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Curriculum Unit 80.ch.08  
by Marc Feeley

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In *The Development of the Mill System Economy in Connecticut* I want eighth grade students to see American History as a process of thinking, questioning, and understanding. In addition to asking students to understand the concept of an economic system, I want them to see the study of history as a process. History should be more than facts, heroes, and holidays. Students should see it as a body of knowledge, and generalizations useful both to interpret past events and to understand present challenges. History should be used to assist youngsters in dealing with what is current. My hope is that in this unit, and others like it, the student will view history as an intellectual mode to be applied when deemed appropriate. Henry Kissinger describes history as “not a cookbook offering pretested recipes. It teaches by analogy, not by maxims. It can illuminate the consequences of actions in comparable situations, yet each generation must discover for itself what situations are in fact comparable.” I hope that from this six week unit students will develop a positive attitude about the study of history, but even more I’d like them to gain a positive attitude about themselves. I will expand upon this statement in my strategies and activities. For now, however, let me just say that students will be employed in this unit as active learners. They will be asked to apply data to a series of problems and to arrive

at solutions. They will test their hypotheses and assumptions. My goal is for youngsters to see themselves as capable learners. This unit should achieve my goals for studying history.

The period of the early 1800's is customarily described in American History classes by events leading to the Civil War. Instead of focusing the study of this period on a single event, the war, I plan to develop the idea of a new and different economic system emerging in the United States. A local wire factory that was established in 1818 and still functions today will serve as an illustrative example of this idea for my eighth graders. It is my intention that the mill's presence in our community will give this project a concrete reality that will inspire and challenge my classes.

To look at the state of American manufacturing between the end of the War of 1812 and the beginning of the Civil War, one need not look beyond the Northeast. By 1850, as the United States pushed its borders from ocean to ocean, 75% of the country's manufacturing employment was located in the new England states, New Jersey, New York, and Pennsylvania. And as late as 1860 this same region employed 71% of all Americans who worked in manufacturing. <sup>1</sup>

Industrialization is a process. It takes place in an area where many types of manufacturing support and supplement each other. A textile mill, for instance, would be located near a source of machine tools which in turn would be located near a source of iron products. Large scale industrialization also implies the creation of a market greater than its immediate geographic region. Furthermore, an industry develops when technical knowledge and "factor endowments" (resource availability, labor, demand) come into contact with each other usually under the direction of a wise entrepreneur. In the Northeast, the development of small but growing plants caused it to become a leading manufacturing region. <sup>2</sup>

The decades following the Treaty of Ghent in 1815 saw Americans discovering rather than developing a sound basis for a national mill system economy.\* Much of the system's foundation appears to have come about naturally. Certainly the cheap and abundant water power, vast amounts of hard and soft wood, hard igneous rocks of all shapes and sizes, and iron ore deposits, although not discoveries of the 19th century, still waited to be fully utilized and appreciated. Domestic manufacturers geared themselves to areas previously serviced by imports as internal trade challenged the supremacy of foreign commerce. A national system of transportation grew and the mills of the Northeast found outlets for their products in the South and West. After the war of 1812, trade became regional, and in some industries (boots, textiles, men's clothing) it was national in scope. Capital came from shipping interests which had felt competition and harassment from Great Britain. <sup>3</sup> In addition, banking facilities increased, labor became more specialized, and the Federal Government established protective tariffs. By the second quarter of the 19th century, the United States had evolved into a nation consciously and enthusiastically pursuing a manufacturing course. <sup>4</sup>

Although farmers would outnumber mill workers for several more years, the decade of the 1830's was the take-off point for manufacturing in the Northeast. Visitors from England were impressed by a product's low cost which was based on its standardized production and a large-scale output. <sup>5</sup> Better methods of distribution lead toward a decline in self-sufficiency among many Americans. Indeed by 1830, leading transport lines had begun fierce competition resulting in the Northeast receiving greater service from railroads, steamship lines and canal companies, but at a lower cost than had been the case a few years before. Urban centers, too, had emerged prior to the War and now Boston, New York, Philadelphia, and Baltimore were bustling commercial and manufacturing centers that acted as examples for disenchanting farmers, and import and export depots for manufacturers and consumers of the hinterland. In retrospect, the decade of the 1830's must be considered a watershed in American manufacturing history. <sup>6</sup>

Connecticut's location, centered in the growing manufacturing region of the Northeast with its long seacoast and major rivers, seemed to make it "a natural" for the development of a mill economy. Manufacturing almost appeared instinctive in the Yankee's desire for financial gain, greater personal comfort, and in most cases a spirit of civic responsibility. It also allowed greater numbers of people to fulfill these aspirations than were able when the state's economic elite were involved primarily in commerce and shipping. But these factors couldn't come into play until almost the third century of Connecticut's occupation. Until this time, our forefathers' inventive genius was held in check by their efforts to master their environment. Struggling to survive was a full-time job. And when all was quiet on the homefront, there was the constant reminder that England controlled and discouraged American manufacturing. <sup>7</sup>

Yet, in spite of Connecticut's industrial leanings and potential, the years following the War of 1812 found her to be very much an agricultural state. Farming in 1820 employed 50,518 people while 17,541 found work in "shops." Two-thirds of the state's 275,000 citizens lived on small farms. Just thirty-eight companies were incorporated and only Eli Whitney's firearms and Simeon North's pistols had national markets. Five years after the second war with England, Connecticut's hay crop exceeded the value of cotton and wool textiles by \$1,000,000. <sup>8</sup>

But as Connecticut citizens entered the 1820's, the prospects for manufacturing began to mature. Their state had favorable conditions for a mill system economy. Its area was less than 5,000 square miles and was divided into three geographic areas by rivers. The Connecticut River Valley had good farm land, but areas removed from it were burdened with poor, rocky soil making agriculture a challenge. Although the state had no deep water harbors, it had several good, small ones with New Haven and New London being the best among them. Even in the twenties, Connecticut had good transportation facilities as turnpikes reached its larger towns connecting manufacturers with their markets. As a result of these factors, growing numbers of mills were already taking advantage of excellent water power along the state's streams and rivers. <sup>9</sup>

Industries were found in rural towns to the degree that they could meet the needs of their residents. In Windham County, for example, looms could be found in most houses and each town had forges, tanneries, and saw and grist mills. Several artisans, too, including cabinet makers, tanners, hatters, and harnessmakers were located within an easily accessible region. The War of 1812 gave many small industries, both in rural and more urban areas a real boost; perhaps out of necessity. The scarcity of foreign goods during the war forced many persons to begin manufacturing products which had previously always been provided for them. <sup>10</sup>

