

THE WESTWARD MOVEMENT AND THE TRANSIT OF  
AMERICAN MACHINE TECHNOLOGY:  
THE CASE OF WOOL MANUFACTURING

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The importance of the transit of culture, and more specifically the transit of technology, from developed to developing nations has long been recognized by economist and historian alike. The contributions of Samuel Slater and a host of others in the movement of men, machines, and ideas across the Atlantic from England to the infant textile industry of North America are too well-known to require repetition here. Lacking, however, are studies which attempt to identify and to evaluate the diffusion of technology within a single country. The purpose of this paper is to examine and to assess the transit of machine technology in wool manufacturing between two regions of the United States (the Northeast and Midwest) during the late nineteenth century, and to illustrate the impact of environment on business decision-making.

Thinly populated regions with primitive internal transportation and prohibitive access to external markets often develop small service centers which provide local residents with inexpensive and frequently needed goods. The eight states of the Midwest (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) constituted such an area after 1850. Small towns initially formed around the nucleus of rural stores, but the merchant, blacksmith, lawyer, and doctor were soon joined by the businessman interested in factory production. Within a short time a community of any size also boasted a myriad of small processing and manufacturing plants which drew their raw materials from and geared production and sales to the local economy. These residentiary enterprises, as they are often called, sought to capitalize on their close proximity to final product markets and resources while enjoying protection from eastern competitors because of the high freight charges on goods shipped into the region.<sup>1</sup>

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<sup>1</sup> Rather than the frontier, denoting an area on the "cutting edge" of civilization, and therefore, unsettled, the region under discussion is one in which popu-

Woolen mills constituted only one of many residuary industries which arose in the Midwest, and in 1870 the region claimed 881 factories of this type. The typical midwestern woolen mill of the period was small with a total capital investment of less than \$20,000. The average mill owner employed fewer than twelve workers, a combination of men, women, and children, who normally operated plant machinery from mid-March through late-November.<sup>2</sup> Raw wool was purchased from local farmers, or from a commission merchant located in a larger midwestern city, while factory output was marketed through rural merchants on a consignment basis or was sold through a small company store, usually housed in one room of the factory. Pioneer wool manufacturers also derived profits from custom-order production and by processing raw wool for local farm families whose members wished to knit, to weave, or to sew garments at home. Most mills confined sales activity to a small area within an approximate thirty-miles radius of each plant.<sup>3</sup>

By the mid-1870s woolen factories in the Midwest found it possible to buy oil, dye, soap, and other everyday necessities from supply houses located in the large cities of the region. The acquisition of major textile appliances such as carding and spinning machines, looms, and fulling mills, however, usually required a special trip to the Northeast. Eastern textile machine builders had dispatched a few agents to the Midwest as early as 1860, but such individuals merely accepted advance orders; they could not of course stock complete machines and their replacement parts.

A number of pioneer mill owners possessed only limited knowledge of textile fabrication. Consequently, when a midwestern businessman interested in wool manufacturing journeyed to the Northeast in search of machinery his first few stops often involved visits to textile mills in the region. There he sought to induce a machinist or plant superintendent to leave his position and move west. If successful, the newly employed expert accompanied the would-be manufacturer on the remainder of his trip, supervising the selection and ordering of plant equipment from eastern firms. As in the North-

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lation is dispersed and the economy is primarily oriented around a large number of small towns that constitute relatively self-contained agricultural service centers. In other words, residents have yet to experience the impact of industrialization and urbanization

<sup>2</sup> U. S. Bureau of the Census, *Census of Manufactures: 1905, Textiles, Bulletin 74*, pp. 134-136.

<sup>3</sup> For a detailed analysis of these mills, consult the author's "Midwestern Wool Manufacture, 1860-1914" (unpublished Ph.D. dissertation, University of Missouri 1966).

east, machinery manufacturers sometimes sent their own mechanics to the midwestern factory site to assemble machine parts and their connective apparatus as they arrived. The records of C. G. Sargent and Company of Graniteville, Massachusetts, and other concerns suggest that machine builders did not attempt to realize a profit from this service, but simply required mill owners to pay the costs of the mechanic's room and board, wages, and travel expenses.<sup>4</sup>

