THE MEANING OF SCIENTIFIC MANAGEMENT

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THE TERM "scientific management" is much abused, as is probably also the idea it represents. Any subject so complex and dynamic is bound to give rise to ambiguity and diversity of interpretation. It is often thought of as a technique: the sequence of research, standardization, planning, and control. But in a very fundamental sense it is more truly an attitude or even a philosophy: the full acceptance of the standards and methods of scientific investigation for the solution of every variety of problem presented by industrial life.

Thus, from its very beginning scientific management has meant the use of experimentation, collection of data, analysis of data, and formulation of principles based on such analysis, rather than relying on past experience and custom. That is what Frederick W. Taylor had in mind when he attempted, as a "case study," to apply the scientific approach to an industrial operation like shoveling. Of course there has been a long evolution from that time to the present. Now the outlook and findings of experimental psychology, physiology, statistics, and sociology are included among all the techniques and methods applied to improving the productivity of industrial effort.

In establishing scientific management in a particular industry or plant, to be sure, all phases and techniques cannot be instituted at once or developed at an equal rate. Obviously executives would prefer to proceed according to some pattern or order of priority, and certainly this should be possible now that we have had more than 50 years' experience with scientific management. As a matter of fact, the course of development which scientific management itself has followed provides one of the most practicable patterns. Perhaps, therefore, an examination of scientific management from the point of view of its evolution can serve as a logical and constructive way to understand its import and its application to industrial problems.

Recounting the evolution of any subject is a precarious undertaking, for there are many chances for error both of commission and of omission – many chances to misinterpret and to overlook details that later prove significant. The task of recording developments in their proper sequence and at the same time arranging related ideas in logical juxtaposition is sometimes exceedingly difficult, especially when certain developments lie dormant for a long time and certain discoveries, though important in themselves, lose their essential relationship to the main theme of evolution. It becomes necessary, therefore, for each writer to adopt a logical pattern of evolution and then select such details as will give a true picture of progress in the field and proper emphasis to its most important characteristics. Thus, many patterns of evolution might be developed for the same subject, each different, yet correct and useful in bringing into focus different phases and significant developments.

Scientific management has by now

not only a long history but also a large bibliography and many students versed in its principles and practices. Likewise, it has many branches and phases, each constituting a mature field of study, many of which also have a long history of development both along with and aside from the general subject. In fact, a complete account of the evolution of scientific management would consist of a description step by step of the progress made in each of its separate phases. The greatest practical results, however, have been achieved when progress in the several phases has been integrated, correlated, and directed toward the general objectives of management as a whole. For the purpose of the present survey the best approach seems to consist, therefore, of dividing the subject into its several branches or phases and then giving a brief account of some of the more significant developments in each so as to indicate the general trend of progress in the field.

The Economic Phase

Scientific management had its beginning in its economic phase, the phase in which it faced its major problem and established its main reason for being.

Determining the Value of Work. When F. W. Taylor, the founder of the movement, took his first managerial position, he was confronted with the problem of "soldiering" and general restriction of output, a problem that so irked him that he was tempted to give up, as he says, "the whole damn thing." [1]

He was not long, however, in finding the real cause of this practice. There was then no satisfactory method for determining what constituted a proper day's work for a worker nor any incentive to induce him to do as much as he easily could. Even when piece-rate systems of wage payment were in operation, rates were frequently cut as the workers became more skilled or whenever their wages exceeded the current average. Furthermore, when the workers increased their speed to lessen the time required to complete their tasks, instead of being rewarded, they often were laid off or discharged. Management typically assumed little responsibility for the economic welfare of labor, and the workers proceeded to protect themselves against the vicissitudes of the system as best they could.

The situation existing at that time — in the early 1880's — is not hard to account for when it is recalled that the mass-production stage of the industrial system was then comparatively new and ill prepared to manage large numbers of workers in the manufacture of complex products. The situation differed markedly from the factory system preceding it, in which the number of workers in any one establishment was usually small and the supervision of the workmen was usually in the hands of the proprietors of the enterprise.

Under the older system an individual worker, or at most a group of closely associated workers, completed all stages in the manufacture of a large portion of the relatively simple products of the day. These products could be placed on the market, generally a competitive market, where they could be evaluated in terms of money, making it possible thereby to determine with some degree of accuracy the worth of a laborer's contribution to society. Conditions then were not so different from those existing today in some of our more primitive or less complex and less integrated industries where work of a handicraft

[1] Frank Barkley Copley, *Frederick W. Taylor: Father of Scientific Management* (New York, Harper & Brothers, 1923), Volume I, p. 5.

nature is performed. As examples the following are roughly appropriate: agriculture, especially under the sharecropper system; the cutting of pulp wood; much of coal mining; fruit packing; garment manufacturing, to some extent; repair work of many kinds; barbering; and other service trades.