As the war ended, these emerging industries found themselves aided by a coastal trade and the anticipation of a growing sense of economic independence from Great Britain. However, with the culmination of war, Great Britain was anxious to resume its American trade which had ceased with the Embargo in 1807. England's more established factories could manufacture *and* transport goods to the United States and still sell them more cheaply than the same item could be marketed by an infant American mill. Connecticut's budding manufactures needed the support of a strong central government in the form of a protective tariff. They received this aid and were soon to become a leading manufacturing state. <sup>11</sup>

To further understand the evolution of mills in Connecticut prior to the attack on Fort Sumter, one must see the relationship between agricultural and demographic developments during this period. Inventors and inventions, for which Connecticut is now famous, did little to improve its farms. As early as 1750, people were leaving Connecticut to go west. When Tocqueville visited America in 1831, he claimed that the state's emigration was so great that one-third of the members of the U. S. Senate and one-fourth of those in the House of Representatives were born in Connecticut. <sup>12</sup> And in 1819, it was calculated that in the preceding

thirty years, Connecticut emigrants and their descendants numbered over 700,000 while approximately 300,000 remained. <sup>13</sup>

The exodus continued until 1840. Families grew and land was not available for fathers to give their sons. In addition, soil was poor and worn out. Little knowledge of fertilizers existed, and farmers used antiquated practices and methods. They tried to overcome these obstacles by forming farmers' associations and attempting to find scientific farming techniques with the help of Yale and the state legislature, but to little apparent avail. The lack of progress in agriculture contributed to the fact that in 1819 the United States' growth rate was thirty-five persons per 1,000 while that of Connecticut was four or five per 1,000. <sup>14</sup> Those who fled Connecticut prior to 1840 were not only frustrated farmers but also young, ambitious, and in many cases, rather cosmopolitan in outlook. Rich virgin lands of the west were the beneficiaries of these emigrants, but so too were urban centers of intellectual and commercial life, especially New York. Connecticut clearly provided a number of gifted citizens to other parts of the nation. It is those who remained behind that are of particular interest to this study.

The constant departures of Connecticut citizenry compounded by no significant growth in population gives evidence that the state had reached its full potential "to support, by agriculture, under agricultural conditions of that time, a larger number of people that she already had." The population in 1820 was 275,248. If there were to be an increase in this number in the foreseeable future, it would have to earn its keep in an occupation other than farming. <sup>15</sup> Yet, in spite of the vast numbers leaving the state, labor was the mainstay of the emerging mill systems. Connecticut's water power was good but no better than many states. Few minerals-iron ore and copper being the exceptions-were found within its borders. In fact, two of the most successful early industries, tinware and hats used imported materials and no water power. Neither was capital in great supply. The one essential factor was cheap and abundant labor. <sup>16</sup>

Even though cheap or free western land must have been an incentive to disappointed farmers, Connecticut mills don't seem to have wanted for an adequate labor force. Research shows that an abundance of cheap labor existed in the first half of the 19th century. In 1813, a pistol maker in Berlin paid an apprentice \$6 to \$8 a month and a skilled worker \$12 a month. Board was \$1.50 to \$2.00 a month. In 1832 a male textile worker earned \$1 a day' a woman earned 35c; and a child's wage was 21c for a day's work.\* Some factories, such as those in New Britain, paid their employees only once a month. These wage scales were no different from those of neighboring states and were higher than European standards. To increase earnings, many breadwinners attempted to hire-out their entire families which usually consisted of themselves, their wife and four to six children. An agent for a Pomfret cotton mill tried to convince a failing farmer that his entire family could earn \$450 to \$600 a year at his mill; whereas the year before the farmer probably earned \$180 to \$200. It was labor as much as anything else that contributed to the early success of the mill economy. <sup>17</sup>

The manner in which mills distributed their products was essential to their survival. I defined industrialization earlier as, among other things, a process whereby goods are manufactured for an area greater than the factory's immediate region. The successful 19th century mills developed markets far beyond their direct environment. The Connecticut River could be navigated two-thirds of its distance within the state and rivers in the two other sections of the state were navigable for ten to fifteen miles. Although these rivers were valuable for transportation, they were not sufficient enough to support the economy of a major manufacturing state. Although by the early 19th century Connecticut had an excellent turnpike system, railroads were a necessity. By 1845, three railway lines crossed the width of Connecticut. <sup>18</sup> (See Appendix A). Lines connected manufacturing towns to each other and the coast. Railroads helped many towns to prosper financially, but

these were cities already beginning to flourish. Cities that were declining before 1820 were not aided by railroads. There was little rail activity in the northwest and northeast sections of the state. When trains did come to these rural areas they brought inexpensive goods and produce from the trans-Mississippi West. Railroad development in Connecticut aided the manufacturing areas “but condemned the old country towns to an economic death.”<sup>19</sup> One of the ironies of this study is that rail transportation which for so long held out hope for small or distant mill towns, when it finally arrived blew a final whistle on the town’s very existence.

The success of Connecticut mills is told in the business they acquired outside the state. Proximity to New York City was an advantage especially for an industry such as hat manufacturing in Banbury. But the state’s manufacturers developed a national clientele particularly in the non-industrialized South. Carriages from New Haven and Danbury’s finest hats found demanding markets throughout the South, especially in Charleston. State tinware was sold in Detroit and as far west as the Mississippi Valley. And Georgetown’s sieves and cheese safes were distributed in Charleston and in Ohio’s Western Reserve.<sup>20</sup> The character of the Yankee peddler has been recounted and romanticized throughout state history. It appears that his role became limited by the 1830’s. By this date, most major manufacturers had retail outlets in major regional cities. The peddler, as with the small rural mill town of Connecticut, seems to have fallen victim to the state’s progress in financially wise marketing techniques. A report of 1832 by the Federal Government found 75% of Connecticut manufactures going to New York, Philadelphia, Boston, Providence, or Baltimore. From these cities, products were distributed to the interior or exported.<sup>21</sup>

Capital investment to begin a business is essential, yet in Connecticut money for this purpose was not abundant. [For a discussion of the process of capital accumulation in early 19th century Connecticut, see Unit VII of this volume] The state was not one of the leaders in this area. In 1800 Connecticut had five chartered banks with a total capital of \$595,000. Massachusetts by this date had twenty-two chartered banks with a total capital of \$8,042,000. Some initial investment came from shipping and commercial interests which diverted their profits when they felt thwarted by military or economic pressures from Great Britain. Not only was some capital forthcoming from this segment of the financial community, but it also contributed a needed amount of business acumen. But a general scarcity of capital meant use of poor equipment as well as the inability of mill owners to keep up with frequent technological breakthroughs by Connecticut inventors. Despite financial hardships of the 1830s and 1840s, by 1850 Connecticut mills employed 30,000 workers.<sup>22</sup> (See Appendix B major Connecticut manufacturing sites in 1850).

