evans described his automatic flour mill as follows: These five machines – the Bucket Elevator, Bucket Descender, Hopper Boy, Archimedean Screw Conveyor, and Belt Conveyor . . . all water powered – perform every necessary movement of the grain and meal, from one part of the mill to another, and from one machine to another, through all the various operations, from the time the grain is emptied from the wagoner's bag . . . until completely manufactured into flour . . . without the aid of manual labor, excepting to set the different machines in motion.

In the late 1700s and early 1800s, Evans' automated milling ideas were implemented throughout the milling industry. Mills were retrofitted with commercially available systems designed to improve upon Evans' original concepts. As larger commercial mills were constructed, smaller mills within Delaware, Maryland, and Pennsylvania, similar to Faulkland and Greenbank Mills, fell into disuse. While many were damaged beyond use from flooding or fire, some were gutted and repurposed as homes.

In New Castle County the only remaining mill that still contains good examples of Oliver Evans automated milling equipment is the Cooch-Dayett Mill near Cooch's Bridge, DE. This mill is owned by the State of Delaware and managed by the Delaware Nature Society. It is in good condition; however, the milling equipment is demonstrated infrequently. As of this writing, Cooch-Dayett Mill does not maintain a permanent schedule of tours and operation.

For those wishing to examine Oliver Evan's milling equipment up close and routinely in operation, a visit to Abbott's Mill in Sussex County, southwest of Milford, DE, is recommended. Abbott's Mill still retains its operational turbine waterwheel powered Oliver Evans' automated milling equipment and has a back-up Fairbanks-Morse two-cycle diesel engine that operates on occasion as well.

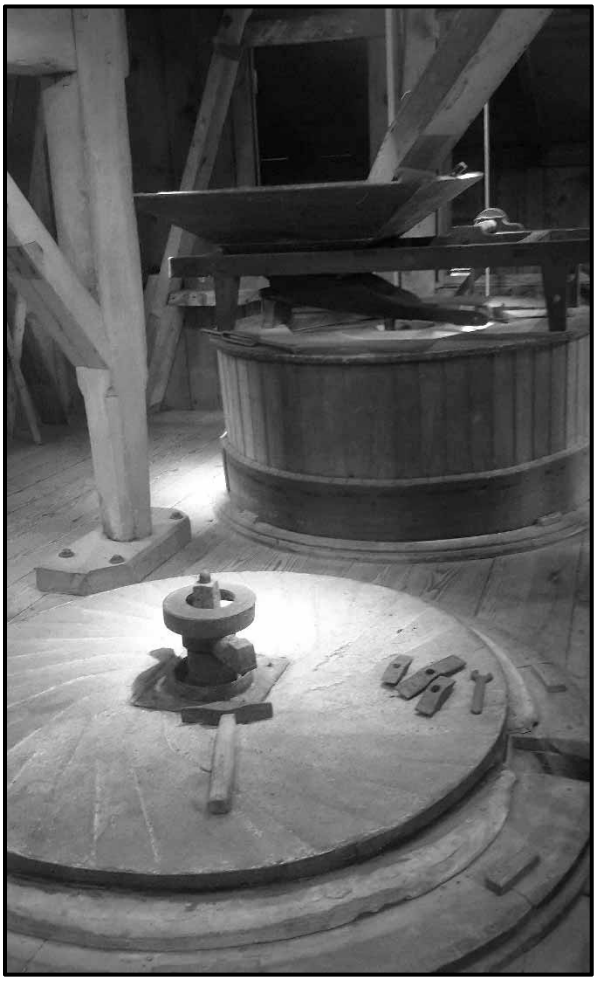
Abbott's Mill – Milford, DE

Abbott's Mill dates back to 1795 when it was constructed on seven acres of property which included a twenty-acre pond. Built by Nathan Willey on property purchased from Levon Poynter, the mill has always been dedicated to the milling of grains. Willey purchased milling equipment after building the mill near a dam he constructed for the pond. The first water wheel was probably a breast-shot waterwheel for powering the millstones. The mill would not have been automated when constructed. A fire devastated the mill in the 1800s but it was quickly rebuilt. Automation at the mill (known as Johnson's Mill at that time), didn't arrive until the late 1800s with the installation of an Imperial Wheat Scourer and Polishing Machine in the basement of the mill.

After Willey's death in 1812 the mill was sold subsequently to James Owens, Isaac Riggs, and several members of the Johnson family where it became known as "Johnson's Mill" by the late 1800s. The mill then was owned by William S. Daugherty for a short time who sold it to Ainsworth Abbott in 1919.

Abbott modernized the mill so just he and his wife could operate it. Abbott's Mill operated continuously for the next 44 years until his wife, Mary, passed away in February 1963. At age 78, Abbott sold the mill to Howard and Frances Killen in October 1963. Recognizing the historical and cultural importance of the mill, the Killens sold the mill to the State of

Delaware a short time later. Abbott's Mill was listed on the National Register of Historic Places in 1972 and in 1979 the adjoining property was added to the Register.



The site is now a cooperative effort between the Delaware Division of Fish & Wildlife, the Delaware Division of Historical & Cultural Affairs, and Delaware Nature Society who operate the facility as the Abbott's Mill Nature Center. The site offers programs and activities designed to foster a greater understanding and appreciation of our natural environment as well as Delaware's industrial heritage.

One set of millstones (left, background) during Abbott's time was likely devoted to grinding corn while the other (left, foreground) ground wheat, barley or similar grains. It is unknown the quantity or type of Evans' milling equipment in operation in the mill during the early 1800s. The first piece of "modern" milling machinery installed in the mill was an Imperial Wheat Scourer and Polishing Machine (located in the basement) sometime prior to 1900. History of the mill is unclear if the four oldest Evans' bucket elevators still existing today were added at the same time as the scourer or later when one or more roller mills were added as the first steps in automating the milling process. It is unknown if an Evans' "Hopper-boy" was ever installed in the mill as no signs of such a device exist today.

A major renovation of the mill took place in 1905-06 with the addition of a west wing. Wheat, barley and oats could now be turned into a much finer grade of flour than the millstones could produce.

Mill records do not indicate when the more powerful and water-efficient turbine waterwheel replaced the old breast-shot waterwheel. The renovations of 1905-06 may have required more mechanical power forcing the change or the turbine could have been added as late as 1933 when the "Chesapeake-Potomac Hurricane" passed northbound along the west bank of the Chesapeake Bay. The area was inundated with rain and high winds that may could have damaged the wooden waterwheel beyond repair forcing replacement with a more modern turbine wheel.

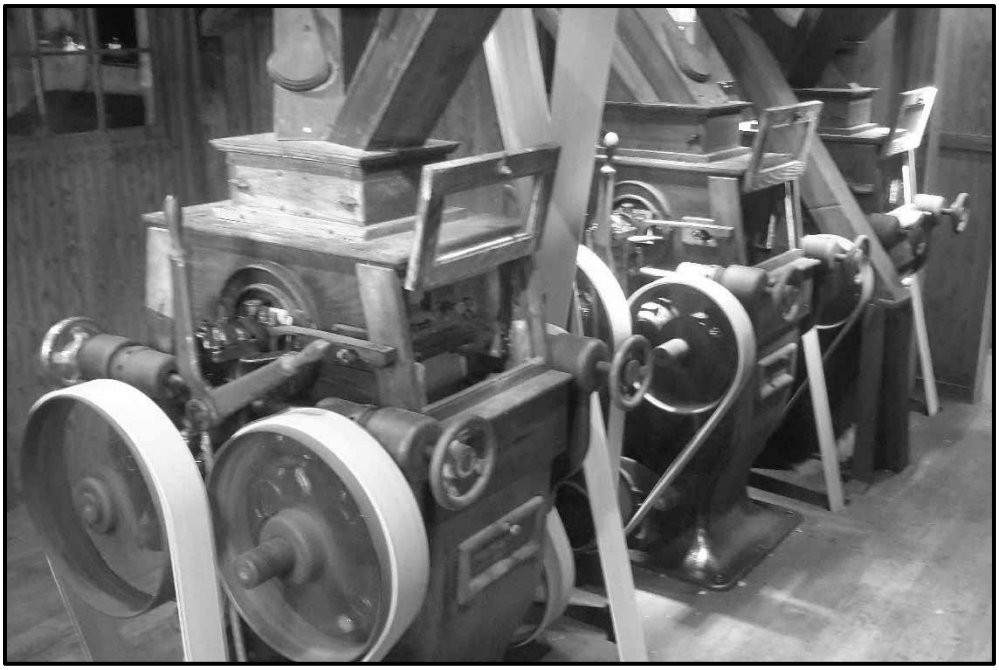
In 1925, Abbott bought a used Fairbanks, Morse and Company 20-horsepower diesel engine from a company in West Virginia for $525. Built in 1919, the Type Y, Style H, fuel injected, water cooled, two-cycle engine is installed in the basement. The mill's line shafting is designed such that either the diesel engine or turbine may operate the roller

mills and related equipment leaving just the mill stones powered from the water turbine wheel.

The implementing of a large mill expansion would have been a significant investment for a mill owner. No doubt increased grain supplies resulting from improvements in farming and harvesting, as well as increased demands for flours and other ground products due to increasing population figured into a decision to expand. Demand for higher quality finished products as well as improvements by competitive mills in the area made such upgrades and expansion necessary.

The list of equipment added in 1905-06 includes:

- The 3 Break Wolf Company Roller Mill (shown below)
- An S. Howes "Eureka" Wheat Scourer and Polisher
- A Wolf Company Sieve "Gyrator" Bolter
- A Wolf Company "Pearl" Flour Packer
- A Griscom & Co. & McFeely Flour Dresser
- A Sprout Waldron Receiving Separator
- Ten or more Evans' conveyors/elevators and related chutes, diverters and bins



On a good day Abbott could produce over a ton (10 to 12 barrels weighing 196-pounds) of high-quality flour. The mill did not operate on a daily basis. Usually one day was set aside for receiving and cleaning grain, another for grinding, and yet another for bagging and delivering. The only help hired was for deliveries, which went as far as Georgetown and Dover. Abbott preferred to work alone and retired in 1963 at the age of 78. He and Mary, his wife, are buried at the Odd Fellows Cemetery in Milford.

