An emphasis on the sources of invention and economic growth ruled the day mainly because engineers and economic historians (many of them economists) were the earliest scholars to take a serious interest in the history of technology. Quite naturally, the questions they posed reflected the interest of their professions. Readers learned much about the exploits of inventors, engineers and industrial leaders and how they built modern America. Conspicuously absent were the day-to-day experiences of working people and the roles they played in industrial enterprises.

The following essays represent attempts to right the balance by integrating the history of workers with the history of technology. The first selection, from Judith McGaw's *Most Wonderful Machine*, addresses the relationship between mechanization and work in the papermaking industry of Berkshire County, Massachusetts. In addition to noting the impact of mechanization on the health of workers and the pace of their work, McGaw discusses the gendering of technology within the industry's labor system. She argues that men's work tended to become mechanized while women's work did not.

The second essay, from Charles Dew's *Bond of Iron*, examines industrial slavery through the ironmaking operations of William Weaver at Buffalo Forge near Lexington, Virginia. Close scrutiny of Weaver's record books allows Dew to reconstruct the daily lives and labors of Weaver's slaves and so provide intimate details seldom available to historians. Dew argues that the possession of essential skills by slaves like Sam Williams and "Tooler" gave them a certain ability to ameliorate their condition, something that fieldworkers (the vast bulk of southern slaves) did not have.

The final essay, by Merritt Roe Smith, seeks some common patterns between free and industrial slave labor and finds them in the ways industrial workers accommodated to regimentation through the practice of on-the-job pacing, as well as in their communal activities outside the factory gate. Although outright violence occasionally flared within and around industrial workplaces, all three authors recognize—and emphasize—the daily, often covert resistances and reciprocal practices that existed between masters and workers in antebellum America.

Gender and Papermaking

JUDITH A. MCGAW

Several thousand men worked in the Berkshire paper industry between 1827 and 1885. Of necessity I have relied primarily on statistical summaries to identify who comprised the work force and how its composition changed over time. By itself, however, such an approach cannot answer the question "Who were the workers?" It automatically excludes from consideration salient but nonquantifiable characteristics. One of these—workers' pride—deserves special notice at the outset, because it pervades workers' correspondence and memoirs and should influence the interpretation we place on the quantitative evidence that follows. It was expressed most directly by Alfred Hoxie in 1930 as he recalled his fellow employees in the 1880s:

> The old paper makers took a lot of pride in their work. If a man was a machine tender he thought of course he was the big fellow in the paper business. Best paid job, and the skilled man. The loft man—[I] was a loft man. He took pride in that. They had learned their trade, and it was a matter of pride to them.

From Judith A. McGaw, *Most Wonderful Machine* (Princeton, NJ: Princeton University Press, 1994), pp. 282–283, 289, 296–297, 304–305, 309–311, 317–318, 322–324, 334, 337–353, 368–369.

Hoxie's recollection might be suspect as filtered through the haze of memory, but the same message reverberates in contemporary workers' correspondence. Writing from Bridgeport, Connecticut, in 1849, Charles Barnes informed the Cranes:

> I thank you for the offer which you have made me, but I must now decline accepting it, and as you have another person engaged to fill the place designed for me, I trust it will not be much of a disappointment to you that I refuse to accept.
>
> As to the other situation you mention, at Ballstown Springs [Ballston Spa] I would say that I consider it no compliment to be tendered such a one, under J.G. [the mill's sometimes drunken superintendent], a being with more tongue than conscience. It would be beneath the dignity of any man with a mind sensitive to attempted injuries, and that too without the least provocation.

Thirty years later, despite diminished prospects for advancement, A. M. Martin's letter from Holyoke sounds the same note of pride:

> Mr. S. R. Wagg informs me that you are in want of a first class machine tender and I having a good experience of 14 years on machine I think I could suit you in every respect. I do not get drunk and neglect my work and can say that I neither chew tobacco or drink rum. I am now to work for the Crocker Mfg. Co. Have been for the last year. One thing I will say two is that in changing orders I do not change as most machine tenders do at random or guess work but use figures to [do] it and there by know just what my machine is making per hour and also being very corect to weight in changing and starting on difrent orders. Can furnish you any amount of the best recomends in the hand. Should you feel like giving me a trial pleas state wages and if steady work etc. My object in changing is to better my self[.]

Writing from the same town two years later, Edward Breck expressed the same sentiment more succinctly: "This sheet I write on was made by my self." . . .

Mill owners . . . visited the mill, yard, engine room, and machine shop, . . . maintaining familiarity with all of the skills their diversified work force possessed. Their increasingly generalized knowledge contrasted sharply with their workmen's growing specialization. The divergence was especially noteworthy between owners and skilled paper workers, those workmen with whom owners had once held much in common. . . . [B]y 1885 most paper workmen no longer designated themselves "paper maker," the traditional term signifying training and expertise in all phases of paper manufacture. Only a small group of retirees used the term in preference to any other. Instead, over four-fifths (80.4 percent) of those specifying paper-making occupations identified themselves as possessing more specialized skills and knowledge. Paper workmen listed themselves as "machine tender," "back tender," "engineer," "finisher," "assistant finisher," "foreman of the drying room," "superintendent of the rag room," and so forth.

