SCIENTIFIC MANAGEMENT

LinkedIn Posts by Bob Emiliani

April 2021

With May-June 2021 Addendum

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Bob Emiliani

Photo by E. Goldensky, Philadelphia

Fred. W. Taylor

PRESIDENT 1906

OF

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Introduction

Thank you for your interest in this curated compendium of 58 LinkedIn posts and associated Scientific Management articles from the early 20th century. This content, posted on LinkedIn from April to June 2021, comprises 585 pages.

Scientific Management was the first modern form of progressive management. Out of Scientific Management came the discipline of industrial engineering which, in turn, was instrumental in the development of the Toyota production system (TPS) and the practice of scientific thinking (PDCA, kaizen, A3 reports, etc.) that is embedded in The Toyota Way. Lean management, being a derivative of the TPS and the Toyota Way, is part of this lineage.

However, several influential people in the Lean community have for years attempted to dissociate Lean from Scientific Management – to claim the two are completely unrelated. While they been vigorous in their efforts to do this, their motivation for doing so is unknown to me. What I do know is their collective deep ignorance of Scientific Management; its principles, aims, goals, practices, and struggles. In short, ignorance of the history of Scientific Management as told by the people who created it, practiced it, and wrote about it.

Anyone familiar with Lean management who reads this compendium will see countless striking parallels between then and now. What is contained in the articles will sound very familiar, indicating that our efforts to advance progressive management over the last 40 years are apparently much less than we imagine.

Why did I unrelentingly post these articles?

1. To respect the work of our forebears who sought to develop the practice of management into a science
2. To educate people about Scientific Management
3. To prove the (obvious) lineage of progressive management, from Scientific Management to Toyota's management practice to Lean management
4. To show the innumerable similarities between then and now
5. And, unhappily for me, to discredit those who claim expertise on this subject and to try to end the disrespectful efforts aimed at misinforming Lean practitioners

I hope you enjoy this compendium. It is part of the history of progressive management. As such, this document may be useful for future reference or for amateur or professional historians who may someday be interested in studying and writing about the "Lean era."

Regards,

Bob Emiliani
17 June 2021
www.bobemiliani.com

Scientific Management: LinkedIn Posts by Bob Emiliani / Bob Emiliani

Cover design by Bob Emiliani

First Edition June 2021

Unpublished work by Cubic LLC, South Kingstown, Rhode Island, USA

“To get out of the pit we require an outside view. No chance from the inside. A system cannot understand itself. Understanding comes from outside. An outside view provides a lens for examination of our present actions, policies. Knowledge from outside gives us a view of what we’re doing, what we might do, a road to improvement, continual improvement... Far better, more trustworthy, is an outside view. A new way of looking at things. It is only by that outside view that we get ahead...”

– W. Edwards Deming

Professor Bob Emiliani

Please visit bobemiliani.com

You know who else wanted to make work easier for workers? Sakichi Toyoda. "...the purpose [of TPS] should be to make someone’s work easier..." -- Akio Toyoda. https://bobemiliani.com/akio-toyodas-view-of-tps-a-critical-analysis/

Taylor circa 1900

Image source: https://en.wikipedia.org/wiki/Frederick_Winslow_Taylor

Most people today have a negative view of Frederick Winslow Taylor because be called workers lazy and accused them of "soldering" – "Underworking, that is, deliberately working slowly so as to avoid doing a full day's work... is almost universal in industrial establishments" (TPSM, p. 13) – and in saying this he disrespected workers. Not so fast! What these critics don't understand is the context: Workers avoided doing the work because it was too difficult (you can relate to that, right?). An important goal of Scientific Management was to make work "smooth and easy for the workman" so that they would not resort to soldiering. In the early 1900s, he and others proved his hypothesis to be correct time and time again. This misunderstanding of Taylor is a lesson for all in the importance of understanding the details and fact-checking.

Linked in

Professor Bob Emiliani

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PSEMR, a predecessor to Deming's PDSA from 1917. Better than PDSA? Perhaps. Notice the five items listed under Principle 3, "Execute" -- all are key characteristics of Toyota kaizen (which more people need to understand). Also note Principle 5. See https://bobemiliani.com/book/kaizen-forever-book/