The exact layout of every mill grist mill was different reflecting how the owner wished to perform the milling operations. Abbott's Mill is representative of how the Oliver Evans' automated milling equipment would have been installed and used. The mill diagram on the following page, drawn by mill curator Steve Childers, depicts the various Oliver Evans elevators that moved material through the various pieces of milling equipment within the mill.

The Milling of Corn

More bushels of field corn were most likely processed by Abbott's Mill than of barley, oats, or wheat. At Abbott's Mill, Ainsworth Abbott took shelled corn a farmer had removed from the cob and poured it into a trapdoor (1) directly in front of the first-floor loading dock door. From there the corn kernels fell into a hopper (2) in the basement. For those farmers not having access to a corn sheller, their unshelled corn with kernels still on the cob could be dumped into a machine called a Corn Sheller (not shown but located in area behind the trapdoor). The sheller removes the kernels from the cob and directs the corn kernels to gravity chute (3). The kernels fall into the same storage hopper (2) in the basement as already shelled kernels would be stored.

As the kernels filled hopper (2), if the water wheel was operating, the Evans' Bucket Elevator (E-4) would move the kernels vertically up to the third floor of the mill. An Evans' Bucket Elevator was nothing more than a continuous loop of canvas or leather belting with small tin cups attached every foot or so along the belting. The belting was contained within an approximately 4" x 6" pine board square duct. On the third floor of the mill, as the small sheet-tin cups went "over" the large top pulley, the cup would dump its load of corn kernels which would fall down a chute.

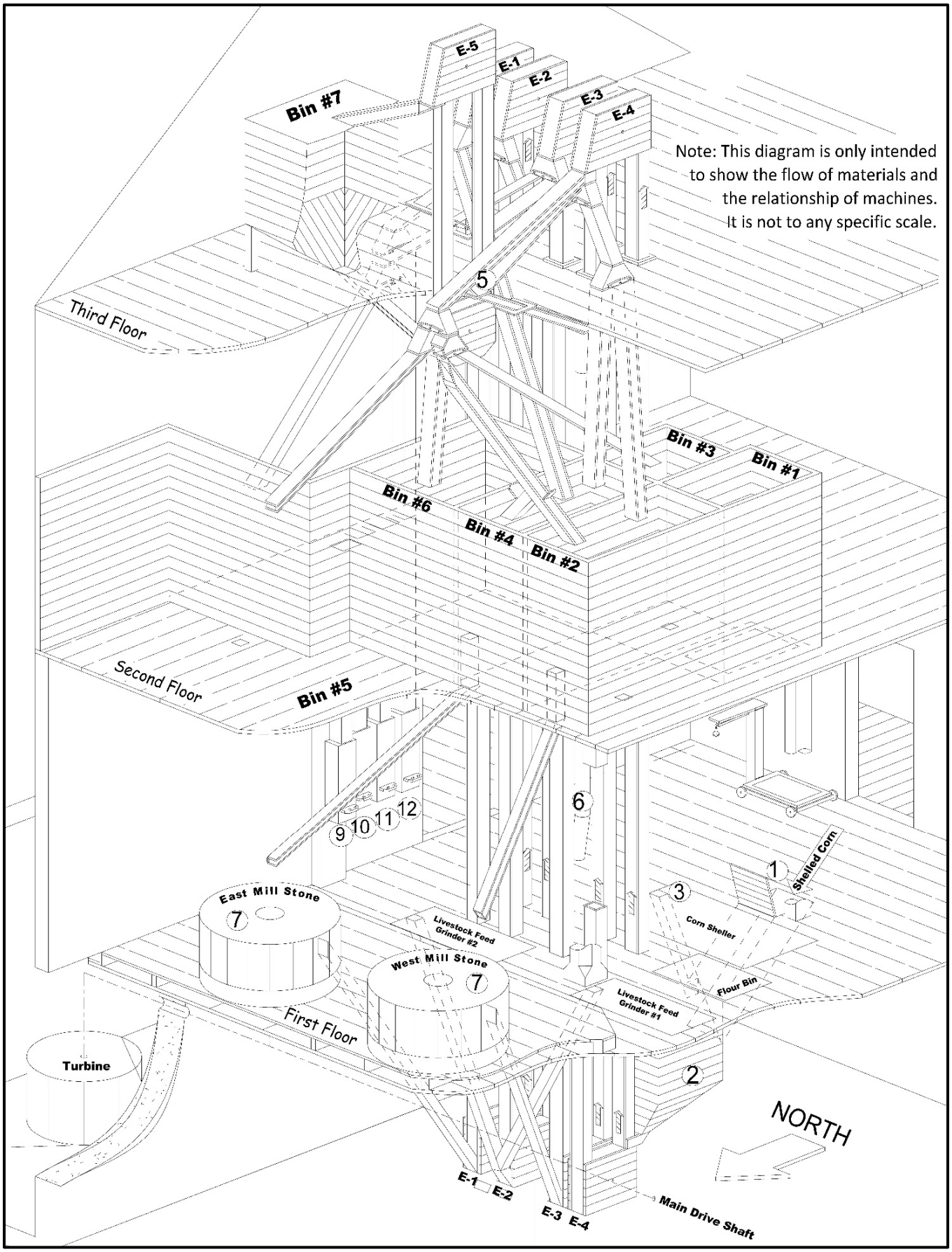
On the mill's second floor were a number of storage bins of varying sizes. These bins held corn kernels, corn meal, and corn flour as the milling operation progressed. On days corn was received, it would be transferred from hopper (2) up to one or more of the storage bins 2, 4, or 6 via Evans' Bucket Elevator (E-4).

Where the incoming material was stored was determined by setting the Evans' Diverters that were part of the conveying system. Cords from the diverters on the 2nd and 3rd floors were routed down through holes in the floors so that Abbott could switch diverter settings from the first floor without having to climb the stairs. Corn kernels lifted to the third floor by bucket elevator (E-4) might be directed down to the Corn Cracker and Sifter on the second floor.

Kernels of corn could be diverted through a home-made debris separator (5) on the third floor and then routed into bins 2, 3, 4, 5 or 6. Seeds and other debris that went through the ¼ inch hardware cloth mesh fell via a pipe (6) where it was collected on the first floor.

Corn from bins #2, 4, 5 or 6 could be directed into either of the 48-inch Mill Stones (7) on the first floor. After being ground the meal fell to Evans' Bucket Elevator E-1 or E-3 to be lifted to the attic where it was routed with diverters and chutes to a home-made Shaking Corn Meal Sieve (8). There it was separated into corn meal that fell to the first floor to be bagged (9), and tailings that fell to another bag (10) for poultry feed.

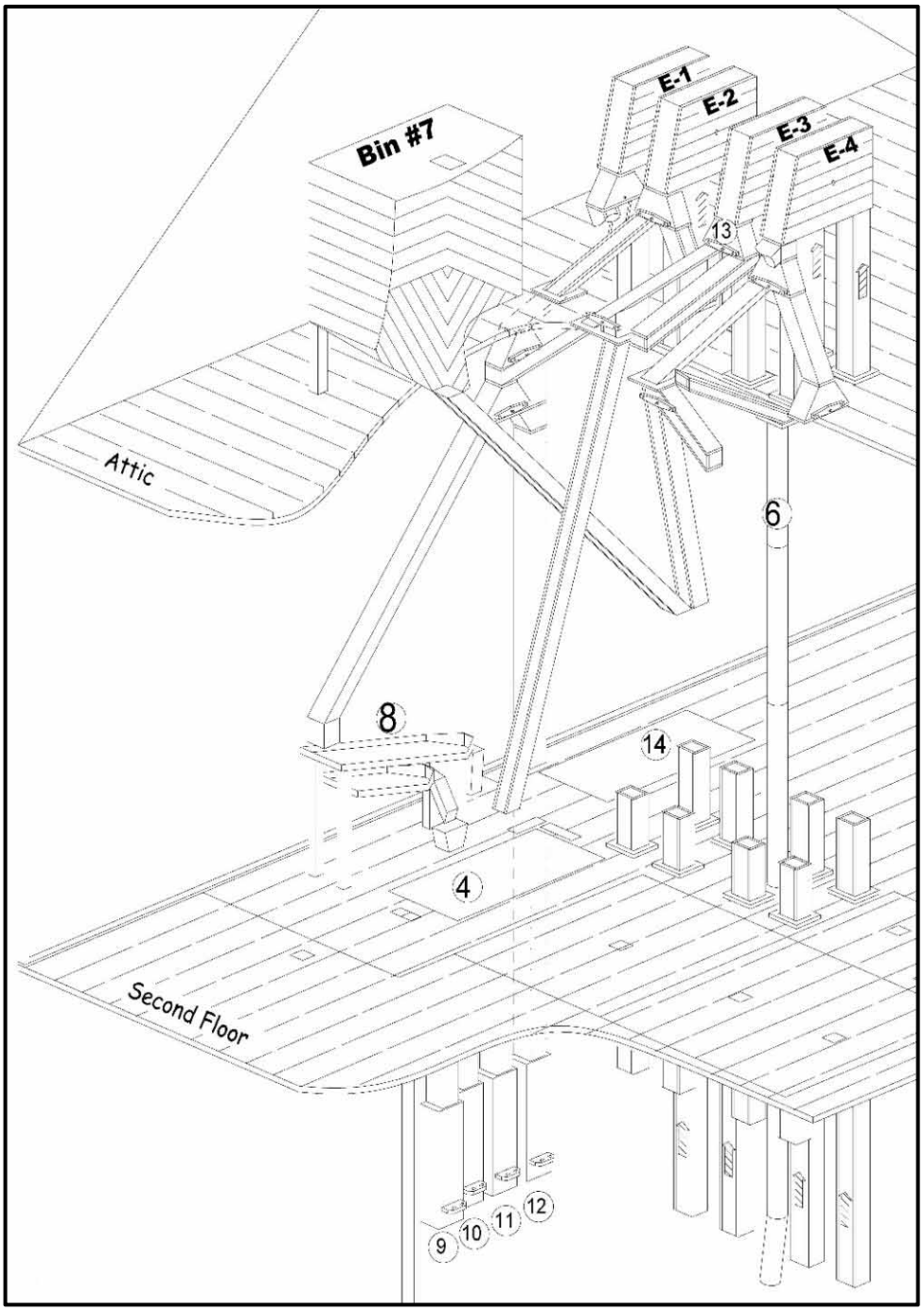
Meal from the West Stone could also be diverted by a valve (13) in the attic to bucket elevator E-5, which lifted the cornmeal to bin #7. From there it fell to the Corn Cracker and Sifter (14) on the second floor and then down to the first floor to be bagged (11).



