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Philadelphia: The American Industrial Center, 1750-1850

EVEN THE MOST SCHOLARLY historians are influenced by where they have lived and the records they have used. Until recently Englishmen dominated the writing on early industrialism or the so-called Industrial Revolution, and New Englanders emphasized their contributions to the early industrialism in the United States. Consequently, these historians, beginning in the nineteenth century, formed a picture of industrial development as emanating from England to a relatively backward world; in America, English technology supposedly found its first congenial environment in Massachusetts and Southern New England. These beliefs were re-enforced by contemporary foreign commentators. Since Boston is the nearest to Europe of the major east coast ports, early visitors from abroad tended to land there, and if they reached as far south as Philadelphia at all, it was likely to be for only a brief stay. From these circumstances there arose a traditional belief that England, far in advance of other nations in commencing industrialization, depended vitally on the Watt's type of steam engine and Arkwright's textile machinery. The story, retold as recently as this year, insists that new machines only reached the United States a generation or more after their general use in Britain.[1] The

[1]David J. Jeremy, *Transatlantic Industrial Revolution: The Diffusion of Textile Technology between Britain and America, 1700-1830* (Cambridge, Mass., 1981); and Peter Lane, *The Industrial Revolution*, (New York, 1978).

legend continues that textile production in Massachusetts and Rhode Island in the nineteenth century marked the most important coming of mechanized industry to America.

Within the last generation each of these suppositions has been proven erroneous by students of early American industrial technology; but textbook errors and inherited beliefs tend to be perpetuated in one volume after another and to change only slowly. The present-day interpretation of American technology and culture holds that the general knowledge necessary for the improved industrial and transportation machinery introduced after 1770 was common to America, Britain and France, at least, and was in part shared by the Western European world. Depending largely on how its culture inspired mechanics, each nation developed machines suitable to its markets, geography and resources. British culture was more conducive to the emerging artisan-capitalist than French, and American culture much more favorable than either of the others. Americans, who highly respected the utilitarian, were by far the most ready to welcome physical change. They granted social prestige to successful mechanics, and also possessed vast resources that would richly reward technological advances. Consequently the Industrial Revolution, developing around the chief areas of urban business concentration, took different forms in each nation.[2]

In America of 1770 Philadelphia was the wealthiest and most populous city. Surrounding it from Wilmington north through Chester and Camden to Burlington and Bristol and west along the Schuylkill River to Phoenixville were shops and mills somewhat hampered before the Revolution by British colonial prohibitions on types of finished processing, particularly in iron and steel. Except for such British regulations, which included laws against corporate forms and banking, Philadelphia in the decade before the Revolution might have become the center of a more rapidly growing business area. A bank would have been promoted by Robert Morris, iron and steel manufacturers by several groups of capitalists, and canals and roads to the interior would have been undertaken had government assistance been possible. To this degree Britain gave herself a head-start through her various

[2]For further discussion see Thomas C. Cochran, *Frontiers of Change: Early Industrialism in America* (New York, 1981), Chapter 1; and *Pennsylvania: A Bicentennial History* (New York, 1978).

types of control or influence over colonial activities.[3]

The head-start was relatively unimportant in the long run, because the progress of machinery took different forms in the two nations. Each nation mechanized manufacture of the products for which there was a large supply of raw materials and demands for finished goods. In Britain the demand was for textiles for home and export, for machinery that would cut the costs of such goods, and for canals and highways that would facilitate their movement from manufacturing areas to seaports. In the Philadelphia area, flour was the chief export and wood products the second, both going to Europe and the West Indies as well as being in demand at home. Consequently, while Britain led the world in the first generation of textile machinery, the young United States led in the complete mechanization of flour milling, in wood working, and in river steamboats.

Steam has a varied history between the two nations. The practical steam engine of the eighteenth century was the Newcomen type useful chiefly for pumping, of which England needed many both for deep mines and the artificial creation of water power. In America or the United States mines were shallow and water power abundant. The Morrises used a Newcomen engine in a New Jersey mine in the mid-eighteenth century and one was installed in Philadelphia in the 1770's, but with abundant water power as near as Falls of the Schuylkill neither the city nor other Northeastern regions needed these antiquated, inefficient forms of steam, except for pumping city water supplies.

The same situation prevailed even after James Watt's improvements on the Newcomen engine from 1769 to 1784. His condenser, as well as rotary motion, which was also available on Newcomen engines, made low pressure steam tolerably efficient for directly powering a mill.[4] But in the United States water power was still much cheaper, once the installation had been made.[5] The contribution of Philadelphians interested in steam chiefly took the form of designing engines for transportation.