PERSONAL EFFICIENCY

Trade Mark Reg. U. S. Patent Office

THE·HOW·AND·WHY·MAGAZINE

Published·by·the·LASALLE EXTENSION UNIVERSITY·Chicago·Illinois

Five Principles of Effective Work

By L. V. Estes, Inc., Efficiency Engineers

Plan	Schedule	Execute	Measure	Reward
To plan rightly, you must know:	The work must be scheduled. A schedule, to be effective, must be:	It must then be executed:	The work accomplished must be measured:	If your work is accomplished effectively, you should be rewarded with:
1. What work is to be done.	1. Definite.	1. Skillfully.	1. As to potentiality.	1. Good working conditions.
2. How it is to be done.	2. In harmony with other schedules.	2. Accurately.	2. As to your past records.	2. Health.
3. When it is to be done.	3. Difficult to accomplish, but—	3. Rapidly	3. As to the past records of others.	3. Happiness.
4. Where it is to be done.	4. Possible to accomplish.	4. Without unnecessary effort.	4. As to quality.	4. Self-development.
5. How fast it can be done.	5. Rigidly kept.	5. Without unnecessary delay.	5. As to quantity.	5. Money.

Mr. J. H. Patterson, President of the National Cash Register Company, is a firm believer in concise, graphic presentation of facts.

And for this purpose he has adopted the unique plan of analysis in sets of *Five* factors and presentation in *pyramid* form.

It was, therefore, quite natural that in the early stages of the work of L. V. Estes, Incorporated, in his plant at Dayton, the "Five Principles of Effective Work," each analyzed into its five factors and displayed in pyramid form, were developed as indicated on the chart above.

Education aims to make the man prevail over the circumstance.—R. W. Emerson.

Professor Bob Emiliani

Please visit bobemiliani.com

Print advertisements from L.V. Estes, Inc., a Scientific Management/Industrial Engineering consulting business between 1919-1921. What is notable is the creativity in the advertisements (images and text) and where the ads appeared -- in trade publications such as Factory, Industrial Management, Bankers' Monthly, and other periodicals targeting C-level executives. Look at the ads very carefully. I know of no similar advertising creativity or advertising campaign targeting the C-level in the publications they read with respect to Lean management. Not in the 30+ years of Lean (hint, hint).

Emiliani Comment: For decades people have said "most business leaders see lean and kaizen as mostly a cost reduction program." Is that still true? It seems to me that times have changed and C-level leaders' viewpoints of Lean have changed. They see Lean management as increasingly irrelevant, no longer as a cost reduction program. What might advertising look like that would make Lean management relevant to CEOs? And where would such advertisements be placed and in what medium?

PIONEERS OF PROGRESS

Balboa—soldier, explorer, *pioneer of progress*—found the great Pacific at the end of an untrodden path. The thousands who have since followed can not efface his footprints.

Leadership belongs eternally to those who blaze the trail.

Founded twelve years ago, L. V. Estes Incorporated almost immediately left the beaten path of Industrial Engineering.

It was at that time a little known profession practiced by individuals. Among them were several now honored as pioneers in the science of securing maximum production with the least expenditure of time, energy, material and expense. Too often they were termed "efficiency men"—patronizingly or suspiciously.

The vision of the six original members of L. V. Estes Incorporated included a comprehensive engineering service, rendered by an *organization*, which would surpass the service of an individual no matter how capable he might be.

Now, the Estes roster has grown from six to that of a national institution.

Clients, moved by gratitude and satisfaction, tell us our goal is reached—our vision realized.

But the vision has grown. L. V. Estes Incorporated is still pioneering over untrodden paths. Guided by ideals that in themselves set a standard, this institution is leading the way through a wilderness of unrest toward the promised land of a better understanding between men—toward increased output and everlasting benefit for Capital, Management, Labor and the Public.

Inquiries for literature will receive courteous attention.

