Baconian system could be applied, that a practical science could be created by following the three principles of that system, viz., the correct and complete observation of facts, the intelligent and unbiased analysis of such facts, and the formulating of laws by deduction from the results so reached . . ."

The results of all this was a new science—that of scientific management. Quite properly, Taylor is called its father. . . .

The ideas of this new science, under any conditions, could scarcely be realized in a day. Taylor spent a lifetime in devising methods by which they could be made into realities. The growth of Taylor's ideas along these lines is apparent throughout his biography.

Thus, the biography is an account of the growth and genesis of scientific management as well as a life of Taylor . . . . It is interesting to follow the step-by-step growth of the Taylor System and to witness the development of the "scientific" methods which are quite usual today—time studies, written instructions, standardization of tools and their care, the planning department, functional foremanship, and so on.

To all these matters, Taylor applied the scientific method. For everything there had to be a standard. Unlike "The Century Dictionary," which defines a standard as, among other things, "a criterion established by custom, public opinion, or general consent," Taylor insisted that a standard was a criterion or model established as a result of scientific investigation.

The work of Taylor along the lines of scientific investigation as applied to industry is too well known for extended comment. His celebrated metal cutting experiments have taken care of that. The Taylor Society, moreover, has enlarged and extended the scope of the Taylor principles of management and in this way has made them more universal. It is to a field in which his work is less well known that the universal applicability of his methods is revealed most startlingly.

In 1901 Taylor purchased some 11 acres of property in the extreme northwest limit of the city of Philadelphia. By this time he had left the Bethlehem Steel Works and had decided to devote the rest of his life, "without pay," to the promotion of scientific management. It was his intention to make of his property, Boxly as it later came to be called, his permanent home.

These were some of the unusual features of his home:

> The windows of his living and dining rooms were seven feet high by nine feet wide; the frame enclosing the huge sheet of glass was hung and swung on ball-bearing pivots placed at the sides. Each window had a shutter operated by a valve; you raised a trap in the floor, turned a valve, and the shutter would rise.
>
> For the conservatory, which was circular in shape, he designed a moving platform operated on a circular track, so that the man arranging and caring for the flowers could stand above them and pull himself around. For each of the fireplaces in the main hall, the living room, and the dining room, he designed a wood box, the bottom of which was the floor of an elevator ascending from the cellar, and thus overcame the need of carrying wood through the house. Each fireplace, besides having a chute for ashes, had a screen which dropped down from the chimney. Above the eaves of the house was placed a cooling chamber with pipes leading to the furnaces and down through other parts of the house to give ventilation through registers." [Volume I, page 190.]

It was to his garden and grounds, however, that Taylor turned his principal attention. Due to the way in which the previous owner had laid out the grounds he was confronted with a particularly difficult problem. It was not at all as he wanted. Consequently, it had to be changed. In the process, Taylor devised a method, hitherto unknown, by means of which growing things, even large trees and delicate flowers, may be transplanted in a way which leaves the most minute root fibers undisturbed.

His enthusiasm for golf led to Taylor's famous grass-growing experiments. He designed a putting green 50 feet by 40 feet and it was laid out in the garden at the front of the house . . . His green, he decided, must be the "best possible green," so he consulted the best grass experts and for three years while using a "good rich garden soil," followed their methods.

Under these methods, however, the "best possible green" did not materialize, "so, of course, he set out to get it."

> As is frequently the case, what at first started with a few simple experiments opened out finally into quite an extensive investigation, covering many elements, the relative importance of which it would have been difficult for anyone to foresee at the start. [Volume II, page 205.]

The extent of these experiments may be appreciated when it is realized that they were carried on for a period of 8 years, or from 1907 until the time of his death in 1915, and that Robert Bender, expert gardener, who was actively in charge of the experiments, had for his helpers a force that from time to time ranged between 10 and 30.

Experiments which were started in a somewhat desultory way soon made Taylor realize that what he wanted to discover was the particular variety of grass which would produce the finest and best surface for a putting green, and then to develop an artificial soil especially suited to growing this grass. "Our object," said Taylor, "became to suit the soil to the grass, not the grass to the soil."

To make his grass-growing experiments yield results, it was necessary, as it had been in the shops, to resort to his principle of standardization. That is, he had to find a standard grass and a standard soil in which to grow it. In all, there were 23 objects which Taylor intended to discover; among others, there were: how to germinate seeds, the proper number of spears per square inch which should be germinated in order to develop grass quickly, the kind of soil in which old roots thrive best, how to promote rapid deep rooting, and the most favorable time of year for planting seed. Regarding these experiments, he wrote:

> One of the first principles governing scientific investigation is that each experiment shall involve only one single change or innovation. And this simple rule has been closely followed by us, although it has, of course, called for a large number of experiments. [Volume II, page 208.]

The care with which these experiments were made is well brought out by a statement of H. Van du Zee, civil engineer, who assisted Taylor at the time.

> Every material had to be tested to show its physical characteristics, much in the way sand is tested for use in concrete, and filtration work. Nothing was taken for granted about these materials; positive knowledge was obtained as to the size of their particles (that is, their air spaces) and their water-lifting capacity . . . .
>
> It was impossible to avoid the feeling that, in carrying on these extensive experiments, Dr. Taylor took joy in putting shop management into the work. There was the precise classification of materials, precisely measured proportions of the various materials that entered into the synthetic soils, precise percentage of water to be supplied, and so on. It seemed as if Dr. Taylor had in mind a routing plan for the roots and for the water. In arranging soils of different kinds in layers at various levels, he made provision for the young roots, and maturing roots, and the fully-matured roots. [Volume I, pages 210-211.]

As for the results of these experiments, suffice it to say that Taylor got what he wanted: "the best possible green."

All the while these experiments were going on, Taylor was carrying on his missionary work of espousing the cause of scientific management. Boxly became the Mecca to which the Taylorites made their pilgrimage.

Everywhere he encountered opposition. On the part of management it was, "what is the use?"; on the part of labor, "he's trying to make machines of us."

It is interesting to note that Taylor himself aroused little antagonism among the men in the shops where he worked. This, he explained, was because he made them realize what he was trying to do. It was simply a case, he explained, of changing the mental attitude of the workmen. He made them see that "what couldn't be done" could be done. There was the notable instance—too well known to touch on at length—for instance, of "systematizing Schmidt" in which he convinced the latter that instead of loading only 12½ tons of pig iron, as was customarily considered a day's work, it was possible for one man—"a high-priced man"—to load 47 tons a day. Schmidt, he insisted, was such a man, and, convinced, Schmidt went about to show that it could be done.

For every man, Taylor had a different method. He was an unerring judge of human nature and he seemed to sense by instinct which method would work best with different individuals.

> One of his favorite methods as a manager was this. He would send for a man and say: "I've been watching you." And then, while the man was wondering what he had done, he would add: "'Yes, I've been watching you, and I've discovered you are the kind of man who works just as well when the boss isn't around as when he is. Just for that, I'm going to raise your pay. Now, damn you, keep your mouth shut." [Volume I, page 179.]

Like John H. Patterson, he was a great believer in teaching through the eyes.

> He became a great believer in object lessons, and he always was in a hurry to set up those object lessons that would demonstrate to his men the benefit to them of his methods. In the meantime, he explained to them as best he could; but there can be no possible doubt whatever if he had relied solely on explanation, he, a pale, gibbering ghost, would have been down there at Midvale explaining yet." [Volume I, page 174.]

At Midvale, where he started his career, he started his "fearsome fining system." One man's fines kept doubling until they finally amounted to $64. Then he finally admitted that the breakage for which he was being fined was deliberate, and that he had