

## *Taylorism and the Workers at Bethlehem Steel, 1898-1901*

FREDERICK W. TAYLOR'S reorganization of the labor force at Bethlehem Steel between April 1898 and April 1901 surely qualifies as one of the best-known and most controversial episodes in American industrial history. To generations of students, businessmen, social critics, and trade unionists who have read Taylor's *The Principles of Scientific Management* (1911), his widely reprinted 1912 congressional testimony, and subsequent critiques of these works, the events at Bethlehem symbolized the development of modern business management, particularly the process by which the manager extended his control over the worker.<sup>1</sup> To many, Taylor's efforts at Bethlehem demonstrated the potentialities of "scientific" management, provided convincing evidence of the ability of the stop watch and time study to increase efficiency, and created a hero—the stolid "Schmidt"—who supposedly proved that poor but ambitious men could achieve the promise of American life. Others, notably reformers and unionists, objected that Schmidt's fate was in reality proof of the dehumanization of the worker under scientific management, time study, and incentive wage plans.

That these events should command such attention is persuasive evidence of the historian's ability to shape public perceptions of the past. In fact, the reorganization of the Bethlehem workers was a remarkably modest affair, with little of the drama or significance Taylor or his critics later associated with it. At most it was a peripheral aspect of a much more extensive and important endeavor. If it proved anything, it was the persistence of haphazard, un-systematic methods, even among the leaders of the management movement.

<sup>1</sup> Frederick W. Taylor, *The Principles of Scientific Management* (New York, 1911); Frederick W. Taylor, "Testimony," *Scientific Management* (New York, 1947). Milton Nadwory, *Scientific Management and the Unions 1900-1932* (Cambridge, 1955) is the best guide to the attack on Taylorism.

Taylor had developed his scientific management methods in the 1880s at the Midvale Steel Company in Philadelphia. They included a variety of preliminary steps to improve the operation of the machinery and plant; major revisions in the management to coordinate and systematize the manufacturing process; adjustments to the machines to enhance their performance; and finally, when the plant was functioning at a high level of efficiency, labor reforms to increase the output of the machine workers. Two groups of employees were especially important: the superintendents, supervisors, and foremen who were charged with the operation of the newly systematized plant; and the machine tenders who executed orders in ways prescribed by the corps of planners and supervisors. To insure that the latter performed their tasks properly and at the optimum rate, Taylor employed two innovative techniques. He used a stop watch to ascertain the most desirable time and method for a particular job. When he had completed this "time study," he introduced a unique two-wage incentive plan, the "differential piece rate." The man who worked in the prescribed fashion and achieved the predetermined goal received a high rate, which was above the prevailing wage for the job. The man who did not meet his quota received a low penalty rate, which was below the prevailing wage.<sup>2</sup>

When Taylor began a career as a management consultant in 1893, he discovered that he could no longer implement his methods as he had at Midvale. Employers insisted on immediate results and the depression of 1893-1896 made them even more impatient. As a consequence Taylor often postponed his important organization reforms until he had reduced costs and introduced various superficial changes. Chief among his cost-cutting tactics were time study and the differential piece rate, which he used to "speed-up" employees performing nonmechanized tasks. During this period Taylor often disregarded the supervisors and machine tenders whose output was partly dependent on machine speeds and devoted his attention to laborers who performed uncomplicated tasks. He forced men and women to double or triple their output. He used time study to

<sup>2</sup> Frederick W. Taylor, "A Piece Rate System," *Transactions of the American Society of Mechanical Engineers*, XVI (1895), 856-883. Also see Frank B. Copley, *Frederick W. Taylor Father of Scientific Management* (New York, 1923), I.

ascertain the maximum pace. His high rate became the minimum rate. Though the workers suffered numerous hardships, he persisted and, in the opinion of most of his clients, succeeded.<sup>3</sup>

Yet Taylor did not forget his management system. To prepare for the time when he could again introduce the full panoply of scientific management reforms, he worked tirelessly to improve his knowledge and techniques. One of his major goals was to determine the optimum conditions for machine tool operations in order to control the variables which made it so difficult to set accurate tasks for machine tool operators. The resulting analysis of "the art of cutting metals" became a landmark in the history of technology. Taylor also revised his time study procedures. Recognizing that his methods were haphazard and inaccurate, little better than the "rule-of-thumb" rate setting methods he condemned, he employed an assistant, Sanford E. Thompson, to improve his methodology. Beginning in 1895, Thompson developed the procedures and equipment that Taylor's time study experts would use in the future.