Steve Childers' drawing of Abbott's Mill when Abbott ceased corn milling in 1963.

Tailings from (14) went to E-1 and then to the Corn Meal Sieve (8), which had a finer screen.

Corn for feeding livestock would take a slightly different route through the mill. Ninety-nine percent of the corn we see in fields from our cars, trains, and look down upon from airplanes is field corn and not "sweet corn" which we consume at our tables. Field corn (also known as Maize corn) can be processed for human consumption by having its kernels ground into cornmeal of varying coarseness or ground into the powder we call flour.



Detail drawing by Steve Childers' of Abbott's Mill for the milling of corn.

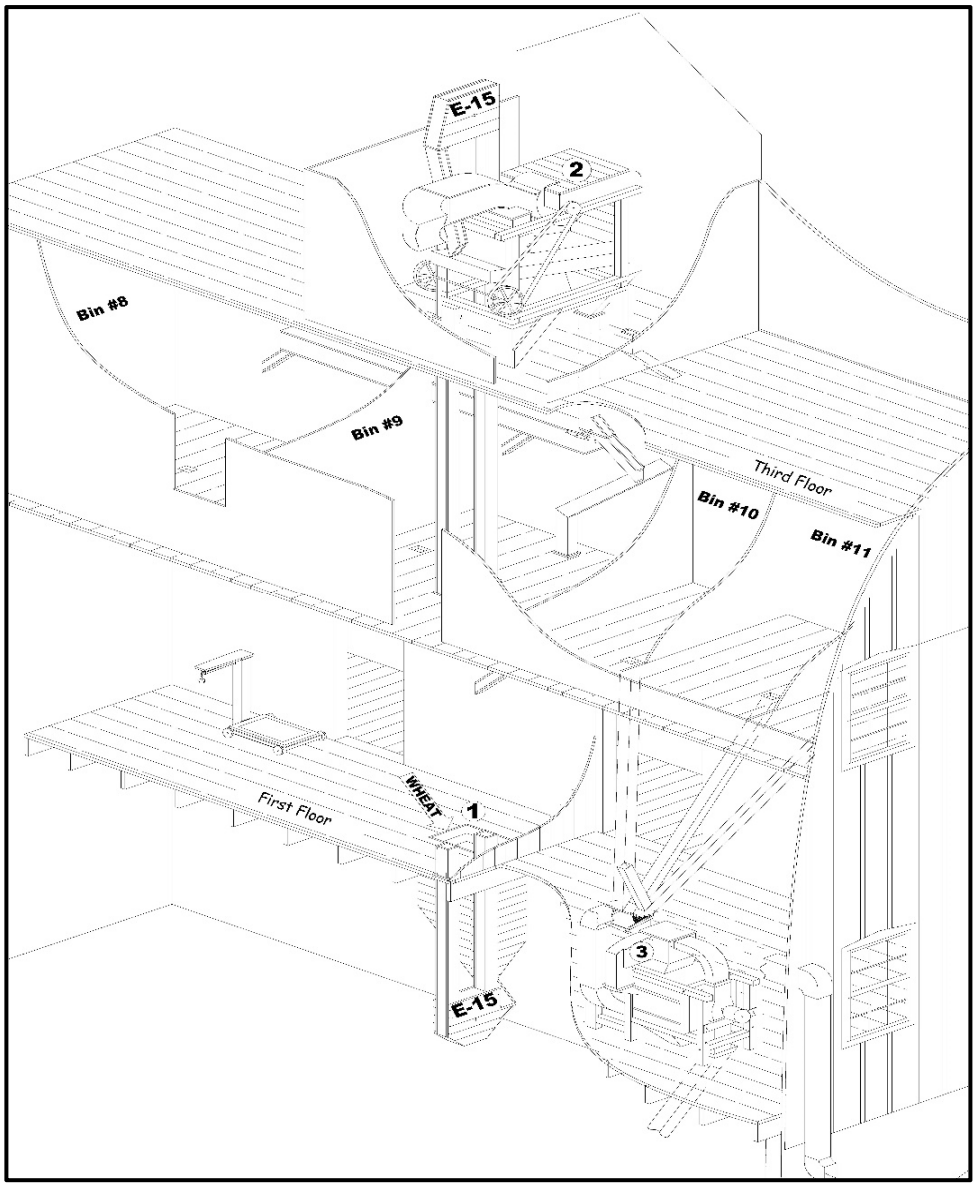
Corn ground for feeding cattle often includes grinding up the cob and any husk that protects the ears and is a course grind suitable for animal feed. The two processes would be kept independent in a grist mill to insure no cross-mixing of the ground product.

Unshelled corn could be dumped directly into the Livestock Feed Grinder #1, where it then fell to bucket elevator E-2 to be lifted to the attic. There it dropped into a chute that returned it to the first floor to be bagged (12).

Shelled corn could fall by chute from one of several second-floor bins into the Livestock Feed Grinder #2, from where it then followed the same route to be bagged (12).

The Milling of Wheat

For processing of wheat and similar grains, there are two stages to the process; grinding of the grain and the subsequent separation of the ground material into flour and other products. The process used to produce white wheat flour is done with machines called "roller mills". The grain being processed is passed between pairs of rotating hardened steel rollers, either corrugated or smooth, multiple times using multiple roller mills. The roller pairs of a mill have one slow turning roller and one fast turning one turning in the opposite direction.



Steve Childers' drawing of Abbott's Mill for milling wheat.

By a mill's roller pair turning toward each other, and at different speeds, the rollers pull the gram between them grinding it into finer material. Passing from mill to mill were the space between each pair of powered rolls is progressively smaller, provides a gradual reduction to the material being milled.

Each time material passes between a pair of mill rolls, the resulting stock is run through the gyratory bolters, with stacks of sieves with different screen and cloth meshes. Vibration and air flow contribute to separation of the material. The ground endosperm (the tissue material inside wheat grain) is gradually reduced in particle size and separated from the bran (harder outer shell of the grain) and germ (reproductive part of the seed that germinates to grow a new plant) by running it over screens or sieves.

The stock that passes through (called the "Thrus") the finest bolter sieve is flour. The

remaining material (called the "Overs") of each sieve (particles not fine enough to pass through) are directed to another roller mill where the rollers are slightly closer together producing a finer grade of flower. Some "over" material may be removed as bran, germ or shorts and is primarily used for feedstock.

At Abbott's Mill, incoming bags of wheat were weighed and then poured into the trapdoor (1) just inside of the first-floor loading dock. Falling through the trap door, a chute guided the wheat to a small bin in the basement. An Evans' Elevator, E-15, lifted the wheat to the attic level. There the wheat is fed to the Sprout Waldron Receiving Separator (2) on the third floor. The separator removes dust and chaff by blowing the dust and chaff from the grain and out west facing attic window.

As the separator screened the wheat, foreign matter, small seeds, and any other debris fell back to the first floor where they were bagged, weighed. Whatever weight of discarded material was removed from the wheat resulted in an equivalent weight being deducted from the total weight of the incoming wheat. Millers often said "We don't pay for dirt." The bagged waste material was usually returned to the farmer to dispose of.

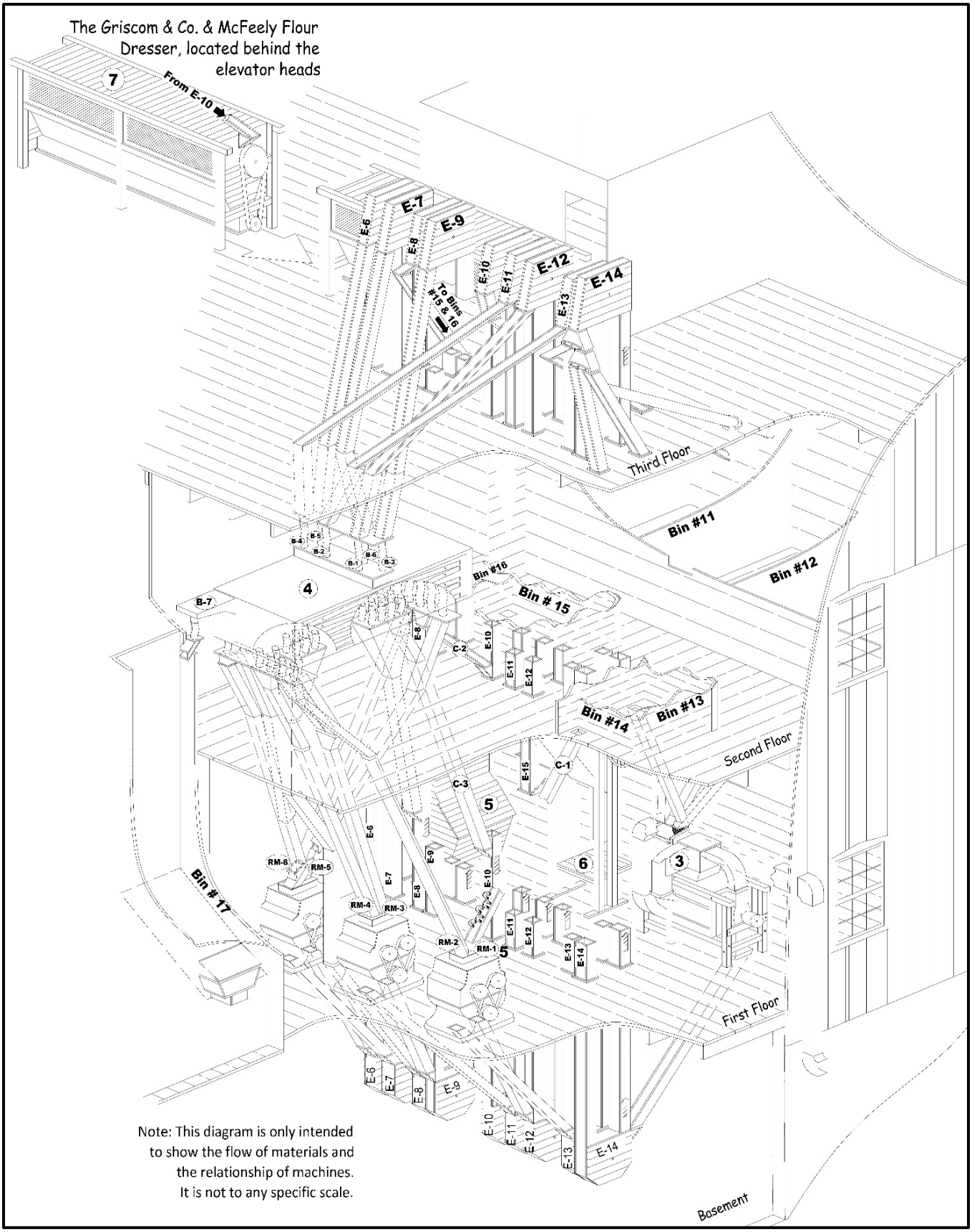
Cleaned wheat from the Sprout Waldron Receiving Separator was fed by an Evan's Spiral Conveyor (a small log with a spiral formation of wooden blades turning within in a horizontal square box) to one of several very large bins 8, 9 and 10 on the second floor. Both storage bins 8 and 9 allowed the cleaned wheat to drop down to the receiving area to be bagged for seed (not depicted on drawing). Bins 8 and 9 do not feed into any milling machines so the assumption is they were used for cleaned seed grains coming from the Sprout Waldron Receiving Separator to be bagged. Bins 8, 9, 10, 11, and 12 are the size of small rooms, measuring almost 8 feet wide by from 3-½ feet to 11 feet long.

