to carry a sufficient amount. This was standardized and now the twelve kinds of paper have been reduced to four, with a saving of $1,000 in the stock, 60 per cent in the storage space occupied, and the available worth of this paper for the demands that may be made on it is 20 per cent more than what it was formerly. This illustrates the saving made on but one class of material used in a factory where standardization is being worked out.

Such methods of purchasing compel the purchasing department to be intimately associated with the working of the materials through manufacture, and result in the following:

First. Uniform material best adapted to the work saves labor and delay in workrooms.

Second. Minimum of kinds and sizes necessary to be carried.

Third. Storage space saved.

Fourth. Lower costs through buying in larger lots.

C. *Storage of Materials.* The physical aspects of a storeroom under *Scientific Management* do not differ greatly from those in the *systematized*. A proper means of holding or piling the stores, laid out in an orderly fashion, is provided. To avoid confusion in a varied terminology, mnemonic symbols are used to designate the different kinds of stores. The maximum and minimum mentioned above are determined for each kind, and kept on the ledger sheets in the central planning room. The bookkeeping for the stores is not carried on in the storeroom, the storeroom force simply acting on orders. The location of the materials is also indicated on the ledger sheets, or, as they are known, the balance of stores sheets.

The storeroom in the *systematized* plant is not likely to carry all the materials and supplies used in the entire plant. The engine-room, plumbing and construction supplies may be carried in places provided for them, but not controlled as other materials are. Stationery and office forms and supplies may be carried somewhere else under a different system. Even in well-systematized plants such items as are not considered a part of the general stores system cause more or less trouble by being used up unexpectedly.

Under *Scientific Management* it is not sufficient, when materials are required, to send a requisition to the stores department, but all orders or work which require material have the items looked up and assigned to the specific orders by the balance of stores clerks, and this material when assigned to a given order is not available for another order which may follow. This is done before the materials are required for use, and this method serves as advance warning to the stores clerks if an unexpected demand for a particular material is likely to occur. Quick action is then possible in purchasing more.

The work of moving materials into the stores department and moving them from the stores department to the particular place where they are to be used, becomes a function of the planning of the work, and of the routing of the work, and the workman who is to use them should not be delayed or have to give a thought to the materials which he needs for his next job. They are moved in the right condition for his use to the point where he can use them to the best advantage. The *time* which the workman spends looking for or waiting for his materials can be better spent in effective work. The proper working of the stores department in many industries, and especially in mercantile establishments, is a very important one.

D. *Execution of Work.* The theory of the proper execution of work is that it should be planned completely before a single move is made—that a route-sheet which will show the names and order of all the operations which are to be performed should be made out and that instruction cards should be clearly written for each operation. Requisitions on the stores department showing the kind and quality of the materials and where they should be moved, and lists of proper tools for doing the work in the best way, should be made up for each operation, and then by time-study the very best method and apparatus for performing each operation is determined in advance, and embodied in the instruction.

By this means the order and assignment of all work, or routing as it is called, should be conducted by the central planning or routing department. This brings the control of all operations in the plant, the progress and order of work, back to the central point. Information which even in the *systematized* plant is supposed to be furnished by the knowledge of the workman or the gang-boss or foreman, is brought back to the planning room and becomes a part of the instruction card.

In many *unsystematized* plants no attempt is made to change the method by which the workman performs his operations. Plenty of time and money may be spent on special machinery, but when that is installed very little time is spent in a close analytical study of the time elements and motions involved in operating, in order to make it possible for the workman to work in the easiest and best way and to furnish a fair basis of remuneration.

When the analytical study has been made, the probable time of operation determined, and a sufficient incentive has been added in the shape of a bonus for performing the work in the given time and in the way specified, then work can be much more accurately controlled from the central planning room because it is likely to be done in approximately the time determined and without lagging.

By *functional foremanship*, which has been described by previous speakers, the management brings to bear on each phase of the work a man particularly fitted by selection, training and experience to assist in performing that part of the work. His function is to assist the worker and cooperate with him to enable him to increase his earning capacity by eliminating trouble or delays or wrong methods. Even in the well-managed *systematized* plant the manager will tell you that the weak point in his business is the inability to secure good foremen, or good superintendents. He demands:

First. That the foreman shall know all about the work which is done in his department.

Second. That he be a good disciplinarian.

Third. That he have the ability to crowd work through and get it out quickly.

Fourth. That he be cautious and accurate.

Fifth. That he be able to keep account of innumerable details.

To find all these qualities combined successfully in one man is exceedingly difficult, to train such men is also difficult, and to secure them by natural selection and "survival of the fittest" takes too long; but to train men for functional foremanship by selecting the best man fitted to do the particular function and then training him in that, is simply one kind of division of labor which has marked the progress of civilization.

The execution of work which is largely repetition, where the individual processes are simple, reaches a very high efficiency in many *systematized* plants. The difficulties in securing efficiency increase as the work becomes more varied and with less proportion of it repeat-work, and in proportion as these difficulties increase ordinary systems fail to produce results in more intricate work. This can be attained, however, by the central planning room from the analysis and time-study which is put into all operations of work and reduced to instruction cards.

E. *Efficiency of the Worker.* On many simple operations in manufacturing, piece-work has always been considered the most efficient method of securing output and low costs, and it is true that where the remuneration is a just one and when the employee is supplied with proper materials and works to the best advantage, this method of performing work approaches very close to that of *Scientific Management*, but such conditions of piece-work are the ideal rather than the usual. As stated above and emphasized by previous speakers, piece-work with prices based on the snap judgment of a foreman or by an imperfect test of a single worker, is not the correct method to secure the greatest efficiency. Besides this, there are many kinds of work which are not adapted to piece-work. Under *Scientific Management* the efficiency of the worker and machine depends on five other conditions, after assuming that the parts of the management which have to do with purchasing, storage of materials, etc., are well performed. These conditions are:

First. Analysis and synthesis of the elements of operation.

Second. Scientific selection of the worker.

Third. Training of the worker.

Fourth. Proper tools and equipment.

Fifth. Proper incentive.

First. The first condition on which the efficiency of the worker depends is that *the management shall analyze carefully and thoroughly every operation into its ultimate elements;* shall then reconstruct those elements in their proper sequence, eliminating those which are unnecessary or those which are bad, and reducing the form to a written instruction card for him to follow; the time elements having been determined and becoming a part of the instruction card. It is interesting to see what develops when one really begins to study a seemingly simple operation. The motion-study alone of bricklaying makes possible the elimination of sixteen unnecessary motions. The change in location of a machine which was operated by a girl who sat with her back to an aisle where heavy trucking was done caused an increase of 25 per cent in her work. Every time she heard a truck approaching she involuntarily shuddered, probably wondering if the truck would strike her. Removing this operator to a quite corner caused the increase.

One factory doing light manufacturing has lately put some time into studying what have always been considered simple operations. In certain places a differently shaped receptacle was made for the articles on which work was being done, bringing the pieces within six inches of the left hand, whereas for years before the worker had had to reach for these and occasionally stop work to bring the articles farthest away within reach