[3]Prior to the Revolution, Benjamin Franklin said, "I do not know a single imported article into the northern colonies, but what they can either do without or make it themselves." Quoted in Victor S. Clark, *History of Manufactures in the United States, 1607-1860*, I, 211. For more on Philadelphia business activity see Clarence Ver Steeg, *Robert Morris, Revolutionary Financier* (Philadelphia, 1954).

[4]John Kanefsky and John Robey, "Steam Engines in Eighteenth Century Britain: A Quantitative Assessment," *Technology and Culture*, 21 (April, 1980), 161-186.

[5]See Louis C. Hunter, *Water Power: A History of Industrial Power in the United States, 1780-1930* (Charlottesville, Va., 1978).

An interesting example of how the improvement of steam engines grew from "state of the arts" in the Western World is that Philadelphians John Fitch and Oliver Evans designed engines without ever having seen a Watt type, or perhaps even a Newcomen engine.[6] Fitch with the help of a Dutch clock-maker built several double-acting Watt type engines for boats on the Delaware from 1787 to 1790, but lack of enough speculative local capitalists to finance larger boats and intense stage coach competition along the level banks of the river, prevented his commercial success. Evans, as we shall see shortly, pioneered high pressure engines that opened the great interior water ways to steamboats.[7]

As a final note to the early phase of steam: Watt's low pressure condensing engine, representing about a quarter of the steam engines in England by 1800, was used relatively less after that date, and the new high pressure engines, first put on commercial sale in Philadelphia in 1802 by Oliver Evans, became the prevailing type. It is hard to determine whether Watt ever contributed anything to the rise of industry in Philadelphia or, for that matter, anything essential to industry in Britain.

Assigning proper influence to steam engines has taken us ahead of the general account of Philadelphia as an industrial center. In spite of interruptions from the Revoluntionary War such as British occupation in 1777 and 1778, Philadelphia and its immediate area continued to grow rapidly.[8] Either by handwork, as in textiles and chemicals, or by machines in metal or wood products, the people of the eighteenth-century city worked primarily at manufacturing. While profit from off-shore trade remained important, particularly during the European wars from 1793 to 1807, the real stimulation to industrial growth was trade with the immediate hinterland, which meant bringing iron, food, wood and leather to the city and taking home Philadelphia's manufactured products. Diane Lindstrom sees this "East Coast Demand" model as true for the first half century of national life in all the ports of the Middle States.[9]

The growing city needed more building materials for both ships

[6]Frank D. Praeger, ed., *The Autobiography of John Fitch* (Philadelphia, 1976), p. 9.

[7]Eugene Ferguson, *Oliver Evans* (Wilmington, Del., 1981).

[8]James T. Lemon, *The Best Poor Man's Country* (Baltimore, 1972), 123.

[9]Diane Lindstrom, *Economic Development of the Philadelphia Region 1810-1850* (New York, 1978), 9.

and houses than any other non-edible products, and proportionally far more than were needed by the built-up cities of Europe. So it is not surprising that machine-made nails appeared in the late 1790's, that circular saws soon cut timbers and siding, and that the screw augur was invented. To the British, all of these devices remained unused curiosities. Building construction remained the chief form of American capital investment throughout the nineteenth century.

As a rapidly growing center of trade and industry, Philadelphia needed means for raising working capital for its expanding business. The result was the initial use of the "modern" corporation for private purposes. The corporation had as early as Roman times facilitated government participation in semi-public ventures such as distant foreign trades, roads or harbor improvements. But such traditional use was different in kind from that of a group of merchants starting a joint-stock insurance company in Philadelphia in 1751, or a later group successfully petitioning both Congress in 1781 and the Pennsylvania State legislature in 1782 for a charter for the Bank of North America, a profit-making privately owned corporation. This innovation of using the corporation as a means of gathering together the savings of many investors for large private enterprises was a creative business adjustment to the need for large amounts of capital. More perhaps than elsewhere in the world, Philadelphia's entrepreneurs dreamed of roads, canals, mills and factories that only awaited the needed financing. The initiation of the corporate device was symbolically the most important economic advance in the City's history.

