

furnace. So that particular department in our works (and if I remember rightly it was the only department in the Midvale Steel Works that ran right straight through the year) the open-hearth furnace, ran and always will have to run, right straight through, night and day, although the work was so arranged that it was rarely necessary to pour a heat on Sundays, so that the smallest possible number of men were kept at work in the department on Sunday. Now, in this department there were two 12-hour shifts at work. I say 12 hours because there were practically two shifts of 12 hours each to run these furnaces. And I can say, that for the whole time that I was at the steel works, it was a matter of the very gravest concern to all of the managers that there seemed to be no way of doing away with the 12-hour shifts under scientific management. But it was made easier in this way—that is, this practice was made justifiable to a certain extent in this way—that the task of the men running that—that the tasks which were given to the men who worked on 12-hour shifts were made lighter than the tasks given to the men running on 10-hour shifts. But that does not make the necessity for these long hours of work any the less unfortunate. And I used to regret this necessity the whole time I was at this works; it was a matter of great concern. Time and again we consulted as to the possibility of introducing 8-hour shifts in the place of 12 hour shifts, and since I left there I understand that this has been tried, and that the workmen themselves seriously objected to it, and preferred to go back to the old 12-hour shift. This is merely hearsay, however, what other people have told me, and therefore is not given as of my own knowledge. But I understand the workmen themselves said that when they boarded in houses with other people and had to have different mealtimes and sleeping hours, working partly in the daytime and partly at night, so that they had to have their meals in the middle of the afternoon or middle of the night (when no one else took their meals), they looked upon it as a hardship, and my impression is that the eight-hour shift, after being tried, was abandoned. On that point I am not sure, however, Mr. Chairman.

The Chairman. How do those conditions compare with the conditions existing at the same time at the United States Steel plant?

Mr. Taylor. The conditions in many of the plants of the United States Steel Co. are and always have been deplorable—deplorable to the greatest extent. Now, I do not wish to be understood as criticizing the managers of these steel works. I think a great many of the men in that business recognize the very deplorable state of things that exists there; and certainly there are now deplorable, if not shameful, conditions existing in the steel business. I say this most heartily. As far as possible, that sort of conditions would not be tolerated under the principles of scientific management. I have heard of many cases where year in and year out men have worked with almost no vacation and very little lay off, and that is inhuman; it is impossible.

The Chairman. You consider it to be one of the essential features of scientific management that a time study must be made with a time-piece, such as a stop watch, in order to determine the length of time that a piece of work can be done in, to hereby give a knowledge of it.

Mr. Taylor. I know of no other way of determining how fast work ought to be done than by timing the workman, Mr. Chairman. As long as time remains one of the most important elements (and in the past most of the disputes between employer and employee have been connected with the question of how long it should take to do the work), I fail to see how you are to know anything about time without timing. I know of no way of getting any accurate knowledge in this field except by watching a man who is doing the work at the proper speed and recording his time. The old way of guessing as to how fast a man ought to do a thing (and that is the way I did, as I explained to you, when I was a foreman under the old system of management) is most unsatisfactory as to both sides. This old-fashioned guesswork is quite as unsatisfactory to the workmen as to those on the management's side.

The Chairman. Under your system, when you have made a time study with a stop watch, do you then take the exact time that you have

found by the stop watch and say that is the time in which the work must be done?

Mr. Taylor. No, sir; never. We first take a good man, not a poor man—we always try to take a man well suited to his work. We then assure ourselves that that man is working at a proper rate of speed; that is, that he is not soldiering on the one hand, and that on the other hand, he is not going at a speed which he cannot keep up year in and year out without undue exertion. We then determine as accurately as we know how the proper speed for doing the work, by timing the man with a watch, and having determined that, then we add a marginal percentage of time to cover unavoidable delays and accidents, and, in many cases, we make an extra allowance when the workman who is called upon to do this particular job is not especially skilled at it.

For illustration, Mr. Chairman, to show you what I mean by this marginal allowance, suppose you were asked in a shop to turn axles for a standard railway car. This is a piece of work which as you know is done by the thousand, and done year in and year out; and now that the railway master mechanics of the country have established a standard car axle, the conditions have become uniform for doing this piece of work. We will assume that a company is going into the manufacture of these axles as a regular business, and that they propose having men working on these axles year in and year out. The time study would be made first to determine the quickest time in which the axle ought to be machined. By the quickest time—I do not mean any improper time—but the quickest proper time in which that work could be done by the workmen if they did not have the slightest interruption or delay or anything of that sort. And after having determined this time, then 20 to 27 per cent of that time is added to cover unavoidable delays and all such accidents as may happen to a workman. That 20 to 27 per cent has been found, from long experience, to give the workman plenty of time to overcome those little unavoidable delays and interruptions which interfere with his work. This allowance has been generally accepted by the workmen as correct, and I have never heard this allowance disputed as incorrect.

If you were to take that same axle, for instance, where only 10 or even 100 axles were to be turned in a shop, you would in this case have to allow as much as 70 per cent additional time to the man. This is because you cannot expect a workman to go right at a job which is new to him and do everything just right and at the same speed which he could readily maintain after having more practice.

In some other classes of work it has been my habit to add as much as 225 per cent to the time in cases similar to the one I have described. I think that is the highest per cent that we have been accustomed to add to the "quickest reasonable time" in which the work might be done.

The Chairman. By what scientific formula or mathematical calculation did you arrive at an addition of 20 to 27 per cent to the time which you have determined by that stop watch?

Mr. Taylor. We have done that through a very careful study—and this study has been repeated over and over and over again—of workmen well suited to their particular jobs. They were told, "Now, men, we want to arrive at a proper allowance for unavoidable accidents and delays, and I want you to cooperate with me." This is the way we talk to the workmen when we propose to make a time study in ninety-nine cases out of a hundred—"I want you to cooperate with me in arriving at the truth regarding this fact. Now, go right ahead and do the work as it ought to be done. I want to know what time it will take, first, to turn the axle, and then I want to see what is the proper allowance to make for unavoidable accidents and delays." We would then watch and time that man, not for one axle alone, but frequently for days at a time, until finally we would both agree as to what was the proper time. During this time we would watch, of course, carefully to see whether he had not perhaps forgotten something—had not slipped off the track and was making some unnecessary motions, and then as a result of this careful joint study between the workman and the management the proper percentage allowances are accurately determined. You see that it is joint, because both sides cooperate; we have one man who is watching and records the time, and the other man who works,