To publicize his innovations and attract clients, Taylor described different aspects of his management system in papers to the American Society of Mechanical Engineers. One of these, "A Piece Rate System" (1895), emphasized the differential piece rate. Though Taylor devoted considerable attention to time study and the organizational features of scientific management, his listeners and readers were particularly interested in his novel approach to the incentive wage. "A Piece Rate System" established Taylor's reputation as an expert on labor matters and produced several new clients, including the Bethlehem Iron Company of South Bethlehem, Pennsylvania.<sup>4</sup>

The Bethlehem management was attracted to Taylor because of new and potentially adverse circumstances that confronted the company in the late 1890s. A decade before Bethlehem had become a leading military contractor, producing armor plate and gun forgings for the Navy. The military business had been lucrative until the mid-1890s, when two problems appeared. Reacting to

<sup>3</sup> Copley, *Taylor*, I; Daniel Nelson, "Scientific Management in Transition: Frederick W. Taylor at Johnstown, 1896," *Pennsylvania Magazine of History and Biography*, XCIX (1975), 460-475.

<sup>4</sup> In 1899 the name was changed from Bethlehem Iron to Bethlehem Steel.

widespread suspicions of profiteering, Congress reduced the price of armor plate and threatened to build a publicly owned plant. Shortly thereafter, Charles M. Schwab became president of Carnegie Steel, the only other armor plate manufacturer, and launched an aggressive campaign to increase Carnegie's share of the market.<sup>5</sup> Both problems plagued Bethlehem until 1901, when the company's principal stockholders sold their holdings to Schwab. In the interim, President Robert Linderman adopted a defensive posture, cutting costs to insure the company's competitiveness. To aid in this process, Russell Davenport, one of his chief subordinates and Taylor's former boss at Midvale, called Linderman's attention to "A Piece Rate System."<sup>6</sup> Taylor and scientific management soon became key elements in Linderman's strategy.

Because of "A Piece Rate System" Linderman assumed that Taylor's principal duty at Bethlehem would be to introduce that method. At several meetings in late 1897 he and Taylor discussed the differential piece rate at length.<sup>7</sup> But the latter soon disabused him of his original assumption. On January 4, 1898, Taylor warned that "before piece work can be successfully introduced," it would be necessary to take "entirely out of the [workers] control" many "details connected with the running of the machines and management. . . ." At the same time, "a careful study of each type of machine should be made so as to ascertain its driving and feeding powers . . . and a table should be made for each machine which indicates the best cutting speed, feed, etc. for doing work as well as the time required to do it."<sup>8</sup> Several weeks later Taylor added that the "whole method of putting orders into the shop and the inspection and payment for the work, and of making up your labor returns, must be overhauled and improved before Piece Work can be introduced."<sup>9</sup>

<sup>5</sup> For the background of these developments, see H. F. J. Porter, "How Bethlehem Became an Armament Maker," *Iron Age*, CX (Nov. 23, 1922), 1339-1341. For the conflict with the government, see Walter R. Herrick, *The American Naval Revolution* (Baton Rouge, 1966), and Robert Hessen, *Steel Titan, The Life of Charles M. Schwab* (New York, 1975).

<sup>6</sup> H. F. J. Porter to Taylor, June 30, 1897, Frederick W. Taylor Papers (Stevens Institute of Technology), File 63C; Russell Davenport to Taylor, Nov. 22, 1897, *ibid.*, File 57C.

<sup>7</sup> Taylor to Davenport, Jan. 3, 1898, *ibid.*

<sup>8</sup> H. F. J. Porter to Linderman, Jan. 4, 1898, *ibid.*, File 33.

<sup>9</sup> Taylor to Linderman, Jan. 19, 1898, *ibid.*, File 32.

Taylor clearly intended to install the management system he had developed in the 1880s, not simply the cost cutting methods he had utilized in the 1890s. Several factors accounted for his change of tactics. First, he knew that Bethlehem, unlike his previous clients, was a substantial enterprise; Linderman was worried about the company's profits, not its survival. Second, his principal task was to reorganize several large and complicated machine shops, not the kind of factories—a paper mill, motor assembly plant, and grinding department—he had managed in the 1890s. The distinction was crucial to a man who had devoted much of his time and creative talents to improving machine tools and machine shop processes. Technical obstacles aside, Taylor was emotionally reluctant to adopt the expedient tactics that he had used in other industries. As a result piece work would be among the last of Taylor's reforms, a final climactic step to the reorganization of the plant. Equally important, it would apply primarily to machinists and other machine operators. Taylor intended to shift the Bethlehem laborers to piece work, but he did not consider them an important or even an integral part of his overall plan.

Taylor arrived at Bethlehem in April 1898 and made rapid progress in the following months. He reorganized the plant's managerial hierarchy, eliminating men who demonstrated little ability or who were unsympathetic toward his work. He launched a new series of metal cutting experiments that culminated in the development of "high speed" tool steel, his most famous invention. He reorganized the tool room and stores areas, and introduced a "planning department" to coordinate the work of the factory. By the spring of 1899 he had begun to recruit specializing supervisors—"functional foremen"—to run the plant.<sup>10</sup> Taylor's reforms affected dozens of Bethlehem employees but this group did not include "Schmidt" or the others later identified with the Bethlehem reorganization. It was the supervisors and foremen—the managers rather than the workers—who now worked under scientific management.