The ease with which states chartered banks and other corporations illustrates the flexibility given by small legislatures, each anxious to advance its own state in competition with its neighbors. The Bank of North America on Chestnut Street in Philadelphia was the first commerical bank in the world to be chartered by government for private business interests. Corporations for hard-surfaced roads, insurance, and industrial ventures soon followed. The growing market for corporate securities led to the first American stock exchange. Ten Philadelphians who wanted to specialize in corporate and government stock trading met at the Merchants Coffee House in 1791, organized a Board of Brokers, and elected Mathew McConnell president. Six years later they organized a more strictly governed group with an entrance fee for permission to "trade on the floor."

The Old World suspicion of corporations other than those for public works suggests a continuing one-way only aspect of trans-Atlantic communication. Since Americans were, in general, ready to try anything new, there was a continuous westward transmission of both old and new technological and business ideas, often carried personally by emigrants. In contrast, Britain was relatively set, traditional and secretive in its ways, and did not need skilled artisans from the United States. Usually Britain sought to advance productivity by more minute division of skilled labor, America by more machines. Evans failed to market his flour milling machinery, Rumsey his steamboat. Several men could not interest the British in cut nails or improved carding machines. Few American machines, even if promoted by their inventors, met a warm reception in England, or if made use of, the new knowledge was carefully guarded. The public flow of knowledge eastward therefore appears small. In addition to the business corporation, improvements in milling machinery, factory-made nails, ring spinning, leather belting in place of gears, power saws and other technologies — all met British resistance and were adopted there only after they had been used in the United States for many years or even decades.

The rising wealth and population of its fertile and forested back-country trade area fed the continued growth of Philadelphia. While canalizing the Schuylkill River and connecting it with the Susquehanna had been discussed since pre-Revolutionary days, the first new link with the hinterland was the Philadelphia and Lancaster turnpike, a British type hard-surfaced road built by a Pennsylvania corporation chartered in 1791. Within four years, under the presidency of able financier William Bingham, the road was completed to Lancaster, and even after paying at many toll gates, the cost of moving goods from there to Philadelphia was reduced by two-thirds. Similar roads pulled New York, Trenton, Philadelphia, Chester and Wilmington together. In fact, as we have seen, the stage coach competition on both sides of the lower Delaware was so strong that passenger steamboats could not meet it until after Robert Fulton's success with a boat on the Hudson, a boat far bigger than John Fitch could ever finance. The band of factories from New York and northern New Jersey to Wilmington, Delaware gradually became in the mid-nineteenth century the greatest industrial complex in the world. In no other industrializing nations

were there two cities as big as New York and Philadelphia only 80 miles apart. By the late eighteen-thirties, when the two big cities were connected by canals, imports from overseas came to Philadelphia through the port of New York, while machinery, iron, coal and various manufactures moved north from the lower Delaware. Such an industrial axis builds upon itself, developing better machines and methods until by 1840 it was probably the world center of mass production. The area has, of course, retained much of its importance even in later periods in a much larger United States.

Perhaps because of lessons in the need for cooperation in settling a wilderness, Americans have always readily joined together for common ends. To encourage agricultural improvement, manufacturing, and trade Philadelphians and others formed societies. There was the old and honorary American Philosophical Society "for the promotion of useful knowledge," the Society for the Promotion and Improvement of Roads and Inland Navigation, and the Pennsylvania Society for the Encouragement of Manufactures — all meeting in the city during the eighties. The last mentioned of these organizations built a spinning mill in 1787, but when it burned in 1790, it was not rebuilt. With intense competition from well-developed household manufacture and hand spinning and weaving in small "factories," Philadelphia was probably the most difficult area in the nation for the introduction of machine processes in cotton factories. It should be born in mind that the intense British competition before 1812 was in hand woven fabrics, and very largely in such fabrics up to 1820.

While Philadelphia was to remain the chief textile city of America, turning out yarn, print goods and carpets, the exciting developments of the turn of the century were in flour, paper, ships and highly varied metal machinery from printing presses to steam engines. In the 1790's the nearby Brandywine valley with some 60 mills, producing textiles, flour, paper, processed iron and wooden parts, was called by a Boston Gazeteer the center of American industry.

Of the various technological innovators between the Revolution and the War of 1812, Joshua Humphries, Nathan Sellers and Oliver Evans are among the most interesting. These men were not trained scientists but essentially artists working with wood and metal to build useful machines which gave them an aesthetic pleasure akin to that from creating sculpture or painting. Philadelphian Robert Fulton

actually painted and sold miniatures and other pictures, rather second rate productions, before turning to boat machinery and submarines where he was far more successful.

