Taylor is Dead, Hurray Taylor! The "Human Factor" in Scientific Management: Between Ethics, Scientific Psychology and Common Sense

Riccardo Giorgio Zuffo
University "G. d'Annunzio" of Chieti

Approximately one hundred years after the historical insights of Adam Smith on the division of labor (1776) as a determining factor in value creation (Taylor, 1911), the first conceptions of modern industry and what would come to be known as Scientific Management were born. The incubation period had been long. But, in 1879, Taylor, at twenty-three, was hired at the Midvale Steel Company where he progressively deduced and outlined those principles, models, and ideologies that would go on to influence production and the way to "live" their work, and reconfigure their daily life for an entire century. Now, a century later, life is full of great promise and many changes and by rereading Taylor's works contextually to the "Progressive Era" (Gould, 2000), they assume the paradigmatic value of a broader debate (Nelson, 1975, 1980), concerning what extent his work and action can be in some way rediscovered and focalized.

With Taylor, work had evolved in a way so as to permit the social and economic emancipation of millions of men. However, in order to fully understand Taylor's centrality for work it is necessary to first overcome the personal and the ideological dimensions that have made Taylorism both a symbol of labor's oppression, and a beacon of mankind's well-being. The history and chronicle of the 20th century has considered Taylor in many ways an engineer, a technocrat, a rationalist, a great hero and benefactor of humanity, an emblem of ferocious capitalism and of the modern factory's alienation. But Taylor was also genial, curious, and dogmatic; irascible, arrogant, and

condescending; ambitious wealthy, sophisticated, aristocratic, and famous. He was a friend of presidents and ministers. He also had a wide audience due to his newspaper contributions (Copley, 1923; Kanigel, 1997; Nelson, 1975). Lastly, he was political, favoring Roosevelt in the 1901 elections (Taylor, 1911). Taylor was certainly a complex and ambiguous figure, but above all, he was an expression of his time.

Taylor was born the idealistic and enlightened son of the educated bourgeoisie that characterized America during the Progressive Era (Sasso, 1984; Rossi, 1988, 1995). As did many other industrialists, academics and scholars who supported the belief in the modern age, he also took part in the building and shaping of America's greatness (Nelson, 1975; Gould, 2000). Taylor was the Zeitgeist of his time: his life and his action were metaphors of an epochal change. Therefore, it is difficult to condense his contribution which was defined within its rapport with differing thematic areas to that which he contributed and confronted with obsession and excellence. Certainly Taylor, in relation to the historical developments of applied psychology, was the first scholar to recognize the "human factor" as scientific management's central aspect both as a factor to be evaluated and understood scientifically and also as a factor with rich and complex political, social, ethical, and economic implications (Münsterberg, 1913; De Masi, 1992). The scientific aspects of work and man at work, as social subjects, coexisted. The factual and the ideal man together, became the fundamental factor for the growth of United States and the new concepts of labor during the 19th century.

Scientific Aspects of Taylor's Scientific Management

His model was one where techniques (today we would say technologies) of product, processes, machines and tools, along with working methods and control systems, were in a systematic equilibrium with the workers. The human element, as a central component in Taylor's conception, is in its rapport with the factors outlined here.

The first is relative to the model of scientific management that Taylor implemented in his daily practice, combining factors considered scientific or scientifically plausible, and factors where science had yet to enter, such as common sense, trade practices, and folk psychology.

Taylor gradually developed his theory of scientific management by aggregating a disperse and fractal understanding while he began to outline, which is typical of fast and fluid historical periods such as the period of industrialization. Taylor's main objective was to pursue a scientific model or rather, to "search for scientific truth," by outlining certainties and gradually improving on his first approximations. These approximations, sometimes called sophistries (Nelson, 1975; Kanigel, 1997), cunning and often "careful communication," were the consequence of the impossibility to perform his studies in a laboratory context. Taylor needed to work in *corpore vivo*, in the concrete reality of the factories: approximations to gradually overcome in favor of more scientific reconfigurations. This kind of hybrid, incomplete or intuited knowledge became the theoretical path for many disciplines in the following decades, such as the psychology of work and organizations, sociology, management, and organizational behavior studies, for which Taylor was the appropriate model, frame, and support (Kaneklin, 2004).

Confronting a time of knowledge specialization, and the continuous emergence of new and useful disciplines and subdisciplines, Taylor developed his system in order to reconfigure a global theory of understanding focused on production factors. Although it may be related to the emergence of other technical disciplines of the 19th century, scientific management is still a recent concept when compared to medicine, mechanics, physiology, and engineering. Nonetheless, it is a complex concept, characterized by multidisciplinary aspects and sustained by insights and common sense psychology, (as well as by more scientific theory fragments) that all merge together into a sort of 'bricolage.' In other words, a fluid intelligence with the capacity to think logically and solve problems in novel situations, independently from acquired knowledge. This was typical of the heroic phase of scientific management from the end of the 19th century until the First World War (Accornero, 1980; Zuffo, 2004). Adam Smith (1776) foresaw the importance of the "division of labor" and the causes generating it but he could not see beyond. He could not have known the implications that would follow in terms of productive and cultural assets and daily work. Within the interpretations of industrial work, Taylor's commitment represented a cultural turning point. Taylor outlined a model of management where various disciplines intersected and progressively created a new synthesis.