L·V·ESTES INCORPORATED

INDUSTRIAL ENGINEERS

Number One—
The Estes Institution

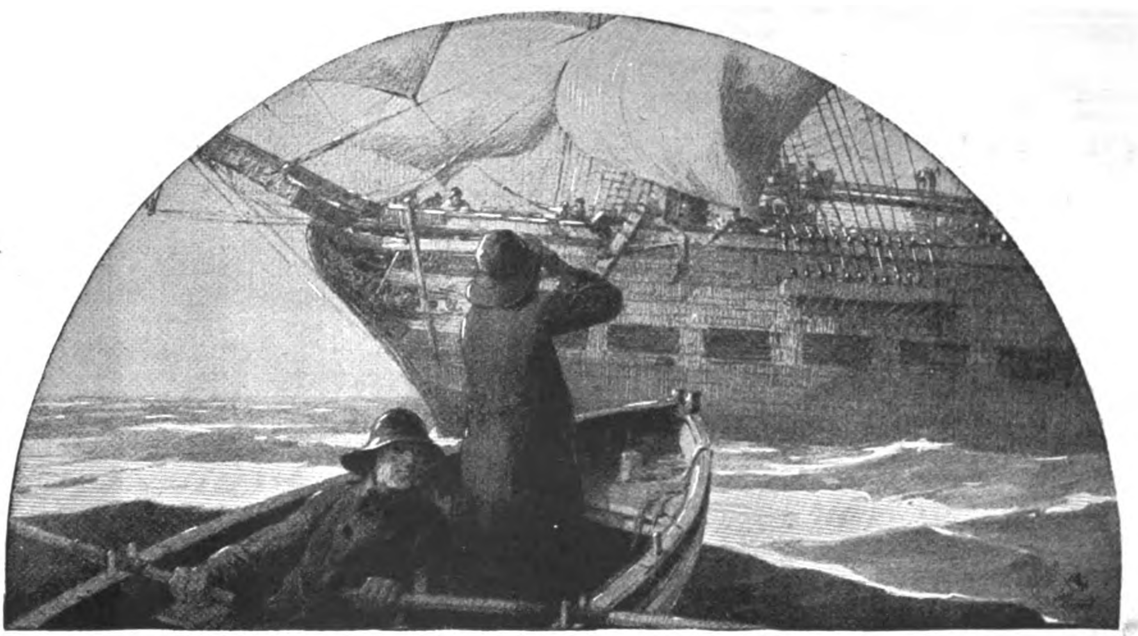
1505 Century Building, 202 South State Street, Chicago

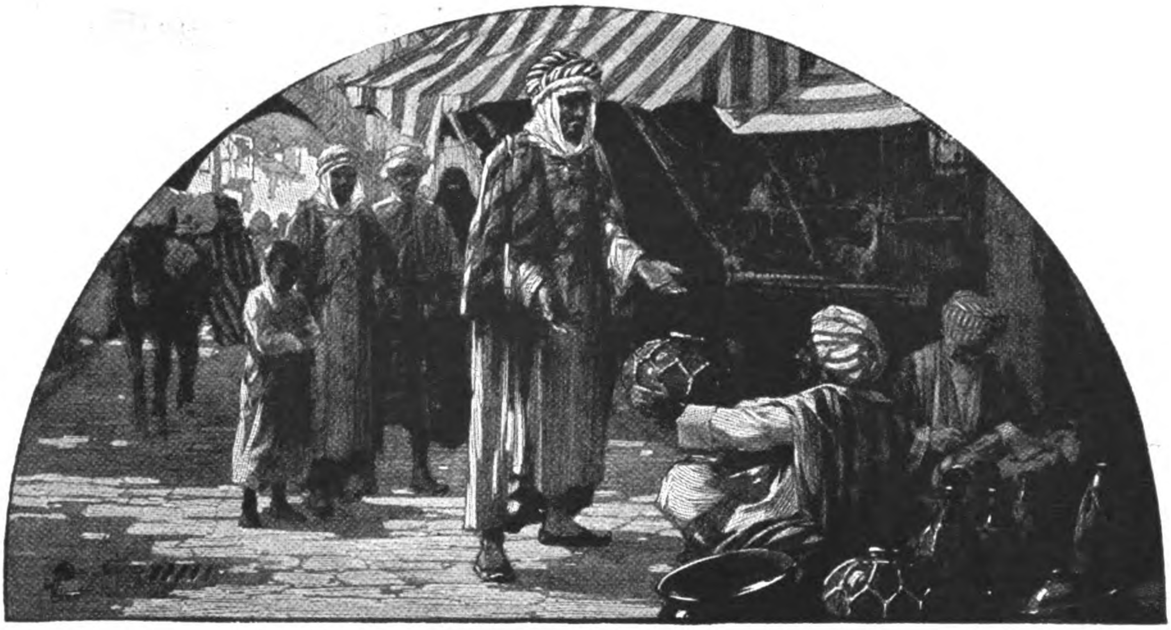
ESTES SERVICE

ORGANIZATION · PRODUCTION CONTROL
METHODS AND PROCESSES

COSTS AND ACCOUNTING · APPRAISALS
INDUSTRIAL RELATIONS

For Higher Standards of Business Management





THE ETERNAL ROMANCE

The bazaars of ancient Bagdad and the towering stores and spreading factories of modern America are each expressions of BUSINESS, the Eternal Romance. The difference lies in one word —*organization.*

Modern business is *organized* making and marketing. Modern manufacture, buying, and selling, are on a gigantic scale due to *organized* effort and they call for still greater perfection of organization, for they make demands which no individual executive can meet. The answer to this need is Industrial Engineering as practiced by L. V. Estes Incorporated.