The British sinking of the American ships in the port of Philadelphia in 1777 and 1778 gave local ship designer Joshua Humphreys the opportunity to take the lead in building vessels of new design that were broader of beam with less superstructure and depth, and carrying more sail in relation to tonnage and manning. Humphrey theorized, when he sold the new national government the naval vessels, that if the United States did not have a big navy, it must have a fast one so that the choice of fighting or running safely away would rest with the Americans. One of the merchant ships of his type, the "Rebecca Sims", built in 1801, sailed from the Delaware Capes to the Mersey river on England's west coast in 14 days, a lasting record for sail.

Nathan Seller illustrated "America's . . . . strong romatic and emotional . . . involvement with its technology."[10] He tried to improve whatever mechanism or process he turned to. In the 1780's he invented a better straightening board for paper making, as well as the process of annealing brass and iron, not copied in England for nearly a generation. The continuous improvements in metal working of men like Sellers, while not spectacular in single instances, kept Philadelphia in the forefront of the industry here and abroad.

For both brilliance and versatility Oliver Evans outranks the other inventors of his generation in the United States, and, some scholars would argue, in the entire world.[11] Born into a literate family of farmers and artisans near Newport, Delaware, in 1755, Evans attended school until he was fourteen and continued to read all he could find about machines. In 1772 while apprenticed to a wagon-maker, he designed a condensing steam engine. Not surprisingly, this seventeen-year-old boy failed to find backers. In 1780, after an unsuccessful attempt to introduce new wool carding machinery, he joined his brothers in a flour mill near Wilmington. Within five years he had installed machinery run by water power and transmitted by leather belts that completely automated the production of flour from wheat. This step forward in the world's chief industry, patented and increasingly used

[10]Eugene S. Ferguson, *The Americanness of American Technology* (Wilmington, Del., 1975), 2.

[11]See Eugene S. Ferguson, *Oliver Evans*; and Greville and Dorothy Bathe, *Oliver Evans* (Philadelphia, 1935).

from 1791 on, seems, at least, to rival Watt's improvements on the steam engine. Evans' chief claim to fame, however, is not so much the fact that he increased the productivity of flour mills, but that he "practically initiated the modern science of handling materials," and achieved the American ideal of complete automation.[12]

By the mid-seventeen-eighties Evans had also designed a high pressure steam engine that he hoped to use in road vehicles. Both Maryland and Pennsylvania gave him patents on the flour machinery, but only Maryland on the road vehicle. Having moved in the late eighties to Philadelphia, he was selling various machines, but had only enough money to experiment with and gradually perfect small stationary steam engines. At his works at Ninth and Market Streets from 1803 on he pioneered commercial sale of high pressure steam engines for all purposes, shortly before Richard Trevethick and others did in Britain.

During these years Evans wrote the *Millwright's Apprentice* (1795), a standard text for the next half-century, and the *Young Steam Engineers Guide* (1805) which preceded British writing on the subject. Meanwhile he invented machinery for artificial refrigeration, central heating, air conditioning and many other improvements which he did not vigorously promote. In 1805 he successfully drove a steam propelled vehicle through the streets of Philadelphia and was prepared to build steam trucks. Five years later he offered to put all his money into a steam railroad, but cautious investors were not interested in financing either development, and as late as 1816 he was futilely seeking help from Congress. English capitalists with far more wealth, were no more venturesome in their own country. Evans' Mars Works turned out engines for all sorts of in-city industrial uses and for steamboats. His son opened a plant in Pittsburgh in 1812 that supplied high-pressure engines to boats on the vast interior river systems. In all these developments there is no evidence of direct transfer of ideas from England.

By the early nineteenth century there was a self-accelerating effect on industrialism in Philadelphia where many machine shops were within half a dozen blocks of each other. While there was no machine tool industry as such, the specialization was accomplished by parcelling out work to the shop with the proper machine. From continuous conversation between the master mechanics, and a lack of the secrecy

[12]Joseph Wickham Roe, *English and American Tool Builders*, (New Haven, 1916), 246.

that hampered Britain, came continuous improvements in tools, materials and processes. Although lacking in the old city, water power was nearby within Philadelphia County. Josiah White in 1809 built a plant at Falls of the Schuylkill (then a village) to make nails, wire, and later, screws. This factory is said, probably inaccurately, to have had a rolling mill from the start.[13]

