

Scientific Management in Transition: Frederick W. Taylor at Johnstown, 1896

BETWEEN 1880 and 1901 Frederick W. Taylor (1856–1915) introduced a series of technical and organizational changes in various Pennsylvania factories that profoundly affected the theory and practice of industrial management. Known collectively as “scientific management,” Taylor’s innovations were a synthesis of old and new techniques that acted as a catalyst on the late nineteenth-century management movement. By far the best known of his methods was stop watch time study, which he began at the Midvale Steel Company of Philadelphia in the early 1880s and applied extensively at the Bethlehem Steel Company between 1898 and 1901. After 1901, because of widespread concern over labor unrest and Taylor’s promotional efforts, journalists, social critics, and many employers increasingly associated scientific management with the study and the reorganization of work, and thus with Taylor’s activities at Midvale and Bethlehem.¹ As a result his work was, and is today, discussed primarily in terms of its effects on work, incentives, and industrial discipline.²

Yet an examination of Taylor’s activities at a third, little-known Pennsylvania factory, the Johnson Company plant at Johnstown, in 1896, suggests a different view of his career and significance. Taylor’s basic achievement was not the development of new tech-

¹ Taylor retired in 1901 and devoted the remainder of his life to the promotion of scientific management. In his post-1901 writings he seldom referred to his early work except at Midvale and Bethlehem.

² These ideas appeared in the early works on scientific management: C. Bertrand Thompson, *Scientific Management in Theory and Practice* (Cambridge, 1917); H. B. Drury, *Scientific Management* (New York, 1915); and Frank B. Copley, *Frederick W. Taylor* (New York, 1923). They are also reflected in most recent writings on Taylor. See, for example, Sudhir Kakar, *Frederick Taylor: A Study in Personality and Innovation* (Cambridge, 1970); Daniel A. Wren, *The Evolution of Management Thought* (New York, 1972), chapters 6–7; Samuel Haber, *Efficiency and Uplift* (Chicago, 1964), chapters 1–2; and Edwin T. Layton, Jr., *The Revolt of the Engineers* (Cleveland, 1972), chapters 6–7.

niques such as time study, but the refinement, extension, and integration of existing methods known as "systematic management." His preoccupation was not work but the optimum utilization of plant and machinery; the individual worker, as well as stop watch time study, played only a secondary role in his management system before 1901. Nor is the continuity between Taylor's efforts at Midvale and Bethlehem as clear as many studies, which have emphasized time study and the worker, have suggested. Scientific management emerged in a series of sequential steps, responses to outside forces and Taylor's changing perception of the functions of business administration. At each succeeding stage in his career prior to 1901 it became more elaborate, complex, and all-inclusive. Had it not been for the depression of the 1890s, the Johnstown plant might have been the first "scientifically" managed factory, anticipating Taylor's activities at Bethlehem and his disciples' efforts at the Tabor and Link-Belt companies in Philadelphia after 1901.³

In the decade before Taylor arrived at Johnstown the growth of American industrial output and productivity prompted the appearance of a "new factory system," as manufacturers adjusted technology and organization to the opportunities of the burgeoning American market.⁴ The new factory system encompassed numerous changes in the physical setting of the factory, the gradual development of modern personnel management, and the rise of "systematic" management, that movement among late nineteenth-century engineers to introduce system and order into industrial activities.⁵ Systematic management overlapped the other innovations and provided the cohesive force that translated the new factory system into higher profits. It was also closely related to the evolution of mechanical engineers from technicians to managers, and reflected

³ Taylor's followers, notably Carl G. Barth, thoroughly reorganized the Tabor Manufacturing Company and the Link-Belt Engineering Company's Philadelphia plant between 1902 and approximately 1908. Tabor and Link-Belt became model factories which Taylor used to demonstrate the effects of his work.

⁴ This theme is developed in my forthcoming book, *Managers and Workers, Origins of the New Factory System, 1880-1920*.