Workers' letters convey the same sense of specialization. Almost all asked for a specific job and those mentioning two positions usually indicated a preference. When enumerating their qualifications, workers listed their experience at a particular task far more often than any other trait. Some were even more specific, such as William P. Phair, writing in 1852, who had "attended Cylinder Machines on course paper"; James Lovell, who heard of a machine-tending position in 1870 and explained, "I have not been used to Cylinder Machines, but thinking it might be for the Fordrinier I concluded to write you"; or Walter R. Brooks, applying in 1872, who noted his

expertise at bank note paper making. Those few who claimed the broad experience of "a paper maker by trade" or "a regular bred paper maker" were atypical, such as Mr. Grady, an old man when he sought work in 1847, and Peter Sulivan, a newly arrived Englishman writing in 1881. More common were unemployed individuals who noted their special skills, but expressed willingness to perform other tasks. For example, Joseph Carroll wrote in 1871: "I am used to engines & finishing, but am not particular to making myself generally useful in the line of papermaking. I am just from England and am desirous of obtaining a situation as soon as possible."

. . . [I]nventors and developers of new machines most successfully replicated the manual skills of male employees: vatmen, couchers, layboys, loftmen, sizers, and some finishers, such as rulers. Thus, we might expect that, for men at least, mechanization altered paper mill work adversely. In some respects it did. Accelerating the trends that had originated in the hard-pressed hand mills of the 1820s, the adoption of new and improved machines subjected workmen to a more hectic pace, longer hours, and periodic unemployment. Moreover, unlike earlier paper makers, machine tenders and many of their fellow male employees risked being killed or maimed. Added to the workers' increased specialization and diminished prospects of social mobility, these changes further differentiated the work experience of worker and owner, in this case clearly to the detriment of the worker.

Yet we should not exaggerate the degradation of paper mill work in the wake of mechanization. As noted above, the men who tended paper mill machinery were highly skilled, proud, and often greatly in demand. During prosperous times especially, they capitalized on these attributes to bargain for steady work, more healthful conditions, higher wages, and promotion to supervisory positions. Also, most had only infrequent supervision, so that they could exercise some measure of control over their work. In addition, we should recall that employers had substantial incentives to eliminate or minimize the principal sources of unemployment: low water, equipment failure, fire, and depressed paper markets. And owners spent enough time in the mills to be aware of the hardships associated with long hours, dangerous machines, and unhealthful workplaces, so they generally improved conditions as they found themselves more economically secure. Of course, economic circumstances fluctuated with the business cycle and differed among firms, and so did working conditions.

The worker's situation also varied with his position, so that to visualize men's experience of mechanization, we must first look at the tasks they came to perform. Although machines most often assumed men's traditional paper-making tasks, they did not alter the terms of the sexual division of labor that had prevailed in the unmechanized industry. The new or modified work that men performed around machines bore fundamental similarities to the hand operations the machines superseded. Men continued to hold positions requiring long training, strength, or initiative and jobs conferring prestige or authority. Mechanization multiplied workers' output, changed their specific duties and transformed their working conditions, but it did not free mill owners from their dependence on workmen's skills and judgment.

. . . Machines did not replace workers, reduce their level of skill, or subdivide their tasks. Rather, as intended, mechanization multiplied the output of the limited number of skilled workmen. Eventually, by reducing paper's cost and abetting its more general use, mechanization also multiplied jobs for skilled paper workers, jobs filled by men trained while performing less skilled tasks such as backtender, engineer's assistant,

duster or bleach boiler attendant, and trimmer man. Of the new, non-paper-making positions added by enlarged mills, skilled occupations such as bookkeeper, carpenter, steam engineer, and machinist employed about as many men as did unskilled jobs such as ditch digger, teamster, and night watchman.

Although mechanization did not entail any profound redefinition of paper mill tasks, it did transform the conditions of work. . . . [W]hether or not they tended paper-making machines, all workmen experienced unprecedented pressure to keep the mill's expensive machinery fully employed. The result was a more hectic, less flexible work pace, the most pervasive and permanent deleterious effect of mechanization. Less common and shorter-lived indications that machine production affected paper mill work adversely were longer work days, periodic unemployment, and more dangerous and unpleasant surroundings. Skilled male workers experienced most of this deterioration in working conditions. . . .

Mechanization had a more direct impact on the atmosphere and safety of the workplace, especially affecting the industry's most skilled workers. In the early years, the odor of lard oil, the principal lubricant, and the smoke of kerosene or coal oil lanterns fouled the air over the long hours that unventilated machine rooms operated. Water evaporated from the paper on the machine and dryers and condensed on the cooler walls and ceilings. Some mills lined machine room ceilings with heated oils to reduce condensation, but others remained so damp that one worker seeking employment with Z. M. Crane explained, "My object in leaving this place is on account of the Room in which I work, it is verry wet and is ingering my health." After quoting his wages he concluded, "you see my wages is good—But money will not purches health." Engineers also endured wet working conditions, while rag room workers breathed in air filled with dust and lint from dusters and rag cutters.

In later years improved ventilation, heating, hoods over the machines, better lubricants, and gas lightning alleviated these problems. Mill owners also improved the cleanliness of their establishments. For example, in 1871 a *Scientific American* reporter found H. D. Cone's Housatonic mill so clean that he thought of "carefully removing all dust from his shoes before entering." Similarly, in their 1879 renovation of the Colt mill, Z. M. and J. B. Crane invested in improved sanitation by installing urinals, water closets, and copper-bottomed basins.