There was an old belief expressed in the French Physiocratic doctrine that only agriculture was truly productive and that manufacturing and trade were parasitical. Recent study has not substantiated the widespread extent of this belief in America. Jacob E. Cook, working from the Tench Coxe papers (at the Historical Society of Pennsylvania) says that Hamilton in his famous *Report on Manufactures* was arguing for their value against "non-existent opponents."[14] In 1795 Coxe broke with Hamilton over the latter's support of merchants importing British manufactures.[15] Over a century earlier Charles V. Hagnar had written in a neglected book: "Thomas Jefferson . . . a personal friend of my father . . . indoctrinated him with the manufacturing fever."[16] The father started a cotton mill at Falls of the Schuylkill about 1790. If there were any generally held belief dangerous to early manufacturing, it seems to have been over-optimism about the productivity of machines. For example: Tench Coxe, a hard-headed merchant and land investor as well as an economic thinker said in a speech in Philadelphia in 1787 that he visualized factories practically without workers except for the preparation of materials and supervision.[17]

From the war of 1812 to the severe depression that started in 1839, Philadelphia remained the national center of industry. In the years from 1830 on growth was additionally stimulated by the anthracite local trade, the manufacture of railroad equipment and iron ships. These new businesses added to Philadelphia's continuing leadership in almost the whole range of manufactured products and the machines for making them. 1839 is a logical terminal date for ending this

[13]See Charles V. Hagner, *Early History of the Falls of the Schuylkill, Manayunk, and the Schuykill and Lehigh Navigation Companies* (Philadelphia, 1869).

[14]*Tench Coxe and the Early Republic* (Chapel Hill, 1978), 186.

[15]John R. Nelson, "Alexander Hamilton and American Manufactures," *Journal of American History*, LXV (March, 1979), 978.

[16]*Early History*, 33.

[17]John E. Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776-1900* (New York, 1976), 29.

discussion because in the ensuing decade of phenomenal growth the railroad and better connections by water brought the plants of the corridor of cities from Wilmington to New York into such close relations that to label either of the nation's biggest cities the "center" of industrialism becomes meaningless. Philadelphia and New York were, except for their own metropolitan areas, each other's best customers.

The First and Second Banks of the United States made Philadelphia from 1791 to 1836 the official banking center of the nation. Each of the United States banks was associated with an unusual character. Stephen Girard, a humorless, calculating Philadelphia merchant, born in Bordeaux, became the largest private stockholder of the First Bank. When its twenty-year, Congressional charter was not renewed in 1811, he bought the bank's building on Third Street, liquidated its affairs, and opened his own private bank. Harassed by the chartered banks that resented the intrusion of this millionaire in their market, he became a mainstay of Federal finance during the war of 1812. By 1816 the chartered banks, in order to resume specie payments, had agreed to accept his notes. When Girard died in 1831, he left six million dollars — all for charitable and public purposes — the largest estate in the nation's first half century.

The near breakdown of federal finance in the War of 1812 enabled Girard, with the help of John Jacob Astor of New York, to persuade Congress to charter a Second Bank of the United States with its head office in Philadelphia, for which a handsome classic building was constructed on Chestnut Street near Fourth. After some initial difficulties, the Second Bank came in 1822 to be managed by Nicholas Biddle of an old Philadelphia merchant family. Poet, essayist, and editor, Biddle readily mastered the banking knowledge of his day, and made the Bank of the United States as near to being a national central bank as its charter permitted. As one might guess, this cultured aristocrat was anathema to Old Hickory and vice-versa. President Jackson vetoed the re-charter of the bank, and in 1836 Philadelphia lost its favored financial position.

Industry grew, however, more from the private investments of merchants and landlords than from public issues of stocks marketed by bankers. The state law allowed chartered banks to invest in stock and mortgage bonds; private bankers such as Thomas Biddle or Ste-

phen Girard passed on securities to their customers, but there was no formal underwriting of whole issues by banking syndicates. In spite of this unorganized market, it seems doubtful that conventional Philadelphia ventures suffered from lack of capital resources. Projects that were held back such as steam vehicles or railroads illustrated chiefly the investors' fear of unknown risks. Many canals to connect the City with New York and Baltimore came from private, government, and local subscription, but the giant and risky venture of a rail and water connection to Pittsburgh had to be state financed.[18]