In such industries, if the degree of skill required is not too great, one worker can often be substituted for another. Furthermore, the worker can easily see or compute his individual output as a marketable product or service and gain some notion of its value to society. In such cases the marginal worker is a reality; further, his "marginal product" can be identified and evaluated. The additional or marginal barber, for example, is a specific individual, and the additions to total cost and revenue due to his joining the force can be accurately computed. His departure can likewise be felt, by both the proprietor and the remaining barbers, in terms of reduced cost and income.

In the modern large-scale factory or integrated enterprise the situation is quite different. The complexity of the relationship of capital to labor, of labor to labor of different grades and skills, of all these to the finished product, and of the finished product to market quantities and prices where the forces of imperfect competition are predominant, all introduce an element of considerable remoteness between individual effort and an accurate reward, or wages. Because neither management nor the worker usually knows any longer what constitutes a proper day's work or its value to society, both resort to practices of trading upon the ignorance or weakness of the other, labor resorting to soldiering, strikes, and various means of protecting its skill and energy, and management to driving or other means of getting more work for less money. The inefficiency of such a system was what Taylor confronted and what he sought to improve.

Incentive Payments. Taylor's first contribution to the literature of scientific management, "A Piece Rate System," published in 1895, described a new incentive wage payment plan.[2] Incentive plans previous to this time invariably based the output of the workers upon an average of their past performances. In Taylor's system the standard output was determined not by historical statistics or custom but by scientific research carried on to measure just what and how much a man could do in an hour or day. This type of research, given the name of "time and motion study," was the technique developed to place the many manual jobs in industry on an output or piece-rate basis and is still one of the main fact-finding methods that characterize the scientific management movement.

As to the amount of the wage, the prevailing wage rates in the community for the type of skill concerned were taken by Taylor as a satisfactory starting point. A premium of from 30% to 60%, he found, usually constituted sufficient inducement to elicit the optimum effort of the worker.[3] Thus, having obtained accurate knowledge of what a man was capable of doing and the incentive needed to secure his effort, Taylor and his successors were able to establish wage rates for manual jobs — many of them entirely new — and to guarantee that such rates would not be cut as long as conditions remained unchanged.

[2] *Transactions, A.S.M.E.*, Volume XVI, pp. 856–883.

[3] *The Principles of Scientific Management* (New York, Harper & Brothers, 1911), pp. 27 and 74.

Present-day production methods have reduced substantially the area in which time and motion study can be employed to establish a wage that is entirely satisfactory from the point of view of either capital or labor. Less often in our highly mechanized industry does an individual workman have control over his rate of production, less often can his output be recognized as a separate unit of product, and less often is his manipulative skill the essential factor in determining his worth to his employer. Production today is more largely the result of the machines and the manufacturing system; the worth of the individual worker to his employer is becoming more dependent upon such qualities as his punctuality and his reliability in the continuous operation of his machine, his ability to foresee and to prevent accidents and interruptions, his sense of responsibility in protecting his employer's property and reputation, his capacity for cooperating with fellow workers and supervisors, and his general knowledge, versatility, and resourcefulness.

Modern Incentive Techniques. In recent years, however, new techniques have been developed to cope also with this changing situation in industry. The technique of job analysis and evaluation, involving careful job description and classification, attempts to ascertain what the various jobs and positions are worth to the firm, and merit-rating systems have been designed to measure the worth of the individual job holder. Likewise, there are suggestion systems to reward employees for originating improvements in the production process, promotion schemes for recognizing capacity for higher positions, and other systems of reward for other attributes that may be of value to the employer such as safety, quality, punctuality, and continuity of service. When it is possible to evaluate the product of a group but not of an individual, group bonus plans have been established.

Profit-sharing plans also have proved effective in a number of cases, usually because of the careful study made to institute and operate the plan and the belief created in the minds of the workers that management is attempting to be fair with them in the distribution of income. Because of the remoteness of the reward from the effort of the individual worker, the effectiveness of such plans is to be found thus mainly in the psychology of the situation rather than in a plan's justness in distributing income among the several factors of production.

The growing recognition of labor unions has led to many other techniques and innovations for the protection of the worker's rights, some of them enhancing productivity and some of them exceedingly harmful to the progress of scientific management because of their tendency to multiply the fixed factors to be accommodated and the difficulties in making the changes indicated by research. In fact, unions have usually been inclined to resist the introduction of improvements in the work process developed by the various techniques of research in much the same spirit that workers in the past were inclined to oppose the introduction of new machines and inventions.