From bin 10 the wheat could be directed into the S. Howes "Eureka" Wheat Scourer (3) on the first floor (shown on drawing at right and on the drawing on the next page). The scourer provided the first break of the wheat grain in the milling process, and it separated some of the bran, seeds, and additional dirt from the wheat grains. The scoured wheat dropped down a chute to the basement and was directed to Evan's Bucket Elevator E-14.

Scoured wheat was lifted to the second floor using Evans' Bucket Elevator E-14. Through chutes and an Evans' Diverter the wheat could be directed to wooden room-sized bins 11, 12, or 13 for temporary storage. When needed, bin 14 could be filled with wheat from the scourer for milling. Wheat in bin 14 could be fed to Wolf Roller Mill RM-1 via chute C-1.

Note the horseshoe magnets on the top of the lower portion of chute C-1. The magnets were to remove any metal that might have found its way into the grain from passing through the Sprout Waldron Receiving Separator, the S. Howes "Eureka" Wheat Scourer, or been in the grain from the field or farmer's harvesting.

Cleaned and scoured wheat dropped through C-1 and into the first break (Course Corrugation) of the first Wolf Company Roller Mill (RM-1). In this first roller mill, the kernel is opened, the bran is flattened and the endosperm is broken into large chunks.



Steve Childers' drawing of Abbott's Mill when Abbott ceased wheat milling in 1963.

Although some flour is produced here, the goal is not to produce a lot of flour but to maximize separation of bran from endosperm. The quality of work done here affects each subsequent step, thus determining both the yield and the quality of flour.

From RM-1, the material was lifted with bucket elevator E-12 and fed into the first section (B-1) of the Wolf Company Sieve Bolter (4). Simply referred to as "The Gyrator" because of the motion it makes, this machine separates the incoming coarsely ground wheat meal into three products: Bran, Middlings and Flour.

Inside the sieve bolter some of the sifted meal is collected and dropped toward the finer roller mills. The bulk of the meal from the sieve bolter is either dropped into the second break (Course Corrugation) of the first roller mill (RM-2) where the meal is crushed finer and sent back to the sieve bolter via bucket conveyor E-13 or dropped into the third break (Medium Corrugation) of the second roller mill (RM-3).

Meal being further ground in roller mill (RM-3) would fall down a chute to bucket elevator E-9 were it would be lifted to the third floor and then dropped down a chute to the third section of the sieve bolter (B-3). With each successive trip through a roller mill and the sieve bolter, more and more bran and germ was separated from the flour.

Finished Flour fell from the "Gyrator" into two funnel shaped chutes, where it continued by separate routes to bucket conveyor E-8. Once lifted to the third floor, flour was directed either to the Flour Chest (5) or into large bin 15 above the Wolf Company "Pearl" Flour Packer (6). Bran fell out the end of the "Gyrator" (B-7) into Bin 17 to be sold as poultry and livestock feed.

The "Overs" from the "Gyrator" dropped via C-2 and C-3 to E-10 and were lifted to the Griscom & Co. & McFeely Flour Dresser (7) on the third floor. The flour dresser dropped the 'overs' in the center of a rotating silk covered drum that separated any remaining flour from the by-products. The flour making its way through the silk drum went to the Flour Chest (5) while the by-products (bran, germ and shorts) fell into another bin on the first floor next to the corn sheller (not shown in diagram) and were used for livestock feed.

Not only "The First State" but the Foundation of the Industrial Revolution

Delaware has been long-known as "The First State". Originally called the three lower counties of Pennsylvania or the Crown Colony of Delaware, the territory was the first to sign and ratify the United States Constitution on December 7, 1787. Many historians consider Delaware the state that gave rise to the North American Industrial Revolution.

Oliver Evan's automated milling equipment, and its recognition with the subsequent awarding of U.S. Patent #3 (due to a fire at the early patent office, the first 10,000 patents issued were lost thus those that have been recovered are known as 'X' patents; Evans' patent is now referenced as X3), is often cited as the first example of a fully-automated, continuous-production, industrial process. Every product we use or come in contact with today, is in some manner, a result of an automated, continuous, industrialized process.

Evans' "Young Millwright & Miller's Guide", self-published in 1795, became the most significant text for the flour milling trade well into the late 1800s. It underwent 15 editions and revisions and served as the example for millers along the fast-flowing streams at the foothills of the Appalachians to follow. By 1870, Evans' teachings and ideas had found widespread implementation leading to the flour industry becoming the nation's leading industry by value of product produced.

Soon to follow would be the expansion of the textile and paper industries along Brandywine Creek and other industries along the Red Clay and White Clay creeks. Wilmington, located at the salt-line on the Delaware River, soon became one of the young country's prominent industrial cities. New Castle County made the transition from flour and textile production in the 1700s and 1800s to becoming a prominent producer of railroad cars, ships, and carriages at the start of the 20th century.

Wolf Company "Pearl" Flour Packer

Delaware's early industrial revolution experience guided the state's development of the Court of Chancery to handle business affairs. There are more businesses registered in the state than state citizens (945,326 corporations, 64% of the S&P 500, to 897,934 citizens in 2012) due to corporate-friendly tax laws and incorporation laws.

It all started in a grist mill along the Red Clay Creek. After a healthy dose of skepticism, Evans' ideas caught on and spread throughout the state to mills at Greenbank, Cooch's Bridge, and Milford. Evans' continuous automation theories and practices became the guiding principles for other patented machinery in other industries. The industrial revolution was sparked by a Delawarean living on a creek the Indians called "that never-ending stream".

Details concerning of the layout and operation of Abbott's Mill are courtesy of Steve Childers.

2019 EDITION LETTER FOOTNOTES

Faulkland Mill – Added Footnotes

[A] – Sentence restructure: "Among these the gristmills, built to convert grains into flour, were perhaps the most important."

[B] – millseat, millsite spellings throughout document changed to mill seat, mill site, etc.

[C] – Born in Newport, DE, Oliver Evans is arguably an under-celebrated American inventor and is definitely a relatively unknown Delawarean. While occasionally remembered, and compared to James Watt for his innovations in steam technology, Evans foresaw multiple future technological developments and the industries those inventions would spawn. Evans compiled a list of over eighty inventions including self-lubricating bearings, a machine gun, and continuous baking oven. Evans' major accomplishments and visions include;

- 1783-1792 – Oliver Evans develops a series of material conveying devices transforming his manually operated mill into a fully automated mill on the Red Clay Creek just northeast of Brandywine Springs (now known as Faulkland). His invention of the automated grist mill is considered the *prototype for all automated, continuous-production processes used in industry today*. In 1793, Oliver Evans' automated milling equipment is installed at Greenbank Mill where it survived and was used routinely until the arson fire destroyed the mill in 1969. Evans receives patent #3 for his inventions which is signed by President George Washington and Secretary of State Thomas Jefferson.

- 1795 – Evans published the *Young Millwright & Miller's Guide* which became an industry standard works describing how to design and operate an automated grist mill.

- 1801 – Evans experiments with and improves James Watt's low-pressure steam engine design. It is the start of Evans' work leading to the creation of the high-pressure steam engine generally used throughout industry in the 1800s and even today. Watt's steam engine, designed in partnership with Matthew Boulton, is considered a vacuum or atmospheric steam engine. Watt's design used steam to push the piston to the end of the cylinder. The design incorporated a condenser to quickly condense the steam admitted to one side of the piston. The condensing steam created a vacuum in the cylinder thus allowing the pressure of the atmosphere to return the piston back into the cylinder for the second half of the stroke. While Watt's design is considered the first "steam engine" (steam pushed the piston in one direction, atmospheric pressure "pushing" the piston to returned it), it had a maximum working pressure of atmospheric pressure (also known as barometric pressure or nominally 14.7 pounds per square inch; less at higher elevations). With the steam operating pressures equal to atmospheric pressure, the work that could be achieved by a Watt engine was limited. Evans changed Watt's design by adding valves to allow the steam to push a cylinder's piston in both directions making it a double-acting steam cylinder engine. Evans raised operating pressures to many times atmospheric by improved boiler designs.

