Then he would call his name. He went right through the class until just one-half the class had held up their hands. We always noted when he got half-way thru the class and the middle boy would snap his fingers he would say, "That is enough; that will do." What he wanted was to find out just how many minutes it took the average boy in the class to do the example which he gave. Then we found that Wentworth timed himself when he first tackled those problems. He got his own time for doing those five examples, and the ratio between his time to do the examples and the time of the middle boy of the class enabled him to fix the exact stunt for us right along. The speed of the class changed. He did not change. All he had to do was to get this ratio of change, and he could say, for instance, the average of that class will take 2 hours if I can do the examples in 25 minutes, and in this way he was able to give the class its proper stunt right along. That was the first instance of a time study of mental operations which I had ever seen. Under scientific management we are working constantly making mental time studies now. If we want to find how much time it takes for the average machinist to read a new drawing which he has never seen before, the man who is in the planning room and who is especially skilled in reading drawings—that is what he is there for—keeps a close tab on the time it takes himself to read all kinds of drawings, and he knows, for instance, if it takes him 10 minutes it will take the average man in the shop, say, three or four times that long. That, for example, may be the ratio between the skilled man and the average man in the mental operation of reading a drawing. The moment he knows how long it takes him, then by multiplying he knows how long it takes the average man. He has to keep himself constantly in touch with the men in the shop in that way, of course. Mental time study is made by us now, just as it was made by Wentworth in 1872.

Mr. Tilson. How do you first find out how long it takes the man in the shop to do it? How does this man in the planning room first find out how long it takes the other man to do it?

Mr. Taylor. You must realize that a lot of similiar information is already known for other drawings. So that the man in the planning room has a general line on how long it ought to take to read drawings, and this makes it difficult for any workman, if he even is inclined, to fool the planning-room man very much. The planning-room man calls in a reliable workman and says, "John, I want you to study this drawing, and study it right, and let me know when you have got wise on it." Now, in this way he asks several men of about average ability to make this study and finds that it takes them, on the average, 20 minutes to do it; then he will study the drawing himself and see how long it takes him to get onto it. In this way he gets the ratio of his speed to that of the average man in the shop. Once that ratio is determined it becomes a rather simple matter to make this kind of mental time study.

Mr. Tilson. But, after all, that is only approximation?

Mr. Taylor. The whole subject of time study is only an approximation. There is nothing positively accurate about time study from end to end. All that we hope to do through time study is to get a vastly closer approximation as to time than we ever had before. That is one reason why we have to allow this big margin of safety, as I explained to you. A marginal allowance of from 20 per cent to 225 per cent is added to the observed time, so as to cover all kinds of uncertainties.

The Chairman. When you make a time study of a man at physical labor do you not always eliminate in that time study the pauses in that man's work, the time when he is not actually applied at his labor, so as to get at the accurate and actual time in which he performs the labor?

Mr. Taylor. There is a printed page (indicating) that is typical of just what is done in time study illustrating this part of the subject.

The Chairman. That will not put the answer to my question in the record.

Mr. Redfield. Let us put this in the record.

The Chairman. I wish to get a direct answer to my question.

Mr. Taylor. To answer your question, we do both things. We take the gross time, the whole time which the man takes in doing the job, and then we make at the same time another study which includes the productive time alone, the time he is engaged in actual work. On this printed page there is a study of the gross time, and a study of the productive time as well.

The Chairman. When you make a study of the productive time you eliminate in that study, and are able to do so by virtue of your stop watch, the periods in which the workman is not engaged in productive work?

Mr. Taylor. Yes, sir.

The Chairman. How can you take a mental study of the productive time, the mental time that it takes to work out a problem? Would you be able in your time study to take the time of the mental pauses that occur during the time when the problem was being worked out?

Mr. Taylor. The time during which the man stops to think is part of the time that is not productive.

The Chairman. Can you get a record of it with your stop watch or by any other method of timing?

Mr. Taylor. We can get the time during which the man is thinking with the stop watch in just the way that I described to you in the reading drawings, by telling a man to do some mental act, and then seeing how long it takes him to do it.

The Chairman. Would not that simply be the gross mental time from the time the man starts to work?

Mr. Taylor. Yes.

The Chairman. Would you be able to make a time study showing the amount of time in that gross time that was non-productive mental time?

Mr. Taylor. I would assume, Mr. Chairman, that if you asked a workman in advance, saying, "Now, John, I want to find out how long it will take you to get a complete notion of what you are going to do in this work. Now, play fair with me, John. The moment I tell you what you are to do you start and think and plan it all out and don't start to work until you have your plan all made." I think John would be fair in that. I think he would do his thinking in a fair way, just as he does this work in a fair way. And that he would tell you when he had finished making his mental plan.

The Chairman. Why could you not take his word?

Mr. Taylor. You could not be absolutely sure that he was deceiving you in some way. But I have found that when you are straightforward with men and when you explain to them what you are trying to do, and when they believe that you are in the main straightforward yourself, and that there is no crookedness back of what you are trying to do, men will generally cooperate with you honestly.

The Chairman. Why do you not take his word for it in the physical work then as well as taking his word in the mental work?

Mr. Taylor. Yes—

The Chairman. Why put the stop watch on him?

Mr. Taylor. Because he cannot use the stop watch on himself. He cannot work and put the stop watch on himself at the same time. As I have told you time and again, Mr. Chairman, the way we do in almost every case is to go to the man in perfect frankness and say, "John, we propose to make a joint study of this kind of work; we want to get at this together because it is for our mutual interest to do so. I am sure that you will work fairly on this." As I told you in the case of those laborers, we paid them double wages when they were being studied in that way. We doubled their wages. They played perfectly fair with us. They did not either overwork or underwork. They worked at a proper pace for a fair man to work at. That is the way we get all our information. It is through co-operation. It is not through any sneaking business. It is not through any underhanded business. I think, Mr. Chairman, you will see that in everything I have written in relation to the time study I have advocated absolute frankness and no underhand work. There is no sneaking about it if time study is properly applied.

Mr. Redfield. Have you explained how you arrived at the percentage of increase in pay necessary to make men desirous to work under scientific management? You have said that it was sometimes 30 per cent and sometimes 50. How are those figures arrived at?

Mr. Taylor. Again, that has been the subject of a scientific investigation. It is not the question of my judgment or of any other man's judgement. I am very glad that you brought this matter up, because the average person thinks that the premiums which we pay of 30 per cent for this kind of work, 50 per cent for