Regardless of the plan, however, some system or technique for measuring the value of a man's output and relating it to the amount of his earnings so as to provide an incentive for superior effort cannot be overlooked as absolutely essential to the progress of scientific management. That incentive is a potent factor in every work situation is well recognized by the psychologist.[4] It has not been ignored with impunity in any wage-payment system.

The only problems concerning incentives lie, first, in the accuracy of evaluating a person's work and, secondly, in matching that work with a proportionate reward. The separating and distinguishing of productive accomplishment from mere semblances and prejudices is, of course, extremely hard to accomplish in a complex economy. Progress in many of these newer techniques, such as job analysis and merit rating, is now in about the same stage of development as were piece-rate wage systems when Taylor began his work: they look only to the record of past performance for their standards. What is needed is a research technique comparable to time and motion study that can provide accurate standards of success in the performance of mental, managerial, and professional duties.

It is a fact, however, that the increasing strength of organizations of many groups of persons so employed tend, like labor unions, to curb all activities that pry into the secrets of the craft or upset the "status quo." The difficulties of the problem are sufficient indeed to induce anyone but the true scientist to surrender the whole attempt in favor of a simpler scheme such as seniority or "from each according to his ability and to each according to his needs." Further progress in this phase of scientific management may well mark its next significant achievement.

The Administrative Phase

Closely allied to the economic phase, and essentially a part of it, are certain activities that may be classified as administrative. These include organization, production planning, accounting.

Organization. Taylor's contribution to the subject of organization, a system known as "functional foremanship," was concerned mainly with the shop. The principle involved in this system, now called more broadly "functionalization," has been applied widely to organizations of all kinds. The system developed by Harrington Emerson and known as the "line-staff" type of organization has also found wide application. In modified form it has become the divisional type so effective in large firms of great diversity and dispersion.

Emphasis in organization, however, has shifted in recent years from matters of the division of authority and responsibility, which mainly concerned the early contributors, to problems of initiative and morale. It is not enough that subordinates in an organization have carefully delineated authority and are made accountable for carrying out their orders; the real problem is to get subordinates to assume responsibility, to use initiative, and to cooperate with others without waiting to be told.

In getting the support and the teamwork of the lower ranks in the organization it is often realized that the formal hierarchy of superiors is less effective than what is called the *informal* organization. This is composed of the natural leaders in the group, the union representatives, and various outside agencies and individuals, and is made effective through the general relationships and mutual influences of these various equals in rank. This aspect of organization has brought to the front in recent years various schemes known as middle management, multiple management, committee organization, and industrial democracy.

[4] A. T. Poffenberger, *Principles of Applied Psychology* (New York, D. Appleton-Century Company, 1942), p. 401.

Planning. Detailed planning has always been an essential characteristic of scientific management. The steps in the process are: (1) *research* to find out and present the facts; (2) *standardization* based upon the findings of research to provide norms or measuring sticks; (3) the formulation of complete *plans* and the issuance of the necessary orders; and (4) the *control* of operations as planned by continuous comparison with standards. It is said, in fact, that no management can be called scientific unless each and all of these steps are properly performed. Thus, scientific management is said to be "management based on research," "management in accordance with standards," "planned management," or "management that fully controls every detail of operation." Progress in this phase may be counted by the minuteness of detail in planning and the accuracy of control.

Accounting. Cost accounting as a phase of administration had its beginning in the systems of shop records developed by Taylor and others concerned with the determination of factory cost and the control of inventories. These early cost-accounting systems were concerned mainly with job-order manufacturing in an attempt to distribute overhead on a realistic basis and to accumulate all the elements of cost of each process and product. Attention was later devoted to process costs and systems applicable to continuous or mass-production methods of manufacture. Accounting thus attempted to follow up actual production step by step in order to keep the management fully informed of its position in relation to costs and values. The records compiled were essentially historical, revealing what had been accomplished, the status of all elements at the moment of recording, and their effects on the firm's financial condition.

In recent years cost accountants have not been satisfied to concern themselves only with records of the past and present; in addition to these they have taken the standards developed by research and combined them to prepare accounting reports for future periods. Thus they do not wait for an item of cost or revenue to be incurred, but as soon as standards are developed, operating statements for future periods are prepared. Standard bills of materials, first prepared by the product engineers and designers and then submitted to the purchasing department for pricing, provide materials cost; records of the time and motion study department, first prepared to show standard times and labor cost, are then submitted to the personnel department for estimated changes in wage rates to furnish labor costs; records of fixed costs are examined and revised in the light of future expectations to constitute overhead. From the sales and statistical departments estimates are prepared for anticipated net revenues, thus to complete the operating statement for the future period. These budgets covering all aspects of operations are then prepared for various levels of output, such as at rated capacity, at 90% of capacity, at 80% of capacity, and so on, and possibly for an output in excess of rated capacity taking into account overtime wage rates and other extra expenses.