The industrialization (Hinsley, 1962; Balbo, 1967; Nelson, 1975; Noble, 1977; Jones, 1983; Jacoby, 1984; Schmitz, 1995) required a new theory of interpretation able to handle the new production factors of emerging enterprises, made possible by the significant technical and scientific developments of the era. The relationship between modernity, capitalism, and technology (Geymonat, 1971) became closer, or rather the same as the alliance between modern science and capitalism. This relationship was further strengthened in the name of "techniques," as a paradigm for the modern imaginary rationality consistent with the "bourgeois" mentality (Nacci, 2000). Marx (1857, 1867) clearly foresaw in Das Capital the tendency of the era to substitute the "dead labor" of machinery with living labor of workers. Sombart (1913) spoke of "modern technology," which, unlike previous empirical techniques, was systematically based on science, thus becoming rational. In his view, technological progress was an activity that no longer needed the mediation of man being primarily pursued for its own sake. As Nacci (2000) stated, the contrast between handcrafts and capitalism is perhaps the same contrast that occurred in the transition from ancient techniques to modern technology: that from empiricism to rationalism. At the beginning of the 20th century, Oswald Spengler (1918) spoke of a cyclical progression of science, destined to a great flowering, to reoccur, to wither, and become academic. Taylor's Era was indeed a "Progressive Era," in which scientific and technical knowledge had already been acquired and coupled with increasing available capital. All these factors led to a period of great change, innovation, large capital accumulation and finally to the "decline," as The Decline Of The West stated (Spengler, 1918).

Taylorism as an organic, ideal and incomplete system, collided with the dawn of Ford's moving production line (Russel, 1977), a forerunner element of modern work, which contributed to psychologists revoking their focus on the workers, who were then transformed into dependent variables for technology (Accornero, 1980, 1997). Twenty years later, Ford faced a fully-developed business system, a relationship with

techniques more engineered and less casual, and an enterprise system at the peak of maturity. Ford gradually reconfigured and circumscribed the idealistic aspects of Taylorism (Benyon, 1973), by hiding them behind an increasing technicality to the point that the power of his original contribution eventually faded and reduced the organization of work into a moving production line (Lee, 1916; Ford, 1922; Nevins, 1954). Therefore Taylorism, considering its idealistic peculiarity, increasingly appears as nothing more than an ideological flag to wave (Wrege & Stotka, 1978; Wrege & Greenwood, 1991; Whitston, 1997); instead of being seen as a subterranean river emerging into daylight, showing us its complexity and legacies for future generations.

Political, Social and Ethical Aspects of Scientific Management

The pursuit of science, his public actions and the personal conduct of the man from Philadelphia stand justified by the social and ethical dimensions inherent in Taylorism (Copley, 1923; Nelson, 1980; Kanigel, 1997). The social value of his theories can be contextualized within the severe economic depression which occurred between 1875 and 1895. A time in which efficiency was becoming a key issue for industry, as it had been generally throughout American society. The 19th century witnessed the advent of globalization represented in its modern form. In terms of scientific and technical development, Germany and England were the most advanced competitors dominating the economic system, while the United States still lacked skilled workers, product knowledge, and know-how. Yet, the United States was becoming the largest market worldwide, consequently having the need for large scale production and process manufacturing (Chandler, 1977). Taylor's work ranked high among this social and economical context. However, only while considering the framework of a still deeply backward industrial reality is it possible to fully understand and value Taylor's actions and practices.

It was indeed the common opinion of the most advanced areas of American East Coast industry that there was a need to pursue rationalization's process and increased competitiveness. This pursuit was inhibited by backward legislation "adventurers" involved in financial fraud and an economic system characterized by insufficient competition and oligopolies (Veblen, 1904). The Efficiency Movement (Angelici, 1928; Forgeaud, 1929; Bonazzi, 1995), culturally influential in Europe, argued that all aspects of the economy, society and government were riddled with waste and inefficiency. Labor force stability, the study and analysis of workers activities and remuneration issues were some of their efforts primarily directed at: outlining new production logic, comprehending machine efficiency, understanding the new setting and function of management and more generally, the problem of resources being wasted.

According to a positivist point of view, Taylor considered social contradictions resolvable through a rigorous and scientific study of production factors. These factors should become the conditions for efficiency, wealth generation and workers' well-being through a full deployment of collective energy and the pursuit of the "good of the nations" (Taylor, 1903, 1911). For Taylor, the selection of workers became a functional need to be verifiable and scientifically proven. Accordingly, Taylor highlighted the weight of the political, social and ethical values produced by science. His books

frequently referred to social utility. This clearly appeared in *The Principles of Scientific Management* (Taylor, 1911) and it also emerged from his less political works (Taylor, 1895), and public statements (Taylor, 1912). Great attention to social and ethical issues certainly described Taylor's efforts, but they were also typical of the American scientific community at large (Gantt, 1910) whose main goal was to demonstrate, according to a functional logic, how their theories or models could have collective utilitarian values (Nelson, 1975, 1980; Rossi, 1995). Actually, "the shift from government as an instrument of promotion to a means of regulation was one of the key developments of the progressive spirit" (Gould, 2000, p. 62).

