fore handled this class of labor, although he understood managing workmen."[16] Time study at the Simons Rolling Machine Company on the manufacture of bicycle balls was made by Sanford E. Thompson, a graduate civil engineer. Dwight V. Merrick, one of the earliest to make a profession of this branch of scientific management, combines practical experience with technical training as a background. Successful time-study or methods-study men have been drawn from the ranks of both college trained and shop trained men. In many instances it may be easier or wiser to utilize shop trained men, particularly in work of such an intricate character, or involving such trade knowledge, as to make of paramount importance the intimate familiarity that results only from years of experience as a workman. In such a case, considerable assistance and guidance from a scientifically or technically trained man may be essential. For example, a skilled machinist would benefit by the help of a mechanical engineer or an expert tool designer familiar with the purposes and technique of methods study. A mechanical engineer of limited practical experience in the trade would be successful in such a case in proportion to the degree of interested and honest co-operation he was able to secure from the workmen. In simpler industries, where operations are elementary, technical education is of more importance than actual experience in performing the operations concerned.

The temperament and personality of a "methods" man must be such as to enable him to gain the confidence and co-operation of the workers and to overcome difficulties in accomplishing his purpose without creating antagonism. Workers are most likely to trust men whom they know and who have had practical experience in their trade or occupation. Hence, where suitable candidates are available, it is best to select and train men for this function of scientific management from within a company's own organization. In a group of fifteen of the best men whom I have trained for methods-study work, eight were from the ranks of workers or foremen, and seven were college graduates. The latter included a civil engineer, two chemical engineers, one mining engineer, two mechanical engineers and one graduate of a school of business administration.

The qualifications of an ideal time-study man may be summed up as follows:

[16] *Shop Management, op. cit.*, p. 48.

1. Mental qualities.
a. An understanding of human nature.
b. An analytical turn of mind.
c. A questioning attitude toward existing knowledge and practice, coupled with a desire to prove all things.
d. Keen perception and foresight.
e. Open-mindedness, freedom from prejudice or disposition to jump at conclusions.
f. Ability to concentrate.
g. Good judgment, common sense and a sense of proportion and values.
h. Accuracy.
2. Personality and character.
a. Tact.
b. Patience and self-control.
c. Honesty and dependability.
d. Frankness and fairness.
e. The courage of his convictions—self-confidence.
f. Grit, tenacity, perseverance.
3. Education and training.
a. A general education at least equivalent to that of a high-school graduate.
b. A sufficient knowledge of management to understand the relation of methods study to other functions.
c. A knowledge of the rudiments of mechanical engineering, embracing mechanical drawing, physics and mathematics.
d. An intimate knowledge of the processes of the industry in which he is engaged and skill in their performance.
4. Ability to get things done.
a. Constructive imagination, inventiveness.
b. Resourcefulness, ability to surmount difficulties.
c. Ability to inspire and sustain the interest of others and to secure active co-operation.
d. Freedom from hesitancy in deciding to start and carry through a plan of action.[17]

Needless to say, few candidates will be found ready made—possessing all or a majority of these qualifications in the desired degree. What the selected man lacks must be made up in one or both of two ways: (1) instruction and training; (2) assistance or co-operation of others possessing the qualifications that he lacks. Perhaps ability to secure and utilize effectively the knowledge and assistance of others is the most important qualification for methods study,

[17] This is a composite statement of qualifications based upon the writings of Taylor, Gantt, Merrick, S. E. Thompson, Lichtner, Lowry, Maynard, Stegemerten and other practical men, as interpreted in the light of the author's experience.

whether in the case of the man of principal responsibility or an assistant.

IV. The Operator Selected for Time Study

Qualifications of Workman Co-operating with Methods Man

One of the points about which there has been most confusion relates to the skill and productive ability of the worker who co-operates with the time-study or methods man. This is equally true of the degree of skill of the worker for whom production standards or tasks should be set. The situation is somewhat clarified if we bear in mind what is too often lost sight of, that scientific management has for one of its basic principles, as stated by Taylor: "They (the management) scientifically select and then train, teach and develop the workman, whereas in the past he chose his own work and trained himself as best he could" and furthermore, as Taylor stated in the third principle, "They heartily co-operate with the men so as to assure all of the work being done in accordance with the principles of the science which has been developed."

Taylor repeatedly said that the task or standard of production should be so fixed as to represent what a *first-class* man could do. In his "A Piece-Rate System," in enumerating the advantages of the system described, Taylor said, "It automatically selects and attracts the best men for each class of work, and it develops many first-class men who would otherwise remain slow or inaccurate. . . ."[18] He speaks of ascertaining by elementary time study "the quickest time" in which work can be done. This would imply its being done by a "first-class" man. In this regard, however, he is much more specific in his classic paper "Shop Management," presented eight years later, from which the following is quoted.

> The possibility of coupling high wages with a low labor cost 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.
>
> That there is a difference between the average and the first-class man is known to all employers, but that the first-class man can do in most cases from two to four times as much as is done by an average man is known to but few, and is fully realized only by those who have made a thorough and scientific study of the possibilities of men.

[18] P. 858.

The writer has found this enormous difference between the first-class and average man to exist in all of the trades and branches of labor which he has investigated, and these cover a large field, as he, together with several of his friends, has been engaged with more than usual opportunities for thirty years past in carefully and systematically studying this subject.

This difference in the output of first-class and average men is as little realized by the workmen as by their employers. The first-class men know that they can do more work than the average, but they have rarely made any careful study of the matter. And the writer has over and over again found them utterly incredulous when he informed them, after close observation and study, how much they were able to do. In fact, in most cases when first told that they are able to do two or three times as much as they have done they take it as a joke and will not believe that one is in earnest.

It must be distinctly understood that in referring to the possibilities of a first-class man the writer does not mean what he can do when on a spurt or when he is over-exerting himself, but *what a good man can keep up for a long term of years without injury to his health. It is a pace under which men become happier and thrive.*[19]

Even more definite, however, is Taylor's statement further on in "Shop Management":

> Perhaps the greatest difficulty rests upon the fact that no two men work at exactly the same speed. The writer has found it best to take his time observations on first-class men only, when they can be found; and these men should be timed when working at their best. Having obtained the best time of a first-class man, it is a simple matter to determine the percentage which an average man will fall short of this maximum.[20]

Dwight V. Merrick, who worked with Taylor, Barth and Gantt at Bethlehem and who has specialized on time study to a greater extent than any other man in the movement, says in his book, "Time Studies for Rate Setting," "The operator should be advisedly a first-class worker, skilled in the line of activity under investigation and of somewhat better than average ability. . . ."[21] In contrast to these and other similar statements, we find writers on the subject speaking of the "average" man. In discussing a paper read before this Society, Mr. Joseph A. Piacitelli got to the root of the matter when he said, "Another point brought out is that we must time the average man or time work on the basis of average performance. That is true if we want to know how long it takes to do a job or to get an average. *But* we should be most inter-

[19] Pp. 25-26.
[20] P. 168.
[21] P. 5.