hopeless task! It is the failure to recognize this point which makes re-examination of methods derived by stop-watch time study such a fertile field for possible savings. We have now hundreds of thousands of timed therbligs transferable to any kind of work where human motions and decisions are made. The achievement of books of errorless time study, transferable and interchangeable on all kinds of work, is now assured.

97. Professor Spaeth, as a psychologist, ought also to appreciate that *speed is an important variable in automaticity*, and that when a worker operates at more than a certain amount below the speed of his automaticity, his manual process is transferred from his unconscious mind to the conscious mind. Therefore, the greater the accuracy of the records of the times, and the relative times of the therbligs, the greater the value of the original data, from the *Skill Study Standpoint*.

98. It is a law of motion study that fast motion and slow motions do not and cannot occupy the same paths in space. This fact we have used as a working theory since 1885, but it was not until we had perfected the apparatus of micromotion study and the stereochronocyclegraph methods that we were able to record the amount of variation from paths of the economic speeds, the amount and effect of muscle rebound, the conscious interference of automaticity, and the phenomena of behavior in general. These data proved by exact records of practice the correctness of our general theory and practice, that one of the greatest hindrances to progress in learning the trades is the usual and customary practice of teaching the learner to begin his learning at *demonstration speed*, and then, after having acquired the ability to produce an acceptable quality together with the automaticity of such demonstration motion, expecting him to learn a different set of combinations of motions of different paths, with a resulting habit interference for the rest of his life. For example, to the observer's eye, it may appear that both hands and eyes arrive at certain locations simultaneously, and he will so record. Then, perhaps, his ear will note the sound of the motions or the use of tools, which show that the motions were not precisely simultaneous. The errorless micromotion process records the facts, and shows that if motions are ever performed exactly simultaneously it is so rarely as to be negligible. In other words, there is no such thing in motion study as simultaneity of performance of two anatomical members of the body. For practical work, variations of less than 1/4000 of a minute are considered as simultaneous. However, records can be made with any degree of accuracy desirable without extra effort and the results can be regrouped as desired.

99. The "five per cent error" that Professor Spaeth expects is enough to make data on this subject useless for finding laws for methods of least waste in learning processes for acquiring the super skill of the One Best Way. All such errors are, of course, eliminated by the micromotion process.

100. The lateness of the hands which follow in or near the paths made up of the sequence of locations of points of focus thru which the eyes have already passed is an indication of the degree of automaticity, skill, distraction and habit interference at the particular method recorded. Conversely, the lateness of the eyes, if they follow the sequence of locations of the hands, is evidence of subnormality. The quantity of time late is too small to measure with a stop-watch, and of course the relative locations of the eyes and hands cannot be determined or recorded by the stop-watch method.

101. The greater the amount of automaticity, the greater the amount of space, the greater the amount of time and the greater the number of therbligs that the hands are late, or behind time, in following the eyes, in each cycle of the operation. In fact, it might be said regarding the motions of the hands and eyes, that the amount of variation from simultaneity is an index of one's automaticity. Regarding the motions of the two hands, the percentage of therbligs begun simultaneously is an index of skill. The greater the percentage of therbligs begun simultaneously with both hands, the greater the skill.

102. We had the honor of co-operating on a problem of lateness of the lips, as compared with eyes, in reading tests made on young children of various ages. This last subject, however, can be explained best by Professor Courtis, an engineer in education, author of the Courtis Tests of Educational Methods, who believes that correct fundamental records of actual performance are the basis of all progress in education. Professor Courtis is to be congratulated on the pioneer work which he did long before his remarkable theories and practice were appreciated. Many similar problems can be cited; for example; the effects of variables on constructive imagination; the likeness of the motions of epileptics in seizures to automaticity of the skilled worker, etc.

103. These are a few typical studies that require accuracy of paths of motion in three dimensions and accuracy of timing.

104. It must always be remembered that our records of *the best man obtainable* become the norms for all such scientific investigation. Such records, taken primarily for scientific purposes, have invariably helped us to find and use the laws of motion study, absolutely necessary for teaching the One Best Way to do work to organizations on a large scale.

105. All of these facts are shown beyond argument or doubt in the Simultaneous Motion Cycle Charts. When the result is unsatisfactory the place and the cause can be located on the chart and corrected. Therefore, the determination of fundamental laws for synthesizing methods of least waste for the skilled, as well as the learning process of all manual education, demands data regarding Skill Study, which at the present time is a subject unrecognized in any college curriculum, and is not given the slightest consideration by Professor Spaeth at the time that he criticises the micromotion method. This subject must be recognized, and will be, to compensate for the trend of modern industry in specialization and standardization of the workman, and in the division of labor. This is absolutely necessary, that the underlying principles regarding the skill of super-specialized workers may be most efficiently transferred, and that the underlying principles of methods of least waste and greatest productivity may be taught a worker regardless of how small a subdivision of the whole his particular division or specialty represents.

106. In paragraph 3 we are astounded to find that Professor Spaeth says, "In my opinion the stop-watch, instead of being inaccurate, is already far too accurate." Compare this with what Mr. Barth says in his paragraph 5: "Of course, it would be preposterous to maintain that, even with a somewhat uncertain final quantity to be measured, it would not always be desirable to employ the most refined measuring device obtainable." Professor Spaeth's paper deals only with time study, not motion study. Therefore, he has missed everything that has to do with complete recording of all behavior of the super-expert to find the scheme of perfection of method of work, or perfection of method of teaching perfected method of work. If he recognized the possibilities based upon actual accomplishments of the micromotion method together with the fact that errorless times are a free by-product, it would seem possible that perhaps he could learn to use our errorless times as a base, afterward changing each of them to such degree of inaccuracy as he desires.

107. Professor Spaeth points out, in paragraph 3, what he considers the errors of stop-watch time study, and implies that the micromotion method shares in these. In our paper we endeavored to confine our principal criticism to the statistical standpoint leaving other criticism for later papers, as we there stated. That our statistical arguments do apply to micromotion study data is proved by the practice which enables us to determine from accurate data whether or not the observed worker is of the highest order, for purposes of demonstration and for permanent data. We shall not endeavor to defend the stop-watch method from his attack, but shall here discuss simply the application of his remarks to our method. It must be said, however, at the start, that by his last sentence in this paragraph Professor Spaeth shows that he does not appreciate Dr. Taylor's great invention of timing the work period and the rest period separately. This seemingly unimportant invention of Dr. Taylor's is seldom appreciated, but those who really understand the Taylor System as well as the Taylor methods are in complete agreement with Dr. Taylor's belief that this separation of the timing of work from the timing of rest is imperative for best results.

108. Delays are of two kinds, avoidable and unavoidable. They must be accurately recorded and classified. Unless they are accurately recorded and classified, it is impossible to plan for the utilization of both the periods of "avoidable delay," (therblig 15), and "unavoidable delay" (therblig 16), for the purpose of "rest for overcoming fatigue," (therblig 14). As a result the amount of fatigue allowance that can run concurrently cannot be deducted from the total amount of allowance of rest for overcoming fatigue, and consequently the correct amount of time to add to the net time of an operation cannot be determined.

109. The amount of fatigue allowance is best estimated as a percentage of the synthesized time of the work cycle. The more inaccurate the time of the work cycle, the more this inaccuracy is compounded. Nothing could be more ridiculous, statistically, than "fatigue curves" based upon inaccurately observed stop-watch time study, averaged to the fourth decimal and with no data whatever regarding the fatigue causing factors,—no statement whether the observed worker had chair, nail keg or tote box to sit on, etc. This one point alone, handled and covered to perfection by the micromotion method, should be considered