As Taylor (1911, p.1) asserts, "President Roosevelt in his address to the governors at the White House, prophetically remarked that 'The conservation of our national resources is only preliminary to the larger question of national efficiency." Efficiency to obtain through "close, intimate personal cooperation between management and the men," which is the "essence of modern scientific or task management" (Taylor, 1911, p. 10). The reference to Roosevelt in the 'incipit' of *The Principles of Scientific Management* is emblematic of a political choice and an economic conception that considered the common ground between different social factions attained by scientific progress and it's, 'truth'; which represented the essence of scientific management. Similarly, at the end of this work, he referred to the "increase in prosperity and diminution in poverty, not only for the men but for the whole community immediately around the men" (Taylor, 1911, p. 75-76).

The Human Factor

Taylor's most famous works were aimed at obtaining scientific sustainability, while focusing on the needs of the social system, and were also an examination of the 'man at work.' There are many examples of Taylor's attention to the human factor, not only in his books, but also in biographies in which he was the focus, and in the scientific continuity of his *cooperators* (Gilbreth, 1921). Worker selection and evaluation, which led to the further development of applied psychology, is indeed a central aspect of scientific management. There are three famous examples of such, illustrated by Taylor, which represented the first steps between scientific management and applied psychology and also demonstrated their political and ethical justification.

The first example is that of the workman Schmidt who was actually a Dutchman named Henry Noll. This example referred to the controversy over fatigue, which had interested physicians and physiologists from all around the world (Gilbreth & Gilbreth, 1919; Lombardo, Pompili & Mammarella, 2002) since the late 19th century (Mosso, 1891). This argument mainly concerned a social and organizational aspect. Firstly, the value of scientific management may relate to any kind of work organization and to any kind of work, even the simplest, such as pig-iron handling. A second aspect is that of the so called "first class laborer," or rather the man who best personifies the work to be done. The second example is the bicycle 'balls' inspectors selection. It referred to reaction time, which was a standard topic of both applied psychology and of the industrial controversy. Speed and processing times were considered an index of the individual worker's efficiency as well as the performance of a system. The great

underlying social issue was that of the eight-hour day, an ongoing controversy within the American industrial association and the labor movement today (Zuffo, 2002).

The third example is the supervisor's evaluation, focusing on which qualities and skills they should have in order to be selected. In *Shop Management* (Taylor, 1903) Taylor recognized the importance of both management evaluation, and the inability of psychology, or rather physiology, to give satisfactory answers (Münsterberg, 1913). Even if the social and political dimensions of management were still limited to an official apparatus such as ASME, Taylor himself led the controversy against a still backward authoritarian and incompetent entrepreneurial system.

Fatigue and First-class Laborer

Taylor's (1911, p. 9) aim was the "substitution of scientific methods for rule-of thumbs methods" thus, within the comprehensive system of Taylor, worker selection assumed a central value. The first step of scientific management was indeed to check the performance of the "techniques" involved, such as machines, shape and choice of tools, measurement and control equipment, but always in relation to the human being. The system required a rigorous analysis of all empirical work processes that were checkable and recognizable in real work situations. Each unique factor of production had to be analyzed, as well as the study of those actions and movements. Features and work rhythms of the workman that were more compatible with other factors in the field, implicated an "*elementaristic logic*" (Gilbreth, 1911; Gilbreth & Gilbreth, 1917, 1919).

Taylor's system found its fulfillment in *Shop Management*, although it is only in *The Principles of Scientific Management* that his system reached its heights, not only theoretically, but also politically and ideologically (as revealed in the case of the workman Schmidt or by that of the bicycle balls' inspectors). This is how Taylor gradually set up his system which primarily involved a method and people able to apply it. Method was considered a link between technologies and human labor, aimed at studying human work and the characteristics (Derickson, 1994) that make up the optimization of performance.

The identification of the "*first-class laborer*" (Taylor, 1911), able to meet the technical and methodological conditions proposed, was indeed one of the most important factors of scientific management. The selection became a prerequisite for the application of the working method and for the achievement of the expected results. The "first-class laborer" concept had a great relevance in Taylor's thinking, despite what happened in the subsequent development of the Fordist mass industry, where the pure rhythm of the moving production line was the only necessary and sufficient condition for human adaptation to the techniques.

When Taylor addressed the problem of reconfiguring the work of the pig-iron handler (Wrege, 2000), taking advantage of the opportunity to study pig-iron loading for the purpose of lowering loading costs, his first step was to "find the proper worker to begin with" through scientific selection (Taylor, 1911). The function of selection was primarily the explanation of required standards, and afterwards, the identification of those men who could be "adapted" to the reference model. The scientific precision with which all factors were analyzed, led to "the possibility of coupling high wages with a

low labor cost." This opportunity "rests mainly upon the enormous difference between the amount of work which a first-class man can do under favorable circumstances and the work which is actually done by the average man" (Taylor, 1903, p. 9).