Estes Service is *organized* application and interpretation of the laws of scientific management to modern business. Its scope extends everywhere in the field of business and to all branches of any business. It finds the facts and applies them fairly to the end that production is increased, costs are lowered, and products bettered, with a direct benefit to manufacturer, workman and consumer.

A special booklet dealing with the scope of Estes Service will be mailed on request.

Number Three
The Scope of Estes Service

L·V·ESTES INCORPORATED

INDUSTRIAL ENGINEERS

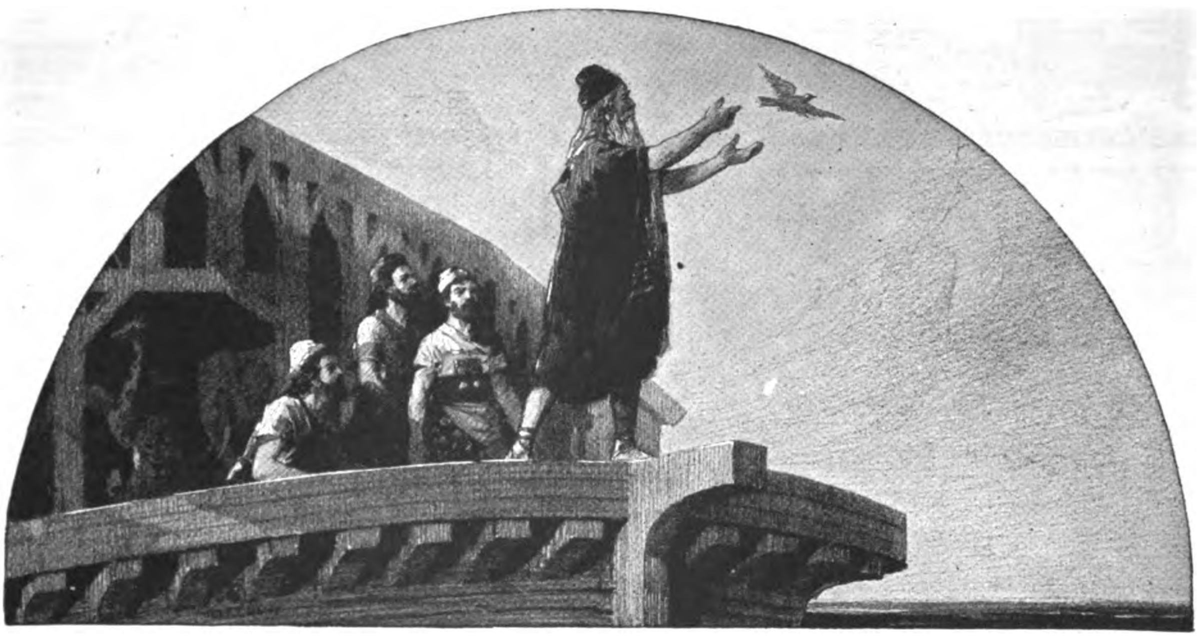
1505 Century Building 202 South State St., Chicago

ESTES SERVICE

ORGANIZATION · PRODUCTION CONTROL
METHODS AND PROCESSES

COSTS AND ACCOUNTING · APPRAISALS
INDUSTRIAL RELATIONS

For Higher Standards of Business Management




The Lesson for Business Men in America's Achievement
BRITANNIA
FRANCE
AMERICA—great, big, powerful America—is big enough to acknowledge the benefit of competent counsel.
With all her resources—all her knowledge—all her experience, America has wisely recognized the war experience of France, England and other nations. She has set aside pride and prejudice to utilize willingly the dearly bought knowledge of her allies.
This broadminded, farsighted, sound business policy accounts for the speed and power with which America's blow to autocracy has been delivered.
Utilize the Resources of a Forty-Engineer Organization
Profit by your country's example. Successful firms will not let pride in self achievement, or prejudice against the outside viewpoint, prevent them from accepting the counsel of experienced, industrial engineers.
The organized, supervised service of L. V. Estes, Inc., makes available the knowledge and experience of more than forty specialists, gained through many years of practical work in many different kinds of industry. Employment of such knowledge justifies honest pride—demonstrates true efficiency—guarantees enduring success.
Free Book—"Higher Efficiency"—is a 24-page illustrated booklet sent without obligation to executives on request. Please mention which of these departments interests you most.
Factory Efficiency—Industrial Accounting —Office Efficiency
L·V·ESTES INCORPORATED
"RAISE WAGES WHILE CUTTING COSTS"
Industrial Engineers
1829 McCormick Bldg., Chicago
ESTES SERVICE
Raises the Efficiency of Factory & Office
ESTES SERVICE
To Solve Industrial Problems

LEADERSHIP!