- 1803 – Evans improves existing boiler designs to generate higher operating pressures and increased steam generation. He is the first to introduce cylindrical boiler designs and Evans introduces the idea of a "flue" between the ends of the cylinder to carry hot combustion gasses through the boiler. The use of flues provides improved thermal efficiency and adds strength to the design. The addition of flues and "stay rods" permit boiler operating pressures to increase from tens of pounds of steam pressure to over 100-pounds steam pressure.

- 1804 – Evans puts four wheels on a flat-bottomed boat containing one of his high-pressure steam engines. He installs wheels with paddles on either side of the craft and mechanically connects the wheels and paddles to steam engine. Evans demonstrates his "Oruktor Amphibolos" in Philadelphia and it becomes the first combination land and water vehicle. It won't be until 1807 that Robert Fulton patents the paddlewheel steamboat!

- 1805 – writes a description of a heat transfer process and machinery that becomes the basis for what we call "refrigeration". Evan's writings detail a gas being compressed. The gas heats as a result of its compression. That gas is cooled to a liquid state as heat removed while maintaining the gas still under its original pressure. The liquid has the pressure it is at reduced in a controlled manner through an orifice where it returns to a gas. As the liquid returns to the gaseous form, it is now colder (adiabatic expansion). Jacob Perkins builds the first "refrigeration machine" roughly based on Evan's work in 1834 and Carl von Linden patents the first commercial design in 1876

  Evans publishes "The Abortion of the Young Steam Engineer's Guide" becoming the first published in the United States devoted to steam technology and engineering. As part of the introduction Evans wrote;

  > "The Abortion of the Young Steam Engineer's Guide contains an investigation of the principles, construction and powers of Steam Engines. A description of a Steam Engine on new principles, rendering it much more powerful, simpler, less expensive, and requiring much less fuel than an engine on the old construction."

- 1809 – Evans writes to President Madison about a ship he believes can be built that can submerge underwater by changing its buoyancy though adding water to internal tanks. Evans describes how the vessel will maneuver right/left/up/down underwater using moveable surfaces. An Archimedean screw is Evans' choice for forward/reverse motion and his design includes the ability to return to the surface by reversing the buoyancy of the vessel.

  Evans is chartered to install his high-pressure boilers and steam engines in mills in Lexington, Kentucky and Pittsburgh, Pennsylvania.

- 1813 – In an article published in the *New York Commercial Advertiser*, Evans describes strings of "stagecoaches" pulled by his high-pressure steam engines as the stagecoaches travel on a dual set of parallel "pathways" composed of stone, wood and iron. The pathways will be smooth, employ slight grades and they will make slight curves as they transverse the countryside. Evans envisions people doing everyday things such as enjoying meals, entertainment, and sleeping, as they travel between cities on trips lasting hours to days.

- 1819 – Oliver Evans dies a poor man not ever seeing his submarine or his refrigeration ideas explored. John Stevens will demonstrate Evan's concept of carriages moving on pathways in Hoboken, New Jersey six years after Evans dies.

The Red Clay Valley has been the birthplace for many technological innovations as America transformed from an agricultural to industrial economy. While Evans is no doubt the most diverse inventor to have relied on the water power of the Red Clay Creek, others have joined him. The Marshall family operated an iron rolling mill on the Red Clay at what is now known as Marshallton, DE where they pioneered the manufacture of galvanized steel. A pair of Marshall nephews to the Marshallton Marshalls began making rag-based paper in a Red Clay Creek powered mill at Yorklyn. By the early 1900s they were revolutionizing the vulcanized fibre

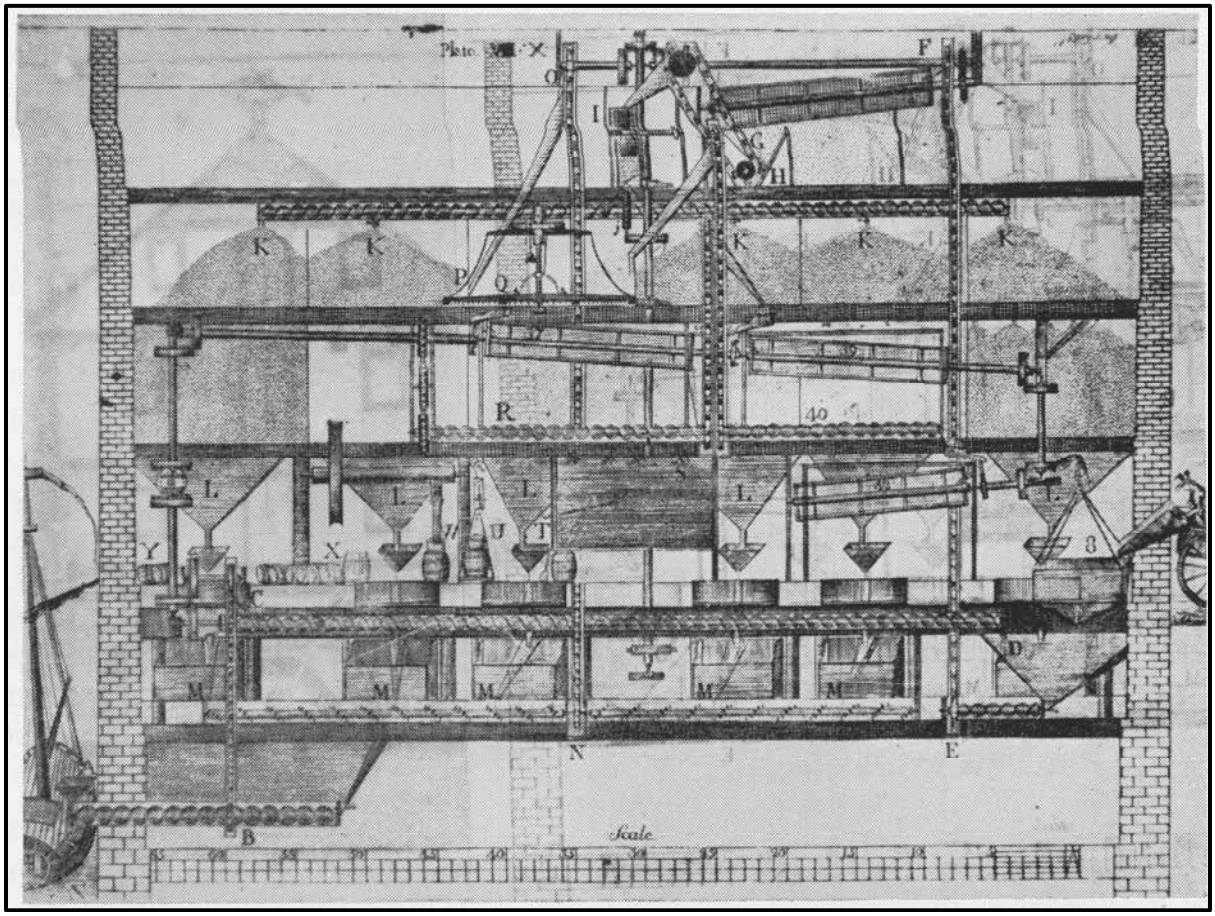
business having invented the endless fibre machine. William G. Philips, an owner of Greenbank Mill, is detailed in this monograph including his invention of what we today call the multi-purpose step ladder among other wooden articles. The Wood family took over operation of what had been the second sheet-iron rolling mill in America and patented a shovel that was used in the hand digging of the initial Chesapeake & Delaware Canal. The Woods also perfected the making of sheet tin and sheet zinc along with replicating the process used in Russia to make a sheet iron that was rust resistant. It is Oliver Evans however, starting with his continuous milling inventions at the end of the 18th century, that preceded all the rest.

[D] – Actual purchase date was July 16, 1782.

[E] – The land that Evan's purchased was located in the area now known as Faulkland, DE. Most of the 400 acres appears to have been bounded by the Red Clay Creek on the east, the road presently known as Faulkland Road on the south, Newport Gap Pike on the east, and what is now known as Hercules Road on the north.

[F] – Numbering added, punctuation changes: "These consisted of the descender, an endless belt set at a slope upon which material could ride downward; the conveyor, a screw made of sheet iron on a wooden core shaft; and the drill which was essentially an elevator for moving materials horizontally rather than vertically."

[G] – Figure 1 - cleaner photo substituted (original below)



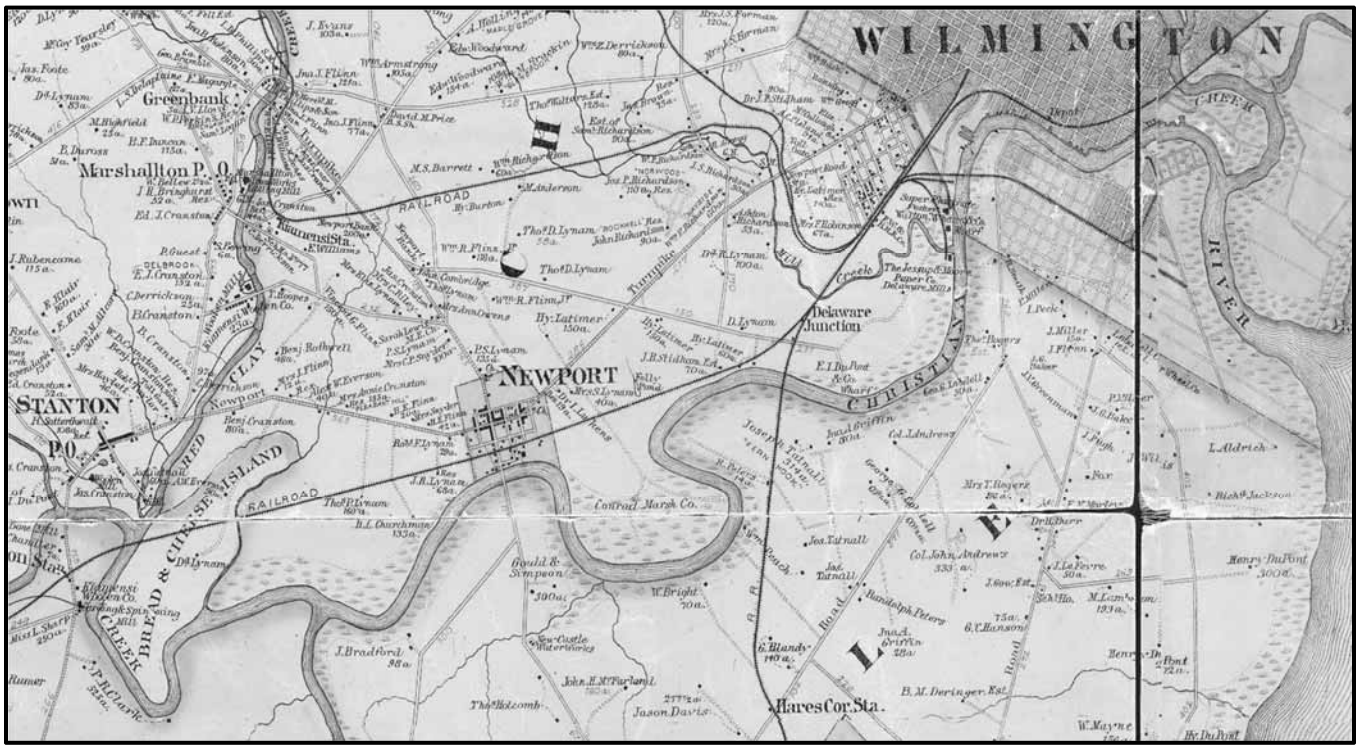
Oliver Evans' automatic flour-milling machinery, similar to that installed in his Red Clay Creek mill. (From Oliver Evans, *The Young Mill-Wright's & Miller's Guide* (Octoraro, 1807), plate X.)