The modern accountants are thus doing in actual practice what the theoretical economists have always done by assumption, i.e., they prepare a series of cost and revenue amounts for the various levels of output of a particular firm. Judged by methods of presentation, however, the similarity of the reports of these two professions has seldom been recognized by either group. The economist usually prepares his charts and tables on the basis of unit costs and revenues, whereas the accountant keeps his budgets on the basis of totals and draws his charts as "break-even charts," "profit diagrams," and the like.[5]

Although accounting has been developed in the past mainly to serve investors and creditors, and more recently to serve legal and taxing authorities, its service to operating management has not been overlooked. It will no doubt become more and more the chief control technique in administration, provided only that accountants understand thoroughly the production processes in order to organize accounts on the basis of controllable factors and even on the basis of the causes of variance from established standards, if possible, and learn how to translate the products of both technological and economic research into projected operating statements.[6] The preparation of these operating statements or budgets based upon scientific standards may well be the main contribution of accounting to the scientific management of the future.

The Engineering Phase

Although economics, as previously pointed out, furnished scientific management its main problem, engineering supplied its principal methodology and many of its techniques. The majority of the workers in the field have been trained in engineering and have usually been practicing engineers in some of its many branches. In fact a new branch of engineering has come into existence in recent years, commonly known as "industrial engineering" or sometimes as "methods" or "management engineering," whose special field of activity is practically coterminous with that of scientific management, including matters of economics, administration, and personnel in addition to those of physical equipment and methods of manufacture. However, the specific division of engineering that has served the worker most intimately and done most to integrate workers, equipment, and technological processes is what is usually designated as "tool engineering" or, more broadly, "equipment engineering." Its service to scientific management is indispensable and constitutes the essential factor in linking together the two fields of activity.

Improving Physical Facilities. It was axiomatic with Taylor, Gantt, and other founders of scientific management that the starting point in improving the efficiency of a worker was not with the worker himself but with his tools and also with the physical facilities surrounding his work station. So it has often been found that if proper equipment and working conditions are provided, the worker responds automatically and proceeds to adjust and improve his own methods and conduct without waiting for outside assistance. If he is given a clean place at which to work, he is more inclined to keep it clean; if he is given a dirty place, he is inclined to make it dirtier; he usually keeps good tools good, makes poor tools worse.

It must be recognized that man is probably the most adaptable creature in the universe; he can work with some degree of effectiveness within very wide ranges of temperature, humidity, foulness of atmosphere, and in bright light or dim; he can adjust himself to awkward positions and movements; he can withstand noise, vibration, and other

[5] Walter Rautenstrauch, *The Economics of Business Enterprise* (New York, John Wiley & Sons, Inc., 1939), p. 29 ff.

[6] J. B. Cooper, "Accounting by Causes vs. Accounting by Accounts"; paper read before the Birmingham Chapter of NACA, January 1947.

irritations; and with the crudest of implements he can perform operations of great delicacy and precision. But when measures of output are carefully made and efficiency is calculated, it is invariably found that all such distractions and their necessary adjustments are not without their costs. It was early learned by those making scientific studies that careful attention to the comfort of the worker was not only humane but profitable.

Even the most simple and most commonplace improvements have often had to wait a long time for someone to discover them and prove their merit. Taylor improved the output of his men by selecting shovels of the right size and handle length for the work to be done, and Gilbreth increased the output of a group of girls by providing them with slats about the size of an ordinary footrule to use instead of their bare hands in folding paper. Many improvements lay in such simple gadgets as wrenches with crooked handles, foot rests, hopper-shaped bins, adjustable seats, better tote boxes, and other "fixments."

Tool Engineering. In the evolution of tool engineering the first stage was probably the discovery of simple devices to serve as an auxiliary to man's own body members, for example, a pole to extend his reach, a lever to give him greater force, pliers to increase his grip, a hammer to save wear and tear on his fists, and so on.

The second stage was the development of tools and engines to do what man had been unable to do, either absolutely or without prohibitively great effort, time, and probability of failure. James Watt was elated when a cannon maker produced a cylinder so accurate that the clearance between piston and cylinder wall was no greater than the thickness of a worn shilling. The lathe built by Henry Maudsley about 1798, which geared rotary motion to horizontal motion and made it possible to cut a perfect spiral or cylinder, had much to do with the rapid advancement of the industrial revolution. The invention of steel to cut iron, alloy steel to cut ordinary steel, and metallic carbides to cut alloy steel are developments of the same order which have enabled man to do what he could not do previously.