⁵ The best brief introduction to systematic management is Joseph Litterer, "Systematic Management: Design for Organizational Recoupling in American Manufacturing Firms," *Business History Review*, XXXVII (1963), 369-391.

their positivistic outlook. At first, individual engineers reacted to what appeared to be unique problems. By the 1890s they began to develop and refine management systems on the basis of their earlier *ad hoc* solutions. Finally, they introduced new procedures that grew out of the experiences of other businessmen—innovations they discovered through trade or professional journals or the work of a new group of management consultants.⁶ By 1911 Henry Kendall, a leader in the management movement, could write that conservative manufacturers who clung to the older “unsystematized” techniques of factory management “will be forced to change or be eliminated.”⁷

While engineer-managers shared a common viewpoint, they emphasized specific problems and solutions rather than comprehensive management systems. Probably the most popular topics in the management literature of the late nineteenth century were cost accounting methods, especially techniques for ascertaining and allocating overhead costs. Many so-called management systems were really accounting systems with special attention to overhead or “burden” costs. By the 1890s many engineers, including Taylor, favored some form of “machine hour” method of allocating costs, a procedure by which overhead costs were related to machine use.⁸

The management reformers revealed a similar interest in the acquisition and handling of materials. They centralized purchasing, standardized materials, and insisted that stores be kept in designated areas and dispatched only when requisitioned by foremen. In well-organized plants they introduced a special staff to move materials to and from the storerooms.⁹ To integrate and regulate the various steps in the manufacturing process, they devised numerous production control plans in the 1880s and 1890s. These involved the use of cards or tickets issued by the engineering or production office to convey instructions to the foremen and workers and to elicit information on particular jobs and costs. The engineers also advocated a larger clerical staff to record the data needed for

⁶ Leland Jenks, “Early Phases of the Management Movement,” *Administrative Science Quarterly*, V (1960), 424.

⁷ Henry P. Kendall, “Types of Management: Unsystematized, Systematized, and Scientific,” in Dartmouth College Conferences, *Addresses and Discussions of the Conference on Scientific Management Held October 12, 13, 14, 1911* (Hanover, N. H., 1912), 124.

⁸ S. Paul Garner, *The Evolution of Cost Accounting to 1925* (University, Ala., 1954), 187–188.

⁹ Kendall, “Management,” 120–122.

effective operations. Factory clerks were an essential feature of systematic management.¹⁰

Finally, the reformers applied the same principles to the factory worker in order to make him more efficient and productive. Their favorite method for achieving this goal was the incentive wage. The earliest incentive systems were profit-sharing plans, products of the growing concern over the "labor problem," particularly the strikes and unrest of the mid-1880s.¹¹ But most engineers rejected profit sharing because it did not tie the worker's reward to his behavior and thus smacked of philanthropy. In the words of Frederick W. Halsey, inventor of the most popular incentive plan, profit sharing was "wrong in principle, and cannot be in any large sense a solution of the wages problem."¹² Instead, Halsey proposed the "premium" plan, which offered workers bonuses for greater individual output. "Surely," he wrote in a statement that epitomized the engineers' approach, "a system which increases output, decreases cost, and increases workmen's earnings simultaneously, without friction, and by the silent force of its appeal to every man's desire for a larger income, is worthy of attention."¹³

Starting, like most mechanical engineers, as a machine designer and machine-shop manager, Taylor first distinguished himself at Midvale as an inventor and technician. By the early 1880s he had demonstrated a remarkable technical proficiency. As he later confessed, invention was "a mental dissipation . . . a very great amusement rather than a labor."¹⁴ The results of his creative work included an improved railroad car wheel, an elaborate set of forging equipment, a powerful steam hammer, and a variety of devices to facilitate machine tool operations. Taylor's machine tool inventions were part of a larger project that became the basis of his fame as a

¹⁰ Seymour Melman, "The Rise of Administrative Overhead in the Manufacturing Industries of the United States, 1899-1947," *Oxford Economic Papers*, III (1951), 90-91.

¹¹ For early antecedents of the "premium," see U. S. Commissioner of Labor, *Regulation and Restriction of Output, Eleventh Special Report* (Washington, 1904), 126.