As the number of woolen factories increased in the Midwest, a few enterprising businessmen established independent dealerships in the region aimed at offering mill owners a full line of new machinery. Such companies eliminated the necessity of an eastern buying excursion and visits to several different machine builders. Dealers normally collected a 10 percent selling commission for their service, but, like the manufacturers' representatives, these concerns only displayed floor samples from which the mill owner placed orders. Actual delivery of equipment involved a waiting period ranging from a few weeks to several months. In addition to firms which concentrated all their efforts on machinery, a number of dry-goods commission merchants, wool dealers, and textile supply houses in the Midwest also solicited equipment orders from pioneer wool manufacturers.<sup>5</sup>

The cost of machinery constituted well over 70 percent of the total capital investment in wool manufacturing during the late nineteenth century, and the inadequacies of the midwestern and national transportation system made freight charges on heavy textile appliances extremely high.<sup>6</sup> As a result, midwestern mill owners attempted to reduce these expenses by ordering only those parts of a particular machine which could not be fabricated by the local blacksmith or carpenter. Requests for blueprints of a machine and directions for its assembly frequently accompanied inquiries con-

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<sup>4</sup> For examples, see C. G. Sargent Company to The Buell Manufacturing Company, Graniteville, Massachusetts, December 15, 1893, in the C. G. Sargent Collection, Merrimack Valley Textile Museum, North Andover, Massachusetts, and E. N. Dewdall to Watkins Mill, St. Louis, Missouri, October 31, 1860, in the Watkins Mill Collection, Jackson County, Missouri, Historical Society Archives, Independence, Missouri.

<sup>5</sup> Correspondence from Merritt and Coughlen, Indianapolis, Indiana, January 25, 1867, Cutler and Thompson, Milwaukee, Wisconsin, October 21, 1870, J. P. Thompson, Milwaukee, Wisconsin, April 13, 1871, and J. B. Carson Brothers, St. Louis, Missouri, December 27, 1871, to C. G. Sargent Company in the C. G. Sargent Collection illustrates the business activities of other firms also engaged in the sale of textile machinery to midwestern mills.

<sup>6</sup> Thomas R. Navin, *The Whittin Machine Works Since 1831* (Cambridge, 1950), p. 378.

cerning its overall cost. Such was the case in December, 1868, when the superintendent of the North Star Woolen Mills of Minneapolis asked the C. G. Sargent Company if "... we could get the fan or blower [for a wool dryer] from you and make the rest of the machine here under your instructions ... [because] the cost of transporting such a bulky machine so far as this is enormous."<sup>7</sup> Machine builders often agreed to sell parts to a midwestern customer and to let him have the rest built locally from their blueprints, but they exacted an additional fee for the right to use those parts shipped from the Northeast in the homemade appliance.

Although new machinery was available, midwestern wool manufacturers tended to buy secondhand equipment whenever possible. Such equipment was not only cheaper, but it effectively served the needs of producers located in the Midwest. The very structure of the market for woolen cloth and yarn encouraged the adoption of used machines. Secondhand and sometimes obsolete equipment proved quite capable of producing the coarse- and medium-quality cassimeres, flannels, and jeans demanded by rural and small-town customers. Relatively high east-west freight rates on low-value goods of this type discouraged or prohibited eastern textile mills from competing with the small factories of the Midwest in sales to the local market.<sup>8</sup> And since the horse and wagon, along with the surface condition of dirt roads, governed the regularity of service and speed of delivery in rural areas, few midwestern wool manufacturers suffered heavy competition from other factories within the region. Thus, mill owners in the Midwest could see little need to produce new equipment featuring the latest technology so long as they could obtain used machines at a much cheaper price or locate repair parts for old ones already in operation.

Used equipment proved readily available from several sources. By 1870, several individuals, such as Albert O. Wilkes and William H. Dillingham, both of Louisville, Kentucky, had established machinery exchanges which specialized in the purchase and resale of secondhand merchandise.<sup>9</sup> The pages of textile trade journals, such

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<sup>7</sup> P. P. Eddy to C. G. Sargent Company, Minneapolis, Minnesota, December 4, 1868, in the C. G. Sargent Collection.

<sup>8</sup> On some items eastern textile manufacturers found that transportation charges prohibited shipment to the Middle West. On others, producers in the Northeast could maximize profits by concentrating on high-value fabrics which were not price competitive with goods manufactured by midwestern mills.

