result, and has trained a selected worker to employ the best methods and motions, it is often necessary to wait an interval until this worker acquires speed and skill through practice in the new way of doing the work. The time-study man is then in a position to make the time observations upon which piece-rate, task-times or other forms of incentive wage may be based.

The appropriateness of each of the different kinds of timing mechanisms for making these observations will depend in a very large measure upon the nature of the work in hand. It is not possible here to consider many of the endless variety of situations with which time-study men have been confronted. A few typical cases will, however, suffice to point out some of the determinants of our problem.

We shall first consider the time study of construction work. Here the elements of the work are usually relatively long and somewhat variable in the time required for performance. The cycles or repetitions of groups of elements are often irregular. Under these conditions a stop watch offers all the accuracy that is necessary for an elementary time study. In fact, neither the motion picture apparatus nor the time-study machine would be at all satisfactory for most of such work, with observations such as can be obtained with a stop watch. Standard elementary times can be tabulated, and formulas derived therefrom, which permit a fairly easy and uniform method of rate setting without the necessity of timing each slight variation in the work.

As a second example we will consider a department containing only special-purpose machines, all doing identically the same piece of work; a condition such as might exist in an automobile parts factory. The work we shall imagine has suddenly started in at a very high rate of production, and may in all likelihood just as suddenly end. The motions, or elements of the work of operating these machines, may bear very little relation to any other work going on in the same plant.

There is, of course, a tremendous importance attached to the development of exactly the right kind of accessories and fixtures for operating these machines and to the motion-study part of time-study work. This done, the time studies for rate setting can probably be done just as well with a stop watch as with any other kind of mechanism, for the simple reason that over-all times are all that are necessary—the elements being of no importance as an aid in developing formulas for saving observations.

A third situation which we shall consider is representative in a broad and general way of a great deal of manufacturing work. We shall consider a grinding department of a factory which manufactures ordinary open-end, forged wrenches. There are a dozen or more different kinds of wrench—single end, double end, straight handle, "S" handle, light weight, medium weight, etc. There are, of course, a dozen or more sizes of each kind, each of which may be finished in two or three different ways, all of which variables affect the time required for grinding.

The elements which comprise each cycle of work are very short; pick up wrench, grind one side of head, turn, grind other side, grind handle, etc. —which range in time from .003 to .03 of a minute. To obtain the times of these elements with a stop watch with anything like the necessary degree of accuracy is quite impossible. Even that the simultaneous equation, devised by Mr. Barth, does not give satisfactory results is the conclusion I have reached after an often repeated struggle to employ it for the determination of times of short elements.

The best that can be done with a stop watch is to obtain the over-all times of all the different varieties of work which pass through the department. This involves a great deal of observation work and involves the likelihood of considerable irregularity in the rates which are set.

If, however, we can determine the times of the elements with a high degree of accuracy, we can with a relatively few observations prepare a set of tables or formulas from which the time of any piece of work can be determined. For example, the time to pick up a wrench can be determined by a few observations on large, medium-sized and small wrenches; the times for the in-between sizes can readily and accurately be interpolated. The times for grinding "S" shaped handles would differ very much from the times for grinding the straight-handled wrenches, but the other elements would be practically the same—and so on. There are two mechanisms with which the times of such elements can be obtained; one is the motion picture apparatus, the other the time-study machine I have described. The motion-picture method is unquestionably more accurate; it is absolutely accurate. It it, on the other hand, much more expensive; the original equipment is more elaborate, the films cost very much more than the paper tapes, and the labor of converting the machine records into numerical tabulations of times is greater. If the time-study machine is more than sufficiently accurate for most situations, as I believe it is, why should one go to the considerable additional expense involved in the motion-picture process?

4. *Training of Workers.* The training of the whole body of workers in a department, or a plant, is the final phase of the work of the time-study man. Timing mechanisms may prove useful, or even necessary, in this connection in order to determine what particular part or element of the work may be giving difficulty to a worker.

For classes of work similar to the construction work to which we have before referred, the stop watch will doubtless prove adequate for all requirements of training and instruction work.

While the stop watch may prove adequate for setting rates for work such as that described as occurring in a department performing a single operation for a long time on a single article, some more exact instrument may well prove helpful in analyzing the performance of individual workers incidental to their training. In this way the workers may be helped in finding their points of weakness and correct them.

For kinds of work such as those typified by the wrench-grinding operation above described, the same exact kinds of timing mechanism employed for rate setting will most likely prove helpful in training the whole body of workers. It is difficult to help a worker unless one can analyze his performance into its elementary parts and thus put a finger upon his weak spots. The time-study machine is much cheaper and quicker, but the motion-picture apparatus would undoubtedly be of especial value in helping one worker to visualize his performance as contrasted with that of another and more skillful worker.

The above notes represent my present opinions, which are not ventured with the thought that they possess any degree of finality. It is simply my hope that any future discussion on this subject may be so classified that each one's experience may be co-ordinated with others and in course of time a body of information accumulated regarding each phase of time-study work. These should be of value to all those who are interested in the establishment of fair and equitable rates of pay for workers, and at the same time a fair and proper equivalent quantity of work performed.

(*Continued from page* 165)

official endorsement it cannot be carried through to real action until a long period of education, in high places as well as in low, has been pursued.

National planning of some sort is inevitable. It is important that the plan adopted be a well-considered one. It is not a simple problem to solve. The inevitability and complexity involved create a great responsibility for those who are aware of these facts. We shall find a solution, but that solution depends upon the quantity and quality of thought and action that we devote to it in the near future.

Reviews

University Education for Business. By James H. S. Bossard and J. Frederic Dewhurst, University of Pennsylvania Press, Philadelphia, 1931, pages xii, 578.

Here is an exceptionally valuable book which analyzes and assesses the progress of university business education in this country. It should be of substantial value in clarifying and crystallizing educational thought on the problems of business education; and it will help to throw into proper perspective the relative importance of the different phases of the problem.

While in no sense an answer for some of the strictures of Dr. Abraham Flexner in the discussion of vocational education in his recent book "Universities—American, English, German," it does present a more honest and hopeful picture of the objectives and quality of collegiate business instruction than Dr. Flexner offers.

The discussion of objectives is naturally primary and on this point the authors say: "Four distinct objectives are mentioned in the formal announcements of these schools. These are: (a) training in the general fundamentals of business; (b) training in various specialized phases of business; (c) training for business leadership; and (d) equipment with the cultural and ethical foundations for business life." Agreement seems to be general that the aim is not to impart knowledge of specific methods so much as it is "to train students in habits of work and methods of thought and oral and written expression." "It would be most unwise to assume that the school should abandon its traditional aims and devote its energies exclusively to the development of 'personality,' but it is equally obvious that the maintenance of high standards of scholarship should not be the sole aim of an institution