

You will see that the science of doing every little act that is done by every player on the baseball field has been developed. Every single element of the game of baseball has been the subject of the most intimate, the closest study of many men, and, finally, the best way of doing each act that takes place on the baseball field has been fairly well agreed upon and established as a standard throughout the country. The players have not only been told the best way of making each important motion or play, but they have been taught, coached, and trained to it through months of drilling. And I think that every man who has watched first-class play, or who knows anything of the management of the modern baseball team, realizes fully the utter impossibility of winning with the best team of individual players that was ever gotten together unless every man on the team obeys the signals or orders of the coach and obeys them at once when the coach gives those orders; that is, without the intimate cooperation between all members of the team and the management, which is characteristic of scientific management.

Now, I have so far merely made assertions; I have merely stated facts in a dogmatic way. The most important assertion I have made is that when a company, when the men of a company and the management of a company have undergone the mental revolution that I have referred to earlier in my testimony, and that when the principles of scientific management have been applied in a correct way in any particular occupation or industry that the results must, inevitably, in all cases, be far greater and better than they could possibly be under the best of the older types of management, even under the especially fine management of "initiative and incentive," which I have tried to outline.

I want to try and prove the above-stated fact to you gentlemen. I want to try now and make good in this assertion. My only hope of doing so lies in showing you that whenever these four principles are correctly applied to work, either large or small, to work which is either of the most elementary or the most intricate character, that inevitably results follow which are not only greater, but enormously greater, than

it is possible to accomplish under the old type of management. Now, in order to make this clear I want to show the application of the four principles first to the most elementary, the simplest kind of work that I know of, and then to give a series of further illustrations of one class of work after another, each a little more difficult and a little more intricate than the work which preceded it, until I shall finally come to an illustration of the application of these same principles to about the most intricate type of mechanical work that I know of. And in all of these illustrations I hope that you will look for and see the application of the four principles I have described. Other elements of the stories may interest you, but the thing that I hope you will see and have before you in all cases is the effect of the four following elements in each particular case: First, the development of the science, i. e., the gathering in on the part of those on the management's side of all the knowledge which in the past has been kept in the heads of the workmen; second, the scientific selection and the progressive development of the workmen; third, the bringing of the science and the scientifically selected and trained men together; and, fourth, the constant and intimate cooperation which always occurs between the men on the management's side and the workmen.

I ordinarily begin with a description of the pig-iron handler. For some reason, I don't know exactly why, this illustration has been talked about a great deal, so much, in fact, that some people seem to think that the whole of scientific management consists in handling pig iron. The only reason that I ever gave this illustration, however, was that pig-iron handling is the simplest kind of human effort; I know of nothing that is quite so simple as handling pig-iron. A man simply stoops down and with his hands picks up a piece of iron, and then walks a short distance and drops it on the ground. Now, it doesn't look as if there was very much room for the development of a science; it doesn't seem as if there was much room here for the scientific selection of the man nor for his progressive training, nor for cooperation between the two sides; but, I can

say, without the slightest hesitation, that the science of handling pig-iron is so great that the man who is fit to handle pig-iron as his daily work cannot possibly understand that science; the man who is physically able to handle pig-iron and is sufficiently phlegmatic and stupid to choose this for his occupation is rarely able to comprehend the science of handling pig-iron; and this inability of the man who is fit to do the work to understand the science of doing his work becomes more and more evident as the work becomes more complicated, all the way up the scale. I assert, without the slightest hesitation, that the high class mechanic has a far smaller chance of ever thoroughly understanding the science of his work than the pig-iron handler has of understanding the science of his work, and I am going to try and prove to your satisfaction, gentlemen, that the law is almost universal—not entirely so, but nearly so—that the man who is fit to work at any particular trade is unable to understand the science of that trade without the kindly help and cooperation of men of a totally different type of education, men whose education is not necessarily higher but a different type from his own.

I dare say most of you gentlemen are familiar with pig-iron handling and with the illustration I have used in connection with it, so I won't take up any of your time with that. But I want to show you how these principles may be applied to some one of the lower classes of work. You may think I am a little highfalutin when I speak about what may be called the atmosphere of scientific management, the relations that ought to exist between both sides, the intimate and friendly relations that should exist between employee and employer. I want, however, to emphasize this as one of the most important features of scientific management, and I can hardly do so without going into detail, without explaining minutely the duties of both sides, and for this reason I want to take some of your time in explaining the application of these four principles of scientific management to one of the cheaper kinds of work, for instance, to shoveling. This is one of the simplest kinds of work, and I want to give you an

illustration of the application of these principles to it.

Now, gentlemen, shoveling is a great science compared with pig-iron handling. I dare say that most of you gentlemen know that a good many pig-iron handlers can never learn to shovel right; the ordinary pig-iron handler is not the type of man well suited to shoveling. He is too stupid; there is too much mental strain, too much knack required of a shoveler for the pig-iron handler to take kindly to shoveling.

You gentlemen may laugh, but that is true, all right; it sounds ridiculous, I know, but it is a fact. Now, if the problem were put up to any of you men to develop the science of shoveling as it was put up to us, that is, to a group of men who had deliberately set out to develop the science of doing all kinds of laboring work, where do you think you would begin? When you started to study the science of shoveling I make the assertion that you would be within two days—just as we were within two days—well on the way toward development of the science of shoveling. At least you would have outlined in your minds those elements which required careful, scientific study in order to understand the science of shoveling. I do not want to go into all of the details of shoveling, but I will give you some of the elements, one or two of the most important elements of the science of shoveling; that is, the elements that reach further and have more serious consequences than any other. Probably the most important element in the science of shoveling is this: There must be some shovel load at which a first-class shoveler will do his biggest day's work. What is that load? To illustrate: When we went to the Bethlehem Steel Works and observed the shovelers in the yard of that company, we found that each of the good shovelers in that yard owned his own shovel; they preferred to buy their own shovels rather than to have the company furnish them. There was a larger tonnage of ore shoveled in that works than of any other material and rice coal came next in tonnage. We would see a first-class shoveler go from shoveling rice coal with a load of 3½ pounds to the shovel to handling ore from the Massaba Range, with 38 pounds