The source of capital is still somewhat of a mystery. Shipping interests contributed, as did banks when not affected by national panics. Many mills, however, seem to have started out so small that vast amounts of capital were not necessary. Several began in cellars or shops attached to homes. Some were started as trades to supplement the none too prosperous occupation of farming. The businesses that developed and succeeded in the early 19th century were those which were careful to avoid overexpansion or investment in a product whose success was not assured. Again the shrewd nature of the Connecticut Yankee comes into play. My guess is that much of a mill’s working capital came from within as it developed and grew.

The relationship in Connecticut between developing industries and conservative politicians during the years 1815 to 1860 should be understood. The period was highlighted by rather forward-thinking governors who were constantly held at bay in their ideas by fiscal ultra-conservatives in the Assembly. The governorships of Oliver Wolcott, Jr. (1818-1830) were particularly favorable to businesses. These men offered tax incentives to industry, asked for appropriation of money for further development of roads and canals, and supported the passage of general incorporation laws in the 1830s. Many of these became reality in some form, but

oftentimes it was long after the petitioning governor had left office. <sup>23</sup> The early 1830s saw the National Republicans or Whigs come to power in Connecticut. Although this party opposed President Jackson and embraced Henry Clay's American System of federally funded national roads and canals and a high protective tariff, the years of the 1830s and 1840s continued to be dominated by fiscally conservative legislatures regardless of which party was in power. <sup>24</sup> Attractive incentives, suggested by governors, became modest when the Assembly voted. Despite the lack of official assistance, no real roadblocks were put in the way of manufacturers during the first half of the 19th century. But Connecticut manufacturing continued to grow during these years. It is a further credit to the driving nature of the state's entrepreneur that in view of a less than enthusiastic government policy toward manufactures, he was able to succeed in making the state an industrial success.

Connecticut's early attitude toward immigrants demonstrates the apparent conflict between politician and entrepreneur. With the departure of so many natives to the West at the time of the emerging factory system, one would think immigration would be a natural answer to rebuild the state's labor force. But in the earlier decades of the century, this was not the case. During these years, immigrants were not welcomed. Special permission of the legislature was required for them to own land and voting rights were granted by town fathers with great reluctance. Rural Yankees viewed this group as unwashed, strange intruders upon their landed and traditional value system. Not until the 1850s, when urbanization and industrialization were underway, did immigrants begin to play a role in Connecticut life, and then only under guarded conditions and suspicious eyes. <sup>25</sup>

As we look back at the industries that were successful in 1850, particularly manufacturers of firearms, brass, clocks, and silverware, we see that all had certain clear characteristics in common. All benefitted from successful inventors and entrepreneurs living within the state. Other than water power, none required a great need for resources. As evidenced by the marketing techniques of manufacturers such as the hatters of Danbury, these industries developed an early recognizable priority in their fields. All began operations in a time of adversity and were prepared to take advantage of the periods of prosperity that followed, And each took full advantage of developing railroads to satisfy their national markets. In 1850 these manufacturers, and many more who aspired to their position, were taking advantage of population changes in the state. With the growth of manufacturing and the diminishing attraction of western lands, people were turning to the cities in great numbers. Between 1840 and 1850, 24,000 citizens had left farming which represented a drastic reduction of those earning a living in agriculture-from 61% to 34% <sup>26</sup> By midcentury, Connecticut had become an urban state.

Georgetown, Connecticut has never been an urban center. Nevertheless, it is home to the Gilbert and Bennett Manufacturing Company, a manufacturer that exemplifies the flourishing 19th century mill. Georgetown is a village that presently is located where the towns of Wilton, Weston, and Redding intersect. The first mention of the village refers to a grist mill established on the Saugatuck River in 1730. This is an area that few would recognize as Georgetown today. References to the Georgetown of today\* note that another grist mill was erected in 1764 on the Norwalk River. The mill was very heavily used as it was located on the main road between Norwalk and Danbury (the modern Route 7).

In 1980 the company employs 500 workers in four locations and is a leading producer of chicken wire, garden fencing, and gates. Currently the mill is in the same location it established in 1834, but this is now a suburban region. However, the village of Georgetown still possesses vestiges of a mill town. The businesses that surround the factory are a combination of those that live off a large industry but also serve the needs of a suburban community. These include taverns, liquor stores, small restaurants, gas stations, and repair shops.

The specific factors for its success correspond directly to the general characteristics for all thriving mills both in Connecticut and throughout the United States. For these reasons, as well as its nearby location and present rate of success. Gilbert and Bennett is an excellent specimen for the study of the mill economy. A discussion as to how other Connecticut mills could be used in this project is detailed in the strategy statement on page 212.

Benjamin Gilbert was a Weston tanner who in 1818 wished to use excess animal hair from his business to make hair cloth sieves. He used hog, horse, and cattle hair for the bottoms of flour and gravy sieves. Gilbert began using surplus hair that was too matted and curled for sieves in making stuffing for mattresses and cushions for the carriage industry. The business grew appreciably and in 1838 Mr. Gilbert admitted his son-in-law, Sturges Bennett, to partnership. In 1830 the partners were forced to move from Gilbert's basement to a small mill near the Norwalk River in the village of Georgetown. <sup>27</sup>

The mill began experimenting with wire cloth sieves in 1834. In order to manufacture this type of product a carpet loom was employed. A carpet loom required more power than could be generated from the stream at the 1830 location, so another mill was established directly on the Norwalk River. This site provided the necessary energy to run the larger wire looms.

The introduction of wire screening signalled the end of Gilbert and Bennett as a domestic-type industry. While cloth was still being used in sieves, much of the work was done by neighbors in their homes. With the advent of wire bottom sieves in 1834, manufacturing depended for most of its production on machines and was too complex to be carried on in homes. The mill became a self-sufficient industry. All work was now done at the mill site. A saw mill was established for making sieve frames in 1848 and in that same year, steam power was first introduced as a source of power. A wire mill was built on the factory premises in 1863 to provide "facilities for drawing iron wire." Prior to this, the manufacturer had purchased iron wire from a mill in Worcester, Massachusetts. <sup>28</sup> Gilbert and Bennett had become a self-contained mill industry.\*

Other characteristics of a successful 19th century mill were the development of national markets and adaptability to changing economic conditions. Gilbert and Bennett sieves were sold throughout the South and as far west as the Western Reserve of Ohio. In 1852 a shop was opened in New York City. But what seems equally as important as developing sound markets was the ability to develop new markets and adapt to their changes. The management at Gilbert and Bennett appears to have done this masterfully throughout parts of animal hooves. The glue manufacturing process had not been successful because glue was being dried on cotton netting. When the glue had dried, the cotton backing couldn't be completely removed. The young Georgetown company resolved this problem by manufacturing wire hex netting upon which glue would be dried. When the glue dried, it could be separated from the wire netting with little difficulty. A product with a successful market was developed. Gilbert and Bennett met the greatest challenge of its first forty-three years at the outbreak of the Civil War. Its southern markets for sieves and carriage cushions had been cut off. As imminent disaster seemed apparent, they shifted their mill's capacity to the manufacture of insect window screens. These proved to be a vast improvement over cheese cloth which had previously been used for this purpose. An other successful market had been developed. <sup>29</sup>