By contrast, nothing could be done to still the deafening noise that Fourdriniers and more numerous beaters brought to the mills' machine rooms and engine rooms. The many moving parts of paper-making machines forced machine tenders to shout when they needed to be heard over the continuous clash of metal against metal, a sharp contrast to the quiet conversation and easy jests the vat room had permitted. Louder talk had prevailed in early beater rooms as engineers seeking diversion raised their voices over the rumble of the rag engine, but as mills added more and larger engines, the thunder of the beaters reduced engine room conversation to a minimum. Also, while the rising tumult of their surroundings effectively isolated skilled male employees from life outside the mill's walls, machines incorporated more tasks and became more automated, making men's work more solitary.

The noise, isolation, dust, odor, and dampness of mechanized mills impaired workers' health and affected the quality of their working lives gradually and undramatically, attracting little contemporary comment. By contrast, the dangers of the new machines were highly visible. Any reader of the local press learned repeatedly of

their destructiveness of workers' lives and limbs. For example, in its first fifteen years (1857–71) the *Valley Gleaner* of Lee reported fifty-four paper workers injured on the job, eight of them fatally. Because men performed most mechanized work, almost all accident victims (87 percent) and all but one of those killed were men. Over two-thirds of these accidents were directly attributable to machine production, while the remainder involved construction workers and teamsters, whose work increased as mechanized mills grew and prospered.

Workers had to exercise particular care around the flying shafts and belts that transmitted power throughout the mechanized portions of the mill. The majority of fatalities and the second largest number of injuries occurred when the transmission system caught men's clothing or arms and they were drawn in and crushed, or thrown across the room. Accidents involving paper-making machines, rag cutters, and machine shop tools caused fewer fatalities, but affected more workers, most of whom lost fingers, hands, or arms. Boiler explosions and escaping steam injured the rest. In the worst instances, high-pressure steam scalded workers in one case fatally, while the force of explosions and flying debris cut and bruised others, including one man who was blown out a window by the blast of an exploding bleach boiler. By the 1870s and 1880s machine makers advertised safety features on cutters and trimmers, and experience with steam boilers made explosions uncommon, but the mill's principal machine and its transmission system remained hazardous. In sum, mechanization had transformed paper making from a relatively safe craft to a relatively dangerous industry. . . .

The absence of evident class consciousness is not surprising given the limited and gradual change in the relative status and comparative activities of workers and owners. Unlike industries in which factories superseded self-employed craftsmen or household manufacture, paper making had always taken place in mills that some men owned and in which others collected wages. Mechanization did not alter this situation; instead, emergent distinction in the tasks and prospects of employer and employed constituted changes in degree rather than in kind. For example, owners came to spend more time in the office and on the road, but they still learned paper-making in the mills and maintained familiarity with the workers and their work. Similarly, before the Civil War some workers still advanced to ownership and owners frequently failed and became employees. After the war workers continued to become owners, although those who bought Berkshire mills failed or held small workers' interests, and the numbers and ultimate fates of those who bought mills outside the county are difficult to ascertain. Moreover, mechanized paper making entailed long hours for owners as well as workers and subjected both entrepreneurs and employees to the uncertainties of a boom-and-bust economy.

Simultaneously, the introduction of machines forged new bonds between worker and owner as they shared responsibility for mechanization. Workers built, installed, operated, and repaired machines, usually supervised by other employees. In the process workers helped shape the equipment, organization, and operating methods of mechanized mills. For example, in the early 1850s skilled employees J. D. Gibbons and Chapin authored many of the letters relaying technical information from L. M. C. Saratoga and Ballston Spa mills to his brothers in Dalton. The correspondence ments especially the continuous expertise workmen contributed to developing dures for processing stock and adding new chemicals. Mechanical invention oc

more sporadically, but between July 1857 and October 1858 the *Valley Gleaner* reported four improvements made by Platner & Smith's workmen: a "letter copying press of a large and unique pattern, which . . . reflects great credit upon the maker . . . an apprentice . . . named William Jenne"; "a new and simple apparatus for handling paper for trimming," which increased output by one-third and cost only half as much as a conventional press; Robert McAlpine's "very simple and excellent device for raising and lowering the pens" on the ruling machine; and a mechanism for grinding the paper-making machine's seven-foot cutter knives "so that any number of knives may be ground exactly alike, thus saving very much, both of labor and the wear of knives," "invented and built by those ingenious mechanics, Messrs. A. and W. Palmer." Workers also abetted and shaped mechanization when training additional workers, sometimes acting as mentors to future mill owners. For example, Byron Weston acknowledged that when Saugerties paper worker James McDonald taught him how to beat stock, he "laid the basis . . . which has enabled [me] to be a manufacturer of the finest grade of paper made in this country." Workers who moved from mill to mill as many increasingly did, helped disseminate and standardize the new technology, exerting an influence that complemented mill owners' visits and correspondence. . . .

. . . In accord with the relatively clear, distinct, and rigid notions of masculine and feminine behavior that emerged in nineteenth-century America, workers viewed themselves first and foremost as men and, thus, as the mill owners' equals, an attitude that made personal negotiation more appropriate than collective bargaining. The refrain of a poem quoted in a twentieth-century publication devoted to early papermaking history and lore expresses this attitude succinctly: "Business is business, but men are men." Similarly, workers' memoirs humorously recount mill owners' foibles and the pranks workers and owners played on one another, emphasizing that owners were fellow men, not remote or superior beings.