<sup>9</sup> Typical of many machinery dealers, when Wilkes and Dillingham first formed a partnership in the fall of 1869 they apparently planned to concentrate all their efforts on the sale of new machinery. The volume of second-hand equip-

as *Wade's Fibre and Fabric* and the *Textile World*, abounded with advertisements listing used machinery for sale to private parties or at public auction, and sales flyers mailed out by mills, wool dealers, and machine shops throughout the East and Midwest permeate extant company records.

Although used machines appeared in abundance, pioneer mill owners complained of their inability to acquire replacement parts and repair service for them. Because the typical factory contained a fantastic conglomeration of used, out-of-date, and homemade machines, skilled maintenance proved difficult to obtain, while the location of the correct part for a thirty-year-old loom or spinning jack taxed the patience of many a manufacturer because quests for parts sometimes delayed or halted production schedules. In some cases midwestern mills found it necessary to send entire machines back to eastern manufacturers or machine shops for repair or overhaul, both a costly and time-consuming operation.<sup>10</sup> To hedge against such eventualities, several factory owners in the region stocked a duplicate set of replacement parts for each major machine, a practice which tied up capital in an inventory possessing little market value.<sup>11</sup>

The rate of technological innovation in the textile industry had slowed markedly during the period when most pioneer woolen men established mills in the Midwest. Between 1870 and 1895, however, two major inventions permitted manufacturers to increase the volume of cloth and yarn while substantially reducing labor costs. The Northrop Loom, perfected and first marketed by the Draper Corporation of Hopedale, Massachusetts, so revolutionized weaving that within ten years after its introduction in 1895 other machines were hard pressed to compete. The Northrop ejected empty bobbins, reloaded the shuttle, and stopped if a warp broke, all automatically. Since the new loom freed the weaver from the necessity of stopping the machine to replenish empty shuttles and to watch for broken

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ment accepted in trade increased steadily, however, and by 1875 Wilkes and Dillingham advertisements strongly suggest that used machinery constituted the firm's speciality

<sup>10</sup> For an illustration of this problem, see Lyman Wilder to W. L. Watkins and Son, Hossick Falls, New York, August 23, 1881, in the Watkins Collection

<sup>11</sup> Expenditures on used capital equipment representing sunk costs with little recovery potential in the market place is also indicative of manufacturers operating in regions where: 1) capital is scarce, 2) the ability to adopt new technology is limited, and 3) the scale of operations dictated by new equipment featuring improved technology prohibits utilization of new machines.

threads, manufacturers found that one unskilled worker could supervise several Northrops in operation at one time.<sup>12</sup>

Spinning also became automatic. For approximately fifty years the hand-operated spinning jack constituted the most popular device in the factory production of woolen yarn. And, because the quality of yarn depended almost entirely upon the ability of the operator, the jack spinner represented one of the most skilled laborers in an American woolen mill. In the early 1870s, the invention of the automatic mule made jack spinning obsolete, thereby eliminating the need to employ trained operators. Although a new mule normally cost \$300 more than a comparable hand-operated jack, the machine cut spinning costs almost in half, assured manufacturers of a constant supply of yarn consistent in quality, and boosted hourly yarn production by as much as 60 percent.<sup>13</sup>

In time the cost advantages of the mule over the jack and the improved quality of yarn on mules became evident to the most conservative manufacturers, but most mill owners in the Midwest failed to utilize the new technology. For example, between July 1874 and June 1883, Davis and Furber of North Andover, Massachusetts, a major producer of automatic mules, sold approximately 1,060 of the new machines to factories located throughout the country. Only 29, however, were shipped to mills west of Pennsylvania.<sup>14</sup> As a further illustration, the *Textile Manufacturers' Directory* and the Davis and Furber records clearly indicate that within six years after the mule was placed on the market woolen mills in New England were converting to the new spinning device at a rate three times that of manufacturers in the Midwest.<sup>15</sup> To be sure, such reluctance by midwestern mills in part stemmed from their size, since the tendency to convert to the latest machine technology bears a marked relationship to the firm's capital invest-

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<sup>12</sup> W. Paul Strassman, *Risk and Technological Innovation: American Manufacturing Methods During the Nineteenth Century* (Ithaca, New York, 1959), pp. 98, 104-106.