The timing of this Mainline system is dramatic. A Pennsylvania Society for the Promotion of Internal Improvements, formed in Philadelphia in January 1825, promptly sent master mechanic William Strickland to England to study railroads. During that year the short Stockton and Darlington line was completed, but George Stephenson's locomotive was used only on a level stretch. Strickland brought home a working model of the locomotive and in 1826 published *Reports On Canals, Railways, Roads and Other Subjects* that proposed to build a railroad differing from the British design. Two years earlier the state had created a Pennsylvania Board of Canal Commissioners to study the building of canals and or railroads from Philadelphia to Pittsburgh. The problems involved in a 300 mile road over the mountains were unknown but obviously very different from conditions in England. The difficulties of canal construction along the Juniata and the rivers west of Johnstown were similar to those already successfully met with on the Erie, the great school for canal engineers.[19] A short but steep haul of a few miles over the inescapable central ridge of the Alleghenies could be handled by stationary steam engines hauling cars up and down on track, as in Europe. On the 80 mile stretch from Philadelphia to the Susquehanna a railroad could be tried. As of 1828 this entire route was the conservative and only certainly possible one, and, after much public debate, it was adopted by the legislature.[20] A year later Stephenson's new "Rocket" in England went up a steep grade and proved that steam engines on rails had adequate traction for hilly country. So it seems possible that had the Harrisburg decision been

[18]See Louis Hartz, *Economic Policy and Democratic Thought Pennsylvania, 1776-1860* (Cambridge, 1948).

[19]See Elting E. Morison, *From Know-How to Nowhere* (New York, 1974).

[20]See Julius Rubin, *Canal or Railroad? Imitation and Innovation in Response to the Erie Canal in Philadelphia, Baltimore, and Boston* (Philadelphia, 1974).

put off for even one year, the Mainline might have been a railroad from beginning to end. As it was, the all rail section from Philadelphia to Columbia on the Susquehanna, finished in 1834, was the longest "trunkline" (a through connection between two major shipping areas) in the United States. The entire Mainline was opened later in the year.

Even while railroads were slowly beginning their spread from 1830 on, canals were being built all over the Middle States and the Middle West, largely with state funds. This money came in good part from selling state bonds in England, and the drying up of this foreign credit after 1836 was one of the causes of the business collapse in 1839. Railroads also received large amounts of state and local aid, but British and European investors were scarcely involved in railroad bonds before the late eighteen-forties.

While industrial growth within Philadelphia County came in a wide variety of products, particularly textiles including carpets, rope and twine, construction materials, paint, pharmaceuticals, printing equipment, iron castings, pipes, and machinery, the most innovative growth of the 1830s was in railroad equipment and the machines for making it. Mathias Baldwin illustrated how the general skills of the American master mechanic allowed him to adjust quickly to new demands. His experience had been in calico printing and other machinery, including a model locomotive for Peale's Museum. When the Philadelphia and Germantown Railroad asked him for a full-sized engine in 1832, he had no hesitation about building a locomotive that proved satisfactory. The efficiency of Philadelphia shops at this time is attested by a leading English manufacturer who told George E. Sellers of Philadelphia that he thought he could show him a shop in England that had at least abandoned old fixed ways "if it has not kept up with America."[21]

William Norris started building locomotives in 1832 just a short distance from Baldwin's shop. The superiority of Philadelphia design for lightly constructed roadbeds with sharp curves is indicated by the fact that of the first 145 locomotives made in the Norris plant 41 were sold abroad. By the end of the thirties, Baldwin, the major worldwide improver of locomotive design during the thirties, was selling engines in Britain.[22] In the continued surge of railroad building from

[21]Eugene S. Ferguson, ed. *Early Engineering Reminiscences of George Escol Sellers (1815-1846)* (Washington, 1965), 126.

[22]John W. Oliver, *History of American Technology,* (New York, 1956), 187. Oliver says that from 1820 to 1870 "steam development in all its phases was more advanced in the United States than in all Europe," 201.

1830 to 1854, Philadelphia and its area supplied most of the equipment, except for tracks. Railroad rails were exempted from tariff duties in 1832, and British coke-processed rolled iron was cheaper than American iron smelted by charcoal and hammered by water power, although the latter was preferred by Baldwin and other makers of machine equipment.

In the 1820's what had earlier been small shops within the city, clustered close to Front Street, each employing only 20 to 40 men and supervised by their proprietors, as at Evans Mars Works, grew bigger. Needing more land, they moved north and west — although mostly within the Old City; in fact, Stephen Morris still had an iron foundry at Third and Walnut Streets in 1828. Single proprietors took in partners who divided management duties between them, and the larger machine shops with up to 2,000 employees by 1835 needed well-paid departmental supervisors.[23] Sellers and Pennock, selling fire engines for both the domestic and export trade in the eighteen-twenties, used the term "senior workmen" rather than "supervisor," a concession to democracy that did not establish a lasting pattern.