The egalitarian implications of shared manliness were underscored during the years of paper industry mechanization by Jacksonian rhetoric and the achievement of manhood suffrage. That some contemporary workers achieved ownership, while some owners reverted to the status of employee conveyed the same message. By the 1860s, 1870s, and 1880s, widely shared masculine experience on Civil War battlefields had reinforced this sense of shared manhood and had helped certify Irish workmen as equals.

Workers' sense of manliness helps account for the absence of protest against the new dangers of the workplace. One suggestive anecdote comes from the lore of the paper industry and involves Nosey Hill.

> It used to be said that one would never be a good machine tender until his fingers had been nipped in the calenders. However true this may be, "Nosey" had little sympathy for his backtenders when they were nipped in this manner. When asked whether he had ever been nipped, "Nosey" promptly answered. "Sure, but I never made a fuss about it. Why I had my arm drawn into a calender up to the elbow once, but I just took it calmly and when the rolls started jumping I jerked my arm out and went along about my business."

As usual, Nosey embodies common experience in exaggerated form. The tale's message—that injury forms an inevitable part of learning, which real men bear with fortitude—simply expresses contemporary notions of manhood, notions that were reiterated and glorified locally in commemorations of Civil War battlefield bravery,

At the same time, the dangers men encountered outside the mills must have minimized their sense that paper mill dangers were unusual or unavoidable. Horses injured far more local citizens than did paper machinery, and local newspapers reported frequent railroad and steamship accidents, including the death of thirty-six-year-old paper worker John Quirk, killed after he boarded the wrong train and fell between cars while searching for the conductor.

Equality based on shared masculinity also helps explain the absence of evidence that Berkshire paper workers acted collectively as adversaries of the mill owners, in contrast to reported organization or spontaneous and sporadic group protest in county industries employing larger numbers of less skilled workers. The skill and small size of the paper mill's male work force apparently enabled workers to keep protest individualized, to express grievances man to man. A few extant letters depict such interactions, although most took place face to face and left no record. Writing to the Cranes in 1857, the father of one of their workers lodged the following protest: "my Boy says that you have paid three Dollars of his wages out to Charles Whitcom[.] if you pay eny mony out for me with out my orders You will pay it again if i can make you[.] you have no rite to pay out my mony without my orders[.]" In a similar tone, James Wells castigated Marshal Crane in 1865 as not having "acted manley by me" when employing him in a different mill and at different hours than they had originally negotiated.

Because owners varied in their personalities, the outcome of individualized protest depended on the man being approached; thus, workers probably exercised most control over their circumstances when they decided to apply to a particular man. Many workers indicated the importance they placed on their choice of employer when they listed who they worked for, rather than their occupation, in the county directory. . . .

I am inclined to believe that, favored by growing numbers and greater local longevity, workers who valued security and pride in a job well done came to exert far greater influence in Berkshire mill towns than those who valued power or affluence. Their expertise with machines, preference for sobriety, and rough sense of equality with the owners left them with few regrets over industrialization and few grievances that they could not express openly. For those anxious to risk seeking greater independence or adventure, the mill doors swung both ways and opened on a variety of paths. Such was not the case for their female co-workers. Their tale remains to be told. . . .

Turning our attention from male to female paper workers, we seem to enter another world, a world cut off from the dynamic arena where male workers and owners wrestled with the problems and opportunities of mechanization. In 1885 most women working in paper factories performed tasks identical to those of women in preindustrial paper mills, and the few who tended machines did essentially "women's" work, seated alongside the mill's smallest and least efficient mechanisms. Women continued to earn far less than men and encountered few of the novel risks and arduous conditions associated with men's mechanized work. For most, appropriate labor outside the home continued to be a transitory stage, peripheral to the domestic and maternal vocations that earned them social approbation. All told outward appearances imply that earlier notions of women's work exerted such powerful influences as to preclude technological change making any significant difference where female paper workers were concerned.

As in preindustrial paper mills, most women could be found laboring in the predominantly female rag rooms and finishing rooms of mechanized mills. The largest number still worked at rag processing, where they either sorted rags by color, fabric, and condition or cut them to open seams, remove fasteners and damaged portions, and reduce the rags to small, uniform squares. Mechanization altered only the number of workers and the distribution of rag room work. The development of more standardized rag grades reduced the relative demand for sorters, especially in fine paper mills. Simultaneously, mechanized mills' greatly augmented fiber consumption made more work for cutters, an increase offset only belatedly and partially by the use of mechanical rag cutters and nonrag fiber.

For most of the nineteenth century, rag rooms remained technologically primitive. Rag sorting involved manual manipulation and visual discrimination. . . . Rag cutters employed the same simple hand tools as women had used in Berkshire's original mill. Melville has left us a graphic account of these women's tools and tasks. In the rag room there "stood rows of girls. Before each was vertically thrust up a long, glittering scythe. . . . The curve of the scythe, and its having no snath to it, made it look exactly like a sword. To and fro, across the sharp edge, the girls forever dragged long strips of rags, washed white, picked from baskets at one side; thus ripping asunder every seam, and converting the tatters almost into lint. . . . [Occasionally] the girls, dropping their rags, plied each a whetstone up and down the swordblade."

