occurring elementary or suboperations, encourages and facilitates the study of motions.

The late Frank B. Gilbreth, probably to a greater extent than any one else identified with the scientific management movement, realized the full importance of study of the motions involved in the performance of work. The machinist's time and energy are saved by delivering and placing materials so that they are convenient to his machine, by standardizing his tools and furnishing him with those best suited to each of his jobs (for instance, a wrench to fit each size of nut to be tightened instead of one adjustable monkey wrench which requires a number of time-consuming motions). He realized that this same principle might with profit be more consciously and extensively applied.

The scientific management movement is indebted to the Gilbreths not only for focusing attention upon this feature of Taylor's philosophy and setting it forth in the light of its true importance but for refining and developing its technique along truly scientific lines, for reducing and codifying its fundamentals and setting, by years of persevering effort, a new standard which industry is just beginning to understand and make an effort to attain.

The bricklaying system developed by Gilbreth while he was engaged in large-scale building construction work, an outgrowth of his early contacts with Taylor and his associates, was an example of methods study embracing standardization of equipment, study and economy of motions, planning and control of materials supply and auxiliary service to the worker. It impressed Taylor so much that he referred to it in his "Principles of Scientific Management,"[9] and frequently cited it as an illustration, along with the classic examples of pig-iron handling and shoveling.[10]

Any methods man, whether he is engaged in highly specialized, repetitive work or in work of a varied and complicated character, will benefit by a study of the refinements of technique and the basic rules developed by the Gilbreths. As I have intimated they may be profitably adapted and applied more extensively than is commonly supposed.

All of this—the study of machinery, of implements, of materials upon which work is to be done and of the motions of the worker in performing a productive operation, of surrounding conditions and auxiliary services that affect the performance of work—may, I believe, be better expressed by the term *methods study*. Time study or time measurement, regardless of the instrument employed, should be considered only as a means in the study of methods. In my own work of installing systems of scientific management I came without much consideration to apply the term "methods section" to that functional division of the planning department having to do with time study and instruction cards. I designated its head as the chief methods supervisor and his representatives in the shop, the functional foremen formerly designated as "speed bosses" or "instructors," as "shop methods supervisors." It is significant that in recent papers dealing with this subject others have independently adopted designations such as "methods department," "methods function," etc., in place of "time study." It was, however, during my recent visit to Japan, where I was called upon to inspect in a professional capacity a number of industrial establishments, that I was impressed with the need for a more comprehensive term to express all that Taylor and his associates included in the term "time study." I found myself constantly calling the attention of managers and other executives of plants that I examined to the need for critical analysis and study of *methods* and discussing the possible improvement of *methods* suggested by even my brief examination.

Mr. Barth pointed out in discussing my paper on "Standards," that time study may not be necessary to the detection of faulty conditions or wasteful motions:

> Such motions are best ferreted out by common-sense observations on the part of a person well versed in the trade, who has caught the right spirit, without any time study. The time study properly comes later, and may then be made by a person less expert in the trade; but no amount of mere time study of an unstandardized complex operation will directly lead to the elimination of its useless or wasteful motions. However, such time studies submitted to the scrutiny of a person well versed in the art may be that person's indirect method for detecting and eliminating useless and wasteful motions. Because of the misconception referred to, a lot of worthless time study is being made the country over by mere stop-watch men. Time study should not be taken up until conditions of machines, tools, materials and motions have all been properly studied in an everyday, common-sense and expert manner, and later standardized on the strength of the information thus gained.[11]

Gantt wrote in 1908: "While the stop watch is often used to establish a method, it is used to determine the time needed to do work only when the standard methods and appliances are used efficiently."[12]

