in a competitive industry—was certain to command the attention of alert and progressive enterprises. Even the emphasis on processing which Taylor made in his expositions—so far-reaching were his technique and his philosophy—caused him to be characterized as "twenty years ahead of his time." Had he then made the various additional emphases which have been made since his day, industry would have ignored him completely as a visionary crusader.

Both logically and practically the limited approach was right. Control of material facilities through knowledge of their characteristics and best methods of their use in that period of conquest of natural forces was the starting point of good management, whether considered from the point of view of individual competitive advantage or of social economy. With that as a base other elements could be permanently reared upon it as a superstructure. Without that base the increments could make only an unstable structure. Early scientific management was right, furthermore, in its insistence that scientific method in the managerial control of material facilities is basically identical with the scientific method in the control of other factors.

There was a deliberate decision to concentrate on a thorough demonstration of scientific management in the field of production and leave to later students the application to other phases of management when new conditions should have increased the relative importance of those phases.

Taylor brought inductive science to bear upon the problem of managing each and every workplace in the shop.[6] Nothing was too minute for painstaking experiments to discover the perfect form of machine, tool or appliance and the perfect method of their use. "Perfect" mechanism or method meant one most economical of the energy of the worker. In the case of machines and tools the capital charges were also taken into consideration. Economy of energy was indicated by increase of output per unit of time without fatigue of the worker, and economy instead of prodigality of energy was safeguarded by a planning of work which took into consideration standard maxima of output per unit of time.

The most suitable materials, machines, tools, appliances, mechanisms, or methods for each workplace and kind of work having been determined by investigation and experiment, the next stage in stabilization of conditions at the workplace was to standardize the best methods of using these. This involved really four steps: first, common understanding of the best tools and methods through publication in standing and special orders, instruction cards and so on; second, promotion and maintenance of understanding through specialized instruction of workers; third, maintenance of standards through specialized inspection and maintenance; and fourth, planning and routing of operations, including preparation and assembly of materials, tools and instructions for each operation. Typical activities involved in standardizing operations of a unit workplace are indicated in the first column of the preceding chart, in which conditions, mechanisms and governing principles are brought into relationship. The net result of stabilization in this manner of the relations of material and human factors at the unit workplace was an increased productivity of the workplace per unit of time, and per unit of machine and labor energy; and therefore reduced unit costs. Reduction of unit cost proved to be the practical and powerful appeal to the interests of industrialists in an active competitive era.

In this establishment of harmony and balance of factors at the unit workplace was discovered the basic principles of scientific management — see preceding chart—which were to have so profound an influence on American industry when eventually applied also in other phases of management. Also in this process of bringing individual workplaces under control it was simultaneously perceived that the immediate environment of workplace relationships must be brought under a similar control in order to perfect and preserve the control at any individual workplace.

Stabilization of the Shop

The stabilization of one workplace after another, even without consideration of their relations, establishes a certain degree of control of the shop as a collection of workplaces. There still remains, however, the problem of co-ordinating the relations between workplaces in order to secure the most effective control of each workplace and of the shop. This indicates that scientific management includes within itself a compulsion to stabilize ever-widening areas of industrial relationship. The forces bearing upon stability of the unit workplace do not all originate within the workplace itself; no matter how completely and how perfectly control is effected at the unit workplace, it is discovered that forces which have their origin in the environment of the workplace impinge upon it and

[6]Cf. Robert Bruere in *Scientific Management in American Industry, op. cit.*, Ch. XXIX.

upset the stabilization effected locally. For instance, in a series of unit workplaces in which workplace Z receives partly worked material from workplace Y, no matter how well Z is stabilized locally, it cannot be completely stabilized if Y is not stabilized and if it makes its contributions to Z in a fluctuating manner. To complete the stabilization of Z, Y also must be stabilized—and X, W, V, etc., in an ever-widening environment.[7] Therefore stabilization of the shop is not merely the incidental sum of the stabilization of all unit workplaces considered as unrelated units; stabilization of all related units is a part of the problem of stabilization of each individual unit. We have impressed upon us here the fact that each unit workplace is but a member of a larger organic whole and that all of them are inter-related and interdependent.

It is this factor in stabilization which has compelled scientific management continually to widen the area of its concern. Stabilization of material factors is not sufficient; human relations must be stabilized. Stabilization of production is not sufficient; merchandising must be stabilized. Stabilization of production and merchandising is not sufficient; general administration must be stabilized. Stabilization of an individual enterprise is not sufficient; all enterprises in the industry must be stabilized. Stabilization of one industry is not sufficient; all industries of a nation must be stabilized. And it is the thesis of this Congress that stabilization of national industry alone is not sufficient; international economics must be stabilized. Achievement of any of these ends is a step toward a more balanced and harmonious industrial and social world life; each end is but a means to another and greater.

The principles and most of the technique pertinent to stabilization of the shop are identical with those pertinent to standardization of an individual workplace. Early scientific management did its work in the first unit area so thoroughly that it discovered the principles and devised and assembled the parts of an integrated technique for stabilization of any area of purposive effort, whatever its nature and size. Whatever the area, research as a principle and as a method remains constant and basic, although things to be investigated may be different. Standardization remains a constant, although the elements standardized may vary. Control through knowledge remains a constant, although the laws which constitute the control vary with the factors to be controlled. Co-operation remains a constant, although the division of efforts and the complementary things to be done reflect the difference in factors and their relationships.

This is apparent to one possessed of the imagination to visualize the shop or industrial establishment as one huge machine. The research problem to determine the most suitable kind of tools and methods at the individual workplace becomes for the shop a problem of most suitable machines, tools and methods in relationship. The problem of gearing the separate tools into a machine representing a unit workplace has become the problem of relative sizes and capacities of many supplementary machines. The problem of the best place to locate material to be worked on at the individual workplace has become for the shop the problem of providing raw materials and moving and storing those in process. The problem of the capacity of the machine has become the problem of the capacity of the shop. The problem of simplifying and standardizing the material for a given product of a unit workplace has become in the shop the problem of simplifying and securing the maximum adaptability of the least possible variety of materials. The problem of the most suitable particular kind of skill for the unit workplace has become the problem of the most serviceable ratios of various classes of skills throughout the entire shop. The problem of the ratio of idle time to productive time at the individual workplace has become the problem for the shop of the idle and productive times of tools and machines in the aggregate. And so on. Most problems of the individual workplace can be matched by problems, more complicated but essentially identical, in the shop conceived as one huge machine. For the shop the methods of research become more complicated and the resultant standards more varied, but the principles and the structures of research, standardization, control and co-operation remain the same.

Some of these principles—and other aspects of scientific management—are not commonly understood and should be considered further.

The term research identifies the principle that judgments and decisions should be based on ascertained facts and not on impulse or guess. Scientific management demands this attitude of mind on the part of all co-operators and toward all problems, small as well

[7]It is obvious, of course, that workplace Z should not be stabilized first; A should be stabilized first, then B, then C, etc., and Z should be stabilized last. The exception to this principle is that purely local stabilization may be developed at all workplaces simultaneously. Mr. Kent (*op. cit.*) has informed the author that Taylor shortly before his death recommended the following order of attack on the problem of stabilizing the shop: (1) stores; (2) materials; (3) tools; (4) machines; (5) methods; (6) rates.