The founders of Gilbert and Bennett constantly demonstrated the flexible character made famous by successful 19th century inventors. As the New Haven shippers at the time of the Embargo and the War of 1812 refused to fold, but invested instead in the carriage industry, and as the Farmington Canal became the roadbed of a railroad, so too did Gilbert and Bennett's management consistently show their skills of adaptability. Whether using a carpet loom to manufacture wire netting or using excess animal parts for glue or

cushion stuffing or using woven iron wire cloth which had been earmarked to be used in southern sieves for the making of window screens, these men of vision demonstrated over and over again the traits of a successful 19th century manufacturer. <sup>30</sup>

Manufacturing in the years following the Civil War was marked by a distinct movement of people from rural to urban areas. The number of manufacturing sites became more concentrated while the number of workers increased as did the value of their products. (See Appendix E). Factories were locating in cities that were serviced by railroads. Turnpikes, too, influenced factory sites, but railroads were of greater importance to post-war manufacturers who now depended upon steam to power their mills. Steam power was dependent upon coal and coal was a raw material transported in bulk by rail. Steam power added a great degree of flexibility to the modern manufacturer. The mill owner was no longer a slave to a specific location on a river, nor was he at the mercy of seasonal variations in the amount of water available in an out-of-the-way stream. Steam power, made available by rail transported coal, allowed him to make consistent schedules for production. <sup>31</sup>

The tri-town region of Wilton, Redding, and Weston in mid-Fairfield County shows the two worlds of 19th century industry. The area possessed both small, water dependent mills and a large manufacturing company that adapted successfully to post Civil War conditions.

The year 1860 saw “sixteen busy shops” along the Norwalk River from its source in Ridgefield to the Norwalk town line (see Appendix F). By 1923 there were four or five. Why the demise of these once active mills?

Mills along the Norwalk River in Wilton and Redding as well as those in Weston collapsed for the very reasons that factories in Norwalk, Danbury, and Bridgeport prospered. These small mills were dependent on water for their source of power. They didn't move to steam because they weren't located on major rail lines where coal could be readily imported. Also, most mills were not large enough for this type of major transformation. The largest mill in Wilton in 1860 manufactured shirts. It employed twenty-four people. The small mills of Fairfield County couldn't compete with factories in larger cities which manufactured their product faster and cheaper, if not better than they could. The small, interior mill town that could not attract a railroad not only suffered from access to raw materials. It also was at a disadvantage transporting its products to markets. But the ultimate death knell for the water-powered mill was the sophisticated marketing practices that larger manufacturers and their profits could afford. Big companies opened retail stores to sell directly to their customers. Catalogue buying allowed shoppers to conduct their business through the mails, eliminating the need for peddlers. And advertising in newspapers signified that 19th century manufacturing had become a multi-faceted, big business. Weston, Wilton, and Redding mills were in a struggle to survive, and they were in way over their heads. <sup>31</sup>

Another key to developing urban centers of manufacturing after the Civil War was immigration. Before 1850 immigrants were outwardly deterred from settling in Connecticut by property ownership restrictions. By the 1870s and 1880s, however, foreigners were seen as a cheap and abundant source of labor. Immigrants were drawn to large cities because many were ports or located on important transportation lines. Once there, unskilled factory jobs, usually in areas in or within walking distance of their neighborhoods, provided the necessary employment and security. Although harassed by the Know-Nothing Party members in the 1850s, and again in the 1880s and 1890s by the American Protective Association, and in spite of main-line Democrat and Republican conservative, anti-labor, anti-immigrant attitudes, immigrants were here to stay. In 1890 Connecticut had a rural population of 123,097 and an urban population of 623,161. And by 1900 foreign-born residents made up 59% of the state's people. <sup>33\*</sup>



Yet Georgetown's wire mill, Gilbert and Bennett, not only survived but prospered. (See Document G). It succeeded because its management made the same necessary decisions that leaders of all successful American industries were making. In Gilbert and Bennett's case, these were the same steps they had been taking since its establishment in 1818. The Georgetown mill continued to adapt to changing markets and economic conditions and they wisely foresaw future trends and developments. Gilbert and Bennett also benefitted from a vast amount of good fortune.

As mentioned earlier, growing 19th century factories moved to steam power. Because of Gilbert and Bennett's rather isolated location, it derived its power not from coal but from water turbines. In 1848 water pressure became a constant with the purchase and control of Great Pond, a reservoir located 5.27 miles northwest of the mill on the Norwalk River at the Ridgefield-Redding town line. <sup>35</sup>

The post Civil War era saw the mill moving away from sieves as the backbone of its production, while continuing to profit in the prewar markets of insect screening and glue drying nets. To these were added poultry wire, coal and ash sifters, and ox muzzles. By 1885, Gilbert and Bennett's place as a flourishing 19th century industry. A fire destroyed the plant. Damage amounted to \$200,000 for which the mill had \$40,000 of insurance. The decisions that were made in rebuilding the properties insured Gilbert and Bennett's success for generations to come. Although the Danbury and Norwalk Railroad traveled through Georgetown as early as 1852, it was during the 1874 reconstruction that the railroad was convinced to run a spur line into the mill proper. Also, Gilbert and Bennett was reorganized as a joint stock company and the machinery that adorned the new buildings was the newest and best possible. The mill was opened and operating within the year. <sup>37</sup>

The development of the industrial economy in 19th century America was fundamental to the development of the United States during the same period. One cannot be understood without studying and understanding the other. If we understand an economic system as the process of human production, exchange, and consumption, then we understand the process of 19th century American History: its strengths, its failures, its aspirations, and its conflicts. <sup>38</sup> The parameters for understanding this process as well as the realization of its factors are available to us in the history of the United States, Connecticut, and our individual localities. The parameters are similar, if not identical, and their characteristics are interrelated and oftentimes overlapping. To attempt to grasp them is to attempt to comprehend the process of history. To neglect to see this historical system at work is, to say the least, unfortunate.

### *Strategy Statement*

The strategies I plan to follow in achieving my goals in *The Development of the Mill System Economy* are ones of discovery and confrontation. Concepts will be developed, tested, and applied to original problems through individual and group assignments as well as large group discussion and sharing. The unit will proceed at comprehension and application levels of learning.