Your Reward for Readiness

Farms, factories, mines and furnaces must produce as well for peace as for war Production is the key to prosperity.

U. S. DEPT. OF LABOR
W. B. Wilson, Secretary.

THE END of one race is but the beginning of the next. Leadership invites challengers.

No industrial organization can rest on its laurels any more than can the athlete. Leaders become losers unless they are always prepared to defend their place with greater strides than ever.

In manufacturing concerns, needless overhead is excess weight—a menace to fitness. Lack of co-ordination between departments deters continued success.

The brain in the executive office must co-operate completely with the hands in the shops. Output per man must be at the maximum—wastes of time, labor and material must be at the minimum.

L. V. Estes, Incorporated, has helped scores of worthy firms to attain and maintain leadership. Estes Service, rendered by over forty experienced engineers under a unique system of supervision, can show you how to meet new conditions, new emergencies and the repeated challenges of competition.

THIS trade-mark pledges to all clients of L. V. Estes, Incorporated, an industrial engineering service consistent with the Estes reputation for leadership and record of results.

A BOOK FOR EXECUTIVES—"Higher Efficiency," a 24-page illustrated book, will be sent free on written request of an executive. No obligation is incurred.

L.V. ESTES INCORPORATED
INDUSTRIAL ENGINEERS
1829 McCormick Building, Chicago, Ill.

ESTES SERVICE

The Solution of Industrial Problems

What Estes Service Really Is!

In response to the popular query—"What is Estes Service?"—we have published a booklet. Its title is "The Scope of Estes Service." It deals briefly with each point of the graphic outline reproduced below.

The scope of Estes Service is perhaps too extensive to be described adequately in any one booklet. What Estes Service really is can best be expressed by what Estes Service does—by the results which it is consistently securing for clients.

A brief survey of this booklet, however, will help those who are not, as yet, Estes clients to arrive at a true perspective of Estes Service. One may visualize in a single reading how the Estes organization helps institutions both large and small to secure better organization and greater production, per man, per machine, and per dollar invested.

This booklet—"The Scope of Estes Service" will be sent promptly, without obligation, to those interested.

L.V. ESTES INCORPORATED
INDUSTRIAL ENGINEERS
1506 Century Building
202 South State Street
CHICAGO

Executive and Supervisory Organization for Correlating the Service of All Divisions

Division of Administration and Methods	Division of Personal and Economic Relations	Division of Industrial Engineering	Division of Appraisal	Division of Costs and Accounting
1. Company Policies. 2. Finance and Capital Control. 3. Improvement of Office Layout, Procedure and Routine. 4. Sales Administration and Methods.	1. Formulation of Policies Governing Cooperative Management and Improved Working Conditions. 2. Organizing for Cooperation and for Selection, Employment, Training, Promotion, Health, Safety and Housing of Employees. 3. Counsel and Supervisory Service in Connection with the Above.	1. Organization. 2. Graphic Executive Control. 3. Plant, Department and Equipment Layouts. 4. Production Control. 5. Material and Stores Control. 6. Quality Standards and Their Maintenance. 7. Development of Equipment and Processes. 8. Standardization of Methods and Processes. 9. Reduction of Wastes. 10. Incentive and Wage Payment Methods.	1. Engineering Appraisals for: Income Tax Computation. Cost Accounting. Insurance Adjustment. Financing. Purchase or Sale. Re-capitalizing. 2. Public Utility Appraisals for: Rate Investigations. Financing.	1. Constructive Cost Methods. 2. Association Cost Systems. 3. Accounting Layouts.