Nor did mechanization alter the pace of women's rag room work. Because mill owners depended on women's care in sorting and cutting rags for their paper's quality, they did not press for greater individual output. The women worked under a modified piece-rate system in which they cut or sorted a specified number of pounds to earn a day's pay and received added compensation for "over work." Expected productivity depended on the quality of the rags and did not increase with mechanization. . . .

Tedious but unhurried manual labor also engaged most other finishing room women. Female workers continued to count paper by hand, a task unchanged by mechanization save for there being more paper to count and more women busily counting it. As with other feminine tasks, quantitative standards derived from qualitative concerns. At Crane & Co.'s Government Mill, which made currency, bond, and bank note paper, counts had to be precise and verified by a second counter. There, an average pair of female counters turned out forty thousand sheets per day. Counts of letter and ledger paper could be less accurate and need not be verified, so that each worker had sole responsibility for somewhat more paper. Finishing room women also folded paper by hand, using wooden blocks as guides. Like other traditional feminine tasks, the work required dexterity and care, but not long training.

The same attributes characterized the few new jobs women performed around machines. As noted earlier, men adjusted and maintained finishing room machines. Women simply sat alongside the mechanisms, feeding in paper or withdrawing the finished product. Most of these women—those tending platers, calenders, and ruling machines—worked in pairs, one woman placing paper in the machine and the other removing it. Perhaps, as Melville described, they obtained "some small variety to the monotony" by occasionally changing places. Smaller stamping and envelope machines required only one attendant, each generally working beside similarly employed women. Apparently, as mechanization created new jobs, owners simply assigned women to those that resembled traditional women's work: those that were monotonous and interruptible, requiring neither long training nor initiative.

The few short-lived jobs women performed in the machine room conform to the same pattern. Before mechanical layboys were perfected, women tended the cutter end of the machine, removing and stacking the sheets by hand. Such work must have appeared perfectly appropriate to women who had performed and continued to perform the same tasks in dry lofts. As long as loft drying persisted, women continued the traditional, repetitive work of hanging sheets to dry and jogging dry stacks to even the edges.

The relative uniformity of women's paper mill jobs is confirmed by their letters of application. They were much less likely than men to request a particular job or to cite their prior experience. Reflecting the limited training required, a few mentioned their lack of paper mill experience, in sharp contrast to male applicants. Owners' letters offering women employment also depict women's tasks as interchangeable. Byron Weston, for example, offered Mary and Sarah Hall work on the calender and the ruling machine, but noted, "We think we can keep you busy at the work we name but want to feel at liberty to ask you to change to other work when we have not enough of the kind you work at generally." Similarly, he told Lydia Smith, "We will give you a good chance, either at finishing & stamping, on the calender or ruling machine. We want you as an extra hand & to do anything in the finishing room. . . ."

Profound continuity despite mechanization also characterized female paper workers' wages, hours, and working conditions. Women continued to earn substantially less than their male co-workers and to lack the unskilled man's expectation of acquiring skills that commanded considerably higher incomes. . . . Statewide data collected in 1885 . . . show 70 percent of paper mill women earning less than $6 a week, whereas only 5 percent of male paper workers earned so little. The majority of men earned $6 to $10 a week, but almost as many, 43 percent, earned more than $10. By contrast, only 1 percent of the women earned more than $10, probably by far exceeding standard piecework requirements."

At the same time, because women's work was not tied to the pace of the machine, women's hours, unlike men's did not increase, come to require shift or night work, or lose their earlier flexibility. Most women routinely accomplished one and a half times the required day's work so that some came to work fewer than the traditional eleven hours even in the early years of mechanization, when female workers were greatly in demand. Most Berkshire paper mill women obtained a ten-hour day long before an 1874 Massachusetts legislative decree mandated a ten-hour [illegible] for female employees. In fact, state commissioners studying the problem in [illegible] found that women at the Hurlbut Paper Company worked only nine hours. [illegible] after, Saturday work gradually declined to a half day. By 1885 one-quarter [illegible] state's paper mills assured all female workers less than ten hours daily. Some [illegible] further curtailed their work hours by taking advantage of the piecework sys[illegible] the 1880s married women left Crane's mill two hours early.

Likewise, women's working conditions remained much like those of pr[illegible] trial workers. Separated from the mill's heavy machinery, they worked in co[illegible] tive quiet, permitting conversation to relieve the tedium of their work. Mo[illegible] unlike men's increasingly solitary jobs, all women worked in groups, in [illegible] alongside other women, so that conversation remained possible. Their [illegible] workrooms kept women away from most new workplace hazards. Men [illegible] nearly seven times the reported injuries and all but one of the fatalities. An[illegible]

few accidents involving women, nearly half occurred when women ventured out of their workrooms and came too close to revolving shafts.

This is not to say that women's work entailed no risks, only that the dangers changed little with mechanization and either remained invisible to contemporaries or were deemed too trivial to report. As Melville observed, "The [rag room] air swam with fine, poisonous particles, which from all sides darted, subtilely, as motes in sunbeams, into the lungs." In addition to risking respiratory disease, at least two women apparently contracted smallpox from infected rags before mills began providing vaccination. Rag room women, especially newcomers, must have cut their hands; paper cuts were certainly ubiquitous among finishing room workers; and long-time paper sorters sometimes snapped tendons after years of rotating their wrists through the same motion. Mechanization increased the number of women at risk, but may have decreased the percentage seriously affected because women, like men, worked shorter average stints in mechanized mills.