¹² Frederick A. Halsey, "The Premium Plan of Paying for Labor," *Transactions of the American Society of Mechanical Engineers*, XXII (1891), 758. For his criticism of welfare work, see Halsey, "The National Cash Register Company's Experiment," *American Machinist*, XXIV (June 20, 1901), 688-689.

¹³ Halsey, "Premium Plan," 761.

¹⁴ Frederick W. Taylor to Morris L. Cooke, Dec. 2, 1910, Carl G. Barth Papers, Drawer 2, Harvard Graduate School of Business Administration.

scientific investigator—the discovery of “the art of cutting metals.” This investigation, a meticulous study of cutting tools and their application, precipitated a revolution in machine-shop techniques.¹⁵ It also helped signal a new era when science would be applied systematically to practical ends and marked the beginning of scientific management. Taylor, the consummate engineer, soon discovered that technical advance demanded organizational innovations of comparable significance.

Taylor's early managerial innovations reflected his preoccupation with machine tool processes.¹⁶ His first step was to study activities that affected machine times and techniques. This led him in two directions. On the one hand he attempted to improve and standardize the actions of the machine-tool operators. In 1883 he hired an assistant to study the men's actions in a systematic way, using a stop watch. By the next year he had introduced an incentive wage plan, his “differential piece rate system,” to force the workers to adopt the most “efficient” techniques. This incentive plan differed from others which appeared in the 1880s and 1890s in two respects: it was based on the time study man's conclusions rather than the customary time required to complete a job; and it offered the worker only a “high” rate and a “low” rate. Taylor intended to make the low rate so low that the machinist who would not or could not earn the high rate would become discouraged and quit. On the other hand, he attempted to insure the continuity of operations on which the machine tools depended. He initiated a series of experiments to determine the best ways to transmit power to the machinery and prevent delays, to systematize tool grinding and tool room procedures, and to provide for regular machine maintenance.

By the mid-1880s these activities led Taylor to perceive some of the problems that troubled other engineer-managers. To insure the optimum utilization of machines and men it was necessary to provide a continuous flow of materials as well as power and trouble-

¹⁵ L. T. C. Rolt, *A Short History of Machine Tools* (Cambridge, 1965), chapter 10.

¹⁶ Daniel Nelson, “Scientific Management, Systematic Management and Labor 1880–1915,” *Business History Review*, XLVIII (1974), 479–500. For Taylor's incentive wage system, see Frederick W. Taylor, “A Piece Rate System,” *Transactions of the American Society of Mechanical Engineers*, XVI (1895), 856–903.

free machinery. In 1885 or 1886 he introduced a system of production planning based on the dispatch of cards from a central office that resembled other production management plans.¹⁷ He also introduced the rudiments of a method of specialized or functional supervision, which substituted a group of technicians, each proficient in a particular aspect of the manufacturing process, for the single all-round foreman.

By 1890 Taylor's reputation as an innovative manager led to his appointment as superintendent of the Manufacturing Investment Company, a pulp and paper firm owned by J. P. Morgan and other Wall Street financiers. His career at the Manufacturing Investment Company, however, was a disappointment. He introduced the differential piece rate (without the benefit of time study) at one plant but was so beset with day-to-day problems, including the financiers' demands for profits, that he had little opportunity to implement his other Midvale techniques.¹⁸ In 1893 he resigned in disgust. Yet his experiences helped him broaden his perspective and convert his ideas from a series of specific answers to machine shop problems to a system of factory management. In the months following his resignation he also added a major new feature to his management methods, a set of accounting reforms complete with a "machine hour" cost allocation procedure that was similar to those of other leading management reformers.

Taylor soon enhanced his position with a description of his emerging management system that attracted widespread interest. In June, 1895, he read "A Piece Rate System" to the American Society of Mechanical Engineers, an organization which embraced most of the management reformers.¹⁹ This paper, which explained the differential piece rate, time study, production planning, and Taylor's other innovations, established him as a leader of the systematic-management movement. Its focus on piece work, a relatively minor feature of his work, led to a general misconception of the nature and basic thrust of scientific management. But it

¹⁷ Taylor's comment on Henry Metcalf, "The Shop Order System of Accounts," *ibid.*, VII (1886), 475-476.

