be taken, I believe, by those most directly concerned with it.

Allowance for Lag Between Elementary Operations or Cycles

As far as possible, it is desirable that the standard unit or elementary time should be "net." For example, omitting any allowance for physical fatigue, personal needs or unforeseen delays, the total time that a "first-class" operator will consume in performing an operation consisting of, say, fifty different elementary operations will be longer than the sum of the standard unit times for these elements determined by the method that I have described. This may be attributed to the lapse of time between thinking and putting the thought into action. To cover this a percentage must be added to the sum of the elementary or unit times. These component elementary operations may be used in various combinations involving many or few of them. Taylor pointed out that this percentage is quite large on jobs made up of a large number of different elements comprising a long sequence infrequently repeated. This factor grows smaller, however, as the work consists of a smaller number of different elements in a sequence that is more frequently repeated.

Such allowance is often listed on instruction cards as "allowance on handling time." The method followed for its determination in the case of simple repetitive work such as the folding of handkerchiefs mentioned in my paper on "Standards," is reasonably satisfactory and accurate as it applies to the specific cases concerned. I refer to comparison of the time for an operation built up from elementary unit times, with the time actually taken per piece, as shown by a protracted "over-all study" from which the time taken by things which do not directly apply to the performance of the operation has been eliminated. If the laws governing this class of allowance were formulated much time and expense due to duplication of effort by different companies might be saved.

In plants where the work is complicated and either non-repetitive or repeated only at long intervals, and where the percentage of allowance on portions of so-called "handling time" or for certain jobs, is as high as 100 per cent, the existing practice and formulae are far from satisfactory even though, under a high-class methods man of long experience, results may be satisfactory to both employer and employe. This has been a source of just criticism. It was as a result of studies started at the Tabor Manufacturing Company with a view to developing a more accurate method of determining such allowances that Taylor's theory, which I have quoted, was evolved. However, these studies were interrupted by the World War before they were carried to a point which would have permitted the development of formulae. It is hoped that this paper may arouse interest which will result in similar studies being undertaken by others. In conducting such research studies for each class of work, there should be selected a number of jobs ranging from the simplest and shortest to the most complicated. These should be studied to determine the necessary percentage of allowance where work is done singly or with a varying number of repetitions.

For reasons which I have indicated, the practice of adding "percentages" to the elementary time in establishing standard unit times would seem to be inadvisable and to indicate that additional allowances should be computed for each job according to its degree of complication and frequency of repetition.

Conclusion

The late Frank B. Gilbreth had a vision of methods studies, or as he expressed it "time and motion studies," being undertaken by and for not a single company alone but all companies in a given industry. Although he perhaps thought of it at the time primarily in its relation to piece work, Taylor had this in mind when in 1895 he said in his "A Piece-Rate System," "There are hundreds of operations which are common to most establishments, yet each concern studies the speed problem for itself, and days of labor are wasted in what should be settled once for all, and recorded in a form which is available to all manufacturers."[16]

I recall also in an early discussion with Gilbreth on the use of the moving-picture camera as a means of making and recording studies that we talked of the possibility of ultimately analyzing, classifying and making time studies of all the elementary bodily movements that might be employed in various combinations in performing any operation.

[16] P. 875.

While a full realization[17] may not be expected in the near future and may not be accomplished in the time, or with the facilities, at the command of those concerned with the practical application of methods study to the production problems of today, progress has been made and it is hoped that work in this direction will be continued and arouse the interest which it deserves. Such work might well be carried on by some of our institutions of learning just as psychological or physical research has been carried on in the past.

It is, however, of far greater immediate importance that methods study conducted along demonstratedly practical lines should be undertaken by and for the benefit of specific branches of industry as a whole. Associations of manufacturers have from time to time in the past undertaken the development of uniform systems of accounting and the investigation of problems relating to design and to materials used in their common products. It seems almost beyond belief that they have not also availed themselves of the great opportunities that joint methods studies would afford. I suggested such a course in a paper read before the American Foundrymen's Association in 1915.

I have the impression that, so far, the only group co-operative effort that has been made in this direction has been in some two or three instances of time studies undertaken jointly by trade unions and employers with the limited object of setting more accurate and equitable piece rates than had been possible by negotiating. Sooner or later, however, as management becomes more enlightened, I feel that the merits of the course here suggested will be appreciated and that such group methods study may lead to a great advance in many of our industrial arts. This would seem to be one of the objectives of the European movement known as "rationalization." I quote Oliver Sheldon's definition of the term:

> Rationalisation is the process of associating together individual undertakings or groups of firms in a close form of amalgamation, and, ultimately, of unifying, in some practicable degree of combination, whole industries, both nationally and internationally; with the allied objects (beyond what is possible to an industry divided into many competitive units) of increasing efficiency, lowering costs, improving conditions of labour, promoting industrial co-operation and reducing the wastes of competition, these objects being achieved by various means which unification alone makes in full measure available —the regulation of the production of an industry to balance the consumption of its products; the control of prices; the logical allocation of work to individual factories; the stabilisation of employment and regularisation of wages; the standardisation of materials, methods and products; the simplification of the ranges of goods produced; the economical organisation of distribution; the adoption of scientific methods and knowledge in the management and technique of trades as a whole; and the planning and pursuit of common-trade policies.
>
> Or, to use the terms already employed in this discussion, rationalisation is that form of industrial combination which is undertaken with the object of widening the scope for the application of scientific management to the extent of whole industries, and achieving the benefits to producers, consumers and the community which scientific management conducted on this scale alone can provide. In a word, rationalisation is not combination, nor is it scientific management; it is, rather, a form of the one with the object of the fullest extension of the other.[18]

A survey such as I have made of the practice of methods study or, as it is most frequently designated in the literature on the subject, "time study" and "job analysis," shows that while the trend is in the right direction there still exist great differences in technique and in conceptions of underlying principles. Likewise, though much of prevailing practice for the time being meets present needs, it falls far short of being truly scientific or even good. That there is a need for better understanding and agreement as to the purposes, principles and practices both in the conduct of methods studies and in the utilization of their results, was strikingly brought out in the discussion of the paper presented by S. E. Thompson at the December, 1927, meeting of the Taylor Society and in the sessions of the 1928 spring meeting devoted exclusively to time study.

Frank B. Gilbreth said in an article published sixteen years ago in the *Journal of Political Economy:*[19] "The great need now is for more efficient co-operation, that work done by one investigator may not be needlessly repeated by another. Through such co-operation only can come the savings that will allow of refinements of the units, methods and devices of measurement that will result in progress

[17] Gilbreth, Frank B. and Lillian M., "Classifying the Elements of Work" and "Applications of Motion Study," *Management and Administration*, Vol. VIII, Nos. 2 and 3, August and September, 1924, p. 151 and p. 295. In these articles the Gilbreths discuss "therbligs," the term covering the elements essential to all physical work. In their opinion there are seventeen of these essential elements or "therbligs."

[18] *Scientific Management in American Industry, op. cit.*, p. 15.

[19] Gilbreth, Frank B., "Units, Methods and Devices of Measurement under Scientific Management," *Journal of Political Economy*, Vol. XXI, No. 7, July, 1913, p. 629.