In Taylor's works, the selection procedure followed a double register system. The first level was characterized by an absolute scientific precision based on the academic knowledge of physiology. Like a machine, the human engine can only achieve certain physical results by optimizing fatigue, labor time, and load during the day. In this sense, attention and care for data collection and direct experimentation appeared to be relevant. In order to learn about the developments in Physiology, Taylor sent his assistants to Europe to observe what was only talked about in the American universities (i.e., reaction time), and with his closest *cooperators* he undertook meticulous studies, looking for general laws on issues such as fatigue, physical strength, and use of force. The research had two protagonists: workers of the Bethlehem Steel Company who were controlled and timed while working. "What we hoped ultimately to determine was what fraction of one horse-power a man was able to exert, in essence, how many foot-pounds of work a man could do in a day" (Taylor, 1911, p. 26). Taylor's early hopes were unfulfilled. Even if a large amount of very valuable data on the labor of the two workers had been collected, Taylor and his assistants failed to find any law or constant relationship between work and fatigue. The law, in fact, was found a few years later by Carl G. Barth, one of Taylor's closest *cooperators*, who confined the law "to that class of work in which the limit of a man's capacity is reached because he is tired out" (Taylor, 1911, p. 66).

The second level refers to the organizational behavior and to various personality traits. On this level it was much more difficult for Taylor to find specific information in the literature of that time (Müller & Silberer, 1968). Taylor recognized the lack of appropriate investigation methods, and the consequent importance for selection to "receive the most careful thought and attention" and to "be under the supervision of competent men who will inquire into the experience, and especially the fitness and character of applicants" (Taylor, 1903, p. 61). The importance of this factor can be seen in the fact that in the planning offices, responsible for the study and the continued review of the applications made, there were people involved in this specific task. "We therefore carefully watched and studied these 75 men for three or four days, at the end of which time we had picked out 4 men who appeared to be physically able to handle pig-iron at the rate of 47 tons per day. A careful study was then made of each of these men. We looked up their history as far back as practicable and thorough inquires were made as to the character, habit, and the ambition of each of them" (Taylor, 1911, p. 45).

Schmidt was the name given by Taylor to the selected workman, actually a Dutchman called Henry Noll, who distinguished himself from the others by working on the construction of his own house after a whole day of hard labor. It was also noticed that money had enormous value to him, which suggested that he had the interest and motivation to apply the new method. According to Taylor's words he was one of those men for whom "a penny looks about the size of a cart-wheel" (Taylor, 1911, p. 20). In general, "one of the first requirements for a man who is fit to handle pig-iron as his occupation is that he shall be so stupid and so phlegmatic that he more nearly resembles in his mental make-up the ox than any other type. The man who is mentally alert and intelligent is for this very reason entirely unsuited to what would

for him be the grinding monotony of work of this character" (Taylor, 1911, p. 28). Honoring small historical truths, "Noll was more than a muscled brute and exhibited traits not wholly alien to today's middle-class sensibilities" (Kanigel, 1997, p. 317). Alas, though Henry Noll was able to finish the construction of his own home, he lost it years later due to his alcoholism.

In Taylor's pig-tale science, or his pursuit of a scientific model, folk psychology and common sense coexisted. It didn't matter if the pig-iron experiments were little more than common sense observations (Nelson, 1975, 1980) or anecdotal data smoothing out inconsistencies (Wredge & Perroni, 1974; Wrege & Hodgetts, 2000); what really mattered was that Taylor's rigorous method had its own ideological value and determinate direction.

Reaction Time and Workday Duration

Another famous example "in which the 'scientific selection of the workman' counted more than anything else, is well illustrated by the very simple though unusual work of inspecting bicycle balls" (Taylor, 1911, p. 43). In this case the scientific dimension appeared absolutely relevant. This theme has a purely psychological character related to the evaluation of the bicycle balls inspectors and to the study of reaction times. The aim is to select the best inspectors for this kind of job. The experiment is famous and, like everything that appears in *The Principles of Scientific Management* (Taylor, 1911), it is written not only for scientific reasons but also in order to have a political and communicational value. The battle over the working day duration is one of the most important historical factors of the 19th century. In the U.S., there was a severe conflict between the various entrepreneurs, who were in conflict more with each other, than they were with the trade unions that had originated in Chicago in 1886 (Taylor, 1911; Nelson, 1980). Thus, at the beginning of the 20th century, the theme concerned both wages and incentive systems (Taylor 1895; Emerson, 1912; Goldmark, 1912; Bedaux, 1921). In the following years, in proposing tests and other innovations, physiologists (with a word used very often shortly thereafter, *psychotecnics*) often found themselves criticizing Taylor's Scientific Management. Taylor was concerned with the problem of underwork, but also often concentrated and thereby legitimized his attention to overwork.