[H] – The sheriff of New Castle County at the time was Thomas Kean. Kean was responsible for putting the mill up for public sale on May 26, 1792.

[I] – Actual sale date was March 15, 1795.

[J] – New Port: In the 18th century New Port was the proper spelling as it was a relatively new port of call for ships traveling the Delaware River to the Christina River. The shallow ports at New Port and Stanton were as far inland as shallow draft 18th century merchant ships could navigate on the Christiana River. The excerpt from a 1881 G. M. Hopkins & Company, Map of New Castle County, Delaware (Courtesy of the Library of Congress), shows the Christina River flowing to the Delaware River (along the right side of the image). The ports of Wilmington, Newport, and Stanton are shown.

Wilmington, Delaware, and the entrance for the Christiana River lie at the "salt-zone" of the Delaware River. The salt line is the region were fresh water from an inland stream or river is mixing with the salt water from an ocean and thus the concentration of salt in the water varies depending on tide and river flows. Placing ports at Wilmington and Newport are ideally located to take advantage of the salt line of the Delaware River in that these ports are unlikely to freeze solid except in the coldest weather. The constant rise and fall of the tides further helps to keep salt line ports from having thick ice sheets form. The wooden ships of the 18th and 19th centuries were generally able to navigate to the Port of Wilmington year-round, something not possible with more northern Delaware River ports. Smaller schooners could move goods between Stanton and Newport and the Port of Wilmington for shipping along the eastern coast of North America and to Europe.

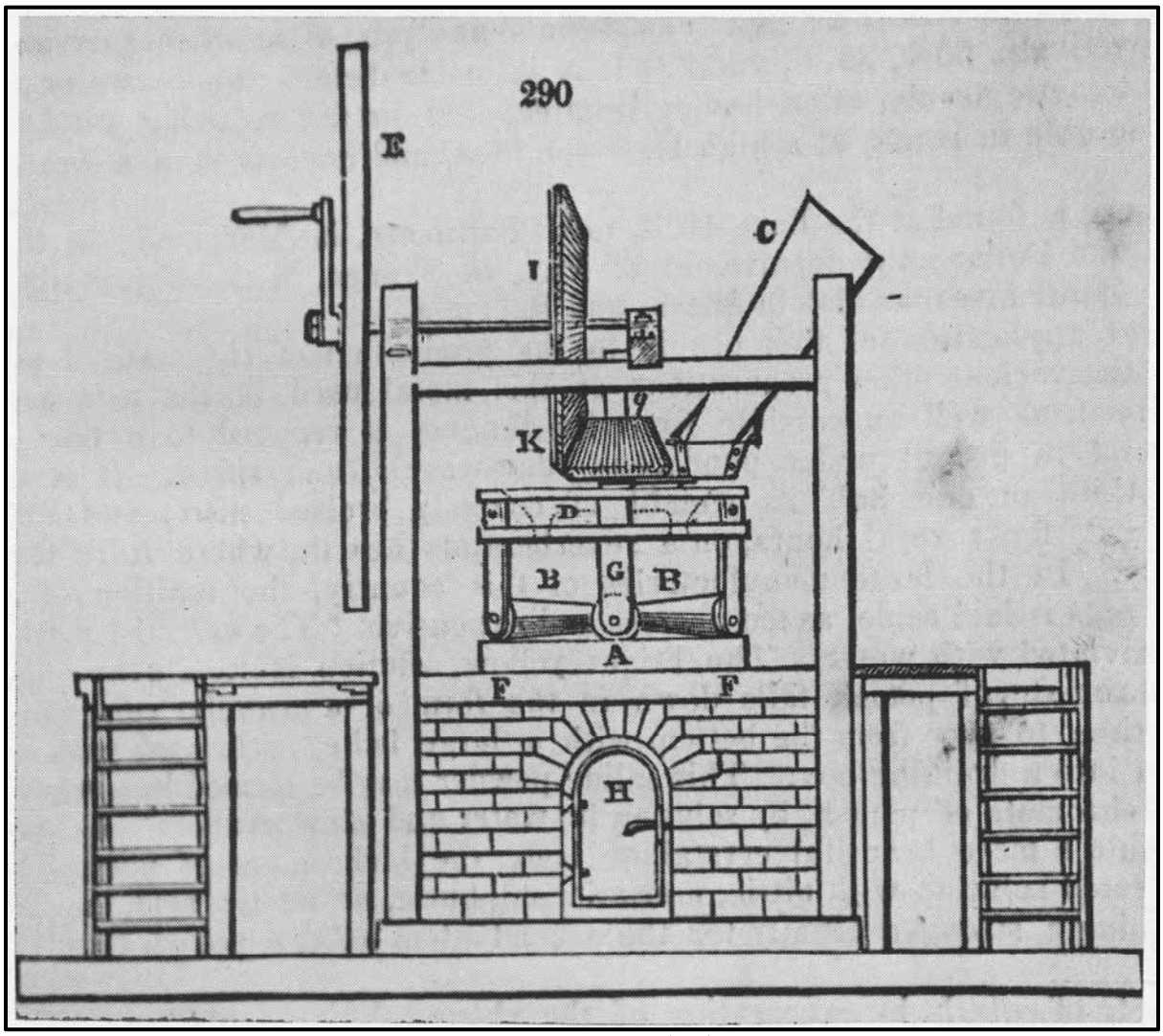


Section of an 1881 G. M. Hopkins & Company Map of New Castle County, Delaware showing the ports of Stanton (left) and Newport (center) on the Christiana River. (Courtesy of the Library of Congress),

[K] – Chalybeate waters are natural springs that have the water impregnated with high concentrations of dissolved iron.

[L] – In the 1800s hair-powders were starch-based products where corn, rice, or other plant material is ground to a dust-like powder and scented with the fragrances such as cinnamon, licorice, lilac, violet, and similar

[M] – Figure 2 - cleaner photo substituted (original below)



The machinery for a chocolate mill, 1845. Six conical rollers (BB) crushed the beans on a bed of marble (A). (From Andrew Ure, *A Dictionary of Arts, Manufactures, and Mines* . . . (New York, 1845), I, 299.)

[N] – Hundredweight – a unit of measure originating in England in the 1300s and representing a weight of 100 pounds. One hundred pounds' weight was also known as a short hundredweight.

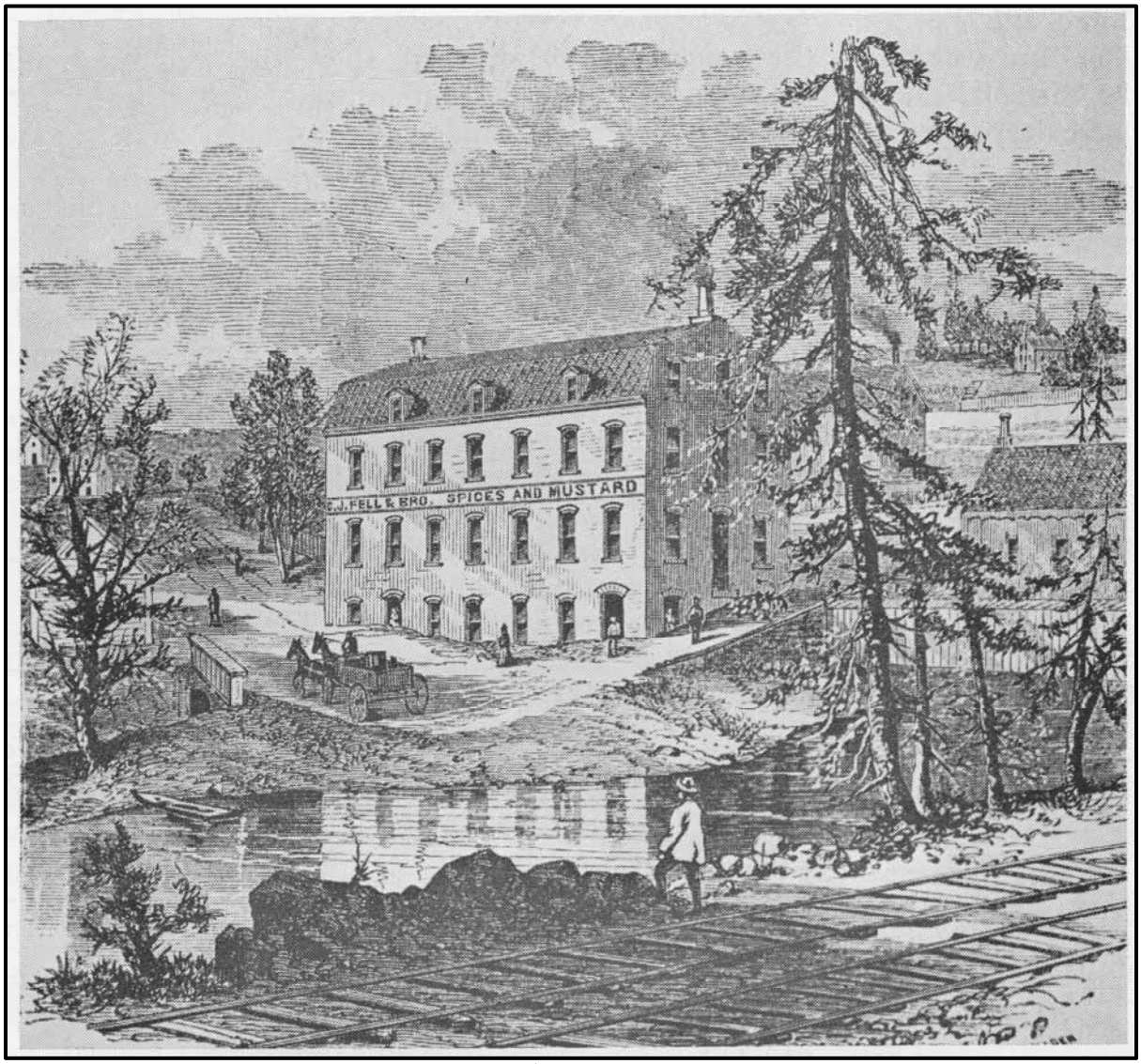
[O] – The Tariff of 1842 was signed into law by President John Tyler. It was also known as the "Black Tariff" partly because it was intended to protect the iron industry. It was a protectionist tariff that cut America's imports by half. The tariff was repealed in 1846 by the Walker Tariff.

