

is a dangerous tool. (Secrist, page 28: "Do not rush headlong into the use of averages. They are commonly but vaguely understood, and it is the particular function of the statistician to adopt that caution and circumspection in the use of numerical facts which the seeming exactness of his tools appear not only to suggest but to make imperative." Again Secrist, page 22: "As caution and analysis are necessary in the employment of averages, no discrimination and judgment are necessary in assigning importance to them when used by others.")

53-9. It is necessary to stress the importance of the *exception*. (Secrist, page 29: "Frequently an exceptional instance which would be ignored in the use of the mode is that particular instance in which one has greatest interest.") We have noted that stop watch time study discards those instances which are "guessed" to be "abnormal." If they were normal enough to record, they should not be discarded merely because they differ from the average. It must also be remembered that these very same so-called "abnormal" times may record the exceptional instances, which are the most desirable to perpetuate. When such times are abnormally high they may be caused by methods and conditions of habit which should be broken and discarded and pitfalls to be avoided.

54. Many more quotations by leading authorities on statistics can be furnished but these few quotations serve to indicate how completely the statistical method can demolish any claims of accuracy or of the scientific method of stop watch time study.

55. The basic criticism of stop watch time study is that the inevitable interference of the human element, when the stop watch is read while it is running or pressed to stop or start, prevents accurate observations and records. Even if one record should happen to be accurate, there is no chance to recognize it, and no chance to inspect, check or repeat the work as then performed, because the surrounding conditions are not also recorded.

56. It must not be supposed, however, that stop watch time study has no uses, for it is much better than nothing. The use of the stop watch also furnishes admirable training for the young management engineer, and it is a necessary, though not an indispensable, part of his education. Without actual experience with the inaccurate stop watch method he will never be able to appreciate the possibilities of interchangeability of micromotion data and their value at any time later to anyone who is either searching for knowledge regarding the best that has been done,

or is interested primarily in finding the one best way to do work. In no other way can he realize that micromotion study is less expensive than stop watch time study. We advocate this training, and have three different kinds of watches made exclusively for us, which have black faces and white hands to cause less fatigue, and which, while intended primarily for micromotion study, are also much better adapted to stop watch time study than any others.

57. We believe these types of watches to be the most efficient of their kind, although their records, when not photographed, cannot compare, of course, in accuracy with those made by the micromotion process.

58. Only through personal experience with the difficulties and inaccuracies of stop watch time study can the young engineer come to appreciate the need for a more accurate method, and the benefits of basing the *art* of time study on the *science* of taking times.

59. It is the right of the young men in this society to learn the science of taking times. It must be realized that loyalty to *principle* does not imply loyalty to *technique*. All advocates of scientific management object to restricting its evolution, especially along lines that insure its acceptance as a science.

60. The young men have studied and practiced stop watch time study faithfully and loyally. They deserve something better, more accurate and more valuable. They deserve the best! It is our duty to warn the young men of the Society to accept no statements regarding any science without definite proof, unless the scientific method has been used in deriving the facts. The young men must think for themselves. They must learn to place emphasis properly, and to realize that the stress that has been laid on "the time that it takes to do work" or "the proper rate of speed at which work should be done" or "time study for rate fixing" in no wise dwarfs the necessity for finding the one best way of the best available.

61. The young men should also be warned that, when they hear criticism about the "high cost of accurate photographic time study," they should remember the cost of the scores of years of stop watch time study records that have been totally abandoned because they were so inaccurate that they did not serve as a basis for cumulatively improving standards, and did not include records of surrounding conditions. In money cost and in cost of time the more accurate methods are the most efficient and economical.

62. It is not our aim in this paper to present at length criticism of stop watch time study, or to describe in detail all the advantages derived from the

more accurate method of micromotion study, which includes accurate timing as an integral part and an important by-product of the quest for fewest, most efficient and least fatiguing motions. We do not need to point out the utter uselessness in executive's theatres, foremen's meetings or workmen's lecture rooms, of stop watch time study, and the possibilities of the utilization of micromotion study film as the basis of craft education and improvements in methods which come through the suggestion system.

63. The part played by micromotion study in determining best results of the three-position plan of promotion will be discussed in one of our later papers.

64. We aim to present for your consideration the objections to the records and devices from the abstract and scientific standpoint, calling to the attention of this Society especially the objections from the statistical side. We desire to emphasize the effect upon planning and control of using data scientifically derived by instruments of precision instead of the non-method-recording stop watch methods.

65. It must not be forgotten that, as Dr. Taylor said in "Shop Management," "time study is an *art*." He hoped that it would be based on a science, and be listed as the first of the four chief duties of the management, that "they develop a science for each element of a man's work which replaces the old rule-of-thumb method."²³

66. In "A Piece-Rate System," written in 1895, he said he hoped that there would be books of accurate data that would settle once for all and that would describe methods of making, recording, tabulating and indexing time observations, since much time and effort are wasted by the adoption of inferior method.²⁴

67. He considered what he said so important that he wrote it again, in the same identical words, in "Shop Management," in 1903, eight years later.²⁵

68. The micromotion method is the only method that fulfills all the requirements that he makes. This method has fought a hard fight and it has won by reason of its scientific accuracy, its records in revising the best that the stop watch had done, and by the co-operation it has secured from the workers everywhere, without exception. It is indorsed today by economists, educators, psychologists and workers, and is more and more being accepted by managers, even

²³"The Principles of Scientific Management," page 36.

²⁴Paragraphs 67, 68.

²⁵A. S. M. E. edition, paragraphs 390, 391, Harper edition, page 177.

those who have advocated and practiced the use of the stop-watch.

69. We had the honor to offer the use of this method to Dr. Taylor himself, practically as soon as the devices and methods of measurement were perfected, and we wish to go on record here as having offered this method for use by this Society and the management engineering profession in general.

70. We repeat this offer at this time for the following reason: We know that the stop watch method is now being subjected, and will be increasingly subjected, both in this country and abroad, to the most careful scrutiny. This examination is being conducted not only by enemies of scientific management but by its ardent friends and advocates, who feel that its future depends upon its ability to live up to its claims of being a science. The sooner this state of affairs is realized, and the sooner that this Society prepares to meet criticism, and to justify belief in its principles and practice, the more satisfactory will be the outcome.

71. As advocate of real science in management; as interested in the progress of the art of management; as vitally concerned in the future welfare of this country, and as ready to fight for it industrially as in war; as engineers trying to do our bit in the problem of the elimination of all kinds of human waste and for better management, we, therefore, feel compelled at this time to indict stop watch time study as having outlived and extended beyond its field of usefulness; as having failed to co-operate with micromotion study; as having failed—and in some cases deservedly—in obtaining the hearty co-operation of the workingman; as having failed to put into the hands of the workingmen and the trade and manual-training schools fundamental data regarding craft knowledge and craft skill, and as having failed to furnish interchangeable data relating to time study elements usable in synthesizing the one best way to do work. We make this indictment before this Society with the feeling that the Society should estimate and measure the two methods submitted, impartially, carefully and with the aim of fostering those methods which have the highest scientific value. We should have been glad to have had this indictment presented before the Society by the advocates of the stop watch method, for some of them are now coming to see the importance of accurate unit times. It may seem to some that the economists are the ones who should have presented this indictment. Unfortunately, however, these economists also, in spite of our previous re-