In the particular case of the bicycle ball inspectors, Taylor showed how the women working at the factory spent a very considerable part of their long workday (10.5 hours a day and 58 hours per week, the legal maximum for women in Massachusetts) in idleness because the required working period was too long. Therefore, Taylor decided to shorten the working hours to ten, but this did not meet with great enthusiasm from the women. A few months later, Taylor shortened the workday to 9.5 hours with two breaks of five minutes each. Then, in September 1897, a month later, he reduced the working day to 8.5 hours. In all these steps the daily pay remained the same, "and with each shortening of the working day the output increased instead of diminishing" (Taylor, 1911, p. 45). Referring to the controversy of his time over fatigue beliefs, Taylor demonstrated how unproductive it was to extend the working time and proposed a rigorous and scientific analysis based on physiological experiments in manual labor. Physiology (Taylor also uses the term "physiology" to refer to psychological issues) was not only used toward the goal of measuring fatigue in relation to efficiency but

also for selection procedures. By studying the case of the balls' inspectors, Taylor highlighted how attention, as well as fatigue, resulted in a considerable amount of nervous tension, "in spite of the fact that they were comfortably seated and were not physically tired" (Taylor, 1911, p. 45). In particular, the 120 women who had worked in the factory for years required an elevated level of attention. Their job consisted of checking the balls one-by-one, by placing them on the back of their left hand, "in the crease between two of the fingers pressed together, and while they were rolled over and over, they were minutely examined in strong light and with the aid of a magnet held in the right hand, the defective balls were picked out and thrown into special boxes" (Taylor, 1911, p. 44).

Once again empirical and scientific psychology were mixed and merged together. In choosing the best girls to do the job, Taylor and his *cooperator* Sanford Thompson, who was in charge of the reorganization of this department, referred to the academic knowledge of Physiology. At that time in psychological departments, experiments were regularly being conducted "to determine what is known as the 'personal coefficient' of the man tested" (Taylor, 1911, p. 45), or in other words *reaction times* (such as simple and differing kind of compound reaction times). "This test shows conclusively that there is a great difference in the 'personal coefficient' of different men. Some individuals are born with unusually quick powers of perception accompanied by quick responsive action. For others the message is almost instantly transmitted from the eye to the brain, and the brain quickly responds by sending the proper message to the hand. Men of this type are said to have a low 'personal coefficient' while those of slow perception and slow action have a high 'personal coefficient'" (Taylor, 1911, p. 45). The most important quality for a worker was to have a low personal coefficient: "For the ultimate good of the girls as well as the company, however, it became necessary to exclude all girls who lacked a low 'personal coefficient'. And unfortunately, this involved laying off many of the most intelligent, hardest working, and most trustworthy girls merely because they did not possess the quality of quick perception followed by quick action" (Thompson, 1993). Therefore, studies on reaction times have found a great resonance in the history of applied psychology (Boring, 1929; O'Neil, 1968).

The reaction time topic, and consequently the speed at which a job could be done, has been widely considered over the course of decades as absolutely crucial for determining the levels of the wages and piecework. Although in simple language, Taylor already showed the connection with fatigue, stress and the need for work breaks, and in this specific case, managed by the workers themselves.

Selection of the functional foreman

By analyzing "the most important and difficult task" of "selecting and training the various functional foreman who are to lead and instruct the workman," Taylor gives great attention to the aspects of selection and psychological evaluation (Taylor, 1903, p. 72). In particular, Taylor argued that with the introduction of Scientific Management, compared to previous empirical forms of organization, foremen were invested with more burdens and responsibilities (Taylor, 1903; Gilbreth, 1921; Nelson, 1980). Also on this occasion, Taylor illustrated the centrality of psychological factors, while recognizing the lack of scientific knowledge and instruments able to meet

scientific management standards. By establishing in advance the difficulty of selecting the functional foremen, Taylor argues that "many of those who appear to have all of the desired qualities, and who talk and appears the best, will turn out utter failures, while on the other hand, some of the most unlikely men rise to the top. The fact is that the more attractive qualities of good manners, education, and even special training and skill, which are more apparent on the surface, count for less in an executive position than the grit, determination and bulldog endurance and tenacity that knows no defeat and comes up smiling to be knocked down over and over again" (Taylor, 1903, p. 72). Perhaps the only selection criteria that Taylor recognizes as "an unquestioned fact" is that "no gang boss is fit to direct his men until after he has learned to promptly obey instructions received from any proper source, whether he likes his instructions or not […]. The first step is for each man to learn to obey the laws as they exist, and next, if the laws are wrong, to have them reformed in the proper way." Along with honesty and common sense, grit and "constructive imagination" (today this would be called problem solving) represented the foremen's most necessary qualities.