Nevertheless, there are instances in which even preliminary studies of methods and efforts at standardization are aided and expedited by time study. These incidental or preliminary time studies indicate the relative importance of various components of an operation, points at which irregularity occurs or where opportunities for improvement lie, many of which would not appear in their true light and some not at all from observation without time measurement. This is particularly true in the case of operations consisting of some eight or ten elements, the performance of which takes, let us say, a total of from only one-tenth to one-half minute. Frequently there may exist and even be practiced by different operators two or more ways of doing the same operation or parts thereof and a correct decision as to which is best may be reached only by time measurement. I have known people, including myself, to be fooled in assuming that one method of performing a simple repetitive operation was better than another, judging by appearance alone, only to find when timed that what appeared to be the slower way was the better. Likewise it seems, for some reason which no doubt the psychologist could explain, that the use of a stop watch in studying work quickens one's perception.

It would, I believe, be unwise to lay down or accept any hard and fast rule as to the stage in establishing standards or studying methods at which one should start making time measurements. For example, it would be as unwise to say that *actual time studies should in no case be made until after all conditions have been perfected* and the method to be adopted decided upon, as it would be to say that *no study or analysis of an operation and no improvement in conditions or method should be attempted until after a minute time study has been made*. Common sense and sound judgment based upon and utilizing experience must be our guide.

With regard to the human element, in spite of the emphasis that was seemingly laid by Taylor, first, upon inducing greater effort on the part of the worker, and, second, upon the improvement of physical conditions and services to the worker, as far back as 1895, as indicated by his paper, "A Piece-Rate System," presented at that time, Taylor was profoundly conscious of the importance of dealing with workers in such a manner as to engender mutual respect, and even cordiality, between management and workers. In short, he realized the importance of creating and maintaining that spirit which is essential to sound industrial relations. He was fully aware of the existence of and the need for taking into account the "human element," a fact which has too often been overlooked by those interested in the social aspects of management. Taylor and his early associates took for granted and practiced as a matter of course what is sometimes spoken of as "human engineering" and is often erroneously regarded as something new and apart from applied scientific management.

It must be borne in mind that in such simple expressions as "proper rate-fixing department" and "differential piece work" Taylor summed up all of the principles, practices and mechanisms that constituted in embryo what we today know as scientific management. A term such as "ordinary piece work" was used by him as a symbol of all that was bad in ordinary shop management.

Treating men like machines, an assertion made by some of the opponents of scientific management without taking the trouble to learn the facts, was far from Taylor's thoughts. This is indicated by paragraphs 85 to 88 in his first paper[13] on the art of management. (These were repeated by Taylor in "Shop Management.")

Fairness, justice and humane treatment are there set forth as essential to the success of management in dealing with workers. He believed that trouble could best be cured by eliminating the cause. As low wages, unfair piece rates and lack of knowledge in regard to the doing of work were at the bottom of most of the dissatisfaction in manufacturing plants, his first concern was to supplant them with something better.

However, neglect of the human factor by those lacking in understanding and experience has no doubt been *one* of the errors that has stood in the way of achieving the most satisfactory results from the utilization of "time study" which *"is by far the most important element in scientific management,"* as Taylor said in "Shop Management." He further said that he regarded time study as the "keystone in the arch" of an applied system of scientific management and that "the arch without the keystone would fall to the ground." He might also have said that the keystone alone would be useless without foundation, supports and the other stones which compose the arch. To these supporting members might be likened establishment and main-

[9] Taylor, F. W., *Principles of Scientific Management*, Harper & Brothers, New York, 1911, p. 77.

[10] "Testimony before the Special Committee of the House of Representatives," reprinted in *Bulletin of the Taylor Society*, Vol. XI, No. 3-4, June-August, 1926, p. 117.

[11] *Bulletin of the Taylor Society*, Vol. X, No. 1, February, 1920, p. 40. Article reprinted in Vol. XII, No. 5, October, 1927, and Vol. XII, No. 6, December, 1927.

[12] "Training Workmen in Habits of Industry and Cooperation," *op. cit.*, p. 1043.

[13] "A Piece-Rate System," *op. cit.*, pp. 880-881.