The third stage in tool engineering was the perfection of machines that run without the constant aid of man, for example, completely automatic machines. The more recent inventions, such as that of the solenoid, the photoelectric cell, radar, and other selective control devices permitting the machine to start and stop without the intervention of man, are said to mark the step in which not only human skill but human intelligence has been transferred to the machine.[7] The meticulous attention given by the founders of scientific management to the simple needs of the worker and the way he performs each element of his work has enabled them, by thus discovering the mechanical elements of his motions, to construct machines that do all that he could do, and usually much better.

Anatomical and Physiological Phases

Proceeding apace with the study of tools and facilities for work, in the evolution of scientific management, is the intensive study of man's anatomy. It was soon learned that man himself could not be taken for granted as tradition and custom had represented him. As new tasks were created requiring

[7] Dexter S. Kimball and Dexter S. Kimball, Jr., *Principles of Industrial Organization* (Sixth Edition, New York, McGraw-Hill Book Company, Inc., 1947), p. 18.

different abilities and skills, his every strength and dimension had to be known and taken into account in determining just how he should perform a task and how much he could be expected to do.

Analyzing Manual Operations. How long is a man's arm and just how far can he reach with it without moving the rest of his body? Upon this information three dimensional work tables are constructed, on which zones are marked out where objects can be easily reached by each hand and where operations requiring both hands should be located. In another case, the length of a girl's arm determines the standard number of telephones connecting with a single switchboard — about 10,000 being the maximum number she can reach from her seat. Distances from floor to knees are measured to ascertain the height of chairs, and from floor or seat to elbows to adjust properly the height of work tables for either a standing or sitting position as the case may be. Backaches of tall workers have been remedied by raising the height of work benches above the standard 39 inches, the proper height for only the average person. The direction and angles through which the various body members rotate are also significant; the wrist, for example, flexes much more easily in one direction than another. Thus, man has been figuratively torn limb from limb and joint from joint in order to measure his capacity for work.

The science of motion study subjects each element of a manual operation to minute analysis in an attempt to find "the one best way" to accomplish the task. The paths of motion are charted, and the synchronization of the movements of each part of the body is noted in order to improve the process by detecting loss-motion, awkward manipulation, misdirected momentum, inaccuracies, and causes of fatigue. Whenever motions are too quick for the eye, high-speed cameras are used in order that views may be studied as slow-motion and sometimes as reverse-motion. These are the same methods employed so effectively in improving the technique of athletes and acrobats.

Recently biomechanics or biophysics, as this science is variously called, has made notable contributions in this field for the purpose of aiding persons crippled during the war to overcome their various handicaps and prepare for positions requiring great manipulative skill. Analysis of the motions made by each part of the human body reveals many possibilities for improvement: the beginner may be more easily taught correct methods, other body members may be utilized or substituted, tasks may be more accurately standardized, motions may be better facilitated by tools and fixtures, or certain motions may be transferred entirely to a machine.

In the physiological aspects of man's capacity for work, attention is directed to the functioning of the various organs of the body, taken both individually for specific performances and collectively in relation to general ability and health. It was learned in the early stages of scientific management that man did not perform as a machine and that his work could not be measured in terms of horsepower or physical units of any kind.

Man tires, for example, in proportion to the duration of strain or tension as much as to its amount or intensity. Thus, a task done quickly is less fatiguing on the whole than one done slowly; a short work-day at a fast tempo is more efficient than a long day at a leisurely rate. The science of fatigue study originated as a part of the scientific management movement and concerned itself with various methods of discovering and measuring fatigue other than relying merely on the judgment of the worker as to the intensity of his feeling of tiredness.

Other studies have been concerned with conditions for the proper functioning of various other parts of the body. It is found, for example, that proper vision requires that light be of the right intensity, from the right direction, and of the right degree of uniformity, that the time required for the eye to see an object adequately varies from 0.07 to 0.30 of a second, that the eye sees more quickly under bright lights than dim, and that colors are distinguished by the eye more accurately and more quickly than shapes or other differentiating features. Also, it is found that the body functions better when the temperature is about 70 degrees Fahrenheit and when the air is about two-thirds saturated with moisture and moving at a rate of not less than about one mile per hour.

Studies similar to these have been conducted in various phases of hygiene to eliminate the hazards to health and make physical working conditions as near ideal as possible, each such improvement being measured in terms of results produced and weighted against its respective cost.

The Psychological Phase

The psychological phase of scientific management has necessarily followed closely the physiological, for the border line between the two is not always easy to discern, or, if so, the one often impinges upon the other to constitute the whole problem which management has to solve. Excellent examples of the progress made in solving a problem involving the two phases may be found in the study of fatigue.

