

that is definite, constant and lasting. If the members of the Taylor Society agree as to the existence of these needs, the questions to be answered are: What can we do about it? How? When?

That there is need for more research of a fundamental character is obvious. Such research would be of inestimable and far-reaching value but I doubt if any but a very large company could afford it alone, and of those who might, it is doubtful if any would have the vision or inclination to defray the cost. It might be regarded as a proper undertaking for one of the numerous foundations but my impression is that their interests lie in other directions. Nevertheless, when we think of the vast amount of research work that Taylor managed to accomplish during his professional career and compare the present state of the art of methods study with its state when Taylor withdrew from active practice, it does not reflect much credit upon those of us who are today engaged in the application of his teachings. Are not Taylor's accomplishments a challenge as well as an inspiration to the engineer and manager of today?

Discussion

G. J. Stegemerten.²⁰ Mr. Hathaway's close observation of innumerable industrial activities as a consulting engineer has placed him in a most advantageous position to speak authoritatively on this and kindred phases of scientific management.

My discussion of the subject will be from the point of view of one connected with a single manufacturing concern and hence might be termed "special" in its scope.

In making detailed analytical studies of the procedure followed in performing an operation, two recognized systems are in use. The equipment used and the manner of making the studies are different but the fundamental principles involved are the same and date back to Frederick W. Taylor. One of these systems is called, by its exponents, "motion study" while they (the exponents of motion study) refer to the other system as "time study." The followers of the second method, however, call their practice "time and motion study."

The terms "time study" and "motion study" used alone are misleading, for each, used alone, implies the exclusion of the other. In reality a time study

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would be of little value if it were not based upon a careful and analytical motion study. Nor would a motion study, failing to take the element of time into account, amount to more. The complete title of either method should really be "motion and time study."

Motion study, as distinguished from time study, involves the intensive study of the motions used to perform an operation and is made under laboratory conditions by means of highly accurate and comparatively expensive equipment. The operator and the necessary equipment are moved to the laboratory, or special screens and recording apparatus are set up in the shop. A motion picture is taken of the operator while working. A special time-recording device is placed in the field of the camera so that the time required to perform the elementary operations may be taken directly from the film, thereby introducing the element of time. Individual motions are studied by attaching small electric lights to various parts of the operator and by making a photographic record of the path of those lights.

When and while the data are being collected, improvements are made which reduce the number of motions required to a bare minimum. When the supposedly best method has been determined, every operator involved is taught its use. (This is in line with that part of Mr. Hathaway's paper which emphasizes the importance of improving methods, instructing workmen, etc.) In this way the element of individual skill is almost eliminated by teaching each operator to be highly skilled. It is expected that effort will be stimulated by establishing a time allowance for doing the job and then offering the worker an incentive to beat it.

Time study, also, subjects each operation of a given piece of work to close analysis but accomplishes this by means of personal observation. This is also done in order to eliminate every unnecessary operation and to ascertain the quickest and best method of performing each necessary operation; also to standardize equipment, methods and working conditions. When the preliminary analysis has been completed, the number of standard hours in which the average experienced man can do the job is determined by time measurement. It will thus be seen that the purpose in mind here differs little from that of motion study.

What we consider as "average," Mr. Hathaway

and others, supported by Mr. Taylor, term "first class." The fact of the matter is that when we think of "average" we really mean "average good" and have instructed our men to bear this in mind in grading effort, skill and conditions. It is not hard to conceive of a group of, say, lathe hands none of whom might be considered "average" as we see it. In other words, we compare performance with what we believe to be reasonably good for that activity throughout the works.

Under time-study methods, the equipment used is a stop watch and the necessary printed form. A study of motions is made by analytical observation on the part of the time-study man. He devises new and improved methods and experiments to find the quickest way of doing the work. The time study is taken only when the method has been standardized.

Motion-study methods have been used, and apparently very good results have been obtained, in many lines of industry. It would seem to be most applicable to work of a standard nature requiring the repetition of a series of dextrous motions.

The only place where time study might not be used to advantage would be on very short jobs. There old-fashioned estimating would probably give good results, but even these estimates should be based on a background of knowledge obtained from analytical time study. Where lots are small not so much time need be given to making the study, for in this case the object is to establish a time value quickly so that the operator will do that particular order as quickly as possible. Where the product is more standard and repetitive, a correspondingly longer time should be given to analytical observations.

Our opinion of the qualifications of one setting out to do time-study work is essentially the same as Mr. Hathaway's, who has stated clearly how and where men of different attainments fit into this work.

To make an intelligent methods study, the analyst must have experience. He must have the confidence which comes from a thorough knowledge of the things under consideration. He will be naturally intelligent and will have not less than the equivalent of a high-school education. He will be thoroughly analytical and will have sufficient salesmanship to convince the workmen and others that his suggestions and recommendations possess merit.

He will have an agreeable and positive personality and will command the respect of those with whom he works.

Among the things which must be considered in making a study of methods, the following will have been given serious thought: equipment, such as machines, tools, jigs, fixtures and the adaptability of such equipment to the work at hand; working conditions (light, heat, ventilation and the nature of the work); the supply of raw materials and the removal of finished parts, and the method of receiving information and instructions.

Having given these points careful consideration, the analyst will proceed further with his detailed study, which should involve satisfying himself on the following questions in the case of each element observed: Why is this element being performed? Is it necessary? Is it being performed in the best possible way? Can it be combined with another element? Is it being performed according to proper sequence?

By subjecting the finest subdivisions of an operation to the close scrutiny just described, the operation, or sets of operations, which constitute an activity, will be found to contain essentials only and hence will result in greater production, at less cost to the company and higher wages to the workman.

A few examples will tend to illustrate what has been accomplished in our plant by an intensive analysis and study of methods, followed by time study, and the application of the standard-time, wage-incentive plan. The specific cases which I shall give exemplify to a marked degree that which may be accomplished by methods study, especially as concerns the improvement of methods.

In the forming, baking and sawing of micarta tubing eight operations, of a total of nineteen originally performed on day work, were improved and three which were found unnecessary were eliminated.

On a day-work basis, mandrels were not kept in an orderly manner and were not identified; only one job was worked at a time. The operator waited while the pouring press heated and cooled; material was not located near the work station, and some operations, which might easily have been performed by girls, were performed by men.

As a result of methods study, the following improvements were made prior to placing the work