¹⁸ These conclusions are based on a study of Taylor's work at the Manufacturing Investment Company that will be incorporated in my forthcoming biography of Taylor.

¹⁹ Taylor, "A Piece Rate System," 856-903.

identified Taylor as a reformer with an engineer's answer to the "labor problem" and attracted additional clients, including the managers of the Johnson Company.

The Johnson Company was a product of Tom Loftin Johnson's spectacular rise as a street railway magnate. In 1869 the young, penniless Johnson had joined the Louisville, Kentucky, streetcar firm owned by Alfred Victor du Pont of the Delaware du Pont family. He soon demonstrated a talent for business and engineering and advanced rapidly; by the 1880s he owned or controlled, with du Pont, streetcar lines in a half-dozen major cities. By the 1890s he had become a leader of the electric traction industry. One of his important technical developments was an improved rail for trolleys which he and Arthur J. Moxham, inventor of a rolling technique, began to manufacture in 1889 for Johnson's lines. Johnson and Moxham called their firm the Johnson Company, and, because the Cambria Iron Company at first produced most of their steel and rails, established their headquarters in Johnstown. Johnson continued to devote most of his attention to street railway promotions, while Moxham managed the Johnson Company.²⁰

Under Moxham's direction the Johnson Company expanded rapidly. In the early 1890s, a boom period for the street railway industry, the company integrated forward and backward: Moxham set up sales offices in major cities to sell rails to traction firms not owned by Johnson and du Pont, and a rolling mill in Johnstown to manufacture rails from Cambria steel. By 1893 Moxham began to study the possibility of a new and larger rolling mill, together with a steel plant, either at Johnstown or some more advantageous point.²¹

In the meantime Johnson had undertaken the production of electric streetcar motors as well as rails. In the late 1880s he had established a small motor repair company in Cleveland under the management of his brother Albert L. Johnson. This company soon began to manufacture motors for Johnson's streetcar lines, and then, like the Johnson Company, for the general market. A. L.

²⁰ Alfred D. Chandler, Jr., and Stephan Salsbury, *Pierre S. du Pont and the Making of the Modern Corporation* (New York, 1971), 29; Tom Johnson, *My Story* (New York, 1913), 29-30.

²¹ *Iron Age*, LIII (Jan. 18, 1894), 115; Chandler and Salsbury, *Pierre S. du Pont*, 26.

Johnson claimed that his product "possessed a remarkable record"; in any event, the Steel Motor Company, as the firm was known after 1893, became one of the four major motor producers in the United States.²² In 1894 it became a subsidiary of the Johnson Company.

Thus, by the mid-1890s the Johnson Company had emerged as an important and prosperous firm. Moxham, a skillful organizer, was primarily responsible for its success. Johnson, on the other hand, was gradually forsaking business for politics; a Democratic congressman in the 1890s, he was to become one of the nation's leading progressives after 1901 as mayor of Cleveland. du Pont, the third important figure in the Johnson Company, died in 1893, and his shares were divided among his brother Bidermann and three nephews—Coleman, Alfred I., and Pierre S. du Pont—who in later years would build E. I. du Pont de Nemours into the world's leading chemical company. Bidermann, Alfred, and Pierre, deeply involved in other activities, left the management of the Johnson Company to Moxham. Coleman became the manager of the Johnstown works in 1894.

The company's success in the early 1890s, Johnson's preoccupation with politics, and the emergence of the inexperienced du Ponts led to the decisions which brought Taylor to Johnstown and profoundly influenced his work there. Having concluded that the company should manufacture steel, Moxham in 1893 urged construction of a modern integrated steel mill at Lorain, Ohio, west of Cleveland on Lake Erie.²³ The panic of 1893 reinforced his conviction. In the short run, he argued, such a plant would help the company reduce costs and compete more effectively during the recession. In the long run it would free the firm from dependence on the steel industry. Perhaps because this move seemed a logical extension of Moxham's policy of vertical integration, Johnson and the du Ponts assented.²⁴ In 1895 the company moved most of its operations and many of its

²² "The Steel Motor Company," *Street Railway Journal*, XI (1895), 547; George T. Hanshett, "Electric Railway Motors," *Street Railway Journal*, XIII (1897), 835.