<sup>13</sup> Merrimack Valley Textile Museum, *Wool Technology and the Industrial Revolution* (North Andover, Massachusetts, 1965), pp. 50-52. Machinery prices of course varied with the model and quantity ordered. The cost difference of \$300 between an automatic mule and a hand-operated jack was calculated from the Davis and Furber sales records, 1870-1880, in the Merrimack Valley Textile Museum. The author is indebted to Helena Wright and James Hippen of the Merrimack Valley Textile Museum for making these records available.

<sup>14</sup> Davis and Furber, *Mule Specification Book*, July 1874-June 1883, in the possession of the company.

<sup>15</sup> *Textile Manufacturers Directory of the United States, 1880* (New York, 1880)

ment.<sup>16</sup> A further comparison between large and small factories in New England (mill size relative to the use of jacks or mules) suggests, however, that the structure of the market in the Midwest represented a significant factor there in the inclination to retain the older, hand-operated equipment.<sup>17</sup> As late as the 1890s, mid-western manufacturers continued to advertise in textile trade journals and in local newspapers in hopes of locating skilled jack spinners, and the machinery inventories in extant company records attest to the fact that all but a handful of mills in the Midwest disregarded the new technology.

Theoretically, in a market characterized by perfect competition, the knowledgeable manufacturer in the Middle West would have continued to employ the hand-operated jack as long as the price of the output emanating from the machine remained above the variable cost of its use. His virtual isolation from both internal and external competition placed no demands on the pioneer mill owner to adopt the newer equipment. The effective working life of most textile appliances under ideal conditions seldom exceeded thirty years,<sup>18</sup> but nothing in the local market indicated to the midwestern producer that he should buy an up-to-date machine rather than completely overhaul his old one or purchase a similar second-hand model. Imperfections in the market led to differences in the cost of inputs in each region of the United States and, in the short run, the new technology might not have proved superior for mills operating in the Midwest.<sup>19</sup> Manufacturers in the region, however, suffered from a serious inability to perceive that their failure to keep abreast of the latest technology might hinder entrance into the national market at some time in the future.

Along with the actual movement of machines, the internal migration of labor frequently transplanted new technical ideas from one locality to another. When a northeastern textile worker joined

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<sup>16</sup> Edwin Mansfield, "The Speed of Response of Firms to New Techniques," *Quarterly Journal of Economics*, LXXVII (May 1963), pp. 309-311.

<sup>17</sup> *Textile Manufacturers' Directory of the United States, 1883* (New York, 1883). In 1873, Davis and Furber commanded the sale of a "self operator" costing \$300. When installed on a jack the apparatus made the machine automatic, thus eliminating the jack spinner. Correspondence in company records seems to indicate, however, that the self-operator failed to work efficiently on all spinning machines. The introduction of the automatic mule the following year made the device obsolete.

<sup>18</sup> George S. Gibb, *The Saco-Lowell Shops* (Cambridge, 1950), p. 535.

<sup>19</sup> As one might expect, an extensive search of extant company records failed to reveal any indication of a systematic depreciation of machinery by mill owners located in the Midwest.

the labor force of a woolen mill located in the Midwest he conceivably acquainted the management there with the latest innovations in machine technology. Yet from the very beginning midwestern mill owners experienced extreme difficulty in recruiting skilled workers from the northeast, and by the 1890s all but a few had abandoned such attempts in disgust. Pioneer wool manufacturers seemed unwilling or unable to offer the requisite inducements, including higher wages, in an effort to attract competent personnel. No doubt the intermittent nature of employment in most mills of the region, stemming from broken machinery, fires, inclement weather, and crop failures which influenced the local economy, discouraged most northeastern workers from migrating several hundred miles west to seek employment in the same industry. Moreover, it seems plausible that those skilled workers who moved to the Midwest contributed little to the advancement of textile machine technology in the region. Given the relatively high level of technology in wool manufacturing, the typical mechanic or machinist lacked the ability or training to construct a complete loom or spinning machine.<sup>20</sup> Indeed, most found it necessary to solicit specific step-by-step instructions from equipment manufacturers in the Northeast in order to repair a broken machine or to install a new one.

