

cause it is easy to put over the bluff of using it properly. The stop watch has been used injuriously by unskilled persons. The scientific use of the stop watch is to take unit times. It has been applied to a good many varieties of work. Take brick laying, because that is a classical case of the application of time study as a method of scientific investigation. Brick laying has a great many variables, such as windows, corners, the nature of the courses, etc. Now, Scientific Management investigators have worked out the time it takes an ordinary skilled brick layer to lay a single brick under each of every conceivable condition. They did not find out how long it takes to lay fifty feet of wall with all sorts of conditions, but how long it takes to lay one brick under any condition of bricklaying. Suppose a contractor receives an inquiry to bid on laying a wall. He receives the specifications and analyzes them: so many corners; so many windows; so many feet of plain wall between; so much face brick; so much filling; etc. By multiplying the number of bricks to be laid under each varying condition by the average time of laying one brick under each condition, he can compute readily an average over-all time for laying fifty feet of wall with all the specified conditions of windows, corners, etc. I give you that as an illustration of the extent to which this precise information is sought, and also as an illustration of the exact prediction possible in the light of precise information.

(2) Precise Prediction. If one by time study and other investigation has secured and filed information telling the time of performing a unit operation with certain tools and materials under certain conditions, then if an order comes in to do or make something which represents a combination of these unit operations, by a simple mathematical calculation it is possible to determine how long it will take to fill the order, what materials and tools must be provided, what conditions established, when work on each part should begin, when and how they should be assembled, etc. In other words, an accurate layout of work on the job becomes possible. In most plants layout is by guess. Guess involves waste. An accurate layout of separate jobs means accurate layout and dovetailing of all jobs, and economical and efficient operation of materials, equipment and labor; in other words, more precise control.

(3) Precise Control. This means that to each of a number of persons shall be assigned, with authority, the responsibility of maintaining one or more of the standard conditions on the basis of which the prediction or layout of a job is made. The principal standard conditions to be maintained are

(a) Standard materials. All materials purchased should conform to carefully-worked-out, detailed specifications. It is surprising, if this is not done,

how great variations there may be in materials received, without violation of the terms of the purchase and grounds for rejection. Materials purchased by detailed specifications, however, should never vary, and should give always the same reaction to the application of the labor of foreman and workman.

(b) Standard storing and issuing of materials. Materials should be under the custody of a person who will issue them only at the time, to the workman, and in the quantity specified by the person who lays out the job. Thus is avoided that surprising, unintentional waste which results from permitting Tom, Dick and Harry to help themselves to material at their pleasure.

(c) Standard conditions under which work is performed. Someone to whom such responsibility has been assigned should relieve the workman of the necessity of maintaining the most favorable conditions of work. The most favorable conditions of work involve many elements: heat, light, availability of material, perfect conditions of machine, bench, tools, belting, etc.

(d) Standard methods of performing operations. This is the responsibility of the foreman and workman. When a job is to be performed, it should be performed by the workman according to the best known method determined by experiment, and nothing should detract the workman from that responsibility. His standard materials have been brought to him; the perfection of the conditions in which he is to work has been provided for; another has seen to it that his machine and tools are in perfect condition and ready; his responsibility is to perform the operation. And he, as well as the person who has laid out his job, should know how long it will take him to perform it, for every condition of operation is predetermined.

There are other elements of precise control which I might describe to you, but I feel that I have made clear the nature of it in describing control of materials, conditions and processes. Do you not see that much waste of material, labor, machine, time, etc., is impossible with such control?

Through what machinery are the three primary aims of Scientific Management (investigation, prediction, precise control) accomplished? This machinery is described in the words *functional organization*.

