

## The Radicals of the Industrial Revolution

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3/12/2006

Eli Whitney's goal as a maker of muskets was to make money at a time when his cotton gin business was tottering near bankruptcy. In 1797, twenty-eight of Whitney & Miller's gins were still, and they did not have enough money to send Whitney to England, even if it would mean that more English manufacturers would buy W&M-ginned cotton. The firm's credit was shot as a result of Miller's involvement in the Yazoo land scandal. Whitney had no great vision for changing the world; he wanted to get out of debt and into respectability.

His money-making method involved complex technology and simple finances. His technological innovation was the “uniformity system,” that is, the use of interchangeable, machine-made parts. It was not the world's first use of the uniformity system, nor the most thorough, nor even its first use in the manufacture of guns; Jefferson reported that “Leblanc, in France, had invented a similar process in 1788 & had extended it to the barrel, mounting, & stock....” Whitney used water-driven machines only to make the lock, which was the most complicated part of a gun and the part that, in the absence of machinery, required a smith. His system was unlike any methodology in any factory in America, and required years of labor on the part of an ingenious nation's most ingenious inventor. Combined with the faith and credit of the United States government, the system eventually saved money on each gun produced and brought the man out of the red and into the black. His ultimate goal never deviated from making money for himself (although, once made, he was a liberal lender); week and a half after the U.S. declared war on Great Britain, he wrote the Madison administration to suggest a contract “upon such terms as to afford a fair prospect of a reasonable profit for his labor.”

His financial methods were simple, almost embarrassingly so. Whitney took no partners and only two clients: the United States government and the State of New York. As much an operator as an owner, he ran only one shop because there was only one Eli Whitney to supervise it. A better-organized firm perhaps would have provided for the material comfort of endless generations of Whitneys, but his

simple arrangement was enough to keep his time occupied in his business until 1820, and by then he had accumulated enough wealth to see out his years in stature and comfort.

In contrast, Nathan Appleton's finances were complicated enough to be a job in itself. In 1815 he “found an interesting and agreeable occupation in paying attention to the sales” through B.C. Ward & Co. His understanding of the financial and organizational particulars of the Merrimack Manufacturing Company, taken together with his large share in the company, probably means that his use of the passive voice in *Introduction of the Power Loom* is hiding his own role. If so, he engineered the creation of a corporation, its distribution of stock, and its periodic re-capitalization in the form of new subscriptions. Furthermore, he was responsible for the handsome dividends that the company paid its owners. It is no coincidence that “The first dividend of one hundred dollars per share was made in 1825,” the same year that Appleton became President, and the dividends continued apace with the company's profits. Further investment in the company was made not by reinvesting profits, but by selling new subscriptions. Appleton's goal was to make a company that churned out cash, and he could do so—for a time—with the machinery of joint-stock ownership. So strong was his belief in this method that he wrote, “manufactures cannot be carried on to any great extent in this country in any other manner than”--not by factories, but--“by joint stock companies.”

This claim was disproved by the example of Alfred Houghton, who carried on his business with a nominally joint stock company, of which he controlled all but three shares out of three thousand. At first glance, he was like Whitney in that he “was” his company; but their similarity of methods stopped at their percentage ownership. Houghton was no inventor, and he had enough time on his hands to manage Arnold Print Works in addition to the Williamstown Manufacturing Company, several miles down the road. He sold not to one or two credit-granting clients, but to a wide market that would not pay a cent until the goods were delivered. Unlike Appleton, Houghton got some of his capital for W.M.C. by incurring debt in the form of mortgages on the property. To differentiate his methods from Merrimack even further, Houghton reinvested much of the profits into the company, rather than award himself dividends. He bought a steam engine for the plant in the 1880s. In 1904, he installed a larger

engine and added 131 looms. The money was coming out of profits, not new shares in the company.

Houghton's goal was to build a company that did not make cash per se, but *value*; that is why he continually invested profits into more capital and not coaches. He understood that the cash could come at retirement, and made arrangements so that operations could continue after he had sold out. In some sense, he vindicated Adam Smith's perception that a single owner is more likely to look after the long-term welfare of a company than many shareholders.

All three men wrought revolutions in their own spheres: Whitney transformed the techniques of manufacture, Appleton the modes of organization, and Houghton the methods of finance. These three disciplines—specifically, their practice on a large scale—together defined the Industrial Revolution, and so none of the men can be dismissed as extraneous revolutionaries.

How do we decide who was the most extreme radical? None had notable views beyond the world of business and technology, and so we are confined to examine their professional methods and influence. But looking at a modern manufacturing organization, we see their influences in roughly equal parts, and the methods taken to logical extremes: all components in a finished good are produced by machine, companies have thousands of shareholders and complex voting structures, and start-ups take on outside debt—in the tens of millions, during the dot-com era—before they produce any profit. It is almost as if we seek to know whether the agricultural, industrial, or information revolution was the most radical; they all have incalculably shaped the world we see.

The word *radical* itself may help; it derives from the Latin word for “root.” Even if the magnitudes of the Engineering, Organizational, and Financial Revolutions were roughly equal, or else incomparable, perhaps we can figure out which change was the deepest.

Whitney's Engineering Revolution is an appealing candidate because it concerns physical entities, which under a materialist worldview are more fundamental than abstractions (such as money). Whitney's new technical methods predated new financial methods, and did not need the financial innovations in order to exist, whereas the joint-stock machinery that Appleton championed, and the

high-risk methods that Houghton used, depended on Whitney's innovations; machines, and only machines, required so much capital under one roof, and gave such a big payout. If Whitney had not taken an analytical view of manufacturing and dreamt of large manufacturing scales, Appleton would have spent his days as a merchant, and Houghton a banker.

But we should not so easily dismiss the importance of institutions. Recall Jefferson's report of Leblanc, who had developed methods similar to Whitney's in France; in the absence of corporate organization and available capital, innovative technical methods die with the man. They would have died with Whitney, too, had not other people seen his armory, “stolen” his uniformity system, and received the investment to set up shops in other industries. He may have been onto a fundamental change, but it would have come to nothing without better ways of securing capital than the good will of Uncle Sam. Appleton's joint-stock methods made it possible to have a revolution in every industry, limited only by the existence of funds, rather than the lifespan and credit of a single man.

Then what do we make of Houghton's contribution? His operation was only one man deep, he pointedly refused to limit his liability, and he did not invent a damn thing. But his revolution was, in fact, the deepest. After Whitney and Appleton, the Industrial Revolution was in full swing, but its creations were hampered by the tendency of its genitors to die. As a result, Whitney Armory withered after 1825, and the owners of Merrimack were far more interested in their own earthly rewards—dividends!—than in the long-term health of the company. But Houghton created more than profit. He created a company, and he kept up investment so that it would stay valuable, even if it meant less cash for himself. As a result, it was easy to sell. Whitney revolutionized the way objects are made, and Appleton the way capital is pooled, but Houghton was a radical of the mind; he thought of a company as larger and longer-lived than its founder, thus removing the last stop from full efficiency, which is ever slowed by mortals taking their piece of the pie before it has finished growing. In this Christian, capitalist Republic, where the mind precedes the making in both time and importance, that change was the most fundamental.