Study of Fatigue. Early studies noted the typical decline in the rate of the worker's output toward the end of work-periods, especially the end of the day and to some extent the end of the week. Consequently, many plans were devised to maintain the high levels of production of the early hours throughout the entire period. Incentive systems were tried with some degree of success, for, as is known, man almost never exhausts himself at work but normally holds back a considerable reserve which can be drawn forth only if the inducement is sufficient.

Even when man is induced to spend himself, however, results are not always satisfactory, for then errors and accidents often begin to multiply. That is why it has been more successful to use such methods as shortening the work-day and work-week, introducing rest periods, providing more comfortable surroundings, furnishing better tools and machines, making tasks easier as a result of motion study, and sometimes providing bunk houses for night workers who find it difficult to secure adequate rest and sleep at home. By the use of methods such as these physical fatigue has been all but eliminated in modern industry.[8] In fact, women are now proving themselves entirely capable of holding many factory jobs previously thought to be for men only.

The situation is quite different, however, in the case of mental fatigue, better known as ennui or monotony. Here the rate of output, though starting to decline toward the middle of an uninterrupted work-period, frequently changes direction and proceeds to rise until the end of the period. The happy anticipation of the end of work and the

[8] See Ralph M. Barnes, *Motion and Time Study* (Second Edition, New York, John Wiley & Sons, Inc., 1940), p. 280.

following period of relaxation, it is thought, causes the worker to sprint and often to reach the fastest rate of the day. Accordingly, in addition to the methods mentioned above, attempts have been made to overcome the effects of monotony through provision for rhythm in work, often by music played intermittently throughout the day; training for automaticity in manual tasks so that reflex actions relieve the mind of constant attention; encouraging conversation whenever permitted by the work process; and creation of greater interest in the job.

The fact remains that in monotony the greatest cause is, after all, not the work process or the job but the worker himself and his relation to his job. The factor determining the degree of monotony experienced by each individual is mainly, it is believed, the ratio of the capacity of the individual to the capacity required by and used regularly on the job. The person with great unneeded and unused capacity, particularly mental capacity, after exerting himself to learn a new job soon begins to look for other things to learn – other fields to master that challenge his ability. But if nothing of the sort can be found on the job, he becomes restless, irritable, and generally dissatisfied. Such a person either obtains employment elsewhere or remains to join in or promote mischief, dissatisfaction, and unrest among his fellow workers.

The development of hobbies is frequently advocated to ameliorate situations of this kind, though much must necessarily depend upon the nature of the hobby and its relationship to the job. This problem is of growing significance in modern industry; for the very same mechanization that has largely eliminated drudgery and physical fatigue has also tended to enlarge the area of probable monotony.

Testing. Probably the greatest practical contribution of psychology to management lies in the field of testing. Although there are many faults to be found with psychological tests, they have been proved far better than no tests at all, but only if they are administered by competent persons who know their various uses and limitations and if taken along with other indices.

In the early days of testing the most practical and reliable use of tests was their ability to single out, by low scores, the unfit. Even when tests did not provide an accurate measure of relative ability throughout the whole scale, they did usually indicate those persons with little possibility of success who should therefore be eliminated. More recently tests have proved equally useful in pointing out for elimination the high scorers, for it is now recognized that a worker may have too much as well as too little of an essential attribute. As mentioned in the previous section, too much ability – intelligence for instance – may cause the worker to find a routine job monotonous.

In testing for a particular attribute the principle is the same. For example, sympathy has been found to be a desirable quality of a foreman or executive – so desirable, in fact, that a person should never be placed in that kind of position who does not measure fairly well up on the scale. On the other hand, a person in such a position should not be too sympathetic;[9] too much, it seems, is just as bad as too little. Psychological tests are thus used to establish both

[9] Peter J. Hampton, "Analyzing Executives for Leadership and Other Qualities," *Trained Men*, Volume XXVI, Number 1 (January–February, 1946), p. 8.

minimum and maximum scores, as well as a norm about which the scores of the most desirable should be distributed.

Psychological testing is progressing rapidly at present by attempts to minimize some of its most potent, and to some extent inevitable, weaknesses. The first of these lies in the empirical method of developing many of the various tests, especially those purporting to test aptitude. The method consists of selecting persons who appear to be successful in the performance of a certain job, noting carefully their special attributes, and then using these attributes as a measure of the fitness or aptitude of applicants for that job. It would seem that some justification for this method other than the pragmatic would place aptitude testing on firmer ground.