ESTES SERVICE

For Better Business Management


Taking the Guesswork Out of Efficiency Service
A Message to Skeptical Business Men
DON'T deprive yourself, your employes and your country of the benefits of higher efficiency simply because some kind of "efficiency service" did not prove satisfactory in your plant.
Efficiency means competency! Therefore "efficiency service" which does not prove competent is not true efficiency service.
L. V. Estes, Incorporated
Offer a Supervised Service of Forty Specialists
It is neither fair to you nor to the profession of industrial engineering to limit your efficiency possibilities to one-man or few-men efforts.
No matter how competent the individual engineer employed, he has his human limitations. A guess here, an experiment there, or an overlooked opportunity somewhere else may reduce your benefits from "efficiency service" thousands of dollars annually.
Estes service protects you against these contingencies. With a staff of more than forty senior engineers specializing in various branches of efficiency work, the Estes Company is able to give exactly the kind of help you need—and all the help you need.
Working in close co-operation with each engineer is a traveling district supervisor who keeps every job in direct contact with the vast store of statistics and powerful resources of Estes headquarters.
Free Booklet: A copy of the new edition of "Higher Efficiency" will be sent to executives who request it over their signatures. Please mention which of these departments is of most interest to you:
Factory Efficency—Industrial Accounting—Office Efficiency
L·V·ESTES INCORPORATED
"RAISE WAGES WHILE CUTTING COSTS"
Industrial Engineers
1827 McCormick Building, Chicago
A Trade Marked Service
A trade mark is a badge of self-respect—a guarantee by the organization behind it to maintain a definite quality standard.
This emblem, marking the industrial engineering service of L. V. Estes, Incorporated, pledges to all clients a service consistent with the Estes reputation for leadership.
ESTES SERVICE
ESTES SERVICE

Another Reason Why
L. V. Estes, Inc., Is in Demand

It is one thing to make a claim—but oftentimes quite another to prove it.

L. V. Estes early in his career saw that rash claims especially in his business, would only stunt the growth of a service which he knew so well to be of great value to progressive manufacturers.

The following letter which was written in 1916 is proof that the present conservative policy was practised by L. V. Estes, Inc., years ago.

THE RICHARDSON PAPER COMPANY
MANUFACTURERS
Felt Papers—Combination Boards

Lockland, Ohio
December 15, 1916

Mr. W. B. Conkey, Pres.,
W. B. Conkey Company,
Hammond, Ind.

Dear Sir:

Your favor of the 14th to hand. In reply will say that we regard Mr. Estes very highly. We are very well satisfied with the work he and his organization have done for us this year. We feel quite sure that Mr. Estes would not make any statements to you that he was not confident he could "make good" on. We are satisfied that if you do decide to employ him, you will make no mistake even though, as you say, he does charge a good price for his services.

Yours very truly,
J. M. Richardson, President,
The Richardson Paper Co.

JMR:CM

Industrial engineering service that gets results is one of the greatest avenues to bigger profits in business—and L. V. Estes' service gets results.

It would please us to tell you just what we have accomplished for other companies in a similar business to yours—and to prove what we can do for you

L.V. Estes, Incorporated

Industrial Engineers

202 South State Street - - - - CHICAGO

Linked in

Professor Bob Emiliani

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A short article by Henry Towne (1844-1924), "the pioneer of the Science of Management," whose early application of "Systematic Management" in the 1870s (see research by Joseph A. Litterer) at Yale & Towne Manufacturing Company, led to his calling for (in 1886) an engineering approach to management that later led to Scientific Management and Industrial Engineering. This is another piece of history worth knowing and to honor our forebears who had the vision to comprehend and begin the development of management as a science. For more info, see https://bobemiliani.com/a-little-bit-of-knowledge-can-be/

30TH ANNIVERSARY NUMBER

INDUSTRIAL MANAGEMENT

The Engineering Magazine

APRIL 1, 1921

In this Number

HERBERT HOOVER
SAMUEL GOMPERS
C. E. CARPENTER
HENRY R. TOWNE
W. M. LYBRAND
GEORGE BABCOCK
A. L. DeLEEUW
W. F. MERRILL
DAVID MOFFAT MYERS

And others

Vol. LXI No. 7

30TH ANNIVERSARY NUMBER

INDUSTRIAL MANAGEMENT

The Engineering Magazine

APRIL 1, 1921

Containing a series of reviews and forecasts, by notable authorities and experts, of the various phases of management science.

The Pioneer Journal of Management Science

Founded April, 1891, by John R. Dunlap

MR. HENRY R. TOWNE, "the Pioneer of the Science of Management," was born in Philadelphia in 1844. He began his active career in 1862 as draftsman for the Port Richmond Iron Works, and during the Civil War was in charge of important engineering work for the gun boats of the United States Navy at these shops. After the Civil War he became a special student of engineering and took an advanced course in physics at the Sorbonne, Paris. In 1868, Mr. Towne became associated with Linus Yale in the manufacture of locks and later in the same year, after Mr. Yale's death, became president of the Yale & Towne Manufacturing Company. Since 1914, Mr. Towne has been Chairman of the Board of that company. He was for five years a member of the Board of Directors of the Federal Reserve Bank of New York, is Chairman of the Board of the Morris Plan Company of New York, is a life member and past president of the A. S. M. E., a past president of the Merchants' Association of New York, etc., etc.—THE EDITORS.

