

with fine character. I there learned appreciation, respect and admiration for the everyday working mechanic.

Throughout my apprenticeship, of course, I had my eye on the bad industrial conditions which prevailed at the time, and gave a good deal of time and thought to some possible remedy for them. It was this that led me to go to a very much larger company, the Midvale Steel Works, in 1878. I think you know my whole history there; starting from a laborer, getting first into the time office, then back on to the machine as gang boss, etc., etc. Throughout my early days at Midvale I found myself very much short of a scientific education, and began by taking a home study course in mathematics and physics, which was given by the scientific professors at Harvard University. After getting all that I could by correspondence in this way, I then went to the professors at Stevens Institute, and asked them for proper text books, etc., and this started my home study course at Stevens.

About two years and a half after this time, namely, in June, 1883, I graduated as M. E. from Stevens, without however, having been there except for the purpose of passing all of the entrance examinations and finally one after another of the examinations required throughout the course.

You will realize that my time was greatly shortened in getting through Stevens from the fact that I was able to pass in languages—French and German—and in history, etc., right off at the start, owing to my experience abroad and to general reading, etc. So that this left me much less actual work to do than the other boys, and enabled me to get through in two years and a half, while I was at the same time carrying on my duties as foreman, master mechanic, chief draftsman, and chief engineer, successively, at Midvale.

You will probably realize that with me investigation, or rather invention, is a mental dissipation, that it is a very great amusement, rather than a labor, and that if I followed my personal inclinations I would be very likely to give the greater part of my time to this sort of thing. I realize, however, that no man has the right to do very much of this kind of work. This is of course especially true when you are doing it with other people's money, and all through my engineering life I had to keep my conscience in very active service to prevent me from devoting too much time to this end of the business, and not enough to the less interesting, but vital, end of every day management and economy, etc.

No one knows better than you that all the theories, fine or otherwise, which we have evolved as to the principles of scientific management, etc., have come after the fact and not before. Neither I nor any man of our group who has been chiefly instrumental in

developing scientific management did so as the result of any preconceived theory. We first evolved the remedy for some existing trouble, and later found out what the theory was that was back of the trouble; and I am not quite sure that some of our group fully understand the weight of this theory, even now.

One of the reasons why I am giving a lot of my time and thought to the growing of grass is that it is an innocent outlet to my tendency to dissipation in the speculative field, in which no one is hurt except myself. Any money that I choose to put in it, or any time, is at my own expense, and even if no results follow no company is hurt. In properly sizing up myself, I believe that the only strong quality which I have is the ability to wait for any length of time, and to keep on working, whether results come or not. This I think is the result of years of habit. I believe that I used to be excessively impatient for immediate results in everything that I went into.

In some grass experiments which you speak of, what I am trying to do is to be able to tell any man in any part of the United States how he can manufacture soil out of raw materials which are purchasable on the market, and which can be reduplicated in any part of the country, rather than to try to tell a man to take some native soil right around him and grow grass in it.

It is absolutely impossible to describe a soil which is in existence so that a man can reduplicate it. You must build up the soil synthetically in order to be able to describe it. And these experiments are chiefly devoted to finding a synthetically built soil which will grow grass better than any soil has in the past. I think I have already reached this, and will far exceed anything that has ever been done in the past, before the experiments are through.

In addition to this, another experiment is going on, which may prove of great value or not, namely, the idea of handing up from a reservoir of water underground the necessary food in solution and the needed water supply to the roots of the plant, so that even in a drought or in the hottest of our Philadelphia summers, grass will stay green all the time, and flourish, where now even with the heaviest of artificial watering it cannot get through some of our summers.

You realize, of course, that in these grass experiments I am experimenting only with the most delicate and difficult of the finer varieties of grass; such grasses as are fit for putting greens, and which it is almost impossible to grow at all under any circumstances in the climate of Philadelphia.

Another part of the experiments in grasses is that in the past, particularly the finer grass seeds, there was no known way of germinating with uniform success. In my experiments I have found a way to

germinate properly four to five times as many, at least, as could be done under the old conditions; namely, I manufacture an artificial soil in which the seeds are germinated, and treat the seeds throughout the germinating period in a definite scientific way.

The grass growing problem is really a very large one when it is treated from a scientific standpoint, and I find it an intensely interesting one. I have already made probably 800 or 900 experiments, and expect to make a great many more. I have succeeded in getting the Agricultural Department at Washington very much interested, and they are going to co-operate with me to a very considerable extent. But one of the first things that I found out was that grass needs air all the time at its roots; and it needs air even more than it does water and nourishment. If you exclude the air from the roots in summer time for five days, you will entirely kill the tender varieties of grass, whereas it will do without water for a long time, and revive; and also without nourishment for a good while.

A rather spectacular part of my experiment is that I have succeeded in growing a grass which was planted in the fall, in the month of November, and which went from the first of June till the first of September without having a drop of rain or other artificial moisture come to it from above. A glass cover was put over it to keep the rain water off, and it received its water supply from the water reservoir below, through the lifting sands which soaked the water up from the reservoir and passed it on up to the roots.

GOVERNMENT EFFICIENCY¹

BY FREDERICK WINSLOW TAYLOR.

It may be said, on the whole, that the quality of the work done by government employes is good, not superlatively so, but on the whole good.

For example, while we have not been leaders in the development of our army and navy equipment, and in the development of army and navy tactics, etc., still we have followed closely in the wake of the leaders. For example, we did not invent the Dreadnought, nor the torpedo boat, nor the dirigible torpedo, nor were we the first to make high power steel guns, but we have been quick in following after the best of the foreign nations in choosing our equipment.

When, however, we come to consider the quantity of service which is rendered by our government employes, we find quite the reverse. It can in fact be safely said that the average government employe does not do more than one-third to one-half of a proper

¹A hitherto unpublished article written probably in 1911.

We experimented with lifting sands from all parts of the country, and finally succeeded in finding sand of a particular grain composition, which will lift water as high as 48 inches from a water reservoir below, and hand it over to the grass roots. Some ordinary sands will lift water only half an inch, some not at all, others all the way between this and 48 inches, depending upon the grain composition of the sands.

The years which Mrs. Taylor and I spent away from Philadelphia were at the time very trying ones, as we both lived in very narrow quarters, in a single room most of the time, and yet we both look upon this period as the most developing perhaps of our lives. We were obliged to mingle with people from all parts of the country and as a result we found the finest kind of men and women living in all ranks of society, and in the smallest and most out of the way places. We both value this experience, because of the enlarged sympathies which it gave us for our own kind.

You of course know yourself the nature of the work involved in systematizing. It involves a mingling of war and peace, of hard blows and tact, which gives one rather a trying life, and I can assure you that this was no less true in the past than it is now. It was a life full of disappointments in many respects and yet full of great satisfaction whenever results were accomplished.

Yours very sincerely,

Dictated by F. W. T. but not revised.

day's work. The reason for this contradictory state of affairs is not far to seek. The quality of the service must be good, because on the whole our people are accustomed to seeing and possessing the best equipment. We are a nation who believe in first-class things, and the quality of the results produced by government employes can be seen and appreciated by the people.

From this fact has grown up the feeling almost universal among government employes, that to make a blunder is fatal, or at least very serious, because a mistake or a blunder will be recorded against the employe and remembered throughout his career. However efficient and energetic an employe may have been in doing his work, this will not atone for his having made a blunder. Consequently, splendid positive constructive results, brought about by a government employe, count for less than freedom from