²³ Chandler and Salsbury, *Pierre S. du Pont*, 29-30; Johnson, *My Story*, 29-33; also Pierre S. du Pont to Arthur J. Moxham, Feb. 5, June 6, 1894, Pierre S. du Pont Papers, File 26, Box 1, Eleutherian Mills Historical Library.

²⁴ "Why the Johnson Company Went to Lorain," *Iron Trade Review*, XXVIII (Jan. 3, 1895), 9-10; "The Johnson Plant at Lorain," *Iron Age*, LV (May 9, 1895), 973.

employees to the new site. This "left upon our hands a considerable equipment in the matter of boilers and of many buildings," and "left [Johnstown] real estate in a depressed condition." Since Moxham and the du Ponts "had faith in this portion of the Company's property" (not to mention large real estate holdings and control of the Johnstown street railway system), and since "Johnstown offered advantages in the matter of skilled mechanical labor," they moved the Steel Motor Company from Cleveland to Johnstown.²⁵ They hired new men, improving the local real estate situation, expanded the plant, and reorganized its operations.²⁶ To help with the latter task Moxham hired Taylor, who began work at Johnstown in early March, 1896.

Taylor's previous experiences with financiers made him wary of Johnson and Moxham, but he soon concluded that they were different. Moxham, whose office was in Lorain, was enthusiastic but demanding—"a man who wants the most minute information regarding everything and wants it right away."²⁷ Coleman du Pont and W. A. Harris, the manager of the electrical department, were "a most willing and considerate set of men. . . ."²⁸ Harris, his immediate superior, was "practical," "energetic," and "active," "one of the quickest men to improve the opportunities presented by the new system."²⁹ By the early summer Taylor had become highly optimistic about his Johnstown assignment.

Taylor's principal duty at the Johnson Company was to introduce his accounting methods. The exact scope of his work is unclear, but apparently it encompassed all the Johnson facilities in Johnstown—the electric motor factory plus a foundry and switch works which remained there. The specific measures Taylor introduced were those he had advocated since 1893. By October he could write that the managers

²⁵ "Memorandum to Stockholders of the Johnson Company," Mar. 24, 1896, Pierre S. du Pont Papers, File 26, Box 1; Michael Massouh, "Tom Loftin Johnson, Engineer-Entrepreneur (1869-1900)" (Ph.D. dissertation, Case Western Reserve University, 1970), 172-173.

²⁶ "Memorandum," Mar. 24, 1896, du Pont Papers, File 26, Box 1; *Johnstown Tribune*, Mar. 4, Apr. 16, 1896.

²⁷ Taylor to Caspar F. Goodrich, June 3, 1896, Frederick W. Taylor Collection, File 60A, Stevens Institute of Technology, Hoboken, N. J.

²⁸ *Ibid.*

²⁹ Taylor to George F. Steele, Oct. 14, 1896, File 70H, *ibid.*

have complete and elaborate returns each month of just what they had produced and the cost, not only of every piece made, but of every operation on every piece, and as this is a comparative statement they cannot fall behind their best previous cost in any operation done in the works however small, without being called to their attention. The books are also completely closed and balanced at the end of each month. . . .³⁰

The reports were so complete "that if gang bosses or sub-foremen have employed one extra laborer during the month . . . it will be brought to his attention."³¹ Apparently he did not exaggerate. When problems at Johnstown and Taylor's absence during the early part of September delayed the August statements until September 18, Moxham—who took Taylor's claims seriously—demanded a detailed explanation.³²