For Taylor, the workmen's features were not determinant in the selection, he looked rather to the correspondence between people and the work to be done. Subsequently, the only way to prove the presence of certain qualities is "through an actual trial at executive work," because success at college, focused on absorption and assimilation, meant little compared to what the individual could express in moral and cultural terms. Besides technical experience, the responsibility for the work and training of other workmen, as well as for command and discipline, was required by the foreman. Therefore, Taylor states: "The difficulty in obtaining in one man the variety of special information and the different mental and moral qualities necessary to perform all of the duties demanded of those men has been clearly summarized in the following list of the nine qualities which go to make up a well rounded man: brains, education, special or technical knowledge; manual dexterity or strength, tact, energy, grit, honesty, judgment or common sense and good health. Plenty of men who possess only three of the above qualities can be hired at any time for laborers wages. Add four of these qualities together and you get a higher priced man. The men combining five of these qualities become hard to find, and those with six, seven, and eight are almost impossible to get" (Taylor, 1903, p. 49). The men's qualities nearly followed the hierarchy existing inside the establishment; from the workman to the manager there had to be a growing technical and "moral" capacity. For Taylor, the need to choose and evaluate people according to their potential was manifest. "If the work is of a routine nature, in which the same operations are likely to be done over and over again, with no great variety, and in which there is no apparent prospect of a radical change being made, perhaps through a term of years, even though the work itself may be complicated in its nature, a man should be selected whose abilities are barely equal to the task. […] On the other hand, if the work to be done is of great variety, particularly of improvements in methods are to be anticipated throughout the period of active organization the men engaged in systematizing should be too good for their jobs" (Taylor, 1903, p.78).

The development of human resources gained great importance within Taylor's system, according to models that are not dissimilar to what, a few decades later, is still proposed by Scientific Management and Organizational Behavior Schools. "The

selection of the men who are employed to fill vacancies or new positions should receive the most careful thought and attention and should be under the supervision of a competent man who will inquire into the experience and particular fitness and character of applicants and keep constantly revised lists of men suitable for the various positions in the shop. […] The knowledge of the character and of the qualities needed for various positions acquired in disciplining the men should be useful in selecting them for employment" (Taylor, 1903, p. 61). The potential of workmen, middle-management and foremen should be evaluated by the same criteria, according to a continuous logic. Tasks and roles should be assigned to workers according to their skills and in anticipation of organizational changes of the specific business area. The task should be in some way challenging, so as to make everyone satisfied with the work assigned and able to fully develop their skills. Facing the occurrence of a disproportion between resources and requirements, Taylor suggested the possibility for the same employer to facilitate the outplacement of *high-flyers* in other production realities able to valorize these resources. This apparent policy of sacrifice is, in contrast, the way to promote the best interest of the establishment. "For one man lost in this way, five will be stimulated to work to the very limit of their abilities, and will rise ultimately to take the place of the man who has gone, and the best class of man will apply for work where these methods prevail" (Taylor, 1903, p. 73). In this way, the best class of man is motivated and encouraged to demonstrate personal initiative and will have the opportunity to rise through the vertical line of command. The functional organization and the centralization of management within the planning department does not inhibit the development of human resources, in fact "the demand for men of originality and brain, capable of performing more brain work and less monotony was never so great" (Taylor, 1903, p. 75).

In addition to theoretical engagement and application engineering, in Taylor there is always an institutional devotion linked to the debate that develops in the industrial and political context of the East Coast on the inefficiencies and backwardness of the industrial system of the time. His thought went beyond the individual company's bounds to assume a dimension more broadly linked to socioeconomic development.

Discussion

Much more than just careful consideration about the professional and technical limits or credits of a scientist have been focused on Taylor's work and personality. His political position aimed at the "good of the nation," linearly expressed throughout his professional practice and theoretical excursus, aptly represented the new needs of a society in rapid transformation. He had a global, not just technical, vision of social development, combining the macroeconomic level of wealth generation (Smith, 1776), competition, consumer and labor with an intermediate level of management and finally with the micro-organizational level of the factory laborer's daily work. Taylorism "defined" the relationship between employer and business systems, between employees' security, and between national interests and wealth valorisation.

Wages and profit were no longer the result of an occasional and spontaneous exchange, or of disturbing power relationships but rather, they became the scientific

result of new relations between different social components. Individualism and discord have thus been replaced with cooperation and harmony and mutual distrust with trust (Taylor, 1912). In this climate of cooperation guaranteed by the superiority of science applied to methods and techniques, goods became cheaper and therefore affordable to a wider segment of the population. The focus shifted from the division of surplus to increasing production, making goods that were previously considered a luxury, available to consumers. The largely increased demand implied that "there are more workers than ever before" (Taylor, 1911, p. 71), working to produce a proper offer. For instance, "making shoes at a fraction of their former labor cost" made it possible to sell them "so cheap that now almost every man, woman and child in the working-classes buys one or two pairs of shoes per year and wears shoes all the time" (Taylor, 1911, p. 5).

Harmony between the workmen and their employers was assured by "the whole people, (the consumers), who bought the product of the first two and who ultimately paid both the wages of the workmen and the profit of the employers." The aim of Scientific Management is indeed "the attainment of all three parties through scientific investigation" (Taylor, 1911, p. 73).

