in units of convenient size on the board as they come from the ironing machine, and one on the right to receive the handkerchiefs after being folded. I would call your attention to the special open-side container in the truck for finished work, drawn out and resting on a shelf attached to the "work place" at just the right height to receive the folded handkerchiefs and with the hinged end let down so as not to be in the way of the operator's arm. The weight of the units both before and after folding is designed to be such as to be easily handled by the operator and to afford a change from the monotony and fatigue of folding at sufficiently frequent intervals; having folded the handkerchiefs contained on a board and having filled a container, the operator places the container in one of the truck's compartments, puts an empty one in its place on the shelf and takes another unit of flat handkerchiefs from the truck on the left, placing it in position for folding. Regular rest periods are however also provided. The trucks are moved to and from the work place by "move men" in accordance with orders from the Planning Department.[1]

Contrast this condition, the result of exhaustive study and experiment, with what existed before when the equipment consisted of tables, about four feet wide, thirty feet long, the tops about twenty-four inches from the floor, running lengthwise across the factory with an aisle at either end. The operators sat on both sides of these tables, and a person to get through had to pass between the backs of the chairs of the operators. Work was delivered from ironing machines in an ordinary box truck, from which it was taken and stored on any unoccupied table space, in boxes under the tables, on chairs, or in any available floor space. It was "given out" to the operators by the forewoman in batches of from ten dozen to thirty-five dozen at a time—one-fourth to three-fourths of an hour's work; the operator leaving her work place, carrying her finished work to the forewoman's table and getting another job—an awkward arrangement owing to the congestion and to the small jobs given out, partly to equalize injustice or inaccuracy in the piece rates by distributing "good work" and "bad work" to all, and partly because about twenty-five dozen was all a girl could conveniently carry and take care of at her work place. There were usually several girls changing jobs at the same time and consequently there was considerable loss of time and confusion. Naturally under such conditions and with a great variety of product there could be little control of the various lots or orders in progress, materials were damaged owing to poor methods of handling and storing while in progress, production was low and the operators dissatisfied.

As a result of the standardized conditions, of adequate planning and control, and of the establishment of task and bonus the average production on this operation was increased two hundred per cent, and the average earnings of the operators increased one hundred thirty-six per cent. The operator in Figure 15 earned her bonus, completing each job in the time allowed on all but three jobs during eight months. Throughout the department the production reached an average between ninety and ninety-five per cent of that established as the standard of accomplishment. A typical weekly report showed that out of twenty-nine operators thirteen accomplished all of their jobs in the time allowed, six earned bonus on between ninety and ninety-six per cent of their work, four between eighty-three and eighty-six per cent, four between seventy-two and seventy-eight per cent, one sixty-two per cent and one forty-three.

Similar standard work places were designed for each of the operations. Figure 15 shows one for "ribboning," i. e. tying the handkerchiefs on a card in attractive form before boxing. Figure 16 shows a truck station in which "jobs ahead" of the "ribboners" are stored and Figure 17 gives a general view of one department with a truck station in the foreground. The orderly arrangement with its ample and unobstructed aisles is in marked contrast to what existed before.

V STANDARDIZED MATERIALS

Standard materials which may be depended upon to react the same to treatment every time are essential to scientific management. Under the old style management fluctuations in output, due to variations in quality of material, are obscured. Under scientific management they are constantly forcing themselves upon the management's attention and demanding action.

But little in the way of illustration should be needed to show the importance of standardized materials. In the case of winding small coils for electric magnets, related under the heading of standardization of tools, our studies showed that an average of one-fifth of the

[1]The writer desires to give credit for work done previous to his connection with this undertaking to Major Frank B. Gilbreth, particularly in the development of individual "workplaces," means for handling ironed handkerchiefs in convenient units, and a standard method of folding. Credit should also be given Major M. C. Herrmann, Mr. Charles Hoffman and Capt. D. J. Walsh for the further development of these methods and means.

operator's time was consumed repairing breaks in the wire due to defects. While it had been known to the operators that there was great loss here, it was not realized by the management until the facts were brought out by the time studies.

Each break necessitated the operator stopping her machine, retrieving the broken end of the wire on the spool, threading it through several guide pulleys, brazing the two ends together and insulating the joint. It was seen that to correct this trouble at its source would require months if not years of work, involving changes in the method of insulating the wire, in the equipment used for insulating and even in securing the cooperation of the manufacturer of the raw materials, by all of which it was ultimately reduced materially. As the number of breaks that might occur during a job could not be predicted, the expedient was adopted of setting the time for the job with no allowance for breaks included. If the time set for a job were to include the repairing of breaks, in order to insure fairness to the operator we should have had to allow time for the *greatest number of breaks that might occur*. This would obviously be too high in the majority of cases. We therefore provided a small printed form for each job on which the operator made a mark each time a break occurred. This slip was turned in by the operator with her time card, and extra time added to each job in accordance with the actual number of breaks.

An interesting commentary on the relations existing between the employees and employers in this plant, and upon the accuracy of the time studies and fairness of the task based thereon, lies in the fact that no evidence was found of any effort on the part of the operators to report more breaks than were actually encountered. Incidentally, I should add that, pending relief from efforts to standardize the wire, the time required to repair breaks was reduced through standardization of tools and machines and improvement of methods.

In machine shop practice the feed, speed and number of cuts are predetermined for each job, and on this basis the cutting time and the time for changing tools is computed. Whether the time set is right or not depends upon the material being standard with respect to hardness and the amount of metal to be removed. If there is any appreciable variation from standard the tool will become dull and have to be replaced before completing the work it should have done; and the speed, feed, or both, will have to be reduced or extra cuts taken, and one or more tools may have to be procured from the tool room. The result is that the job cannot be done in the time set, through no fault of the workman, and extra time must be allowed.

Standards of materials and standards of quality of work done are, after the performance of the first operation, in a sequence almost inseparable. Frequently unless one operation is correctly performed the succeeding ones may not be done in the time allowed or in accordance with the standard method; accurate information as to the quality required, the tolerances or degree of accuracy, the kind of finish, etc. must be supplied in the form of samples, specifications or drawings. Such information is required not only by those who plan the work but also by the operator, the inspector and other functional foremen in the shop. In a machine shop run under the Taylor System not only are detail drawings furnished for each piece and assembled unit, but they contain information, more explicitly and clearly given than is ordinary practice, which by answering all questions in advance, avoids errors or misunderstandings, and saves the time of foremen and workmen seeking information from the draughting room or other sources, etc. The character of this information is shown by Figures 18 and 19.

VI STANDARD PROCESSES OR METHODS

Standard conditions with respect to machinery, tools, other equipment and materials are prerequisite to standard processes or methods, and as a matter of fact, once they have been established in a large measure *standard methods result as a natural consequence*.

There are often several ways of doing a job—but usually only one best way. It is mainly for the purpose of insuring the one best way, making the fullest use of and adherence to the standard conditions established, that work is carefully planned in advance, that route charts and route sheets are prepared, and that detailed instruction cards and tool lists are provided for each operation. In this way we largely overcome the inequalities of experience in various workers who may be called upon at different times to do the same job, and insure that successive operations shall be performed in the most economical sequence. Under the old system of management, John Smith, for example, is an old hand who knows the product and the shop's equipment; he has always done a certain job and has evolved what under the circumstances is the best way —or at least a very good way—of doing it; owing to some circumstance, the next time that the job has to be done John Smith is absent, and it is given to a new