I'm confident that students will leave this unit with a good factual understanding of the emerging mill systems of America, Connecticut, and their individual locality. This can readily be pre-and post-tested. But a more vital part of my strategy is to achieve the objective of having students become aware of the process of history. I expect students to see that history not only happens on newscasts and in textbooks, but also in their own neighborhoods. As a result of this unit, they should see the linkage between events preceding and following the emergence of mills (War of 1812 mill system national markets), and also the connection among events within a given time period (mills machine industries railroads). I intend that my strategy and techniques enthuse students about the study of history and cause them to see its value and usefulness.

A teacher in a town other than Wilton ought to be able to use the research in this project on a mill development on a national and statewide level by making appropriate additions or deletions. Then, by using a local mill site, one that is still functioning or one that has ceased to operate, teachers can establish their own local field study. Students should then be asked to apply their knowledge of the mill economy on a national and statewide level to circumstances in their specific locale. Among the introductory general questions to be asked would be the following:

1. In what ways was this mill indicative of the 19th century mill system?

2. If it succeeded, why did it succeed?

3. If it failed, why did it fail?

4. In what ways was it different from mills of its time? Why did these differences occur? The mill that I intend to use is still functioning. It was and is very successful. This provides certain concrete links between the past and the present. But I think it would, perhaps, even more fascinating to show students the remains of a once-busy mill or a partially preserved mill dam and ask them to speculate and imagine the mill from its remains.

### ***Intro Discussion:***

Why do your parents work? (where they do; as hard as they do) Why do both your parents work? Why do they travel as much as they do? Why don't your parents get jobs where they only have to work six months of the year? These jobs are available! GET THEM TO SEE THAT THEIR PARENTS HAVE CERTAIN NEEDS THAT WORK FULFILLS.

Student will be asked to think back to previous concepts that we have discussed: migration, colonization mercantilism, revolution. Why have we used concepts? To put "things" in categories to better organize our thinking.

## **DEFINE ECONOMICS:**

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The study of man's behavior in producing, exchanging, and consuming the material goods and services he needs. (Discuss difference between goods and services.) AN ECONOMIC SYSTEM is the interrelationship of several factors that influence man's behavior in his striving to satisfy his needs. These include all the factors that affect the economy.

## **CONCEPT LEARNING**

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1. To generalize within a category

2. To discriminate between and among concepts

**Activity #1:**

Ask student to give examples of factors within the category of an economic system. The teacher gives the first three factors:

—labor

—consumer needs (markets)

—resources

Now ask students to give three examples of contributing factors:

—\_\_\_\_\_ (role of government)

—\_\_\_\_\_ (energy)

—\_\_\_\_\_ (transportation) Together give some examples of factors that would not be important contributors to an economic system. These might include: military, church, recreation. Another introductory technique in concept learning might be to put these nine factors together under the heading *Economic System* and ask students which factors support this concept and which do not. Write a one sentence explanation for your answers.

**Activity #2:**

Draw a timeline tracing events contributing to the development of the U.S. as a manufacturing nation from the end of the Revolutionary War to 1850.

**Activity #3:**

Give students the first half of a personal scenario of a Connecticut citizen in the years 1690, 1750, and 1816. The student will complete his scenario based upon his knowledge of Connecticut history and any research he is able to do on his/her own. For each date, factual information will be given to students on a Connecticut resident. Family size, influence of religion, and relations with government will be provided. Several maps showing population patterns, centers of agricultural and industrial activity, and transportation routes will also be made available. Students will be asked to conjecture as to the economic activity of their citizen: how he earned his living; how and where he would market his goods; from where he would get resources or products he needed. Half-completed scenarios of people from the same area could be given to two students. A comparison of each's final assignment and the thinking that went into the completed scenario would be a Valuable exchange of reasoning processes. It would also confirm that ...

1. Connecticut consisted of different kinds of people.

2. Proximity to rivers, the Long Island Sound, and turnpikes affected people's lives.

3. People's lives were influenced by geographic conditions of their immediate environment.

**Activity #4:**

Read the brief description of water wheels (See Appendix H). *Construct a water wheel* . Be sure to explain not only how the wheel is built and how it is propelled, but describe also how the wheel was used to aide in work inside the mill. If constructing a water wheel seems too difficult, make a detailed illustration of one. Explore the rivers and streams in your area. What type of wheel would be most efficient on the waterways of your town?

Activity #5: From data on Wilton, answer the following questions as you might if you were a Wilton representative to the State's General Assembly in Hartford in 1818.

1. How is Wilton similar to other towns in the U.S? How is it different? How do events happening at the national level affect Wilton? (War, tariff, western land sales as examples)

2. How is Wilton similar to other towns in Connecticut?
3. What are the needs of Wilton's people?
4. What are their strengths?

5. What mills and businesses do you think might develop in Wilton in the next twenty years? Why? Activity #6: To understand the challenges and processes of beginning a mill in Wilton in the year 1818, your group of five students will...

1. Review data on the development of events in the first half of the 19th century in America.
2. review data on Connecticut History in the first half of the 19th century.
3. Review materials on Wilton during this period.
4. YOUR TASK is to develop a mill in Wilton. What decisions must be made before your mill will be a success? (What important questions should be asked?)

a. location?

- b. product?
- c. markets/demand?
- d. source of power?
- e. resources needed?
- f. transportation?
- g. labor?

h. financing? INCLUDE the following ...

a. physical map of your mill.

b. give it a name.

c. As a mill owner in Wilton, you are also a Representative to Connecticut's law-making body (legislature), the General Assembly. Write a bill to introduce to your legislative colleagues to help further develop manufacturing in Connecticut.

d. Write a newspaper article for the ( *local paper servicing Wilton at that time* ). Include in it

...

—interviews with mill workers

—interview with mill owner

—interview with townspeople regarding their feelings on having a mill in town

—advertisements selling your product; want ads for workers

e. What problems do you see as a bright young entrepreneur might be over the horizon that will have to be dealt with?

f. What new markets might you be able to develop in in the next ten to twenty years? What new products might your mill be able to turn out?

**EXTRA:**

As students are developing their scenarios, teachers at their discretion might challenge their student's thinking, reacting, and application skills by including the following complications...

1. disease hits town; your labor force is out in half.
2. Storm destroys good portion of your mill.
3. War; markets you've depended upon are now closed.
4. Economic panic hits country; you must deal totally in cash.

5. Competitors create glut on the market; demand down while supply is great; what do you do now? These little "disasters" could be introduced in a number of innovative and stimulating ways. If you are doing the unit

as I plan to at the end of the War of 1812, you might want to have a student from another class announce these happenings as a town crier would at this time. If your unit is later, perhaps you could have the message introduced over a telegraph, on radio, or as front-page headlines in your local newspaper.

## Footnotes

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\*When discussing the development of manufacturing in the years following the War of 1812, it is important to remember that mills were generally emerging only in the Northeastern region of the country. The states that housed large numbers of mills at this time were the New England states, New York, New Jersey, and Pennsylvania.