[P] – The main Fell's spice mill at Faulkland is said to have been powered by "two large water wheels, each 18 feet in diameter and 16 feet wide." From this description, it is possible to calculate a reasonable estimate of the horsepower that could be generated by each of the water wheels. In the 1800s, the Red Clay Creek was known as "that never-failing stream" as it had a reputation for flowing briskly even in times of drought. When the Wilmington & Western Rail Road was being

planned in the early 1870s, the Red Clay was known to provide approximately 700 to 800 horsepower total to power the mills along its banks as it flowed from the DE-PA border to the White Clay Creek at Stanton and the power of the creek serving those mills was a factor in choosing to place the railroad along the Red Clay Creek and not Mill Creek the alternate and shorter path (a Mill Creek route was a couple miles shorter but only offered a 175-200 horsepower throughout most of the year).

The horsepower delivered by a water wheel is determined by the weight of water which falls as the wheel turns. Historical data for the Red Clay Creek indicates the creek to have an average flow rate of 60 cubic feet per second or 26,930 gallons per hour. The actual horsepower delivered by each wheel at the Fells mill could be varied by the positioning of flow-control weirs at the wheel regulating the volume of water passing across the wheel. Calculations indicate that a reasonably designed and maintained waterwheel of the 1800s might have produced between 35 and 55 horsepower continuously per wheel at Faulkland depending on the water flow settings.

Q – Figure 3 - cleaner photo substituted (original below)



The Fell Spice Mill at Faulkland, 1873. (From a woodcut by Van Ingen, in "Wilmington and Its Industries," *Lippincott's Magazine*, XI (April, 1873), 369-388.)

[R] – Figure A – added photograph of the Faulkland area from the Charles S. Philips Collection courtesy of Chester County Historical Society. The collection of four dozen Red Clay Valley photographs from Philips' glass plate negatives is available for viewing at the HRCV office by appointment.

The Greenbank Mill – Added Footnotes

[S] – Walt Chiquoine, *On the Origins of the Greenbank and Marshallton Mills,* Delaware Public Archives, 2013; provides an in-depth examination of the early land transactions related to Greenbank Mill. Chiquoine's conclusion reads;

> "The origins of the Greenbank and Marshallton Mills have been unclear. But the research staff of Thomas Scharf made an error on Greenbank: they found a convenient way to tie Richard Phillips to John Anderson Stalcop's property, all in one deed. It was the wrong deed, at the wrong time, and on the wrong side of the creek. Yet Scharf never claimed Stalcop was the builder of the mill, nor did he say when the mill was built. Those interpretations have been added later."
> "The primary records provide a substantial history of the property. The original warrants and the 1684 survey to Thomas Gillet are clear, as is his mortgage to Allum and Mattson. The family connection from Mattson to Richard Rumsey has been noted, but it is not fully understood. The sheriff's sale from Rumsey to Lefeaver in 1708 refers to Rumsey as a "Planter", makes no mention of a mill, and does not account for a mill in the property's appraisal. The sale from Lefeaver to Laican is recorded, and then Nils Laican splits the property north and south by 1722. The primary evidence indicates that a mill did not exist in 1708, and most probably not before 1712 or later."
>
> "The northern property was settled by Justa Justis and his wife Christian Laican sometime after 1711. They sold portions of their property, including a mill, to their son Swithin in 1747. We believe that the Greenbank Mill was built in this period, probably between 1715 and 1730, and it was likely contemporary with the Marshallton Mill built by Hersey. The deeds give a clear record of the property transferred from Justis to Walraven to Anderson and then to Phillips in 1790."
>
> "The southern property was sold to John Seeds and Isaac Hersey, where it is noted that Hersey built a grist mill around 1725. This mill corresponds to the Marshallton Mill or the Ametek site. Ownership transferred to Isaac's son Solomon in 1767. Isaac Hersey, his sons, and his grandsons operated the mill for many years before it was sold at sheriff's sale in 1819."

[T] – James Clark was an owner of Auburn Factory in Yorklyn, Delaware is a different "James Clark". It is unknown if the two were related. The Auburn James Clark purchased Auburn Factory in 1866 from Jacob Pusey, when it operated as a cotton mill. The Clarks operated it as a cotton mill for a few years before converting Auburn Factory to a woolen mill. Auburn Factory burned in 1888. Clark did not rebuild Auburn Factory but in 1890 sold Auburn Factory to Israel Way Marshall and Thomas Elwood Marshall. The Marshalls were looking to expand their industrial rag papermaking business as they were the major supplier of paper to Wilmington's vulcanized fibre companies. If the two James Clarks were related, it logically follows that the Auburn James Clark might take an interest in the Greenbank Mill James Clark.

[U] – Historic Red Clay Valley's Certificate of Incorporation lists certain objectives or purposes for HRCV that (in part) include; "to promote interest in and engage in the operation of early

transportation (particularly railroads); to preserve and restore historic sites and buildings; to establish and operate museums; and to issue such publications relating to the Red Clay Creek Valley the members deem fitting and proper; all for the public welfare and for no other purpose." The purchase of Greenbank Mill and its eventual spin-off to Greenbank Mill Associates (an independent non-profit organization) are in keeping with HRCV's fundamental objectives (as is the original and republication of this monograph).

[V] – Louis McLane (May 28, 1786 – October 7, 1857) was a politician and lawyer born in Smyrna, Delaware. A veteran the War of 1812, he served as a US Representative (1817-1827) and Senator (1827-1831) for Delaware as well as the Secretary of State (1833-1834) and Treasury Secretary (1831-1833) for the US. McLane was a Baltimore & Ohio Railroad President and a member of President Andrew Jackson's Cabinet. A student at Newark College (later the University of Delaware), McLane had thirteen children and was initially a Federalist later becoming a Democrat. In 1813, during the Philips litigation, McLane was a practicing lawyer in Wilmington, Delaware. His involvement in politics began in 1816 as a US Representative from Delaware.

[W] – The reference given, "Wilmington and Its Industries," *Harkness' Magazine*, Volume I (1872-3) is a most interesting and highly recommended reference. The article not only describes carriage making, but details many aspects of New Castle County industry and travel in the 1860s and 1870s as well. It includes a discussion about the mills along the Red Clay Creek with excellent engravings of various well-known landmarks some of which were used in other HRCV monographs.

A Google Books search or a search of the Internet Archive among other archival resources will turn up PDF versions of the article. The article is also reproduced in Lippincott's Monthly Magazine of Popular Literature and Science, Volume XI, April 1873, page 369 also available in PDF from various internet archive sources. "Wilmington and Its Industries" is the recommended search string.