As the center of scientific and technical thought from Benjamin Franklin's time, the emerging industrial metropolis became a place for new ideas of every kind, but particularly for those with practical aspects. Near the non-sectarian pre-Revolutionary University of Pennsylvania a College of Pharmacy was established in 1820. One year earlier an Apprentices' Library had opened a public reading room. In 1824 leading manufacturers and technicians such as Matthias Baldwin, Franklin Peale and James Sellers formed the Franklin Institute to advance understanding of science and technology. "The central and chief concern of the . . . . exhibitions from 1824 to 1838 was to advance the technical level of manufacturing skills, to increase the use of mechanical power, and to develop mineral resources."[24] The institute offered prizes for innovations such as the smelting of iron with anthracite coal (achieved commerically in 1839) and has published a Journal from 1826 to the present. To promote the interregional interests of the city, Philadelphia merchants established a Board of Trade in 1834.

While business men still read the half dozen six-cent daily papers, largely devoted to mercantile news, a one-cent popularly oriented

[23]Albert S. Balles, *Industrial History of the United States* (Norwich, Conn., 1878), 231.
[24]Bruce Sinclair, *Philadelphia's Philosopher Mechanics* (Baltimore, 1974), 80.

newspaper was first tried in Philadelphia in 1830. This initial effort was not profitable. The paper that succeeded and attracted nation-wide attention was the *Sun* started three years later in New York City.

One should not form an idealized picture, however, of Philadelphia in the second quarter of the nineteenth century. While its wide main streets, public buildings, business offices, hotels and taverns might seem superior to those of other American cities, the alleys in back had as crowded and unsanitary housing as elsewhere in the nation. Philadelphia was, after New York, the chief port for immigrants, who initially could not afford good living conditions. They also were a part of the large population that tended to be transient. Regarding the particular members of the poor as not "always with us," the custodians of relief were anxious to speed them elsewhere rather than to grant relief adequate to the demand.[25] Low-lying land penetrated by inlets such as Dock Creek made for bad sewage conditions, and there were no public health authorities. Volunteer fire companies were highly unreliable and police protection rudimentary.

Before 1835 the city had no public schools, and tuition in private schools was paid by the state only for the parents who would swear they were paupers. As a result education continued, as it always had been, to be a family affair; literate families producing literate children and illiterate families perpetuating their ignorance. When a short-lived Working Man's Party was formed by skilled artisans in 1827, it initially put more emphasis on free education than higher wages.[26] In 1834, after years of disagreement, the Pennsylvania legislature passed a public school bill on a local option basis. Under this law the city opted for a school board and school taxes, while the country areas tended to go on as before. Yet the value of education for designing and operating the relatively simple technology of early industrialism can be over-emphasized. Perhaps more important was the cultural bias, noted by a British observor in the mid-thirties who remarked: "In that knowledge . . . . which the individual acquires for himself by actual observation in the ordinary avocations of life, I do not imagine the Americans are exceeded by any people in the World."[27]

In spite of more and more crowded and unsanitary houses there was

[25]Priscilla Ferguson Clement, "The Welfare Crisis of the 1820's," *Pennsylvania Magazine of History and Biography*, CV (Apr., 1981), 150-165.

[26]See Bruce Laurie, *Working People of Philadelphia 1800-1830*, (Philadelphia, 1980).

[27]Thomas Hamilton, *Men and Measures in America*, (Edinburgh, 1843), 74.

a continuing increase in real wages for both unskilled and skilled workers. Stanley Lebergott estimates the average real wage increase in the nation at about half a percent a year from 1820 to 1850 for the unskilled, and more for the skilled worker. Jeffrey G. Williamson would put the total increase for the unskilled at as much as sixty-two percent from 1820 to 1840.[28] Ironically, since many wages tended to be traditional and slow to change, employed workers were best-off in periods of falling prices, as 1839-42, and worst-off at the height of boom periods as 1834-37. From Colonial days on there had always been a fluctuating group of unemployed, and as time went on their lot was less rather than more alleviated by City agencies. But in view of the general hardships of eighteenth-century families it is difficult to say whether industrialism made poverty less bearable. The line between deprived and comfortable skilled and unskilled workers was always indistinct. Many skills such as hand-weaving were easy to learn while serving a brief term in jail for indigence and disorderly conduct.[29] As work shops expanded into mechanized factories, the old definitions of "skill" often became meaningless, and a good factory job might offer more security and chance of advancement than existed for the artisan plying a skilled trade such as shoe-making or weaving at home. The degree of skill was, of course, an important factor. In 1850 really fine handwoven cottons were still superior to those coming from automatic looms, and it is estimated that there were 2,000 male home weavers in Philadelphia.[23]