\*These costs should be compared with the costs of other products of the day. By the 1840's a good Colt revolver cost \$24; a clock could be purchased for \$4. Pork and beef were selling at \$8 per barrel, wheat was \$1.25 per bushel, and a pound of ham, lard, and butter sold at 6c to 7 1/2c.

\*Georgetown is located on Route 7, 8 1/4 miles north of the Merritt Parkway in Norwalk and 10 miles south of Route 84 in Danbury.

\*See Appendixes C and D.

\*Although Gilbert and Bennett duplicated many practices common to successful 19th century businesses, their attraction of Swedish immigrants in the early 20th century to rural Georgetown was quite atypical. From conversations I've had with company officials, I can find no specific reasons for Swedish workers to choose the wire mill in Georgetown as a place of employment other than the fact that a few originally came to work, found conditions satisfying to their needs, and attracted fellow countrymen to the area. <sup>34</sup>

1. Douglas C. North, *The Economic Growth of the United States : 1790-1860* (Englewood Cliffs, New Jersey: Prentice Hall, 1961), p. 159.

2. North, pp. 156-159.

3. Norris Galpin Osborne, ed., *History of Connecticut in Monographic Form* , Vol. IV (New York: The State History Company, 1925), p. 24.

4. Einar W. Carlson and Keith T. Howell, *Empire Over the Dam* (Cheshire, Connecticut: Pequot Press, 1974), pp. 8-9; Ellsworth Strong Grant, *Yankee Dreamers and Doers* (Chester, A Neglected Period of Connecticut History: 1818-1850 (New Haven: Yale University Press, 1933), pp. 233-234.

5. North, p. 167.

6. North, pp. 166-176.

7. George L. Clark, *A History of Connecticut: Its Peoples and Institutions* , 2nd Ed. (New York: G. Putnam's Sons, 1914), pp. 354-356.

8. Grant, pp. 85-86.

9. Margaret Fuller, *An Introduction to the History of Connecticut as a Manufacturing State* Northampton, Massachusetts: Smith College, 1915), pp. 25-26.

10. Theodore Dwight, *The History of Connecticut* (New York: Harper and Brothers 1841), p. 443.

11. Clive Day, *The Rise of Manufacturing in Connecticut* , Tercentenary Commission of the State of Connecticut, Number 44 (New Haven: Yale University Press, 1935), p. 5.

12. Janice Law Trecker, *Preachers, Rebels and Traders Connecticut, 1818-1865* (Chester, Connecticut: Pequot Press, 1975), pp. 6-9.

13. Day, pp. 1-2.

14. Day pp. 1-2.

15. Fuller. pp. 26-27.

16. Day, p. 7.
17. J. Leander Bishop. *A History of American Manufactures From 1608 to 1860* . Vol. II (Philadelphia: Edward Young and Company. 1864). p. 432; Day. pp. 7-9; Osborn. pp. 42. 181
18. Fuller, p. 25-26
19. Forrest Morgan. ed.. *Connecticut as a Colon and as a State: or One of the Original Thirteen* . Vol. III. (Hartford: The Publishing Society of Connecticut, 1904). p. 276.
20. Phillip H. Knowles and Raymond C. Miller, *The Gilbert Rand Bennett Manufacturing Company: 150 Anniversary, (Georgetown. Connecticut: The Gilbert and Bennett Manufacturing Company. 1968)*. p. 5.
21. Day. pp. 10-15.
22. James Jarvis Morse, A Neglected Period of Connecticut History: 1818-1850, pp. 243-245; Norris Galpin Osborne, ed., *History of connecticut in Monograph form* , p. 32.
23. Grant, pp. 114-120; David M. Roth. *Connecticut: A Bicentennial Study* (New York: W.W. Norton and Company, 1979), pp. 113-114..
24. Albert E. VanDusen. *Connecticut* (New York: Random House. 1961). pp. 205-208.
25. Morse. pp. 20-23; Roth. pp. 115-122. <sup>26</sup>Day, pp. 28-30.
27. Irene Baldwin. "Georgetown and Its People." Diss. Danbury State College. 1965. pp. 4-5; Knowles. pp. 3-7.
28. Baldwin. p. 6; Knowles. pp. 6-11.
29. Knowles. pp. 9-10; Osborn. pp. 382-383.
30. Osborne, p. 383.
31. Ruth O.M. Andersen. *From Yankee to American: Connecticut 1862-1914* (Chester. Connecticut: Pequot Press, 1975), pp. 34-35; Carlson, pp. 175-179.
32. Andersen, pp. 39-42; Carlson, pp. 177-179; Thomas J. Farnham. *Weston: The For in of a Connecticut Town* (Canaan, New Hampshire: Pheonix Publishing, 1979), pp. 164-169.
33. Anderson, pp. 2-3.
34. Wilbur Thompson. Notes dated 1923 in Georgetown file folder at the Wilton Historical Society in Wilton, Connecticut.
35. Knowles, pp. 7-8.
36. Knowles, pp. 13-16.
37. Charles Burr Todd, *The History of Redding, Connecticut* (New York: The Grafton Press. 1906. p. 130.
38. Campbell R. McConnell. *Economics: Principles: Problems and Policies* . 5th ed. (New York: Mcgraw-Hill, 1972), p. 5.
39. Carlson, p. 25; Brooke Hindle, ed., *America's Wooden Age: Aspects of Its Early Technology* (Tarrytown, N.Y.: Sleepy Hollow Restorations, 1975 , p. 133.

## Annotated Bibliography

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\*\*\*Andersen, Ruth O.M. *From Yankee to American: Connecticut 1862-1914* . Chester, Connecticut: Pequot Press. 1975.

Andersen explains post-Civil War Connecticut industry as the effect of immigration and urbanization. Capital was available, transportation established, hardships of immigrants discussed in context of late nineteenth century.

\*\*\*\*Baldwin, Irene. "Georgetown and Its People." Unpublished M.A. Diss. Danbury State College, 1965.

Somewhat like Thomas Farnham's book on Weston in its intent, but certainly not objective. It is more of a personal expose of a native area.

Bishop, J. Leander. *A History of American Manufactures from 1608 to 1860* . Vol. II. Philadelphia: Edward Young and Company, 1864.

This history is a year by year accounting of American manufacturing through the Civil War. Much attention paid to the tariff issue in the nineteenth century. Includes meticulous listing of patents granted and very good charts of manufactures of 1850.

\*\*\*\*Carlson, Einar W. and Howell, Kenneth T. *Empire Over the Dam* . Chester, Connecticut: Pequot Press, 1974.

Valuable information of dams and waterwheels. Good chapter on the decline of a mill area (N.W. Connecticut) when mill owners generally didn't move from water to steam power.

Clark, George L. *A History of Connecticut: Its Peoples and Institutions*. 2nd Edition. New York: G. Putnam's Sons, 1914.