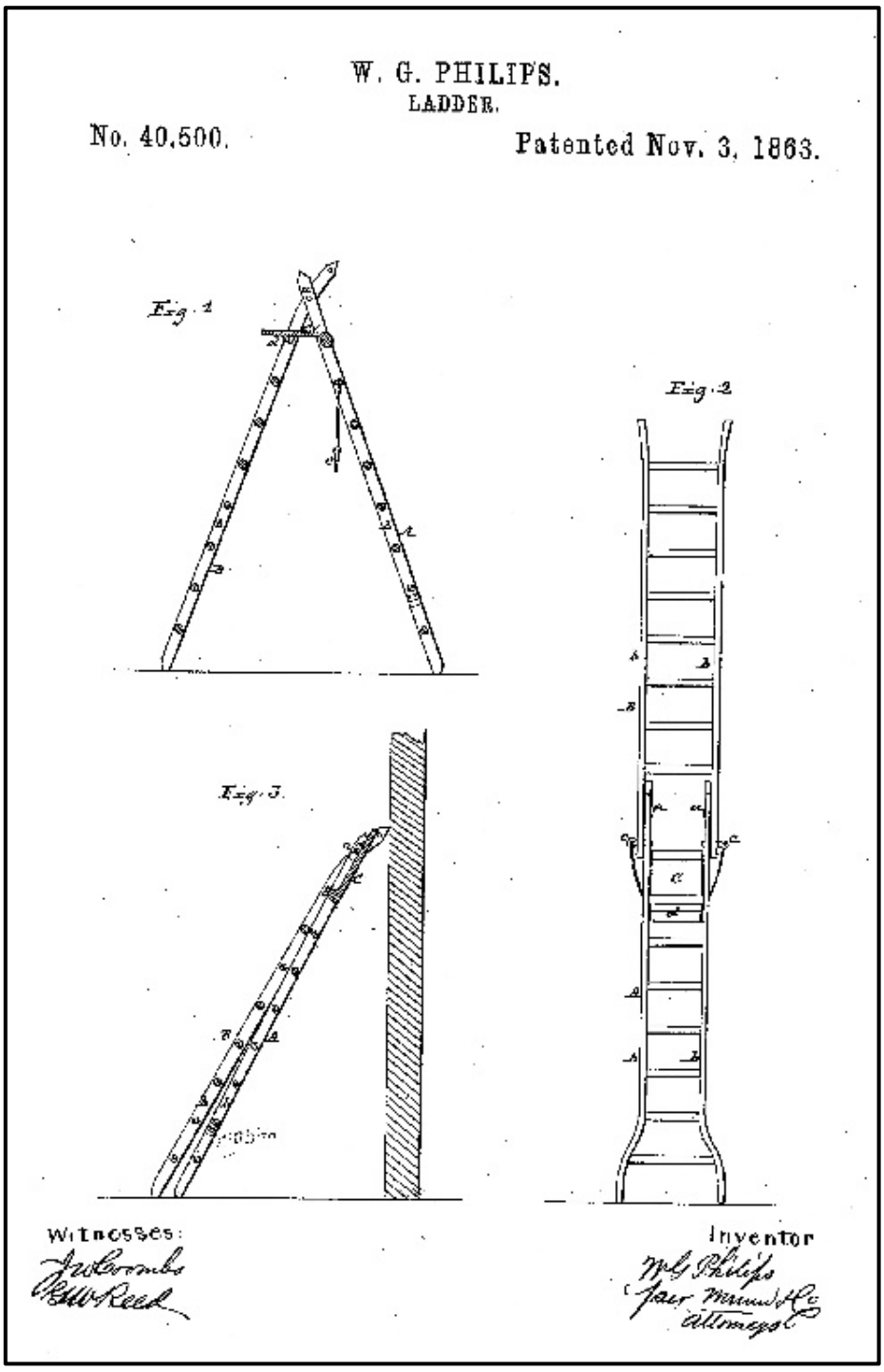
[X] – When the railroad was initially chartered in 1867 the name was the Delaware & Chester County Railroad Company. When the company was reincorporated in 1869 the name was changed to Wilmington & Western Rail Road. Initial Delaware and Pennsylvania documentation show the use of "rail road" for the company's incorporation. By the time the railroad began operations in 1872 both "rail road" and "railroad" were in use by the organization both in print and in legal documents. In 1877 after a bankruptcy the line was incorporated as the Delaware Western Railroad.

[Y] – The Red Clay Valley was a "bread basket" economy in the 18th century as reflected by the numerous mills along the creek. In the 19th century the Red Clay Valley's mills supported a "product" economy as they turned to making products like snuff, paper, and carriage goods which reflected the Industrial Revolution occurring during much of that century. In the 20th century the individual mills and businesses along the Red Clay Creek could not compete with mass production and closed down as the century and larger country transformed to a "large corporation, mass production, big business" economic structure. At the beginning of the 21st century, society seems to be transforming into a "services" economic structure where what is made is highly automated with few workers employed in manufacturing but it all requires maintenance and service by qualified individuals.

[Z] – William G. Phillips received a number of patents and design patents for items he developed at Greenbank Mill. Perhaps his most significant patent was for what we know today as the "multi-

purpose step ladder." The simple straight ladder has been used for centuries. It was not until the 1800s that various alternate configurations of straight and extension ladders began to be patented.

In 1862 John H. Balsley of Dayton, Ohio, received patent 34,100 for the "Improved Step-Ladder." This patent describes a folding step-ladder, taking the basic "A" shape, we are now familiar with. Balsley is widely credited as the inventor of the "A" step ladder, although its configuration is not exactly identical to the step ladders we're familiar with today.



A year later, Greenbank Mill owner William G. Philips was awarded patent 40,500 for an "Improvement in Ladders." Philips' design is known today as a "Multi-Purpose Step Ladder," and various variants are available at stores such as Home Depot or Lowes, among others.

As Delaware produced large crops of peaches in the 1800s, a means to pick the peaches was needed so as not to damage the tree. Philips's patent, intended for Delaware's peach harvesting, applied flat steps to both legs of the A-form step ladder for better comfort and stability. Philips widened the leg ends in contact with the ground or a surface to improve stability and eliminated the truss leg that was part of Balsley's patent by using solid rails for the legs. His ladder included a flat table at the top, could work as either a straight or step ladder, and was economical to manufacture. Philips's lightweight design folded into a compact space making transport and storage easier and Philips's ladder set up faster than Balsley's design. The basic "A"-form step ladders we use today owe their invention to Balsley and their multi-purpose design to Philips.

William G. Philips' patents, by date, are as follows;

Automatic Approach-Opening Gate – Patent #16,187 – December 9, 1856
Method of Opening and Closing Gates – Patent #10,593 – March 7, 1854
(Reissued #324 – August 21, 1855)
Improvement in Ladders – Patent #40,500 – November 3, 1863
Improved Step-Ladder – Patent #91,039 – June 8, 1869
Improvement in Step-Ladders – Patent #110,785 – January 3, 1871
Improvement in Car-Seats – Patent #126,485 – May 7, 1872
Improvement in Camp-Stools – Patent #173,054 – February 1, 1876
Design for an Arm-Chair – Design Patent #1,574 – May 6, 1862

[AA] – The original text stated the road to be Lancaster Pike. We believe the home referenced is the large square house at the corner of Newport Gap Pike and Greenbank Road. The Lancaster Pike is Delaware Route 48 that leaves Wilmington and connects to Newport Gap Pike, Route 41, southeast of Hockessin. In Pennsylvania, Route 41 is named Gap-Newport Pike or Lancaster Pike depending on the map used.

[BB] – Per historian Scott Palmer, James and Ellis Clark did buy Greenbank Mill in 1888. James Clark operated Brandywine Springs Park for a period of time.

[CC] – The photos of Greenbank Mill taken in 1958 are part of the Historic American Buildings Survey, National Park Service, HABS ID: DEL-164, written July 1965. Part II of the report includes the following Architectural Information on the mill which was in use by J. Roy Magargal and owned by Historic Red Clay Valley, Incorporated when the report was filed.

A. General Statement

1. Architectural character: A substantial early mill structure of timber frame with clapboarding and fieldstone masonry with interesting structural and gristmill machinery details.

2. Condition of fabric; In a fair state of preservation considering that it has been in continuous use for 170 years.

B. Description of Exterior

1. Over-all dimensions; Gristmill 50' x 39'; factory addition 45' x 25', both two-and-a-half stories plus basement.

2. Foundations; Stone rubble and mortar.

3. Wall construction: Gristmill has a timber frame with wooden clapboarding; factory addition is of 18" thick local stone and mortar.

4. Porches: Small porch at northeast entry with cantilevered shed roof.

5. Chimneys: Brick chimney on office addition (former chimney now gone on southwest end of factory addition).

6. Openings:

a. Doors: Wooden Dutch doors and wooden sliding shed door.

b. Windows: Six-over-six-light, double-hung wooden sash.

7. Roof:

a. Shape, covering: Gable roofs with wooden shingles, new shingle roof on factory addition; shed roof with wooden shingles over northwest loading area.

b. Cornice: Wooden box cornice.

c. Dormers: One frame dormer with clapboarding on each side of factory addition. Each has six over six-light, double-hung, wooden sash.

C. Description of Interior

1. Floor plans:

a. Gristmill

(1) Basement: 50' x 39' rectangle, four bays long by three bays wide, 12" x l2" wooden post 12' on center support 12" x l3" beams on wooden bolsters which support 3" x 9" joists @18" on center.

(2) First floor: 50' x 39' rectangle, four bays long by three bays wide with entries on northwest (loading) and northeast. A small office addition on north corner by northeast entry, 11" x 11" wooden posts 12' on center support 11" x14" beams which support 3" x l0" floor joists @20" on center.
(3) Second floor: 50' x 39' rectangle, four bays long by three bays wide with room over office addition, 8" x 8" wooden posts support 11" x 15" beams which support wooden floor joists (not measured) but approximately 3" x l0" @20" on center.

(4) Loft: 50' x 39' rectangle, four bays long by three bays wide. Wooden roof rafters 6" x 9" @68" on center with 5" x 8" tie beams, and 6" x 8" king post support 3" x 4" purlins ©25" on center.

b. Factory addition

(1) Basement: 45' long by 25' wide rectangle separated from gristmill by the approximately 12' wide wheel pit and machinery area.

(2) First floor: 45' long by 25' wide rectangle, two bays wide by three bays long with entry door on southwest and interior stairway on northwest corner.

(3) Second floor: Same as above with one exterior loading door on southwest and southeast.

(4) Loft: Same as above with small exterior loading door on southwest only.

2. Stairways;

a. Gristmill: Wooden free-standing stairways in second bay (basement to loft).

b. Factory addition: Corner winding wooden staircase (first to loft).

3. Flooring: 10" yellow pine board flooring.

4. Wall and ceiling finish: Exposed construction.

5. Hardware: Much of the 19th-century machinery in various states of repair still in place including two later grinding stones (originals reportedly moved to Hagley Museum, Wilmington, Delaware). Numerous conveyers and grain-handling equipment.

6. Lighting: Electric (extra lighting recently added for public museum).

7. Heating: Office heater; fireplace in basement of factory addition used for metalwork as well as heating (chimney later removed).

D. Site

1. General setting and orientation: On the west bank of Red Clay Creek with a millrace leading to the mill from the north and joining the creek south of the mill. There are railway tracks on the east side of the creek (Baltimore & Ohio-Landenberg Branch). The New Castle County Correctional Institute is also adjacent to the east. The Grist Mill stands lengthwise northwest to southeast; factory addition northeast to southwest.

2. Outbuildings: A substantial miller's house, now separately owned, is situated to the north across Greenbank Road.

DD – The section on Abbott's Mill is added to provide additional clarity related to the significance of Evan's automated milling equipment through a description of the equipment's original installation and operation in a typical 18th century Delaware grist mill that still exists in the 21st century. The first two photos are courtesy of Delaware Nature Society and the remaining photos of Abbott's Mill are courtesy of Robert Wilhelm.