The new accounting procedures were closely related to other changes in the plant organization. One of these, Taylor's store-keeping system, was a new feature of his management system. Although systematic purchasing and stores methods were prominent features of most production-management plans, Taylor had disregarded them on his earlier jobs. Yet he realized their importance for most factories. In his initial proposals to Moxham, Taylor emphasized the significance of an improved stores system. The first important detail of his system, he wrote, was "an accurate running balance of raw materials, merchandise, and stores throughout all of your establishments."³³ He may have stressed this point because of the chaotic stores methods that prevailed before his arrival. The company had, he recalled, "some hundred and fifty thousand dollars worth of valuable stores and supplies dumped down in a shed helter-skelter, without even protection from the weather, and each workman dived into this pile for whatever he wanted without rendering any account to anyone of what he wanted."³⁴ As a result, the establishment of a stores system and systematic storekeeping methods proved to be a difficult, perhaps the most difficult, part of Taylor's work. The "issuing and charging of materials met with

³⁰ Taylor to Steele, Oct. 7, 1896, *ibid.*

³¹ Taylor to Steele, Nov. 20, 1896, *ibid.*

³² Taylor to William A. Donaldson, Sept. 23, 1896, File 45, *ibid.*

³³ Taylor to Arthur J. Moxham, Feb. 21, 1896, *ibid.*

³⁴ Taylor to Caspar F. Goodrich, June 3, 1896, File 60A, *ibid.*

great opposition from all of the men. . . ."³⁵ This hostility was one of the major reasons for the embarrassing delay in the preparation of the August cost reports. Though Taylor proceeded to "train" the men, it was "a very difficult task and left us very much mixed up. . . ."³⁶ By the early fall he had introduced a variety of forms for recording inventories of raw materials and partially finished products. The results were "so satisfactory and so very apparent" that "the opposition has almost entirely ceased": yet he warned that any future compromises or shortcuts would sabotage the entire storekeeping and accounting system.³⁷

Unfortunately this admonition was not heeded. Within a month after his departure in November, 1896, Taylor received complaints that the cost system was not working properly. "The greatest problem," he replied, was that "the shop manager does not have the benefit of the elaborate balance records. . . ." To remedy this problem "steps should be taken at the earliest minute . . . [to] get the system in thorough working order."³⁸ Still the managers hesitated to heed Taylor's advice; as late as January, 1897, he lectured Harris on the necessity for strict adherence to his procedures if the desired results were to be achieved.³⁹

Taylor also introduced the differential piece rate, which caused additional problems. Until 1896 the company had relied on the internal contract system of production, under which a "contractor" or first-line supervisor assumed complete responsibility for a particular job. He hired the men he wanted, paid them a day wage, supervised them, and hoped to make a profit on his "contract" with the management by reducing costs. The contract system was obviously incompatible with scientific management, and Taylor sought to replace it with the differential piece rate as soon as possible. But the change was difficult, for the men had no experience with piece work, much less a complicated incentive system that stripped the supervisor of his rate-making power. Fortunately for Taylor many of the workers were new and in general "docile and

³⁵ Taylor to William A. Donaldson, Sept. 23, 1896, File 45, *ibid.*

³⁶ *Ibid.*

³⁷ Taylor to George F. Steele, Oct. 14, 1896, File 70H; Taylor to T. Coleman du Pont, Nov. 2, 1896, File 45, *ibid.*

³⁸ Taylor to T. Coleman du Pont, Dec. 12, 1896, *ibid.*

³⁹ Taylor to W. A. Harris, Jan. 15, 1897, *ibid.*

good natured." Even the contractors, whose earnings declined when they became salaried foremen, were a "very agreeable set of men to deal with."⁴⁰ By late September Taylor reported that "rates and prices have been cut down throughout the Shop."⁴¹ By the time he left in early November perhaps a majority of the men in the electric motor plant were working on the differential piece-rate plan.