You have functional organization in this merchandising house, and you know what it is. It is carried out to an unusual degree in manufacturing plants by Scientific Management. First, there is functional organization in the large; planning is separated entirely from doing. Now, in an ordinary manufacturing plant an order is received to make something. That is sent down to the foreman with an order to "make twenty-five of these by the 25th of June." The foreman turns to the workman and says, "Start

on these day after tomorrow." There your foreman has planned who is to do it; how long it will take; how it is to be done; and so on. Under Scientific Management, on the other hand, in a room called the planning room, where is kept on file all the information which has been gathered regarding all phases of operation, the planning is done. First, a list is made of the operations involved in filling this order; and of the materials and equipment required; second, an estimate is made of the time it takes to do each one of the operations with due allowance for uncertainties; third, a day is determined when work on the order is to start in order to meet the date of promised delivery. All planning of that sort is done, and proper orders are made out. On the proper date these orders are issued to the man who has charge of the material, telling him to send it to such and such a machine; and to the workman at that machine, telling him to start the work. Accompanying the order issued him is the analysis of the job and definite instructions for its performance. You know the story of the German General who made warfare scientific. The story is that he was awakened from his sleep and notified that war with France had been declared. He said "Pigeon-hole A" and went to sleep again. When he awoke, mobilization was on. He had filed in the pigeon-hole "A," ready for the emergency, precise directions for conducting it when it should come, and precise telegrams to commanders and officers. That is what planning in Scientific Management means.

I have been speaking about functional organization in the large—the separation of performing, planning and investigating. There is also functional organization in detail. The best illustration is any shop where working people are. In the ordinary manufacturing plant there is one foreman directing the work of the shop. He hires the workmen and discharges them; he tells them what to do; when to do it; how to set up the machine; he inspects results; and so on. Now under Scientific Management the way that would be handled is this: Suppose you have several shops in your plant, each with a foreman with all these responsibilities. One of these men is extra good at directing workmen how to do the work; another man is very good as what we call a disciplinarian,—he can talk tactfully with the workman who is not doing his work right, and straighten out the situation without causing friction; another one is excellent in the technical side of setting up machines. Now, you say to them that instead of each man having a room, and being responsible for everything pertaining to that room, each shall be responsible in all four shops for that in which he is particularly strong. One man, perhaps, will do nothing but instruct workmen in all four rooms; another will be disciplinarian; another will do nothing

but hiring, because he is strong in that; etc. This is functionalization in detail.

I have been talking concerning plans and policies as regards productive processes. A word about plans and policies as concerns sharing in the rewards.

II. *Aims, plans, policies and methods as they concern the distribution of the total income which results.* The particular productive processes which I have described to you produce more with a given combination of materials, equipment and labor than any other productive processes that have been worked out. What is the theory of Scientific Management with regard to the sharing in this extra income? Now Scientific Management is not tied up to any theory of sharing at all. That should be clearly kept in mind. You can have Scientific Management under a regime in which the proprietor takes every bit of the extra income. You can have Scientific Management under a regime in which the workmen get all of it. There is no definite relation between your theory of distributing your income and this technique of management. You can have Scientific Management under the present prevailing system of what we know as individual ownership and control; you can have it under that possible and, as some people believe, probable form of control in which through co-operation the working people own the business and hire a manager. There is no fixed relation between the philosophy of management and of distribution. Scientific Management can be applied at any stage of our industrial progress, under the particular philosophy of ownership and distribution then prevailing. Under the prevailing theory of individual ownership and management, it would be possible for the surplus income of Scientific Management all to go to the proprietor. As a historical fact it does not. The managers have always shared this increased productivity with the working people by increasing wages, and with the consumer by lowering prices. This is how it works. I am saving on costs. I am convinced that the saving will be permanent. To get more trade I lower my selling price slightly. I lower it to the extent necessary to get the trade, and increase my business to the extent I want. Thereby I am sharing part of this increased income with the consumer in lower prices. Furthermore, this policy of precise investigation, precise prediction, and precise control of operations so as to bring about what is predicted, is based on, and conducted on, a spirit of goodwill and co-operation of all workers concerned, and therefore, historically, without reference to any theory of distributing social income, simply as a method to secure the goodwill of everybody concerned, the management has in every case increased wages voluntarily. This precise control requires that everybody shall agree to assume responsibility for doing the particular thing assigned to him or her