Railroads connecting Philadelphia with Baltimore, Lancaster, New York, and Reading built from 1834 to 1840 set the stage for the ending of the early period of industrialism. While railroad rates were substantially higher than those of canals, the saving in working capital from faster movement, and the cheaper costs of construction, particularly in hilly country were to be revolutionary.[31] For example, coal could come to Philadelphia from the anthracite fields on the Reading Railroad in some four hours as against four days by the Schuylkill

[28]Jeffrey G. Williamson, "American Prices and Urban Inequality since 1820," *Journal of Economic History*, XXXVI (June 1976), 313, 313n.

[29]Richard A. McLeod, "The Philadelphia Artisan, 1828-1850," (Ph.D. Dissertation, Univ. of Missouri, Columbia, 1971).

[30]*Ibid*, 2.

[31]For a somewhat contrary view of the effects of railroads in the 1840s, see Albert Fishlow, *American Railroads and the Transformation of the Antebellum Economy* (Cambridge, Mass., 1965).

canal. Hence the same capital could finance many times more goods in transit. As the telegraph spread in the late 1840's, the speed of transactions was again greatly increased in contrast to waiting for mail. Probably this dramatic increase in the tempo of business as much as the new factory technology accounts for "value added by manufacture" increasing from 1845 to 1854 at a rate never equalled before or since in American history.

While far less dramatic in effect, iron boats with screw propellors were perfected in Philadelphia area shipyards in the eighteen-forties. Starting with iron coal barges used after 1829 on inland Pennsylvania rivers and canals, iron proved its superiority over wood in providing more cargo space in relation to the weight of the carrier. By 1842 a line of iron steamers operated between Philadelphia and Hartford, Connecticut; two years later twin-screw iron river or canal boats were sent to an operator in New York City, and by 1850 iron propelled ships from Philadelphia were crossing the ocean, while New York was still using sidewheelers.[33]

With the demonstration of the long lasting heat produced by anthracite coal burned in iron grates, Philadelphia, as the chief port for the anthracite fields, developed a coal trade in the eighteen-twenties to all seaports of the nation. The proof in 1839 that eastern Pennsylvania's iron ore could be smelted with anthracite coal opened a new use for the latter, and relieved any danger of a shortage of wood for charcoal. For Philadelphia it meant an ever larger coal trade that was still growing in 1850. Coal made the Port of Philadelphia the national leader in volume of exports.

Coal and iron products illustrated how the New York and Philadelphia economies were woven together by specializations. In general New York processed goods that came to it by sea, principally sugar and molasses, carried on light industries, and made clothing. Philadelphia led in new metallurgy, engineering, heavy industrial products, textiles, paints, and pharmaceuticals. By 1850 the total manufactured products of New York and Brooklyn were worth more in dollars, but Philadelphia employed more capital and more industrial workers.

[32]Robert E. Gellman, "Gross National Product in the United States 1834-1909," in National Bureau of Economic Research, *Studies in Income and Wealth*, XXX (1966), 22.

[33]See: David B. Tyler, *The Amereican Clyde* (Newark, Del., 1958); and *Steam Conquers the Atlantic* (New York, 1939).

Except for their metropolitan areas, each city continued to be the other's best customer.

The area that by the 1854 consolidation of city and country was to become Philadelphia contained about half a million people.[34] It was bigger than any English city save London. The newly completed ten story Jayne building on lower Chestnut Street was the nation's only skyscraper, and the Penn Mutual building nearby one of the few iron frame and iron facade business structures. In other words, the industrial metropolis of mid-century was far from old-fashioned in appearance. The Pennsylvania railroad was about to enter Pittsburgh, buy control of the Pittsburgh and Fort Wayne, and establish routes to Chicago and St. Louis substantially shorter than those from New York. In finance, however, Philadelphia was distinctly in second place. In addition, more imports came through the northern port, and New York banks grew to finance trade. Furthermore, New York City capital, lacking attractive investments nearby joined that of Boston in going west, while the vast natural resources of Pennsylvania engaged Philadelphia money in the development of its own back country. Consequently, in the decades after 1850 New York and Philadelphia were to diverage more in interests and outlook than in the first half of the century.

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