Being for or against this specific approach to thinking represented in the following decades, and especially in Europe, a division between different ideological factions and the attempt to favor or oppose a cultural hegemony aimed at social control (Le Chatelier, 1914; Friedmann, 1946, 1950, 1956; Mauro, 1950; Butera, 1972; Braverman, 1974; Coriat, 1979; Accornero, 1997) and political struggle. This match lasted a century. Taylor's Scientific Management had been proposed over the decades as a model and a technically instrumental device, crystallized in its apparently incontrovertible scientific truth. The wager of the attempt to develop resources and create wealth, gradually turned into an effort to maintain power and social control. Taylor was a prophet, regarded both as a source of truth and a symbol of brutal capitalistic oppression; an *ikon* to use for submitting workers to new process technologies through the totalitarianism of rationality, thus enabling the production of the millions of pieces needed for the new international competition of mass industry: explicit and implicit touchstone of the new production logics, as a framework of new work in the 20th century.

Taylorism can also be investigated according to its scientific sustainability. Taylor's whole thinking referred to the traditional paradigm of positivist science. The main pursuit of scientific management was the achievement of scientific rationality and theoretical truth, based on a naive realism, considering data and facts as objective, neutral, and governed by laws to be found in nature. Taylor's thinking was certainly refused in various ways over the decades. His management model was not only the result of an engineering discipline (Emery & Trist, 1965; Woodward, 1965; Bonazzi, 1972), but mainly of a "psycho-sociological conception" of the factory, or a centrality of physiology (Derickson, 1994). However, there was a lack of knowledge induced by the backwardness of the scientific psychology of the time which highlights how business historians had taken no notice of physiologists' indictment towards Taylor's system (Chandler, 1977, 1990; De Masi, 1992; Accornero, 1997). Historians have added to the critique of Scientific Management by calling it unscientific. Daniel Nelson (1975; 1980) stated that "it was little more than [Taylor's assistants'] common sense

observation that some 'rest' was necessary. Others argued that the most important mistake of Taylor and his associates was simplifying the results of their study and glossing over the inconsistencies, by substituting quantitative analysis with anecdotal data (Wrege & Perroni, 1974).

Beyond the criticisms of several of his contemporaries, and in contrast to his "cooperators" such as Thompson or Frank and Lillien Gilbreth, there was Goldmark (1912) who called for additional research into "the ultimate physical adjustment of the workers to the heightened intensity of their tasks," and Robert Hoxie (1915) who doubted that time-study practitioners could recognize or eliminate overwork.

Münsterberg, father of applied psychology, was an outspoken supporter of Scientific Management. According to his point of view, Taylor and his "cooperators" first recognized the centrality of the human factor, identifying its correlation with technologies and the opportunity to develop innovative models of work organization. At this level, psychology had a significant role, even if at that time it was not ready to respond to the demands posed by its possible direct applications.

In the United States, industrial research conducted by psychologists and sociologists such as Elton Mayo affected only the surface of Scientific Management and of Taylor's thinking. In 1916, Elton Mayo started his experiments with a group of colleagues who subsequently became involved in the Hawthorne Studies, among them were F. J. Roethlisberger, Professor of Human Relation, and W.J. Dickson, Chief of the Employee Relations Research Department of the Western Electric Company (Mayo, 1933; Roethlisberger & Dickson, 1939). While agreeing with the general layout of Scientific Management, Mayo did not accept Taylor's refusal of informal groups as cause for systematic soldering (Taylor, 1911). Mayo's main belief was in fact that managers must be aware of 'social needs' and cater to them to ensure that employees collaborate with the official organization, rather than work against it.

The first internationally significant Psychotechnics Congresses were still confined within the broader developments of Scientific Management and were far from being opposed to Taylor's model, as testified by the International Congress of Psychology promoted by Claparède in 1920 at Geneva, as well as by the two International Congresses of Psychotechnics held in 1921 in Barcelona and Milan in 1922 (Bauer, 1922; Cerberi, 1923).

In contrast, on the European scene, Taylor's specific contribution was less recognizable and critiques were stronger and more radical than in the United States. In particular, psychotecnics were set against Taylorism. The same reason given by Taylor to explain the need to introduce Scientific Management (Candeloro, 1919; Mauro, 1927), was used to justify psychotechnics as a "social discipline" in opposition to Taylorism. Scientific issues and ethical justifications were often merged together (Merrick, 1919). Charles S. Mayers (1920, 1922), cofounder of the British Psychological Society and the National Institute of Industrial Psychology and director of the Cambridge Laboratory of Experimental Psychology, highlighted most of the critical aspects of Taylorism. He refused the one best way of Taylorist and Fordist footprints that made the worker crash with the monotony of work and the alienation caused by the impossibility to intervene autonomously in their own work. In France, Lahy's critiques (Lahy, 1916; Friedmann, 1946) linked to timing practices and overproduction, were already widely available,

and the first strikes at the Renault plant related to work organization issues dating back to 1912. In Germany, the dissociation from scientific management was even stronger and aimed at countering the growing oppression of 'chained' work. Giese, von Gottl-Ottienfield and Edgar Atzler preferred psychotechnical and physiological rationalization to Taylorism (Forgeaud, 1929). In particular, Atzler stated that Taylor knew dead machines very well, but ignored the living engine of men, which were the object and aim of psychotechnical studies. Otto Lipmann, influenced by the holistic conception of the individual proposed by Gestalt, opposed elementarism, movements fragmentation, and "the one best way" (Friedmann, 1946).

