

no cut on his machine, while this was running idly back and forth. The situation was absolutely painful.

Another case: I was asked by the Chief of Ordnance, a little while back, to go to the Frankford Arsenal.

Mr. Redfield: May I suggest that we are much interested in what became of this particular case, where the machine was running forward and backward and nothing happened.

Mr. Barth: Both the foreman and I sneaked away, but when, on the next evening, I gave an address on the Taylor system before the fifty or more foremen and the complete staff of officers I frankly told them about the case. However, I told them that I did not consider the man nearly as much at fault as the management itself. Those things are always the fault of the management primarily, and only secondarily the fault of the man.

When going through the Frankford Arsenal some weeks ago to investigate the conditions for the Chief of Ordnance and make a report, I found a toolmaker running a shaper on an exceedingly short stroke, with an exceedingly slow speed, and with the finest feed I have ever seen a shaper provided with, so small that I at first thought it a case similar to the one previously related about the planer, but on looking closer I found there was actually a fine thread of a chip. I said nothing, but made a mental note of the matter, and apparently accepted the foreman's voluntary statement that the job was an exceedingly accurate one, and the material an exceedingly hard piece of steel. Evidently, he, too, realized the absurdity of the cut, but considered it up to him to make the best of it.

I have here the article I just referred to, recently written by request of the editor of the Engineering Magazine. In it I relate several interesting experiences I have had with my slide rules, and I suggest that it be incorporated as part of my testimony, particularly as Mr. Taylor was asked to give more specific instances of what slide rules had done as against men's judgment.

The Chairman: It will be inserted in the record.

The article referred to is appended herewith.

Mr. Redfield: If you can give us any more examples of the effect of this system upon the health and comfort of the workmen, and their attitude toward the system, we will be glad to have them.

Mr. Barth: I will do so.

Mr. Redfield: I move that all reference to the Government Printing Office be stricken from the record.

The motion was agreed to.

Thereupon, at 10.05 o'clock p.m., the committee adjourned to meet at 2 o'clock p.m., Thursday, February 1, 1912.

#### Betterment of Machine-Tool Operation by Scientific Metal Cutting

By Carl G. Barth

Mr. Barth was invited by the editors of The Engineering Magazine to furnish transcriptions of some of his records of specific cases in which large gains in output had been secured by applying to metal-working machines the slide rules made by him as an element of machine-shop management under the system he represents—the Taylor system. It was felt that definite data of this kind, even though the records might be of cases not likely to be exactly repeated elsewhere, would be a most practical demonstration of possibilities that are general. Unfortunately, the proposal could not be carried out in that precise form, for this simple reason, as Mr. Barth puts it, that he keeps no records. He adds: "I have never had the inclination to make many personal records of any of the work I have accomplished as a systematizer, because mere records cannot add to the value of that work and because I find it difficult enough to make such necessary records of new knowledge and experience, gained while working for one concern, as will be of further help to me in tackling others—and records of gains made in specific cases by the use of my slide rules would not fall into that class. Besides I long ago became so firmly convinced of and used to the efficiency of these slide rules that even the most astonishing gains made by their use today make no other impression upon me than to make me feel keenly how unfortunate it is that we cannot see our way clear to get them introduced more rapidly."

In lieu of the more formal tabulation, however, Mr. Barth has set down the record of personal experience in a number of characteristic instances, and his reminiscences following carry the closer interest of the familiar atmosphere of the shop and the vitality of an energetic and effective personality.—(The Editors.)

In the following notes I shall try to call to mind some specific cases that have impressed themselves on my memory, because there were certain especially interesting circumstances connected with them. I shall take them up chronologically, though without giving date or place of occurrence.

In one place the depth of cut, feed, and speed were all set by the slide-rule man, to be taken by the tool of one of two carriages on a lathe, in rough-turning a large shaft, and the speed boss for the machine most gleefully reported that the belt would not pull this cut; for, rather fresh at

the job, he had as yet but little faith in the possibility of predetermining these matters in the office, either by means of our slide rules or anything else, and he tried to "rub this in on us" as often as he thought he had a good chance. After the matter had been referred to the chief speed boss without that gentleman being able to find any explanation of this failure, the case was referred to me.

As we had not at that time in this plant succeeded in fully establishing our system of caring for the belting, I at once suspected, on finding that the surface of the belt was in good condition, that there had been an oversight whereby the tension of the belt had been allowed to fall below the minimum set; though it was not so slack that, under ordinary circumstances, anybody would have had it retightened. And that was what we actually found to be the case when the belt man came and ascertained the tension of the belt by means of his belt scales; whereupon, I went back to my office not expecting to hear any more from the matter and feeling that I had gotten a "good case" on the speed boss, who now ought to be satisfied that we knew pretty well what we were about.

However, I was mistaken, for it was not very long before I was again sent for and told that the speed boss again "had it on us," in connection with this very job, for the belt was now able to pull on both tool carriages the cut specified for one carriage only.

Of course, as the slide rules are "tuned" only for a pull that can be safely counted on at the minimum tension specified for a belt running at a certain speed, whenever a belt is retightened to its maximum tension (which is considerably higher than the minimum) it is able to pull a correspondingly larger cut, although it is not possible to take advantage of this circumstance in dictating a cut from the office, as this must be done without any other knowledge regarding the tensions of the various belts in a shop than that they should never be below the minimum tensions specified—except by an occasional falldown on the part of somebody else.

However, when this belt, at its supposed maximum tension, was reported to pull actually twice as much as specified, it seemed rather uncomfortably in excess, and I again sent for the belt man to bring his scales and see if by some mistake or other he had not taken more than he should out

of the belt; and though he was unable to explain how he had done so, this actually proved to be the case to a considerable extent.

Our ambitious speed boss, having been a witness to every move made in the matter, finally admitted that it looked as if the slide rules were after all not a mere bluff, as he evidently had hoped to prove that they were. In fact, this proved the culminating point in this man's attitude to the whole slide-rule proposition, so that, before long, he became one of the greatest enthusiasts we have ever had working with us; and as soon as the further extension of the use of the slide rules was made in that shop, he was taken into the office, himself to dictate, by means of the slide rules, the cuts to be taken under the supervision of other speed bosses. Whenever any of these tried to act as he had originally done in the same capacity, he was able to handle them without any assistance of mine, and perhaps better than I could have done, for he was fully "on to their game" since the time he tried to play it himself.

I have mentioned this case principally as an example of the difficulties we always meet with in introducing these slide rules. It is because we fear that these difficulties cannot be properly met and overcome except by men who are possessed of that absolute conviction as to the value and soundness of these slide rules which comes only from growing up with them, so to speak, that we have not to date taken the risk of placing these rules on the general market.

Considering this case as an example of increased output, it goes without saying that, if it had not been for the slide rules the belt would not have been retightened at the time; hence the output of the machine would have been at the very most equal to the pulling power of that slack belt, and probably a good deal less. In addition to this, the exact information and data put on the slide rules had previously been applied in so respecting this very lathe, along with its companions, that they could all do more work than before.

During the first week in which our slide rules for turning cast iron were put into practical operation in another shop a batch of 18 sheave wheels were put through. Having as yet no line on their hardness classification, we made a guess at this, and then dictated all the cuts and speeds for these wheels by means of the slide rule. The total time