As in preindustrial mills, women's tenure in mechanized mills was briefer than men's suggesting that women continued to give employment a secondary place in their lives. Census takers in 1880 compiled substantial evidence that women worked temporarily, before marriage, and near home. The preponderant female worker was young, single, and lived under parental supervision. Girls under the age of twenty-one made up 41 percent of the mills' female work force, 64 percent of the women remained unmarried, and 46 percent lived with one or both parents. Time book data during the years of mechanization substantiate the impression that most women viewed their work as temporary. At Crane's mill single women averaged less than a year's employment between 1834 and 1848, and only slightly over a year between 1863 and 1876. Single females put in slightly longer average stints at L. L. Brown's mill, but there, too, they were the mill's least persistent workers.

These characteristics of paper mill women and their work typify the vast majority of nineteenth-century women, whose history is "a tale of continuity despite superficial change." For virtually all wage-earning women, "sex-segregated labor markets, the assumption that female workers are transient, and the persistence of lower pay for women encouraged the conceptualization of 'women's work' according to preexisting sex-role stereotypes and permitted the continued employment of women in less mechanized or industrialized occupations. . . . Even when machines or the emergence of new industries created apparently novel jobs, employers consistently assigned women to jobs that were relatively monotonous and did not call for rapt attention, were interruptible and easily resumed, and were not visibly hazardous," jobs like those of preindustrial women. Moreover, the characteristics of female employees' tasks made their work essentially the same as that of the majority of nineteenth-century women: wives and mothers performing housework. In fact, the largest groups of female employees labored as domestic servants and needlewomen, performing tasks identical to those of unpaid wives and mothers.

The striking absence of mechanization from homes and most other feminized workplaces underscores the uniformity of women's work throughout industrializing America. That women usually performed unmechanized work encouraged demeaning generalizations in the mechanically innovative nineteenth century. Contrasting apparent continuities in women's manual labor with dramatic changes in men's mechanized jobs, contemporaries readily concluded that God or nature had assigned women their

work and that society could not or should not alter it. Such assertions minimized the novel functions of women's traditional tasks in their new technological context, obscuring women's contributions to mechanization. Placing women in technological history requires that we set their work in the context of technological innovation. . . .

Paper mills provide a valuable perspective on the role of women's work in a mechanizing society because rag rooms and finishing rooms were visibly connected to the sites of men's technologically innovative work, unlike contemporary homes, laundresses' kitchens, seamstresses' garrets, and most other feminized work locales. Contrasts between men's and women's work in paper mills reveal why women retained their traditional tasks and how those tasks contributed to mechanization. Whereas machines took over craftsmen's skilled occupations in paper mills, women's apparently simpler jobs proved difficult or impossible to mechanize. Yet women's unmechanized work compensated for and abetted mechanization; it assured machine-made paper a market by maintaining its quality. As a result, mechanizing mills grew increasingly dependent on their female employees. Moreover, by remaining relatively unspecialized, female workers gave mill owners considerable flexibility in their employment, a valuable asset as the employment of specialized male workers and expensive papermaking machines reduced flexibility elsewhere in the mills.

Nonetheless, woman's traditional, quality-oriented, unspecialized work earned diminished recognition as Americans came to value progress, quantitative increases in productivity, and specialized skills. The sharpened contrasts between men's and women's paper mill work strengthened traditional assumptions that women lacked skill and did not deserve high wages, beliefs reinforced by women's analogous activities in homes and other feminized work sites. As men grew less experienced in comparable work, employers and supervisors readily accepted that women's skills and financial needs were inferior to men's and greatly benefited from their society's elaboration of those beliefs. Judging from paper mills, then, it appears no coincidence that the doctrine of separate spheres emerged to minimize women's skills and economic importance at the very time that mechanization actually made their work more critical. The obvious serviceability in paper mills of new beliefs about women helps identify women's substantial contributions to industrial mechanization through their labor in the more separate feminine sphere: the home.

Women continued to perform their traditional preindustrial tasks in mechanized paper mills primarily because . . . machine builders did not and probably could not devise commercially viable mechanical alternatives. In particular, the sorting of rags and the inspection of finished paper entailed visual discrimination not replicated by machines and only partially superseded in twentieth-century mills by electronic scanning devices. Similarly, although machines were devised to reduce rags to relatively uniform pieces, mechanical rag cutters could not open seams, remove fasteners, or eliminate damaged portions, tasks for which female rag cutters relied on their eyes as well as their hands.

Women's work around finishing room machines underscores the limits of nineteenth-century mechanization. Although machines successfully imitated the manual labor of ruling or stamping, the precise placement of sheet after sheet of paper, a task involving hand-eye coordination, evidently eluded consistent mechanical replication. Judging from the substantial costs attributable to paper being damaged by finishing room machines, the capacity to handle dry paper

wrinkling or tearing some sheets also proved difficult to build into machines. This accounts for women's retention to remove paper from machines, feed it into calenders, fold it manually, and even its edges after stacking it. Likewise, while it is possible to conceive of mechanical paper counters, it is hard to imagine a machine operating much more rapidly than hand counters but not damaging sheets so as to require further sorting. Only modern electronic technology has produced such an efficient mechanism suggesting that the hand-eye coordination characterizing the female paper counter's work had no acceptable mechanical analog. . . .