A second weakness is the lack of correlation between the stated qualifications needed for a specific job or position and the appropriateness of the specific tests in detecting and measuring these specific qualifications. It is typical, it seems, for almost anyone to prepare the list of needed qualifications — foremen, executives, industrial engineers, personnel employees, or sometimes the workers themselves. Tests are then purchased or adopted which by their name and description appear to divine and measure the specified qualifications. Such a method produces, at best, only generalities and rough approximations which are often little better than ordinary judgment or opinion. The remedy lies in bringing the trained psychologists, who know what each test can do and what it cannot do, into the organization where they themselves can study the specific jobs and compare the tests with the manifestations of the various qualifications as seen on the job. Such persons should then be able to write job descriptions and specifications in terms appropriate for identifying and matching with the specific tests.

Another weakness is that in determining the qualifications needed for a job too little distinction is made between those needed in learning the job and those needed in performing the job after it has been learned. Many jobs appear very technical, difficult, or complicated, but once mastered they become quite routine and eventually monotonous, requiring little further judgment or intellectual effort of a high order. What is needed for such jobs is not superior capacity but a better training program and possibly a longer training period.

A final weakness common to all forms of human testing is that tests cannot be foolproof. Just as college students often scheme to pass tests rather than study to master a subject, employees use their energies to gain higher ratings on their tests instead of on their jobs. This is one area of management where the workers must not be allowed full information, where professional ethics must be relied upon for fair and unprejudiced treatment. There is great danger even in requiring foremen and supervisors to justify their ratings to their employees when using rating scales, unless the rating scales be redesigned to serve as suggestions for improvement to the worker rather than as an accurate report to higher management of the worker's qualities, virtues, or shortcomings. The attempt to prevent or counteract prejudice and unfairness may cause truth to be withheld if it is not obvious or easily provable. On the other hand, if truth should be too cruel, it might be better that it not be made a matter of record or allowed to injure the feelings of the employee.

The Sociological Phase

It is only in recent years that the employees of industrial plants have been studied systematically from a sociological point of view. The foundation studies for this approach are best represented perhaps by the series of experiments conducted at the Hawthorne plant of Western Electric Company.[10]

Studying the Work Situations. In these experiments careful measurements were made of the output rate of a small group of girls doing work of a routine nature under controlled conditions. The studies tended to show that the rate of output of each of these girls was definitely influenced by certain social factors. If a girl generally disliked or became temporarily irked at the girl sitting next to her, for example, her rate of output dropped. Likewise, unpleasant situations at home, ill feelings toward supervisors, anxiety concerning the job, and other factors disturbing her sense of security or her social position had harmful effects on work efficiency. In many cases these effects were sufficient to overbalance opposite effects of favorable physical work conditions, such as shorter hours of work, longer rest periods, and better lights.

Thus, since social conditions and relationships can influence perceptibly a person's efficiency, it is the duty of management, if it is to be considered scientific, to provide for every worker an agreeable environment and a society that is congenial, relatively free of irritations, and, if possible, one that provides status and prestige. Favorable conditions of this kind have been capitalized on, in the form of lower salaries no doubt, by banks and schools and by some offices and department stores that have become known as nice places to work. On the other hand, sponsors of the Fair Employment Practices Act might well afford to give cautious consideration to any policy of forcing people who do not like one another to work together.

Studying Workers' Reactions. Other studies, which may be classified as industrial sociology, assume the general conclusions reached by the Hawthorne studies but attack the problem with a different methodology and from a different point of view.[11] These studies, instead of measuring the rate of output to determine the effect of various social influences, go directly to the worker himself to ascertain his opinions and feelings. The chief fact-finding methods employed include questionnaires, interviews or polls, employee counseling, suggestion systems, grievance procedures, industrial democracy in some of its various forms, and special investigations or surveys. Their purpose is to determine the workers' attitudes toward various aspects of the work situation with the hope of locating the sources of trouble, particularly those appearing in the form of high labor turnover and absenteeism, general conditions of low efficiency, poor cooperation, low morale, and unreasonable union demands or sometimes strikes.

The fundamental proposition in these studies, it must be noted, is not the work situation itself but the work-

[10] Cf. Elton Mayo, *The Human Problems of an Industrial Civilization* (New York, The Macmillan Company, 1933).

[11] See, Schuyler Dean Hoslett, *Human Factors in Management* (Parkville, Missouri, Park College Press, 1946); also, William F. Whyte, *Industry and Society* (New York, McGraw-Hill Book Company, Inc., 1946).

ers' reaction to this situation; not even the social relations as they might be judged by an unprejudiced expert but the workers' feelings about the situation and about the people with whom they must associate.

Hence, management must adopt an epistemology of idealism rather than its traditional and often righteous realism; it must understand that its workers have preferences, feelings, egos, anxieties, and ambitions, and that satisfactions with respect to these are a part of the total reward for work. Perhaps one important corollary of these conclusions is that management must undertake to keep workers correctly informed about matters in which they are vitally interested, which influence their feelings and conduct, and about which they are likely to be misinformed.

