are subject to certain precise scientific procedure and may be entrusted to specialists—professional experts—while the former is a matter of setting up a complex group of devices to insure maintenance and the effective operation of these devices is dependent upon the entire personnel of the organization, and their varying individual interests and capacities for "playing the game." Also, the maintenance of standards may be said to be more important than either of the other two elements of the problem, for the reason that the ultimate object of job analysis and of the establishment of standards,—results in accordance with calculations through precise control—is directly dependent upon it. Job analysis and the setting of standards afford the basis for operating control; the control itself is embodied in the actual routine of operations in which also is embodied the maintenance of the standards.

Planning, routing, order of work, instruction cards and the tickler system; the minute specialized supervision and teaching in functional foremanship; inspection; progress and cost records;—all play their part in the maintenance of standards.

Many of the devices already enumerated as devised by Taylor in the decade 1880-1889 for the establishment of standards were concerned as well with the maintenance of the standards. The assignment of a "task" involved inquiry for reasons why a task was not met, if it was not met, and the straightening out of the improper conditions which were usually the cause of the failure to meet the task; likewise with respect to the differential piece rate and any failure to make it. The functional foremen, each with direct contact with the worker and responsible for the performance of a certain function, was a device for maintaining as well as establishing standards. The separate inspection of the first of a lot of pieces in a run (first as distinguished from final inspection) contributed its part. The automatic grinder for tools and the tool room established at that time looked towards maintenance of standard conditions of tools. The tickler system was established to insure the periodic inspection and conditioning of shafting, belting and machines, and gradually this mechanism was extended to cover other recurrent inspections and other recurrent procedure. The modern stores rooms of carefully classified, inspected and conditioned stores and worked materials was not established, for the reason that the materials used were too few to require it—huge castings, chiefly; but efforts were made to insure better standardization of the castings which came to the shop. For the same reason—the simplicity of the materials and of the processes—mechanisms for the formal recording and analysis of the progress were not devised, but apparently the function was performed without the formality of special mechanisms. The more elaborate devices for the maintenance of standards which are in use today were developed later, when scientific management came to be developed in plants having more complicated operations and conditions.

We find, therefore, that during the decade 1880-1889, as the result of efforts to solve the practical problem of securing greater production, and without preconceived principles or a preconceived philosophy of management, Taylor worked out in more or less crude form the fundamentals of scientific management. There was job analysis by the method of unit time study and the setting of tasks with instructions for their performance; there was the standardizing of conditions so that operations in the shop could be performed under the same conditions as those under which the tasks and times were determined; and there was, to the extent required by the simple processes of the shop, provision for the maintenance of the standard conditions.

There was not yet, of course, the smooth coordination of those elements into a logically beautiful system, and especially the formal separation of functions,—one group in a planning room and another in the shop. But the functions were recognized and provided for, and, looking back, one can see the planning room in embryo. It was not until later that Taylor was in a position to develop scientific management *carte blanche* and as a logical whole, in any plant.

VI. A PHILOSOPHY OF MANAGEMENT

In 1885 Taylor had joined the American Society of Mechanical Engineers. In 1886 Henry R. Towne read his noteworthy paper before that society, "The Engineer as Economist." The new contacts and Mr. Towne's address, added to Taylor's belief that it is the duty of a young engineer to add to the knowledge of his profession, appear to have stimulated Taylor so that the man who had been concentrated on solving different practical problems in the shop began to give greater attention to the meaning of what he was doing.

Beginning with Mr. Towne's "Gain Sharing" in 1889 and Rowan and Halsey's "A Premium Plan for Paying Labor" in 1891, there followed in the A. S. M. E. discussions of methods of wage payment. Taylor conceived the idea of getting his ideas of management before the society by participation in this discussion, and in 1895 he presented "A Piece Rate System." The coating of the pill was too heavy for the medicine within to be effective. What to Taylor's mind was relatively unimportant—the device of a differential piece rate—was adequately discussed; but what he considered of major importance—the methods and conditions of management fundamental to any sound method of wage payment—was hardly touched upon in discussion. Taylor always regretted this particular excursion into the field of discussion of wage systems, for it attracted attention to his differential piece rate at the expense of comprehension of his methods and philosophy of management; and it gave rise to the incorrect tradition held by many that scientific management grew out of attempts to devise a satisfactory method of wage payment. It had, as we have indicated, grown out of attempts to solve the practical problem of getting production in a shop, and the contributions to the wage problem were only incidental.

Disappointed in his venture with "A Piece Rate System," Taylor decided to present another paper which should emphasize management and consider methods of wage payment as incidental—as a phase of management. Eight years later, therefore, (1903) he presented "Shop Management;" and then in 1905 his greatest contribution,—"On the Art of Cutting Metals." In 1911, when the Eastern Rate Case hearings had aroused public interest, he republished "Shop Management" as a book, and published also a popular presentation of his philosophy of management under the title of "Principles of Scientific Management."

Excepting "Notes on Belting" and "On the Art of Cutting Metals," admirable scientific treatises in which Taylor made no attempt to present his philosophy of management (although the discerning reader can find it there), but including Taylor's public addresses, it is not wide of the mark to assert that Taylor never made more than one statement of his philosophy of management. "A Piece Rate System," "Shop Management," "The Principles of Scientific Management" and occasional addresses are essentially one and the same, differing only in emphasis. No one of them is an adequate exposition. Taylor was not primarily a publicist; he was engineer-executive.

VII. DEVELOPING COORDINATION

Taylor left Midvale in 1889 and for a number of years was engaged in developing management methods in various plants, in which were presented the opportunity and the necessity for refinement, but in none of which was presented the opportunity for a complete development. In one plant one phase of his system of management, in another plant another phase, was emphasized. In 1897 his services were engaged by the Bethlehem Steel Co., and again for three years he had an opportunity, with a competent force of younger engineers, to develop his methods. This is the period of great discoveries in metal-cutting, and with respect to his management methods, a period of the development of additional mechanisms and of partial smoothing-out and coordination. "The large machine shop of the Bethlehem Steel Company was more than a quarter of a mile long, and this was successfully run from a single planning room situated close to it.[1]"

VIII. THE FIRST COMPLETE DEVELOPMENTS

In 1902 Mr. James M. Dodge, president of the Link-Belt Company of Philadelphia, inspired in part by listening to Mr. Taylor's discussions before the A. S. M. E. and by what he had seen on visits to Bethlehem, and particularly by the threat to his business on the discovery of high-speed steel, persuaded Mr. Taylor to begin the development of better methods of management in his plant. About the same time Mr. Taylor became interested in the Tabor Manufacturing Co., directed by his life-long friend, Mr. Wilfred Lewis, and in that plant also undertook the development of the new methods. While it might be said that, compared to what had preceded, the earlier opportunities in the Steel Motors Company of Johnstown, Pa., and in the Bethlehem Steel Company, had been relatively complete, it is undoubtedly correct to state that in the Link-Belt Company and the Tabor Manufacturing Company were found what proved to be the first clear fields for the development of scientific management, with practically complete cooperation. Since then many plants have accepted and developed scientific management, but these two plants will always be distinguished as the pioneers

[1] *Shop Management*, p. 110.