In helping to establish and maintain the quality of machine-made goods, paper mill women performed an essential function, one shared by women in other mechanizing industries. Without these women's labors, mechanization might well have been delayed or prolonged by more limited markets for the machines' augmented output. This is not to dispute the general contention that Americans mechanized more readily than the English because Americans more readily accepted inferior machine-made commodities. It is certainly conceivable that, given paper mills' reliance on business markets, maintaining traditional standards figured more prominently in the paper industry than in industries producing consumer goods. But quality is relative, not absolute. Like late nineteenth-century newsprint mills, all industries encountered some market-imposed standards of acceptable product quality and these standards probably declined only gradually as mechanization progressively opened new markets by lowering prices. The role of paper mill women, therefore, suggests that nineteenth-century female industrial employees, although disproportionately concentrated in unmechanized finishing and inspection jobs, made a substantial contribution to mechanization, and one that has been minimized by simply comparing the American emphasis on price and quantity to the British concern with quality. By performing unimpressive manual operations, women successfully enforced standards and applied finishing touches that maintained and created markets for the products of mechanized industry.

Women also helped mill owners adjust output to the unpredictable fluctuations of nineteenth-century markets, for demand was fickle as well as selective. Publishers and paper wholesalers could not usually predict customer response to new commodities such as specialized periodicals, books by American authors, or tinted stationery. In filling rush orders, coping with the business cycle, and tailoring production to meet varying demand for various products, mill owners could rely on the willingness and ability of their female workers to alter their tasks and modify their work schedules. Initially, flexible female workers especially helped unspecialized mills balance out finishing work that varied with the product. Later, women's flexibility continued to be an asset because it compensated in part for the specialization and inflexible schedules of men and machines.

As noted above, employers sought women who would "work at anything in the finishing room" so as to keep them fully employed when demand flagged for the products of one specialized machine. Unlike men, women were expected to move back and forth between various tasks no matter how long they had been employed. . . .

As new technology came to require periodic shutdowns for repairs and maintenance, employers could also more readily reduce female than male employment, thus helping to lower the costs associated with unpredictable technology. When mills stopped for repairs, female workers were simply told to stay home, sometimes for

weeks at a time, whereas male employees continued to work and receive wages. Routine maintenance also curtailed women's employment. For example, rag room women at L. L. Brown's mill lost two days in May 1858 while other workers were "Washing up for Spring."

Mill owners' flexibility in their employment of women reflected the comparative ease with which women learned paper mill work and transferred their skills from one mill to another. Employers revealed their expectation that almost any woman could do the work by issuing frequent general newspaper advertisements for female workers, whereas they relied almost exclusively on informal informational networks to select appropriately skilled men. The rag room work and paper sorting that engaged most female laborers was also the work most quickly mastered. Of the seventy women's jobs advertised in the *Valley Gleaner* from 1860 through 1874, fifty-six fell into these categories, and none of these advertisements cited skill or experience as a requirement. A few finishing room tasks involved somewhat more training, thus a few advertisements and workers' letters of application mentioned experience. But women mastered even these jobs with relative ease allowing mill owners to make do with inexperienced women. For example, calender work took the longest to learn, but when Crane & Co. sought an experienced woman, Ballston Spa mill superintendent Fred Thompson found that the only skilled woman available was a widow who anticipated child-care problems if she moved to Dalton. Rather than offer the widow special inducements to come, as owners often did for male workers, Thompson suggested, "There is lots of Yankee girls about here—but none at liberty that understands the Callenders but it would not take very long to learn on Collar Paper—so I think perhaps it would be better to send you a girl than the widow."

Women also adjusted quickly to differences between mills, whereas even highly skilled men needed time to acquire familiarity with the idiosyncrasies of individual paper-making machines and rag engines. As a result, mill owners could meet short-term demand for female workers through arrangements with fellow manufacturers. Crane family correspondence frequently mentions "girls" sent from Dalton to the New York state mills operated by Crane and Laflin family members, or women brought to Dalton from New York state. Similarly, Byron Weston inquired of May & Rogers: "Can you send us a good girl finisher & one paper sorter for 2 or 3 weeks? Three of our girls are out, sick, & the work is getting very much behind." Evidently the practice was common, for Weston promised, "If you can send only the finisher & will do it we will try & reciprocate." He sent similar requests to Carson Brothers, Platner & Smith, and the Union Paper Company. Such work, at employers' convenience, contributed to single women's brief average tenure, especially during the early years of mechanization, when mill owners coped with very unpredictable markets. For example, Weston was "very much obliged for the favor" when Sa[illegible] Hall filled in for three days on his ruling machine. She had evidently come some distance, for Weston supplied temporary boardinghouse accommodations.

The ease with which large numbers of women learned papermaking tasks, changed one task for another, and adjusted to different mills helped confirm the impression conveyed by emergent differences between men's and women's work that women's work was unskilled, natural, and God-given. From the mill owners' perspective the work was justly designated "unskilled" because it required little training and no formal education. Yet the evidence that machines could not repl[illegible]

women's work and that mill owners benefited from the relatively low wages such work commanded should caution us not to accept at face value mill owners' assessments of their female employees' skills. Comparison of women's "unskilled" paper mill work with women's domestic labor indicates that housework, a new nineteenth-century feminine occupation, ensured all women substantial training in useful manufacturing skills and served to minimize the value of those skills.