The first effective theoretical criticism to Taylor's model can be found in Simon's works (1947, 1957) and subsequently in Thompson and Bates (1957)(Cyert & March, 1956; March & Simon, 1958). Basically, Simon called into question the Taylorist model through the "theory of intentional and bounded rationality." In decision-making, Simon believed that managers faced uncertainty about the future and costs in acquiring information in the present. These factors limited the extent to which managers could make a fully rational decision, thus they possessed only "bounded rationality" and must make decisions by "satisfying." Taylor's principle of maximizing efficiency is replaced by the principle of subjective expected utility (Simon, 1957). According to Simon (1957), this was the only rational choice that took into account the cognitive limitations of both knowledge and cognitive capacity, exceeding the psychotechnical dichotomies.

Finally, one last aspect to remember in relation to the European criticism of Taylorism came from Georges Friedmann (Friedmann & Naville, 1961; Friedmann 1946, 1950, 1956). Starting from 1931, he approached the problems posed by work and techniques, contributing to the development of a prestigious French School of Psycho-Sociology that involved several scholars such as Pierre Naville, Alain Touraine and Elliot Jacques, somehow counter-weighing Anglo-Saxon dominance (Harry Braverman, Andrew Friedmann, Richard Edwards, and Michael Burawoy). For these authors, the unequivocal ideological and ethical opposition to Taylorism (we find little difference between Taylorism, Taylor, and Ford) was aimed at the disintegration of the alleged scientific value of the model. Problems of Industrial Mechanization (Friedmann, 1946), while perhaps lacking in rigorous historical value, had abundant testimonial value, was an intensive report of almost every aspect of the psychological effects of industrial work and was also a vigorous indictment of Taylorism. The unscientific nature of Taylorism was not related to historical limitations, such as the unavailability of a usable body of knowledge focused on specific issues (such as fatigue, heavy work and the one best way illusion), but rather to the opportunity to safeguard clearly defined social interests (Friedmann, 1946). Taylor's Scientific Management was thus countered by psychotechnics which would reveal the dehumanization of work through psychological knowledge. Similarly, Harry Braverman (1974) argued that although Taylor was the pioneer of the biggest revolution that ever took place in the division of labor, his work could not be classified as scientific as it had not gone looking for a "better way to work."

For Aris Accornero (1997), an Italian sociologist, the controversy on Taylorism opened a century of "stomach ache," aimed at understanding if and how, ethical and scientific, scientific management actually was. Supporting the hypothesis of the

scientific nature of Taylor's model, Accornero (1980, p. 98) says it stands the test of time. "Scientific Management was, alas, a procedure responding to scientific canons. Capitalistic ones? Of course. But, what else? If it was just another form of speed-up, we would not still be here discussing of it. It would not have been a revolution at all. But it shook and reshaped the human work of an entire historical era." Taylorism represented a "crucial turning point that discredited the history of work, dividing the era between two different forms of capitalism and two different types of civilization" (Accornero, 1980, p. 99).

Conclusion

Certainly, Taylor's thinking for his time in comparison to the scientific and social development of other disciplines unknown or little known to him, can be considered to have met the positivist scientific canons. Taylor's specificity can be considered scientific enough for the time in which it was expressed and it obviously assumes "the values and limits of the machine metaphor" (Morgan, 1986).

It will be the specialization of knowledge invoked by Taylor that will eliminate the original coherence and unity supporting his system. Thus, the specialization proposed by scientific management both opens and closes a new era. This apparent paradox belongs to the "Decline of the West" recalled by Spengler, which is also a period during which the positive knowledge achieved its final synthesis, connecting science and ethics, natural sciences and moral values, and nomothetic and idiographic sciences. This particular condition belonged to both functional psychology, that had at last become a science without a soul (such as John B. Watson's behaviorism), and to the fragmentation of management theories, or put another way, endless lines of efficiency or organizational behavior consultants. Scholars, the sons of a new culture induced by mass industry, began to look at fractioned and less holistic knowledge, providing precise answers to specific questions.

Today, we seem to require a reunification of ethics and science. It is therefore useful to recall a passage from Heidegger's Discourse On Thinking: "It is not that the world is becoming entirely technical which is really uncanny. Far more uncanny is our being unprepared for this transformation, our inability to confront meditatively what is really dawning in this age." (Heidegger, 1959, p.85). Our present economic development, induced by technological innovations, cannot always respond to the quality of life improvements of billions of men. Wealth is likely to be distributed less and less. The social fragmentation is growing, and in the meantime, it seems that the financial logics dominating productive factors are becoming independent variables. Certainly, as shown by the subsequent historical events, Taylor's era was not free of problems and questionable phenomena. Soldiers of fortune who accumulate great wealth, difficult legislative struggles for the control of trust and the financial economy and financial fraud of Taylor's time, are all reoccurring problems of our uncertain and sometimes dramatic present day. Taylor's personal battle for distributed wealth with some form of equity and in the light of shared ethics and available sciences, seems thus to be both useful and necessary today.

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