Management cannot expect the workers to find out the truth unless they are told — and told and retold. Through education, publicity, advertising, or propaganda management must constantly fight the ignorance, misinformation, and mischievous or malicious rumors that so often create or propagate feelings of distrust and enmity; it must remain aware that the plant is no better a work place than the worker thinks it is, and the wage is no higher or no fairer than the worker is made to believe it is. Furthermore, this information must be brought to the worker in a form and at a level he can understand and embellished by all the devices that appeal to or tickle human nature.

Conclusion

Before concluding the discussion of the phases of scientific management, attention must be directed to the question of properly integrating the various methods and techniques outlined and providing the balance in activities necessary for a going concern. There has been a noticeable tendency at times for persons or firms to apply one technique of scientific management, successfully in itself but to the exclusion of all others. It is probably not recognized that the old economic laws of increasing and diminishing returns apply to the introduction and utilization of a particular technique or method in a given situation just as they do to any other factor of production.

According to the law of increasing returns, a small effort, measured possibly by its cost, may produce only a very small or a negligible result, whereas a larger expenditure in the same direction may prove quite worth while. For example, a one-man time and motion study department has sometimes proved little better than none, or perhaps even worse by disturbing the existing situation. It is the same principle when initial funds allocated are insufficient to employ a person competent for the task, i.e., employing a boy to do a man's work. Such practices, having once resulted in failure, tend to discredit the entire undertaking and so discourage the additional investment needed to overcome the deficiency.

At the other extreme, the law of diminishing returns may apply; for even though increasing returns may be the rule for several additional increments of investment, there comes a time when additional amounts fail to produce proportionate returns per unit. For example, if it has been found that an investment in better lighting, rest rooms, or baseball teams proved profitable, the conclusion may be to increase still further such expenditures, sometimes to the exclusion of other activities already starved for funds. Some students, for example, in interpreting the findings of the Hawthorne experiments referred to above, noted that efforts toward improving the sociology of the work situation were well rewarded even when other factors such as lighting and rest periods were allowed to deteriorate. They therefore hastened to conclude that, if only the social factors could be sufficiently improved, other efforts might well be scuttled. Such conclusions, however, overlook the law of diminishing returns: even the best of schemes begin eventually to reach a point of declining effectiveness in terms of the economic use of effort and resources. When this occurs, it is time to investigate other possibilities and seek for techniques not yet fully or properly exploited.

The general solution to the problems of inadequate returns on the various techniques and methods applied to improving the productivity of industrial effort is to bring about a better balance in the various activities. Too often the effectiveness of one technique impinges upon the proper functioning of another, in which case efforts toward improving the lagging technique are rewarded at a far greater rate than elsewhere. This solution is stated, in a more drastic form than many would entirely agree with, by a leading authority in scientific management, as follows:

> Taylor stressed the necessity for total integration, for the interweaving of every aspect and function into a single hierarchy of defined objectives, harmonious approach and studied detail. Better, he thought, and his experience justified him, to have the entire enterprise scaled to a uniform – even low – standard of effectiveness than to have the constituent parts vary widely in their rated performance and thus inhibit the integrated effort.[12]

But no matter how desirable a goal it may be, total integration is hard to achieve. That is why some pattern or order of priority is needed in establishing scientific management in a particular industry or plant. And, as suggested earlier, the pattern that appears most logical and most practicable, the characteristics of the particular situation being unknown, is the pattern of the evolution of scientific management itself. It is, in the first place, the order of: research, standardization, planning, and application. In the second place, it is the order of "from the known toward the unknown," from the objective toward the subjective, from the tangible toward the intangible. The development of scientific management in the plant repeats in order the evolution of scientific management in general; or "ontogeny recapitulates biogeny," to use terminology from the medical field.

As may be concluded from the scope of the present study, therefore, scientific management began with investigations of commonplace things, many apparently beneath the dignity of the learned professions. As it has progressed, however, it has brought in the learning of any and all sciences that showed promise of making a contribution, and it has continued to check its method and philosophy with the best and most recent developments in each field. The evolution ends in matters of feelings and of beliefs, persuasion and faith. Indeed, there is much in both the technique and the philosophy of scientific management that partakes of the nature of religion. Wherever people are to be influenced and controlled, an element akin to religious zeal and devotion is, if management is to consider itself completely scientific, one of the absolute essentials.

[12] Harlow S. Person, "Progress in Scientific Management," *Advanced Management,* Volume XII, Number 3 (September, 1947), p. 96.