In regard to this topic, Clark stresses two points: (1) Manufacturing in 1800s was natural to Connecticut; (2) Because of diversions prior to 1800s, manufacturing couldn't develop until this time.

Day, Clive. *The Rise of Manufacturing in Connecticut: 1820-1850*. Tercentenary Commission of the State of Connecticut, Publication No. 44. Yale University Press, 1935.

Day sees Connecticut's growth in industry based upon cheap labor and enthusiastic marketing techniques. He sees 1850 as turning point in Connecticut life with shift from agriculture to industry.

Dwight, Theodore. *The History of Connecticut* . New York: Harper and Brothers, 1841.

Emphasizes influence of Embargo and War of 1812 on growth of manufactures in Connecticut. His contrasts beliefs of Ms. Fuller.

+ Farnham, Thomas J. *Weston: The Forging of a Connecticut Town* . Canaan, New Hampshire: Phoenix Publishing, 1979.

Farnham furnishes a good description of the emergence of a town. Emphasizes that the demise of Weston in late 19th due primarily to factors beyond that town's control. This study is done by a professional historian.

+ Fuller, Grace P. *An Introduction to the History of Connecticut as a Manufacturing State* . Smith College Studies in History. Northampton, Massachusetts, 1915.

A Master's thesis covering use of Connecticut manufacturing from 1818-1845. Chapters III and V are analyses and projections of the manufacturing environment in 1818 and 1845.

Grant, Ellsworth Strong. *Yankee Dreamers and Doers* . Chester, Connecticut: Pequot Press, 1974.



Concentrates on techniques of manufacturing, resource availability and marketing practices of early peddlers. Grant goes into depth on leading manufacturers and inventors. Places great importance on the Yankee character and spirit of ingenuity and inventiveness.

Hindle, Brooke, ed. *America's Wooden Age: Aspects of its Early Technology*. Tarrytown, N.Y.: Sleepy Hollow Restorations, 1975.

\*\*\* Hindle includes valuable illustrations on several different kinds of water wheels. Specific information on upkeep, technical use and dimensions of water wheels.

+ Kissinger, Henry. *White House Years*. Boston: Little, Brown and Company, 1979.

First chapters give Kissinger's views on historical perspective. Tacit statements on applicability of history to our contemporary lives.

Knowles, Phillip H. and Miller, Raymond C. *The Gilbert and Bennett Manufacturing Company: 150th Anniversary*. Georgetown Connecticut: The Gilbert and Bennett Manufacturing Co., 1968.

This is an account of the life of Gilbert and Bennett. Useful as both a social and commercial history of a mill.

McConnell, Campbell R. *Economics: Principles, Problems and Policies*. 5th ed. New York: McGraw Hill, 1972.

This is a very understandable economics text for a history teacher. It should be consulted for any project with macroeconomic implications.

+ Morgan, Forrest, ed. *Connecticut as a Colony, and as a State Or One of the Original Thirteen*. Vol. III. Hartford: The Publishing Society of Connecticut, 1904.

Connecticut was behind commercial development of Massachusetts in 1800. The State was hurt by poor farming conditions and attraction of frontier. No population growth between 1790 and 1810. Morgan sees development of manufactures during War of 1812 as important stimulant.

+ Morse, Jarvis Means. *A Neglected Period of Connecticut History 1818-1850*. New Haven: Yale University Press, 1933.

Morse emphasizes that the people with ambition, initiative, intellectual curiosity left Connecticut in their youth. Connecticut became a leading industrial state because of 1) inventors, 2) establishing industries with few resources (nat.), 3) rapidly getting a corner of markets.

+ North, Douglas C. *The Economic Growth of the United States : 1790-1860*. Englewood Cliffs, N.J.: Prentice Hall, 1961

North has written an excellent background on industrialization as a concept. More geographic and economic emphasis on certain key factors of linkage and factor endowments. He looks at national implications of even smallest 19th century mills.

+ Osborn, Norris Galpin, ed. *History of Connecticut in Monographic Form*. Vol. IV. New York: The States History Co., 1925.

Osborn traces Connecticut's industrial development from Connecticut's ship building and commerce. He discusses availability of initial capital as well as interesting useful chapters on uses of power.

Pease, John C. and Niles, John N. *A Gazeteer of the States of Connecticut and Rhode Island: Written with Care and Impartiality from Original and Authentic Materials*. Hartford: William S. Marsh, 1819.

This is a good breakdown of local towns at 1810 Census. It consists of charts, short narrative including population breakdown, nature of society and geographic facts.

Roth, David M. *Connecticut: A Bicentennial History*. New York: W.W. Norton and Co., 1979.

Conservative nature of Connecticut politics 1818-1850 regardless of which party was in power comes through consistently. Roth details interesting comments on state's policy.

Todd, Charles Burr. *The History of Redding, Connecticut*. New York: The Grafton Press, 1906.

Todd's effort is a valuable study of Redding but of little value for overall understanding of Redding's role in U.S. History. Some information on local mills.

Trecker"Janice Law. *Preachers, Rebels and Traders: Connecticut 1818 to 1865*. Chester, Connecticut: Pequot Press, 1975.

The author looks at impact of early industry in Connecticut on laborers. She sees the effects as very negative. Laborers were oppressed, especially women and children.

Thompson, Wilbur. Georgetown file folder. Wilton Historical Society. Wilton, Connecticut, 1923.

Notes certain information on earliest references to village of Georgetown. Discusses mills existing on Norwalk River compared to those in existence in 1923.

+ Tyler, Daniel. *Statistics of the Conditions and Products of*

*Certain Branches of Industry in Connecticut for the Year Ending October 1, 1845*. Hartford.

Includes data on individual state towns as well as information on county and state-wide level. Useful if compared with statistics at other periods of 19th century.

VanDusen, Albert E. *Connecticut*. New York: Random House, 1961.

+ VanDusen deals with period 1818-1850 from a political perspective. This is useful. Chapter on trade and industry deal with topic from pre-Revolution to 1960. Discusses major industries of state during 1818-1850 period.

#### Government Documents

*6th Census of the United States 1840*

*8th Census of the United States 1860*

*9th Census of the United States 1870*

*10th Census of the United States 1880*

*11th Census of the United States 1890*

## Student Bibliography

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Canfield, Leon H. and Wilder, Howard B. *The Making of Modern America*. Houghton Mifflin Company, 1964.

Although Chapter 11, "Changes Occur in American Economic Life," is very thorough as a "facts tell it all" approach, the way the chapter is situated in the text indicates that the authors feel early industrialization is a preCivil War subset of sectional conflict and Westward expansion. This text should be used with highly interested eighth-graders who have a high reading level.

Dawson, George G. and Prehn, Edward C. *Teaching Economics in American History* . n.p. Joint Council on Economic Education, 1973.