During this period Taylor made no effort to initiate time studies

<sup>10</sup> See Copley, *Taylor*, II, and Taylor, "Shop Management," *Transactions of the American Society of Mechanical Engineers*, XXIV (1903), 1337-1456.

or install piece work, either the differential piece rate or the simpler "driving" piece work plan he had used in the 1890s. His intention was to postpone fundamental labor reforms until he had completed other activities, including machine studies and the introduction of high speed steel, that would permit accurate and reasonably definitive time studies. At the appropriate time he would bring Sanford Thompson to Bethlehem for a few weeks to train other time study men.<sup>11</sup> In fact, due to delays in completing the preliminary machine shop work, Thompson did not go to Bethlehem until 1900 and probably never performed the function originally assigned him.

In the interim, however, Taylor made one exception to this approach. In February 1899 he decided to introduce piece rates in the plant yard, where the work was "so crude and elementary," as he later recalled, that "an intelligent gorilla" would be as useful as the East European immigrants who toiled there.<sup>12</sup> The events which prompted this decision are obscure; certainly Taylor viewed the yard work as a minor feature of his assignment. The workers involved were the poorest paid and least efficient of all the Bethlehem employees. Supposedly they did only one-third to one-fourth as much as comparable laborers at other plants.<sup>13</sup> Probably Taylor saw this situation as another chance to demonstrate the effectiveness of scientific management at minimal cost. Since the work did not warrant Thompson's services he brought James Gillespie from the Simonds Company, his previous client. Gillespie began time studies of laborers in the open hearth department in early February.<sup>14</sup>

Before Gillespie completed this assignment, an unforeseen development temporarily distracted him and precipitated the single most famous incident in the history of scientific management. In February the price of pig iron, which had been very low for several years, rose sharply.<sup>15</sup> The Bethlehem Company sold 10,000 tons of pig iron which had been produced several years earlier and stored on land

<sup>11</sup> Sanford E. Thompson to Taylor, Apr. 5, 1898, Taylor Papers, File 124D.

<sup>12</sup> Taylor, *Principles*, 140.

<sup>13</sup> Charles D. Wrege and Amedeo G. Perroni, "Taylor's Pig-Tale: A Historical Analysis of Frederick W. Taylor's Pig Iron Experiments," *Academy of Management Journal*, XVII (March, 1974), 14; George F. Steele to Taylor, Mar. 23, 1895, Taylor Papers, File 70G.

<sup>14</sup> Taylor to Thompson, Feb. 3, 1899, Taylor Papers, File 124D.

<sup>15</sup> Wrege and Perroni, "Taylor's Pig-Tale," 12.

adjacent to the plant. When Davenport dispatched a group of laborers to load the iron on railroad cars, Taylor persuaded him to put the pig iron handlers on piece work. As a consequence Gillespie, together with Hartley C. Wolle, a veteran Bethlehem supervisor, began to reorganize the pig iron handlers on March 11.<sup>16</sup>

Employing time study techniques Gillespie had learned at Simonds, they first attempted to ascertain the maximum output of the nineteen or twenty "Hungarians" who composed the gang. On March 13 Gillespie and Wolle selected ten of the "very best men and started them to load a car at their maximum speed." Working at that rate each man loaded the equivalent of seventy-five tons per day, whereas the previous average was thirteen tons per day. However the men were exhausted after loading one car. Observations of individuals working at their "maximum speed" confirmed the conclusion that seventy-five tons per day was the theoretical limit. "From this amount," Gillespie and Wolle reported, "we deducted 40 per cent for rests and necessary delays and set the amount to be loaded by a first class man at 45 tons per day." They did not indicate why they selected forty percent as an appropriate amount "for rests and necessary delays."<sup>17</sup>

Gillespie and Wolle took their findings to Taylor on March 15. After consulting Davenport and other officials he set a piece rate of 3.75 cents per ton, a rate that would enable a "first-class" pig iron handler to earn \$1.68 a day, the average wage of the 3,100 employees (including supervisory workers) at Bethlehem in 1899.<sup>18</sup> Since the going rate for laborers was approximately \$1.15, the laborer who loaded forty-five tons would receive a forty-six percent wage increase. In view of Linderman's concern about costs this was, at least on the surface, a bold move. Did Taylor emphasize that few men would actually earn the "first-class" wage? Did he point out that men who merely doubled their former output (twenty-six rather than thirteen tons) would earn ninety-one cents per day, or twenty-one percent less than the going rate? Either point pre-

<sup>16</sup> The following account is based on James Gillespie and Harley C. Wolle, "Report on Establishment of Piece Work in Connection with Loading of Pig Iron at The Works of the Bethlehem Iron Company," June 17, 1899, Taylor Papers, File 32.