The Evolution of Industrial Management

A review of the developments which have resulted, during the past three decades, in introducing functional management and in crystallizing empirical managerial methods into a definite and logical science. A notable contribution to the historic record.

By Henry R. Towne

Chairman of the Board, The Yale & Towne Manufacturing Co.

I HAVE often been told that my paper of 1886, "The Engineer as an Economist," printed in the *Transactions* of the American Society of Mechanical Engineers, was the first publication relating to Industrial Management. Whether so or not, it is a fact that almost immediately thereafter information and data previously inchoate began to take form and to find publicity, through the technical press and through the meetings and publications of the American Society of Mechanical Engineers.

I had long noted the entire absence of any forum or medium for the exchange of data and experience in the field of industrial management, except as accomplished by the occasional interchange of friendly visits, notwithstanding the vast fund of experience already accumulated, and the rapid evolution due to new machines and processes, and to the solving of problems presented by the increasing number of new products. I perceived that a new Science was being born, which as yet was not only unorganized, but even unrecognized.

Referring to these facts, in my paper of 1886, I said, "A vast amount of accumulated experience in the art of workshop management already exists, but there is no record of it available to the world in general, and each old enterprise is managed more or less in its own way, receiving little benefit from the parallel experience of other similar enterprises, and imparting as little of its own to them; while each new enterprise, starting *de novo* and with much labor, and usually at much cost for experience, gradually develops a more or less perfect system of its own, according to the ability of its managers, receiving little benefit or aid from all that may have been done previously by others in precisely the same field of work." On this argument I based a plea for the recognition of the *Science of Management*. Evidently the time was ripe for the recognition of this plea, no matter by whom made, for almost immediately there began the publication in the technical press of data and discussions relating to this subject, which showed that it appealed to many interests, that the field was already under active cultivation, and that a great amount of valuable information was even then available. During these years Frederick W. Taylor was conducting the studies and experiments which formed the basis for the theories and rules of practice which he subsequently formulated and gave to the world, and which now constitute his most enduring monument; but with characteristic patience and modesty he withheld all publication of the results of his work until satisfied beyond question that the conclusions he drew were sound and would stand the test of practical adoption and use. His splendid contributions to the new Science began with his paper on "A Piece Rate System" in 1895, and culminated in his monumental treatise on "Shop Management" in 1903, both appearing in the *Transactions* of the American Society of Mechanical Engineers. Coincidentally, Dr. Taylor and his associates began the introduction of "Scientific Management" in numerous industrial plants, and thus the new Science began to take form and grow. To Dr. Taylor must always be accorded the honor of being its earliest apostle and teacher, and of doing the earliest work, in this new field, which merited the title of "scientific." During the following years several national and numerous local organizations were formed for the study and promotion of the new Science, and increasingly engineers and others began to specialize in it.

Henry R. Towne is unquestionably the pioneer of management science. He began, as early as 1870, the systematic application at the Yale & Towne works, of what are now recognized as efficient management methods. In 1886, his paper "The Engineer as an Economist," delivered before the American Society of Mechanical Engineers, probably inspired Frederick W. Taylor, then a young man of twenty, to devote his energies to the labor that formed his life work.

Still young at the age of seventy-seven, Mr. Towne has lived to see the world-wide acceptance of his industrial precepts, and the complete fulfillment of his economic prophecies.—The Editors.

These processes have continued until to-day, greatly promoted and aided by the coöperation of the technical press, some of which is devoted exclusively to this branch of engineering.

To one whose experience covers both the old and the new eras, the contrast between them is most interesting and striking. Prior to 1886 the "military" (as contrasted with the "functional") system of shop management prevailed almost universally. Under this the shop foreman was responsible for almost every detail of his department, and often was an autocrat. He hired and discharged the employees, he fixed their rates of pay, whether day-work or piece-work, he assigned the jobs, and he usually directed all work relating to upkeep of machines, shafting and belting, to tool-grinding, to designing and making special tools, etc., etc., within his domain. Each mechanic under him did the work assigned to him in the way he thought best, did all of his own tool-dressing, his lathe or other machine standing idle while he made any necessary repairs to it or its belting, and depended chiefly on the favor of his foreman for his position and advancement. Empiricism and rule-of-thumb prevailed throughout. In contrast to this we have to-day *functional* management, under which trained specialists are employed, each of whom plans and controls, in all of the shops or departments composing the plant, the operations or "functions" assigned to him, all operations thus being conducted and controlled by a central organization, each of the various divisions of which direct similar operations throughout the plant, the function of the shop foreman, while still important, consisting essentially in giving effect to the plans and instructions of the various functional managers, and to maintaining the discipline of his department. Using the language of the diagram, the old system divided on *horizontal* lines, of location, of product, or of kind of work; whereas the new system divides on *vertical* lines, of functions, such as purchasing, employment, stock control, tool design, methods of work, time-studies, inspection, etc.