As we have seen, female paper workers, like most female employees, performed tasks that required care and attentiveness, despite the monotony of the work. Had their attention lapsed frequently, they would not have fulfilled their function: maintaining quality. Yet the work itself had so little inherent interest that constant alertness must have been difficult to maintain. Indeed, the only apparent stimulation women experienced on the job came from their simultaneous conversation with other women. It seems likely, then, that conversation not only made the work bearable, but also contributed to alert workmanship. One twentieth-century superintendent acknowledged as much when he concluded from an attempt to employ male paper sorters that men could not do the job because they could not work fast enough while talking. . . .

While less remunerative than textile mill work, paper mill work attracted wives and female household heads because it best suited women with children and homes to care for. Paper mill jobs offered two great advantages: flexible hours and safety. As noted earlier, most paper mill women had comparatively short hours by contemporary standards, whereas a number of textile mills employed women longer than ten hours even after legislative prohibition. Lacking housekeeping assistance, wives and widows sorely needed the extra weekday and Saturday hours that paper mills assured all female employees. By choosing to process rags or sort paper, occupations that permitted the adept worker to leave early, a woman could further shorten her hours. Women with unsupervised infants and preschool children must have willingly accepted the lower pay in order to leave work early. At least some mothers also left the rag rooms and finishing rooms several hours early so as to supervise children returning from school, a substantial boon for those with all children between the ages of five and ten, about one-seventh of working wives and widows.

In addition, paper mills accommodated women whose family responsibilities occasioned periodic work interruptions. For example, Elizabeth Wharfield began working at the Cranes' mill in 1846, shortly after her daughter's birth, but left work for several months in 1848. Perhaps she lost her babysitter or her sick toddler required special motherly care. The following year Charlotte Tifeny, who had left work to be with her brother, informed the Cranes, "I would like to come back." She evidently expected reemployment for she wrote in late September and told the Cranes, "I would like an anser beefore cattle show."

Married women especially availed themselves of the opportunity to leave the mills and return. Between 1863 and 1876 nearly half of the Cranes' married female employees left work for at least a month, averaging five months away before returning. Over the same period, only one-fifth of the unmarried women interrupted their employment. Recurrent work interruptions also occurred most frequently among married women. At the Cranes' mill between 1863 and 1876, married women took two or more sustained work breaks over three times more often than did single women. L. L. Brown's time book showed a similar pattern. And timekeepers' records missed additional married women who left one mill and returned to work for a

different employer. For example, Mrs. Hutchens of Cheshire had worked as a paper sorter, probably for L. L. Brown, but applied to the Cranes in 1864 when she wanted renewed employment after spending "some months in taking care of a sick friend."

Paper-making technology permitted women's flexible schedules. Women's shorter hours reflected the technical feasibility of ending women's workdays without shutting down the machines. Likewise, women's ability to leave and return periodically rested on the greater awareness of individual needs that a less labor-intensive industry permitted. . . . [I]n 1880 paper mills averaged 67 workers, about half of them women. By contrast, cotton mills employed an average of 137, about half female, and woolen mills averaged 147, about two-fifths female. Merely in planning, then, paper mills had an easier time accommodating married women's special needs.

Slave Ironworkers in Virginia

CHARLES DEW

. . . By 1860, William Weaver owned sixty-six slaves: twenty-eight adult men, fifteen women, fourteen boys, and nine girls. His core forge crew in that year had all grown to manhood at Buffalo Forge: Sam Williams, master refiner; Henry Towles, refinery underhand; Tooler, Jr., chaffery hammerman; Harry Hunt, Jr., chaffery underhand; and Henry Matthews, forge carpenter. All these men had served their apprenticeship at Buffalo Forge, and often they had trained alongside their own fathers. All belonged to families that had an impressive history of turning out highly skilled artisans.

Assembling a full crew of skilled forgemen and maintaining their number as death and injury thinned the ranks of his original force were formidable challenges for Weaver. These were not, however, the ultimate challenges he faced as a southern ironmaster. Even more imposing was the task of motivating these slaves to work, and work well, at the art—for that is what it was—of ironmaking.

Weaver, of course, had considerable coercive power at his disposal. He could punish any recalcitrant or troublesome slave, but if he had relied on the whip to achieve satisfactory levels of production, his career as a Virginia ironmaker would have been very short-lived indeed. Excessive use of force certainly would have backfired, and a whipping administered to a skilled slave would, at minimum, leave the man sore and incapable of work. It would probably leave him seething with anger as well and looking for ways to get back at the master. Acts of industrial sabotage could be accomplished with relative ease around a forge. To cite only one example, the huge wooden beams that supported the 500- to 600-pound cast-iron hammerheads in the forge—"helves" was the name given to these beams—occasionally broke in the normal course of operations and had to be replaced. The forge would shut down for at least a day, sometimes more, while the forge carpenter installed a new helve. Weaver's forgemen could break these helves intentionally whenever they wished, and who could say whether it was or was not deliberate? Another alternative would be for the slave to burn the forge down. On any working day, live charcoal was the tool to do the job. The slaves, in short, were in a position to do considerable physical

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