Taylor believed that the introduction of piece work had significantly reduced costs at the Steel Motor Works. On October 22 he wrote that "in the classes of work to which it has been applied the cost has been fully cut in two. We have saved enough in armature winding alone, to pay for all the costs of introducing the system and running it. Mr. Harris . . . has succeeded in getting the whole of this work done by women."⁴² Taylor's rather incomplete account suggests, however, that the cost reductions were only partially a result of the differential piece rate. Reduced labor costs were also due to the reductions in "rates and prices" and to the hiring of low-wage women workers in the armature winding department. (The women, incidentally, did not directly replace higher priced male workers; most of the plant employees were new and inexperienced.) The role of the differential piece rate was to force men and women workers alike to attain high levels of production in a relatively short time.

Taylor's method of introducing the differential piece rate raised other questions. He insisted on time studies to determine the rates, but he had neither the time to do the work himself nor an assistant to help him.⁴³ As a result he must have relied on the foremen to make most or all the observations. Moreover, since he had not reorganized the machinery at the Steel Motor Works or installed his belting and maintenance procedures, the times allotted for machine operations must have been little more than guesses based on past operations. In short, the rate-fixing process at Johnstown had a haphazard, "rule-of-thumb" character, not unlike the traditional methods Taylor had attacked in "A Piece Rate System."

Yet Taylor was not wholly responsible for these deficiencies. If

⁴⁰ Taylor to George W. Hammond, July 2, 1896, File 70E, *ibid.*

⁴¹ Taylor to William A. Donaldson, Aug. 23, 1896, File 45, *ibid.*

⁴² Taylor to A. O. Fox, Oct. 22, 1896, File 38, *ibid.*

⁴³ Taylor to Sanford E. Thompson, June 3, June 6, 1896, File 124C, *ibid.*

his personal relations with the managers of the Johnson Company were far superior to his relations with the officers of the Manufacturing Investment Company, the economic environment in which he worked had many unfortunate similarities. At Johnstown, as before, the owners' hopes that their bold innovations would produce high profits quickly soured. Moxham and the du Ponts built the Lorain plant on the assumption that the depression would be relatively short, but their estimates proved wrong. Business did not improve in 1895, and by January, 1896, the company was forced to borrow \$750,000 to meet its short-term obligations. In July Moxham asked Taylor to curtail his expenses and turn over more of his activities to the company employees.⁴⁴ By October Taylor reported that the plant was "almost shut down."⁴⁵ Thus, from the beginning of his work at Johnstown Taylor operated under severe financial constraints. His employers agreed that he performed admirably; indeed, by early 1897 the Steel Motor Works was the most profitable operation of the Johnson Company.⁴⁶ Yet the constant if often indirect pressure to avoid new costs and reduce existing expenses had a constricting effect on his activities. It undoubtedly led to his hasty and somewhat haphazard introduction of piece work. It also prevented him from introducing other important features of his system. It is likely that the company's weak financial position prevented Taylor from completing the development of scientific management at that time and making the Johnson Company the first truly "Taylorized" firm.

Taylor's reports to Moxham and du Pont indicate the additional steps he would have undertaken if resources had been available. In an outline he submitted to Moxham in late February he proposed a planning department similar to the one he had established at Midvale. It would prepare written orders "covering the various items of work to be done, and each man throughout the establishment works from these written orders instead of from verbal orders."⁴⁷ Taylor introduced some of the features of a planning

⁴⁴ Arthur J. Moxham to Pierre S. du Pont, July 18, 1896, Pierre S. du Pont Papers, File 26, Box 1; Arthur J. Moxham to Taylor, July 9, 1896, File 45, Taylor Collection; Chandler and Salisbury, *Pierre S. du Pont*, 31-33.

⁴⁵ Taylor to George F. Steele, Oct. 14, 1896, File 70H, Taylor Collection.

⁴⁶ "Memorandum to the Stockholders of the Johnson Company," Apr. 3, 1897, Pierre S. du Pont Papers, File 26, Box 1.