From 1880 to 1920 the midwestern economy experienced dynamic change. Tremendous population growth combined with an accelerated rural-urban migration to alter markets. Consumers in the Midwest enjoyed increased mobility through perfection of the interurban railway, and the advent of the automobile encouraged road construction and rural free delivery of mail. Mail-order houses, such as Sears, Roebuck and Montgomery Ward, brought the city as close as the small-town post office or the farm mailbox. And, as railroads corrected track-gauge differentials, transfer charges on eastern goods entering the region declined. In short, the Midwest joined the national market.

Pioneer wool manufacturers might have adjusted production and distribution to compensate for such changes had it not been

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<sup>20</sup> As a comparison, such was not the case in the automobile industry of the Midwest in its formative stages at about the time wool manufacturing in the region had started to decline. Given the low level of technology in that industry, several mechanics, working in small shops and barns, were able to design and construct crude yet workable automobiles. Thus the level of technology in a given industry in part determines the ease of transmission from one locality to another.



for three additional factors: the shift in consumer preferences from heavy, bulky woollens to lightweight worsteds for clothing; the movement of fine-wooled Merino sheep to the ranges of the Far West; and an increased demand for ready-made wearing apparel.<sup>21</sup> Under these conditions some midwestern mill owners revamped machinery and techniques and attempted to supply garment makers in New York and Philadelphia or concentrated production on an item such as blankets which seemed less affected by the caprices of fashion. But only a few followed the example of William Whitfield of Lanark, Illinois, who moved his mill machinery to a new building in Big Timber, Montana, and became the plant manager of a small textile factory there.<sup>22</sup> Most chose to sell their equipment at public auction and to go out of business. In the thirty years from 1870 to 1900, approximately seven hundred woolen mills in the Midwest ceased production.<sup>23</sup>

As the number of factories in the region dwindled, businessmen in towns west of the Missouri River opened negotiations with mill owners in the Midwest to relocate idle factories or to sell the machinery from them in one lot. Typically, Chambers of Commerce in Dallas and Astoria, Oregon, and in Florence, Colorado, actively bargained with midwestern mills during the summer and fall of 1901.<sup>24</sup> Secondhand carding machines, looms, and spinning jacks, many of which had been purchased in the early 1870s to equip midwestern mills, were sold off after 1890 to firms located farther west.<sup>25</sup> The brief notation in *Fibre and Fabric* in June, 1896, that seven carloads of used textile equipment would soon pass through Topeka, Kansas, by rail typified the movement of such machinery into the Far West.<sup>26</sup>

As population continued to move westward, the residential stage of manufacturing repeated its previous development in each new area during the period when population was dispersed and internal transportation primitive. Operating within the constraints of the rural, small-town environment of the Midwest, businessmen

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<sup>21</sup> Herman F. Michl, *The Textile Industries, An Economic Analysis* (Washington, 1938), pp. 197, 220, and Paul I. Cherington, *The Commercial Problems of the Woolen and Worsted Industries* (Washington, 1932), discuss the basic problems facing all wool manufacturers in the 1890s.

<sup>22</sup> *Textile World*, XIX (October 1900), p. 671.

<sup>23</sup> *Census of Manufacturers: 1905, Textiles, Bulletin 74*, pp. 134-136.

<sup>24</sup> *Textile World*, XX (June 1901), 1151, XXI (September 1901), p. 547.

<sup>25</sup> For specific examples, see *Textile World*, XIII (December 1897), p. 105, XXIII (December 1902), 1160, XXIV (February 1903), p. 339.

<sup>26</sup> *Fibre and Fabric*, XXIII (June 6, 1896), p. 3.

in the region selected only those aspects of eastern technology which assured them of short-run profits in the local market. Buffered from heavy competition in the sale of low-value goods, that market offered no incentives to experiment with new techniques in the production of woolens. Indeed, in its early stages the westward movement can be said to have directly contributed little to the growth of American machine technology in the woolen industry, and, in fact, encouraged the utilization of obsolete equipment discarded by manufacturers located in regions possessing a higher level of economic maturity.<sup>27</sup>

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<sup>27</sup> It might be argued that the westward movement indirectly contributed to the *rate* of growth in machine technology in the Northeast by offering a market for service on obsolete machinery. In addition, it laid the foundation for a consumers market for finer grades of woolen fabrics as transportation and other factors destroyed the advantages once held by producers in the Midwest.