<sup>17</sup> *Ibid.*

<sup>18</sup> "Employees of the Bethlehem Iron Company with their Salaries and Wages," *ibid.*

sumably would have mitigated his superiors' anxiety. In any case, Taylor did not set a second, lower, penalty rate, the distinctive feature of the differential piece rate system. Since the pig iron handler whose output was not at least two and a half times his former rate would earn less than \$1.15, a separate penalty rate probably seemed unnecessary. Taylor believed that the promise of parity with the other Bethlehem workers would encourage the pig iron handlers to work harder. But he did not actually expect them to earn \$1.68; in fact he anticipated that most of them would earn less than their customary \$1.15. In practice, the reorganization of the pig iron handlers was another example of the driving methods Taylor had developed in the 1890s.

Gillespie and Wolle told the ten "best men" that they would work under the new piece rate the following day, March 16. After some objections, the men consented. But when Gillespie and Wolle arrived the next morning they found the men working with the rest of the gang. The laborers had refused to follow orders and neither the foreman nor his supervisor wanted "to take the responsibility of discharging so many men." When Gillespie and Wolle told the laborers that "having promised to load by the piece . . . they could not work on any other terms," the men "quit work[ing]. . . ." Exasperated, Gillespie and Wolle discharged the laborers. However,

on their way to the time office [the men] were met by Mr. Robert Sayre, Jr., Ass't Gen'l Supt., who having inquired what the trouble was, told the men to wait at the Scale House until he had looked into the matter. He stated . . . that he feared a strike would follow the discharge of these men and that he wished to consult the General Superintendent, Mr. Owen Leibert (Mr. Davenport being absent) before taking any further action.<sup>19</sup>

Leibert instructed Sayre to allow the men to rejoin the gang "until the return of Mr. Davenport when the matter could finally be settled." There is no account of the meeting between Leibert and Davenport, but Sayre subsequently told Gillespie and Wolle to fire the men if they refused "to work by the piece." The next

<sup>19</sup> Gillespie and Wolle, "Report."



morning Gillespie and Wolle "again asked each man individually if he was willing to load by the ton, and as each and every man refused they were given their discharge and paid off the same morning."<sup>20</sup>

From March 17 until early May the social pressure of the discharged men together with "a strong prejudice on the part of the [other employees] against [the] piecework system" made it difficult for Gillespie and Wolle to find candidates for the laborers jobs. When they attempted to introduce piece work again on March 30, the "majority of men" they selected "either did not report for duty at all or worked only one day."<sup>21</sup> To circumvent the "Hungarians'" influence, Gillespie and Wolle attempted to attract Pennsylvania Dutch or Irish workers, with little success. The promise of a higher wage alone obviously was insufficient. But in April Gillespie and Wolle began to treat the piece workers in "a liberal way," giving them "work of a higher description" when they were tired or hurt. This was an additional incentive that, from the workers perspective, made the situation altogether different. As news of this practice spread, opposition gradually declined and laborers began to volunteer for piece work. By the middle of May Gillespie and Wolle "had little difficulty in obtaining men for the work."<sup>22</sup>

Yet even then they found few "first-class" men—an indication of the ominous meaning of that term. On March 30, for example, they recruited seven men from another gang. Of the five who reported for work, only Henry Noll, (the famous "Schmidt") a Pennsylvania Dutch laborer, proved to be a "first-class" worker. A small, vigorous man, Noll was apparently unaffected by the antagonism of his fellow workers or the rigors of his vocation.<sup>23</sup> A variety of other laborers joined Noll during April, but he was the only one who remained on the job throughout the period. Gillespie and Wolle reported that they had hired forty men by the end of May but found only three "first-class" men and ten others who "can make

<sup>20</sup> *Ibid.*

<sup>21</sup> *Ibid.*

<sup>22</sup> *Ibid.*

<sup>23</sup> Taylor, *Principles*, 43-48. For the details of Noll's life, see Wrege and Perroni, "Taylor's Pig-Tale," 9, 15.

a fair day's wages." Most of the rest, they added, "break down after two or three days."<sup>24</sup>

Despite the paucity of "first-class" men, the pig iron operation was highly successful in April and May. From March 30 to May 31 the cost of loading pig iron under piece work averaged 4.8 cents per ton, as opposed to more than eight cents per ton under day work. In addition, Gillespie and Wolle had established rates "covering all the conditions for loading iron" and had broken the workers' resistance to piece work. The able workers also benefited. Noll, for example, averaged \$1.72 per day from June 1 to June 15, and the other "first-class" men averaged \$2.07 and \$1.87. The "very good men" averaged between \$1.35 and \$1.70 during the same period. Others who tried but failed to maintain the pace were transferred to less taxing jobs that were better paying than the yard labor positions. Those who refused to work under the Taylor system or, in the opinions of Gillespie and Wolle, did not make a genuine effort lost their jobs altogether.<sup>25</sup>

