

required by its nature, by competent engineers and executives, and plants in which incompetent engineers or get-rich-quickly executives have tried to appropriate parts of its mechanism under the label "scientific management" (a term which cannot be applied to any separated element of its mechanism); and second, accepting the above distinction, that in no plant representing the serious and genuine development of scientific management has there been a strike, or abnormal friction arising from dissatisfaction of the workers.

The following fundamental truth concerning scientific management should be kept always in mind; an honest undertaking to improve management in the spirit of scientific management and by the method of patient development and adaptation, even though many of the conventional mechanisms are modified and some of them lacking, is genuine scientific management; while the effort to copy the mechanisms with minute accuracy, without the proper spirit, and by the method of get-rich-quickly installation, is not scientific management and almost invariably leads to trouble.

II. TAYLOR'S EARLY YEARS AND PERSONAL CHARACTERISTICS

In Table I is presented a chronology of the outstanding events in Mr. Taylor's life and general statements concerning "mechanisms" and "principles" of what came to be called scientific management, according to his attention to them at different periods of his life. His early life was not different from that of the average boy, except that several European trips of the family gave him, while still a boy, reasonable command of the French and German languages. Entered at Phillips Exeter Academy, he soon had to leave on account of a serious weakness of his eyes. Realizing an inclination for engineering work, he apprenticed himself to the Enterprise Hydraulic Works of Philadelphia, first to learn pattern-making, later the machinist's trade. At the Centennial Exposition in 1876 he had charge of the exhibits of several machine-tool builders, after which he, during the dull times that followed, secured a job as a laborer in the machine shop of the Midvale Steel Company. However, he was soon graduated from this job, and a brief sketch of his subsequent career at Midvale is indeed impressive. Between the ages of 22 and 32 (1878-1888) he was time-keeper, machinist, tool-keeper, assistant foreman, foreman, master mechanic, director of research, assistant engineer and finally chief engineer,

no ordinary accomplishment; and at the same time (his eyes having improved) he earned by evening work the M. E. degree at Stevens Institute, and developed, as the concrete results of his method of attacking the production problem confronting him, the fundamentals of the system which came to be identified with his name. Obviously the accomplishment of an extraordinary individual!

In fact, Taylor possessed the combination of four strong qualities. The first of these was an experimental and inventive mind (he was the holder of numerous patents in a wide and diversified field). An authentic story informs us that at the age of five or six, being troubled with unpleasant dreams and having come to the conclusion that it was caused by sleeping on his back, he constructed a harness which held an obstacle against his back and made it impossible to lie on it with comfort; again, when he came to learn golf he studied the best form, and then constructed a harness in which by practice he coordinated eyes and muscles, much as a pacing horse is developed; and so on.

A second strong quality was a mental quality which enabled him to understand and perceive the necessity of the scientific method—the keeping of all variables under control and the recording of all conditions surrounding an experiment. Early in the series of experiments which lasted through many years, he grasped this essential nature of the scientific method, and thereafter all experiments and investigations conducted by himself or under his direction were precisely controlled and recorded. One has but to refer to "On the Art of Cutting Metals" to be impressed by this fact.

In the third place he had bulldog tenacity and infinite patience. Having decided upon a line of experiments he followed them through after others about him had abandoned all expectations of satisfactory results; the perversity of inanimate things, the indifference—even the frank opposition—of individuals, served as a stimulus for him. Of his metal-cutting experiments it is recorded: "He expected that these experiments would not last longer than six months... with the exception of a few comparatively short periods, however, they have continued... through a term of about 26 years."¹

Finally—possibly the factor which made the other qualities effective—he was a man of common sense, of hard-headed practicality. He had vision, but was

¹On the Art of Cutting Metals, p. 33.

TABLE I.
PRINCIPAL EVENTS IN THE LIFE OF FREDERICK W. TAYLOR.

CHRONOLOGY	MECHANISMS	PRINCIPLES
1865 Taylor born.		
1878 Entered Midvale Steel Co.; successively laborer, timekeeper, machinist, tool-keeper, assistant foreman, foreman, master mechanic, director of research, assistant engineer and in 1888 became chief engineer. By night study earned M. E. degree at Stevens Institute.	During the ten years at Midvale busy on the problem of production, and in that connection devised many of the methods and mechanisms of scientific management.	
1885 Joined A. S. M. E.		
1886 Towne's A. S. M. E. paper "The Engineer as Economist."		The formulation of principles and of a philosophy seems to have been inspired by A. S. M. E. contacts, by Towne's paper of 1886, and by Taylor's belief that a young engineer should contribute to his profession. The first statement of Taylor's philosophy of management was his paper of 1895; the same philosophy was presented with different emphasis in the paper of 1903. During this period he ceased to "work for money" and devoted himself to exposition of principles.
1889 Left Midvale; during next ten years miscellaneous work culminating at Bethlehem Steel Co.	During the ten years leading to and including Bethlehem, improved the earlier and devised new methods and mechanisms, and began coordination of them into a more or less controlled system.	
1893, A. S. M. E. paper "Notes on Belting."		
1895 A. S. M. E. paper "A Piece Rate System."	At Link-Belt and Tabor the system was developed into a more complete, logical and coordinated whole than at any previous time, by younger engineers under Taylor's supervision.	
1903 A. S. M. E. paper "Shop Management."		
1904 Started work at Link-Belt Co. and Tabor Mfg. Co.	Continued development and application of the Taylor methods by the younger engineers who had served with Taylor in this work. Taylor generously gave counsel without remuneration.	Spent the later part of life in expounding philosophy and principles before general public.
1911 Eastern Rate Case and Watertown Arsenal investigation. Publication of "Principles of Scientific Management"; republication of "Shop Management."		
1915 Taylor's death.		