

which he has, he has worked out the number of employees that are required for different jobs in the plant to the point where on a particular morning he can say just how many men are necessary for each job. "This job needs two and seven-tenths employees, or one and three-tenths employees," or whatever it may be. He then routes employees from his reserve department in such a manner that each job has just enough and not too many employees. The amount of unemployment or time lost through waiting for work is practically eliminated.

As Mr. Feiss was making that point I was conscious of the fact that in the room in which he was there was present a number of representatives of one large concern not under scientific management, which did not even have a census of their employees in the central office. The significance of that is, in regard to the development of personnel work, that while we are all talking about lost time and unemployment and endeavoring to cure it by various forms of humanitarian legislation, scientific management has discovered that a large part of the lost time comes about through lost time within the plant, and is endeavoring to eradicate it. The particular plant that I refer to in Mr. Feiss' audience could not possibly hope, with its system, or lack of system, to eliminate much of lost time it had in the plant.

This is the corollary that I wished to mention with regard to Dr. Drury's paper. The two are interdependent: personal, science or human engineering to an even greater degree than we have had it in the past is essential to the proper development of scientific management, and, conversely, scientific management is necessary to the development of the other.

MR. HENRY L. GANTT:¹ Gentlemen: I am sorry that I was asked to discuss this paper. I should much prefer to have been asked to talk on the subject without discussing a paper of this character. The only people who have any possible chance of being in the forefront of this movement are the people who are in the movement itself. It is not humanly possible for college professors to keep up with the movement; it is moving too fast. They are doing something else. If the man who is actually doing this thing from day to day does not know more about it than the man teaching mathematics and doing something else most of the time, he is unfit for the work. In other words, the men who are doing it must know more about it than those just hearing words about it. Therefore it seems to me that it is a great mistake for those

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people who are only hearing about it to write too much on the subject. They give a false impression to the community.

I am not condemning the professors. I only say it is impossible for a man who spends all of his time or most of his time teaching something else to keep up with a movement that is live and growing. The great thing about this is that Mr. Taylor put into it the germ which would grow. He did not give us a fixed or static thing that had no life in it. If he had, it would have been dead by this time. The world has changed in the last two years. If he had simply voiced a formula, something that was dead, something that did not mean anything except what it said on the surface, it would have been all gone, out of existence long ago. The whole world is being made over now. A lot of people do not know it yet, but they are going to learn it awfully quick. I don't know how long it is going to take, but two and a half years more of the great European War and we won't know where we are. I do not think many of us know now.

Dr. Drury's interesting paper on scientific management and progress indicates a great deal of labor, on his part and much ingenuity, but it is highly academic, and I do not see that it throws much light on the future development of the art of management. He says that "system" does this and "scientific management" does that. His use of the terms "system" and "scientific management" seems to me to be strangely inconsistent. To my mind a system is a "mechanism" and scientific management a "method". Neither a mechanism nor a method can accomplish anything of itself, but only through the human intelligence and energy by which the mechanism or method is directed and applied. The same mechanism or method may be used for good or ill at the will of the directing force.

His discussion of Mr. Taylor's activities and ideals has to a large extent, been culled from the ideas of others, who were not very closely associated with Mr. Taylor in the early years, and is largely a series of opinions based upon other opinions. I became associated with Mr. Taylor in the year 1887 and found him a man of strong personality, dominated by a desire to use knowledge as the basis for all his actions. He was at that time chief engineer of the Midvale Steel Works, having risen to that position from being foreman and then superintendent of the machine shop. When he became superintendent of the machine shop, some years previous he realized that the workmen were not doing as much work as it was possible for them to do. A short analysis of this situation convinced him that there were two causes contributing to this result. The first was the fact that employers in general paid

to workmen only the minimum wage for which they could be hired and the workmen, naturally, performed the minimum amount of work which enabled them to hold their jobs. The second cause was a lack of knowledge on the part of both employer and employe as to the best methods of doing the work, and the amount that could be done. Up to that time practically all shop-methods were of an empirical or rule-of-thumb nature, which had been inherited from ancestors or borrowed from contemporaries. He recognized at once the weakness of such a system and determined to apply the scientific method to the solution of the problems which he had to face. That is the analysis of how Mr. Taylor started.