In retrospect, the most striking feature of the episode was not its demonstration of the efficacy of scientific management, as Taylor later claimed, but the casual, unsystematic nature of the rate-setting procedure. Gillespie, a relatively inexperienced man, and Wolle, a novice, timed the men for several days and concluded that seventy-five tons, minus forty percent for "rests and necessary delays," was the task of the "first-class" worker. Taylor then arbitrarily set a rate that would enable the "first-class" pig iron handler to earn the average wage of all the Bethlehem workers. Although the differential piece rate was not introduced, the rate Taylor set for the pig iron handlers was in effect the "high rate" and the yard labor rate was the "low rate," since Gillespie and Wolle discharged or transferred workers who did not make at least that much. Taylor probably adopted this approach because he considered the work relatively unimportant and because it preserved the principle of a high premium rate and a low penalty rate and thus, like the conventional differential rate, "scientifically" selected or eliminated workers.

<sup>24</sup> Gillespie and Wolle, "Report."

<sup>25</sup> *Ibid.*

Taylor later claimed that he also discovered a "law of heavy laboring" as a result of the pig iron loading. At Midvale and again in 1896, in conjunction with Thompson, he had sought unsuccessfully to find a relationship between the amount of energy that workers expended and their output.<sup>26</sup> In early April 1899 Taylor asked Gillespie and Wolle to reconsider the problem, using their data on pig iron handling. As a result they prepared a table, based on the records of the three "first-class" men, "showing the amount of energy expended under different conditions of height and distance reduced to foot pounds." They concluded, however, that the major variable was "the ability and endurance of the men to lift a certain number of pigs, irrespective of the walk or height," and that Taylor's theory "was not applicable to work of this particular character. . . ."<sup>27</sup> Gillespie and "three or four others," Taylor reported, "wanted me to give that up, but I was sure the thing was there. . . ."<sup>28</sup> Seven months later Taylor asked Carl G. Barth, another assistant, to conduct new time studies. Barth returned "in a great state of excitement," having discovered an important "law": ". . . that for every load that [a] man carries on his arms he must be free from load a certain percentage of the day and under load only a certain percentage. That is to say, a man carrying a [ninety] pound pig can only be under load 42% of the day. He has to rest 58 percent of the day."<sup>29</sup> In fact this "law" had no more substance than the other lessons of pig iron handling. Except for the percentages of rest and work, it was little more than Gillespie's and Wolle's common sense observation that some "rest" was necessary. And the proportions were only "rule of thumb" estimates. As Professors Charles D. Wrege and Amadeo G. Perroni have recently noted, they were averages based on a number of dissimilar observations.<sup>30</sup>

In the meantime Gillespie and Wolle were extending piece rates to other types of yard labor. In May 1899 they resumed the work

<sup>26</sup> Taylor to Sanford E. Thompson, Apr. 3, 1899, Taylor Papers, File 124D.

<sup>27</sup> Gillespie and Wolle, "Report."

<sup>28</sup> Frederick W. Taylor, "Conversation" [1907], Taylor Papers, File 79I.

<sup>29</sup> *Ibid.* Also Taylor, *Principles*, 57, 60-61; Carl G. Barth to Taylor, Sept. 30, 1899, Taylor Papers, Notebook 6.

<sup>30</sup> Wrege and Perroni, "Taylor's Pig-Tale," 20-21; Carl G. Barth, "Report on Fixing of Rates for Loading Pig Iron by Half Pigs on Buggies in the Yards," May 29, 1900. Taylor Papers, Notebook 6.

Gillespie had started in February and by July had set a rate that enabled the "best 10 men out of a gang of 40" who unloaded ore at the blast furnaces to average more than \$2.00 per day.<sup>31</sup> There are several possible explanations for the relatively long rate-setting period. First, the job was bigger than the pig iron loading assignment, although not the rate-setting process per se, for the work was simple and repetitive so that the time studies were no more difficult than the pig iron time studies. The time consuming task was finding "first-class men" to take the places of the original ore loaders. A high wage of \$2.00 meant that the successful laborer received an increase of seventy percent or more. Taylor may have been unusually generous with these workers but he surely demanded that they triple their output in return. Even if he expected the other thirty men to earn only \$1.60 or \$1.70 per day, a substantial number of new employees must have been required. Second, Gillespie and Wolle may have undertaken some preliminary efforts to develop a "science of shoveling." There is no direct evidence of such activity. But Taylor asked them to work on the "law of heavy laboring" during this period so it is possible that he also requested them to devote some time to shoveling techniques.