This is a detailed economic approach to teaching of U.S. History. Readings, discussion questions, and suggested activities emphasizing key economic concepts. The booklet contains useful bibliography.

Frizzle, Donald and Kownslar, Allan. *Discovering American History* . New York: Holt, Rinehart and Winston 1970.

This is a text combining primary sources with illustrations and graphs. It is probably more useful in high school classes. If used at a lower level, prior discussion and previewing material is necessary.

Graff, Henry F. *The Free and the Brave: The Story of the American People* . Chicago: Rand McNally and Company, 1968.

Basic information is available in this text but Graff deals with pre-Civil War industrial growth in purely a chronological context of U.S. History. Chapter 14, "Growing Pains of the Young Republic," begins with the Battle of Detroit and ends with the inauguration of Jackson. Growth of industries is explained in as much detail as the admission of Missouri as a state. Relationship of bold faced headings to details below is poor.

Heilbroner, Robert L. *The Development of American Economic Life* . Foundations in Social Studies Series. New York: Harcourt, Brace, Jovanovich, 1978.

For early industrial period, the author concentrates on influence of Hamilton, developing transportation system, and the Lowell Mills. He integrates facts, short readings, and valuable charts and graphs.

Hoyt, Joseph B. *The Connecticut Story* . New Haven: Readers Press, Inc., 1961.

Hoyt's book is the closest thing to a text for middle school students. It treats the period of industrialization very well with efficient and easily comprehensible charts and illustrations.

Mills, Lewis Sprague. *The Story of Connecticut* . 5th ed. West Rindge, New Hampshire: Richard R. Smith Publishing Company, 1958.

Mills' book is a distant second as a text to Hoyt's. *The Story of Connecticut* would be of more value to a teacher interested in an overview of state history, rather than one concentrating on the use of manufacturing.

Sloan, Eric. *Diary of an Early American Boy: Noah Blake 1805* . New York: Wilfred Funk, Inc., 1962.

Superb work for project-oriented, hands-on approaches. This is a great ideas book. It is especially appropriate for the development of the mill system in its explanation and excellent illustration of an overshot water wheel on page 50.

Van Dusen, Albert E. *Connecticut* . New York: Random House,

1961.

A very complete text on Connecticut that could be used in certain circumstances with some students. At middle school level, it would be utilized as a research source or in individual work.

Wilder, Howard B., et al. 4th ed. *This is America's Story* . Boston, Houghton Mifflin Company; 1975.

This is the best middle school textbook for heterogeneously grouped students. Chapters 13, 14, 15 are very readable and well organized. Many ideas viewed from a single citizen's perspective.

## Appendix A

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*(figure available in printed form)*

## Appendix B

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*(figure available in printed form)*

## Appendix C

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The following chart shows data on products manufactured by Gilbert and Bennett. The statistics are for Fairfield County in 1860. The chart signifies that in three of five Gilbert and Bennett production areas there is only one manufacturer. This producer, then, must be Gilbert and Bennett. The chart further proves the virtual monopoly Gilbert and Bennett had in these area of its business. The figures in parentheses after the category “ # of establishments” are the numbers of manufacturers of that item in the state.

*(figure available in printed form)*

## Appendix D

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Statistics of all hardware produced (of which Gilbert and Bennett's manufacturers were included) for the year ending June 1, 1860.

*(figure available in printed form)*

## Appendix E

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Statistics for Total Manufactured Products in Connecticut: 1850-1890

*(figure available in printed form)*

## Appendix F

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Manufactures for the Town of Wilton, Connecticut for the Years 1845 and 1860.

1845	1860
2 Wooden Mills	2 shirtmakers Shops
1 Axe Factory	2 Cobbler Shops
4 Hat Factories	2 Butcher Shops
2 Coach, Wagon and Sleigh Shops	4 Saw Mills
1 Spice Mill	
2 Chair and Cabinet Ware Shops	1 Coal Hod Producer
2 Wagon Shops	
2 Hub Manufacturers	
4 Carriage Shops	
2 Manufacturers of Hoes and Ferrules	
1 Brewery	

FROM THE NOTES OF WILBUR THOMPSON THE WILTON HISTORICAL SOCIETY

*(figure available in printed form)*

## Appendix G

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*(figure available in printed form)*

## Appendix H

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### Water Wheel

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The function of a water wheel is to power a machine to perform a task. Although we don't think of it with today's advanced computers and production systems, the water wheel was one of this country's first labor-saving devices. The amount of power or energy generated by the wheel is measured and described in horsepower. A unit of horsepower is equivalent to 550 feet power per second. Water wheels of the 19th century could operate at ten to thirty horsepower but most functioned with between fifteen and twenty. Water wheels were made of wood. For best results they should be kept in constant use. If not, parts would dry and shrink, eventually becoming loose. Northern mill owners often would build wheels into mills—devising crude heating systems to keep it ice-free in winters. Buckets, into which the water was directed, would leak, diminishing the amount of power of the wheel. The wheel was certainly not indestructible under the best of

conditions. Over a span of five to ten years, most parts of the wheel would need to be repaired or replaced. <sup>39</sup>

The wheel was set in motion by water entering its buckets. The flow of water was the most crucial contribution of the entire process. To insure a constant flow, a dam was built as close to the mill site, and wheel, as possible. If the dam was any distance from the wheel, water had to be carried from the dam to the wheel via a canal or flume.

Efficiency of all wheels depended upon the head (the difference in level between water feeding the wheel and that leaving it.) A wheel performing at a site with a great head water would be quite large and use many buckets. For best results, water should leave the wheel quickly. Construction of tailraces were used for this purpose. Tailraces were made of oak, pine, or cypress as these woods would contribute most to a long existence.

Mills of the 19th century generally used three types of wheels. The *overshot wheel* was one that water entered from the top. Its diameter could be as great as sixty feet and its width could be three feet. Buckets were ten to fifteen inches in depth and the head for efficient operation was ten to forty feet. It operated at approximately 65% to 75% efficiency.

The *breast wheel* allowed water to enter at the side just above the shaft. It operated best with an eight to ten foot head and the efficiency level for the breast wheel was 50% to 60%. The *undershot wheel* was commonly found at medium-sized dams of five to eight feet. It functioned with a low head and the bottom of the wheel was always submerged in the stream. A gate was installed at the bottom of the dam to direct a constant flow at the wheel's vanes. (The undershot had no buckets as there was no need to hold the water for any length of time). The vanes were placed eighteen to twenty-four inches apart. This wheel could operate when water in its reservoir was very low, but at best operated only at 40% efficiency.

## Notes

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Illustrations to accompany student package: Eric Sloane, *Diary of an Early American Boy* pp. 36, 50, 53.

Brooke Hindle, ed., *America's Wooden Age* , pp. 122, 129-132.

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