There had already been established in the Midvale Steel Works a chemical laboratory with Russell W. Davenport as chief chemist, which was one of the first, if not the very first, of such laboratories established in this country. He was in a scientific atmosphere. There were people in high positions who recognized the value of science. I think that I am safe in saying that if there had not been such people at the head of the Midvale Steel Works, it would not have been possible to make any progress. The manager of the works at that time was Mr. Brindley, a graduate of Yale, who recognized the value of scientific knowledge. Mr. Taylor's first investigations into the cutting of metals and other problems soon satisfied him that if he could get work done in the manner indicated as best by these investigations, he could not only reduce the cost of doing the work, but pay greatly increased wages to the operators. Of course, when he began to pay increased wages to the operators, the same old conservative spirit, that you must not pay workmen more than so much, was thrown at him all the time, but he made considerable progress nevertheless.

When I entered his employ in 1887, this work had progressed to quite a considerable extent, although he did not have from his associates the sympathy and support that his results would seem to have justified. The name by which our office went was the "fish house." There were two of us there, one very tall man, and he was called the "big fish" and I was the "little fish." That is the amount of respect which was being shown these methods after seven years. You can imagine how many obstacles he had to overcome. He was, however, not to be discouraged by lack of co-operation, for he had become thoroughly convinced that industry in future must be based not on tradition nor opinion, but on facts, and that natural laws must take the place of the arbitrary laws, which had been deducted from opinions. As soon as he began to investigate anything he almost invariably found out that the usual view, concerning anything that had

not been investigated was wrong, and that it had been somebody's guess. By getting the facts he immediately improved things to a degree almost inconceivable.

Inasmuch as the time element is one of the most important elements in all labor problems and the stopwatch is the means of measuring the time element, a great deal of emphasis has been laid upon its use—more emphasis indeed than there is any necessity for. The result of this has been that many young men equip themselves with stop-watches and set up as efficiency or scientific management engineers, greatly to the detriment of the cause.

On the whole, however, the determination of Mr. Taylor to base all of his actions on facts and to ignore opinions from whatever source, has spread quite extensively throughout the country and a great deal of industrial knowledge has been acquired. The acquisition of knowledge, however, is only part of the subject; the proper utilization of it is the other and in many respects, the more difficult half. As a matter of fact, the acquisition is considerably less than half. The problem of the future, therefore, is to devise methods of utilizing scientific knowledge of industrial processes in an efficient and economic manner. Mr. Taylor devised methods for doing this which are commonly known as the "Taylor System." It is likely that already other systems have been devised which accomplish the same in a more or less perfect manner, but they are all based on the fundamental principle which Mr. Taylor so strongly insisted upon, namely, that action should be based on knowledge and not on opinion.

It will seem to some of you who have been thinking about these things, as a very simple sort of an idea, that action should be based on knowledge and not on opinion; but I can tell you, those of you who have not had very much experience, that three-fourths of our industrial processes today are based on opinion and not on knowledge. I went to a large concern a number of years ago, and we began talking about some of their processes. I suggested that a certain process might be worthy of investigation. "Oh, no," said they; "we have been doing it that way for fifty years, and it is all right." Any process which has ignored scientific knowledge for fifty years is apt to be a good long way from all right, and so we found it. We found it about as bad as it could be.

I want to say another thing. If Mr. Taylor had only devised a "system" it would only be a question of time, in the evolution of things that that system would be gone. The system of one age is not adapted to the details of another age. Conditions change. The principle that he fought for was to base actions on facts and not on somebody's opinion. I am