Whatever the reason, Taylor must have been satisfied with the results, for he ordered the extension of piece rates to other yard labor jobs. Yet after July the work slowed, partly because Gillespie and Wolle left Bethlehem for better paying jobs. A. B. Wadleigh, their successor, "had not before handled this class of labor" and had to be "taught the art of determining how much work a first class man can do in a day."<sup>32</sup> Taylor also insisted that the time studies be done carefully and thoroughly. His caution was understandable; instead of a handful of men he now was dealing with several hundred (by his count as many as 600). Moreover, he expected the rates set by Wadleigh to be permanent—"to last," as he suggested in one statement, "perhaps for twenty years."<sup>33</sup>

Another reason for the delay may have been the opposition of Linderman (or some combination of veteran managers) to reduc-

<sup>31</sup> A. B. Wadleigh, "Report on the Unloading of Stock for the Blast Furnaces," Jan. 25, 1900, Taylor Papers, Notebook 6.

<sup>32</sup> Taylor, "Shop Management," 1358.

<sup>33</sup> Taylor, "Conversation," 38.

tions in the yard labor force. Like Gillespie and Wolle, Wadleigh laid off men who could not earn the defacto "low rate."<sup>34</sup> Taylor later recalled a confrontation with Linderman over this practice.

I got into a big row with the owners of the company on that labor question. They did not wish men, as they said, to depopulate South Bethlehem. They owned all the houses in South Bethlehem and the Company stores, when they saw we were getting rid of labor and cutting the labor force down to about one-fourth, they did not want it. They came to me and said so frankly, 'We don't want that done.' I said, 'You are going to have it, whether you want it or not, as long as I am here. You employed me with the distinct understanding that is what I was going to do. You agreed to it, and got me here for that purpose.'<sup>35</sup>

Like many of Taylor's later recollections this one raises more questions than it answers. Linderman had never agreed to the wholesale firing of his employees. Nor is there any indication that Taylor "depopulated" South Bethlehem.<sup>36</sup> But it is conceivable that Linderman and other plant officials urged restraint in this area while demanding cost reductions in others. In any event, as Taylor noted, "it was . . . of great importance not to fall down on any line in the labor business. I therefore had every one of those data come to me personally to fix."<sup>37</sup>

Relatively little information about this activity has survived. Wadleigh recorded the times (including "rest" periods) of different laborers and then combined his observations to find an optimum time for a particular type of work. There is no indication of how Taylor determined the rates or whether he again used the average wage of all employees at the plant as a goal for the "first-class" man. He did summon Thompson to Bethlehem in the summer of 1900 "to instruct us in the art of working up timed observations."<sup>38</sup> There is no evidence that he or Thompson attempted to shift to the two-rate system—they probably reasoned that the "first-class"

<sup>34</sup> Gantt to Davenport, Nov. 22, 1899, Taylor Papers, Notebook 6.

<sup>35</sup> Taylor, "Conversation," 36-37.

<sup>36</sup> I found no mention of Taylor's work in the *South Bethlehem Globe* for the 1898-1901 period. Professors Wrege and Perroni had no better luck with the *Globe* or *The Bethlehem Star*. Wrege and Perroni, "Taylor's Pig-Tale," 18.

<sup>37</sup> Taylor, "Conversation," 37.

<sup>38</sup> Taylor to Sanford E. Thompson, Mar. 22, 1900, Taylor Papers, File 124E.

group was so small that a specific penalty rate for the others would destroy morale and precipitate new conflicts. Wadleigh apparently studied the size of the shovel, but other aspects of the "science of shoveling" remain a mystery.

Taylor's later writings are the only documentation for other improvements, including experiments to determine the optimum shovel load, the construction of a toolroom to store the shovels and other implements, the creation of a labor office to plan the laborers' work and eliminate delays, and a detailed system of record keeping which indicated to each man daily whether he had earned the de facto "high rate."<sup>39</sup> Taylor proudly proclaimed that he had eliminated covert opposition among the laborers; yet he also admitted on several occasions that individuals inexplicably "forgot" how to shovel.<sup>40</sup> In 1912 he recalled that a "teacher" had helped men who failed to earn the high rate.<sup>41</sup> But the teacher, like the "science of shoveling," was most likely a product of later wishful thinking. If the experiences of the pig iron handlers were indicative, the Bethlehem "teacher" simply applied the "appropriate remedy," which in most cases was dismissal. Taylor's statements that the workers were contented and friendly toward the management also must be discounted, if for no other reason than the fact that he had no way of determining their real sentiments.<sup>42</sup> His assertions that the laborers were (or became) sober responsible citizens—"Many if not most of them were saving money, and they all lived better than they had before"—cannot be confirmed or denied on the basis of existing data.<sup>43</sup> The Bethlehem management had long emphasized these qualities.<sup>44</sup> Perhaps it was only irony that Henry Noll, whom Taylor admired for his self-discipline, later lost his job and home because of excessive drinking.<sup>45</sup>

<sup>39</sup> Taylor, "Testimony," 51-59; Taylor, "Shop Management," 1360-1361; Taylor, *Principles*, 65-72.