⁴⁷ Taylor to Arthur J. Moxham, Feb. 21, 1896, File 45, Taylor Collection.

department—purchase and stores control procedures and a bulletin board, for example—but the company's financial plight led Moxham and du Pont to place these activities under the accounting department. Production management thus became subordinate to record keeping, precisely the opposite of what Taylor wanted. He made several other attempts to introduce systematic planning without an actual department, but these efforts failed, as he probably anticipated.⁴⁸ He also tried to systematize the work of the accounting department clerks, in part by recommending rigid work rules ("no talking above a whisper") and reducing the work day ("giving them all extra time for recreation rather than have them intersperse their recreation with their work, as they are now doing"), apparently with no greater success.⁴⁹

Taylor adopted a similar approach to functional foremanship. His first proposal did not mention functional supervisors, but he soon suggested activities that required specialist managers.⁵⁰ In early November, when his work was virtually completed, he recommended the appointment of a speed boss—a man who would "devote his time to seeing that all machines work at their best all the time"—without much hope that his suggestion would be adopted, at least in the immediate future.⁵¹ But his hesitation was also motivated by his own uncertainty as to the role and significance of functional foremen. He had used them sparingly at Midvale and not at all in the intervening period; under more advantageous circumstances the Johnson Company assignment would have offered him the opportunity to develop this aspect of his system.

Finally, and from Taylor's viewpoint most importantly, he recommended various mechanical innovations and extensive studies of the machinery to determine its capabilities. His suggestions included some of his metal cutting discoveries, his belt maintenance methods, and the purchase of a special tool grinder.⁵² His fundamental point, however, was "the desirability of carefully experimenting with each machine and job to be done throughout the place, so as to determine the maximum capacity of each part of the plant and then insure

⁴⁸ Taylor to W. A. Harris, Jan. 15, 1897, *ibid.*

⁴⁹ Taylor to T. Coleman du Pont, Oct. 21, 1896, *ibid.*

⁵⁰ Taylor to T. Coleman du Pont, Apr. 6, 1896, *ibid.*

⁵¹ Taylor to T. Coleman du Pont, Nov. 2, 1896, *ibid.*

⁵² Taylor to T. Coleman du Pont, Apr. 6, 1896, *ibid.*

each machine being operated at all times under the most favorable circumstances."⁵³ As he had at Midvale, Taylor saw these "experiments" as the key to the extension of his methods. A thorough knowledge of the machinery would affect each of the measures he proposed, as well as the stores and cost system and piece rates. Yet he knew that Moxham had not anticipated an extensive series of machine studies and probably could not afford them in any case. As a result he resigned himself to an important but limited installation of scientific management.

By November, when Taylor left Johnstown, he was generally pleased with his efforts. With modest resources he had made substantial reductions in the cost of manufacture and had impressed his employers. He had shown that he could achieve important results in a relatively short period of time, largely through the introduction of the differential piece rate. To attain these goals he had adopted a pragmatic approach to the major elements of his system—an approach that made scientific management in practice appear little different from the more complete systematic management plans. But this was a price Taylor willingly paid for the opportunity to "educate" his client to the desirability of a thorough installation of scientific management. Unfortunately, circumstances beyond his control prevented this strategy from succeeding at Johnstown in 1896 or afterward. The Johnson Company never fully recovered from the depression, and in 1899 Johnson, Moxham, and the du Ponts sold their interests to the new Federal Steel Company. In the ensuing reorganization Taylor's methods were discarded, apparently ending any influence he had on the operation of the Johnstown plant.⁵⁴

Taylor's work at Johnstown was thus an important chapter in the development of scientific management if not in the history of the Johnson Company. His activities led to a refinement of his existing methods with the notable exception of time study and the appearance of at least one new feature, systematic storekeeping, that he subsequently incorporated in his management system. Above all, they underlined the facts that scientific management was not primarily a technique to organize or control the worker and

⁵³ Taylor to T. Coleman du Pont, Nov. 2, 1896, *ibid.*

⁵⁴ R. T. Lane to Taylor, Feb. 3, 1899, *ibid.*

that Taylor's system in 1898 was far more complex and sophisticated than it had been when he left Midvale. Taylor's reorganization of the Bethlehem plant did involve an elaboration and extension of his time-study methods, but he was able to emphasize this activity after 1898 because he had completed other features of his system on earlier jobs, including his efforts for his third Pennsylvania client, the Johnson Company of Lorain and Johnstown.

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