<sup>40</sup> Taylor, "Testimony," 60.

<sup>41</sup> *Ibid.*, 59.

<sup>42</sup> See Taylor, "Shop Management," 1362-1363.

<sup>43</sup> Taylor, *Principles*, 72.

<sup>44</sup> H. F. J. Porter, "The Get Together Club, No. One," *Social Service*, III (April, 1901), 103.

<sup>45</sup> To counter union charges of worker exploitation, Taylor, Wadleigh and U.S. Army Ordnance officials located and examined Noll in 1913. See William Crozier to Taylor, Nov. 21, 26, 1913; Taylor to Crozier, Dec. 4, 31, 1913, Taylor Papers, File 185D.

If the reorganization of the yard laborers was less innovative and important than Taylor later claimed, the results were nevertheless impressive. During Taylor's final year at Bethlehem (April 1900–April 1901) yard labor costs averaged 3.3 cents per ton of material handled, as opposed to 7.2 cents per ton under day work. On the average, the men handled three times as much material and earned sixty percent higher wages than formerly, figures that again imply a large turnover in the labor force.<sup>46</sup> Noll had earned only \$1.72 per day in early June 1899, while the laborer who received a sixty percent bonus in 1900–1901 presumably earned \$1.84. Since there was no indication of resistance (except perhaps by managers who owned South Bethlehem real estate and by workers who “forgot” their jobs) the workers apparently accepted their fates with resignation. Once more, it appears, Taylor demonstrated the effectiveness of the ad hoc “driving” methods he had developed in the 1890s.

Still, after nearly three years at Bethlehem he had not introduced his labor reforms in the metal working departments and thus had not demonstrated his system's ability to elicit greater output from the workers who really counted. Moreover, he showed no inclination to initiate time studies in the machine shops. According to his principal assistant, Henry L. Gantt, he had no immediate plan to install the differential piece rate as late as March 1901.<sup>47</sup> Several factors may account for this omission. Continued opposition from the management forced Taylor to spend much of his time in 1900–1901 defending himself and his work when, presumably, he should have been devoting his attention to the machinists. He also hoped to perfect his metal cutting studies before he timed the machinists. He believed he had proven his ability to improve the performance of machines and men; why rush the reorganization of the machine shops when a few more months of experimentation might produce important new developments? Whatever the exact reason, the delay meant that few machinists or other machine tenders were involved in the reorganization of the Bethlehem labor force and that the differential piece rate was never introduced at Bethlehem. Equally

<sup>46</sup> Taylor, “Shop Management,” 1362; Taylor, “Testimony,” 65; Wadleigh to Taylor, Apr. 10, 1901, Taylor Papers, Notebook 6.

<sup>47</sup> H. L. Gantt, “A Bonus System of Rewarding Labor,” *Transactions of the American Society of Mechanical Engineers*, XXIII (1901–1902), 351, 359.

important, it meant that the effort to extend scientific management from the management to the workers in the Bethlehem shops occurred under Gantt's aegis rather than Taylor's.

Despite the introduction of high speed steel, production planning, and functional foremanship, Gantt was dissatisfied with the performance of the machine shop. The workmen, he wrote, "would run their machines at the feed and speed called for, but . . . it seemed impossible to prevent them from losing time between operations." When approached, each man "could give a more or less plausible excuse why his machine was not running." In short, "no matter how efficiently the machines were run . . . the men found good excuses for taking more than the prescribed time on every job, and for wasting enough time to hold down the output of the shop very materially."<sup>48</sup> Gantt studied this problem for several months before concluding, as Linderman might have suggested, that a system of piece work was the solution. In early 1901 he discussed his idea with Taylor who agreed that some action was desirable. In March Taylor approved Gantt's proposal for a temporary bonus plan to remain in effect until the differential piece rate could be introduced. Taylor and Gantt never discussed the time studies that were made before the bonus went into effect but it is probably safe to conclude that, because of the metal cutting studies, they were at least as accurate as those Taylor had used to set rates at Midvale. By mid-May twenty lathes engaged in roughing work were operating under piece work, and the productivity of the shop had increased substantially.<sup>49</sup>

Gantt's bonus plan was a variation of the differential piece rate, similar to the scheme Taylor had introduced in the yard. In a 1901 American Society of Mechanical Engineers paper Gantt described it as a less stringent and imperfect form of Taylor's incentive wage.<sup>50</sup> "Task work with a bonus" provided a "high" rate for workers who completed the job assigned by the planning office and a "low" rate for those who, for whatever reason, failed. The "high" rate was comparable to Taylor's premium rate and was earned for output

<sup>48</sup> *Ibid.*, 351.

<sup>49</sup> *Ibid.*, 357.

<sup>50</sup> *Ibid.*, 343.



two to four times the previous norm. The "low" rate was simply the equivalent of the worker's day wage. Gantt's contribution was the more humane treatment of the workers who failed to earn the high rate. Whereas Taylor, Gillespie, and Wadleigh penalized workers who would not or could not earn the high rate, Gantt did nothing, or so he claimed.

As a result, Gantt conceded, the incentive did not operate automatically. His assistant in Machine Shop No. 2, C. H. Buckley, described the methods they used to encourage the workers.

When he [the worker] receives his instruction card he glances at the time allowed for each operation and the total time to finish the piece. He then begins a mental calculation based on his work experience with similar work, the result of which is, 'Impossible.' A very stupid observer can readily see this stamped on his countenance.

If this is the man's first introduction to the system, we rarely try to convince him of the accuracy of the instruction card, but the next morning will approach him and get him to perform a few of the operations with the stop watch in plain sight. In a short time he sees that nothing unreasonable has been asked, and will nearly always start from that moment working with a good will; when once he earns a bonus we experience no further trouble.<sup>51</sup>

Acknowledging that his approach was temporary and imperfect, Gantt permitted the workers to improve the system if they could. "For the moral effect," he allowed machinists to disregard the instruction cards and attempt to complete the assigned tasks by other methods.<sup>52</sup> If they succeeded, the planning office revised the instruction cards; if they failed, they supposedly gained a new appreciation of scientific management. At the suggestion of one of the Bethlehem supervisors, Gantt also introduced a bonus for the functional foremen based on the number of their subordinates who earned the bonus.<sup>53</sup> "The next and most obvious step," he added, "is to make it to the interest of the *men to learn more than their cards can teach them.*" Gantt did nothing at Bethlehem to achieve

<sup>51</sup> *Ibid.*, 368.

<sup>52</sup> *Ibid.*, 367.

<sup>53</sup> H. L. Gantt, *Work, Wages, and Profits* (New York, 1909), 107.

this goal because "no entirely satisfactory method has suggested itself," but he considered rewards for workers who suggested new ideas or developed new techniques.<sup>54</sup> Increasingly Gantt's wage system became something more than the stopgap measure it had been in 1901.

In Machine Shop No. 2 the task and bonus plan was an immediate success. Machine times were cut, in some cases almost as much as scientific management had cut the pre-1898 times, and output increased. According to Gantt, machinists at all levels of ability accepted it enthusiastically.<sup>55</sup> Although only a handful of men were involved, Taylor and Bethlehem managers must have been impressed. Under more propitious circumstances it is likely that the task and bonus would have been extended to other departments, perhaps to the entire works, fulfilling Linderman's original expectation and Taylor's promise.

Unfortunately, Taylor's relations with Linderman deteriorated rapidly in early 1901. His conflicts with the veteran supervisors, his seemingly endless procession of reforms and costly innovations, and a factor beyond his control, a sudden improvement in the steel manufacturers' relations with the government, all contributed to Linderman's disenchantment. By April the break was complete and Linderman discharged Taylor.<sup>56</sup> Gantt, Barth, Wadleigh and the other assistants tried to finish their work, but received little encouragement. By the fall of 1901, when Linderman and the other stockholders sold Bethlehem, the last of the assistants had also departed.

Thus ended the reorganization of the labor force at Bethlehem Steel. Contrary to Taylor's subsequent recollections, it had been at best a subordinate feature of the introduction of scientific management at the Bethlehem plant. Only when some special opportunity or problem arose—the pig iron sale or Gantt's dissatisfaction with the machinists—did he devote much attention to the production employees, either the laborers or the machine tenders. And while Wadleigh's activities cannot be precisely determined, it is

<sup>54</sup> Gantt, "Bonus System," 360.

<sup>55</sup> *Ibid.*, 354.

<sup>56</sup> Copley, *Taylor*, II, 159.

unlikely that he was, or was viewed by his associates, as a major figure in the larger effort. As a consequence the reorganization of the labor force had an ad hoc, unsystematic character, reminiscent of Taylor's work in the early 1890s. With some exceptions it was not a demonstration of the efficacy of scientific management but an example of how aggressive executives, preoccupied with larger concerns, forced marginal employees to work harder. The reformers and union leaders who later criticized Taylor were right about the fate of Schmidt and the other laborers. They incorrectly but understandably assumed that Schmidt was the archetypal employee under scientific management and that his treatment would be the lot of all workers who succumbed to the stop watch and incentive wage.

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