Coincidentally with these developments the subordinate but closely related science of "Industrial Accounting" has passed through a similar period of evolution, has won a recognized standing, and is furnishing a lucrative field of practice to a constantly increasing number of specialists, whose work goes hand in hand with that of the industrial engineer, and is essential to the successful conduct of the latter.

Early in the nineties, believing that the new science should be recognized, promoted, and taught by our technical schools, I presented the subject to the late General Francis A. Walker, then the honored President of the Massachusetts Institute of Technology, and urged him to authorize the starting of a course in industrial management for his students. Doubtful at first, he finally was converted to the plan, and authorized its undertaking by Professor Schwamb, as a part of the course in mechanical engineering. Two years later I urged the matter on Professor F. R. Hutton, who soon became favorably impressed, and thereupon initiated a similar course in the mechanical engineering department of the School of Mines, Columbia University. A few years later a similar course was established by Professor Spangler in the Towne Scientific School of the University of Pennsylvania, quickly followed in the succeeding years by similar action in most, if not all, of the technical schools and colleges; so that to-day, under various names, a course in Industrial Management has become a recognized part of the curriculum in practically all of them.

> **"It will probably not be disputed that the matter of shop management is of equal importance with that of engineering . . . The one is a well-defined science, with a distinct literature, with numerous journals and with many associations for the interchange of experience; the other is unorganized, is almost without literature, has no organ or medium for the interchange of experience, and is without association or organization of any kind. There already exists an enormous fund of information relating to such matters based upon actual and most extensive experience. What is now needed is a medium for the interchange of this experience."—Henry R. Towne, "The Engineer as an Economist," May, 1886.—The Editors.**

At the present time the work thus done in the training of engineering students to qualify them for positions of responsibility in the management of organized industry, is continued and greatly promoted by the presentation and discussion of papers contributed by members and others to numerous technical societies, and by the increasing coöperation of the technical press, as an exponent of which in this new and important field "Industrial Management" is a recognized leader.

* * * *

Editorial Addenda

No record of Mr. Towne's potent part in the development of the Science of management, can be complete without quotations from his eloquent and feeling tributes to Frederick W. Taylor's great achievements. Thus, in 1915, when Dr. Taylor died, in a most impressive letter which appeared on the editorial page of the New York *Evening Post*, Mr. Towne said:

"One of the world's discoverers and creative leaders has closed his career. The world is greatly enriched by what his genius accomplished. The world is grateful that he lived and for what he did."

Prompted by this tribute, Mr. Towne was at once invited to enlarge upon his theme and in a notable leading article in these pages, in May, 1915, he wrote this:

"Among the names of those who have led the great advance of the industrial arts during the past thirty years, that of Frederick Winslow Taylor will hold an increasingly high place. Others have led in electrical development, in the steel industry, in industrial chemistry, in railroad equipment, in the textile arts, and in many other fields, but he has been the creator of a *new science*, which underlies and will benefit all of these others by greatly increasing their efficiency and augmenting their productivity. In addition, he has literally forged a *new tool* for the metal trades, which has doubled, or even trebled, the productive capacity of nearly all metal cutting machines. Either achievement would entitle him to high rank among the notable men of his day;—the two combined give him an assured place among the world's leaders in the industrial arts.

Again he wrote:

"Measured by originality and comprehensiveness Mr. Taylor's paper undoubtedly is the most important thus far contributed to the *Transactions* of this Society. With perfect modesty it makes no claim to sole credit for the achievements it records, awarding due praise to all who were associated in the work, and recognizing that the work itself was made possible by the rapidly developing opportunities which modern materials, processes, and machines have made available, but which previously had not been fully appreciated or utilized. To Mr. Taylor is due all credit for being among the first to perceive these opportunities, to appreciate their possible significance, and, with endless patience and consummate skill, maintained through 26 years with unfaltering persistence and despite all discouragements, to carry forward his undertaking to its successful issue.

* * *

"Mr. Taylor's other and still greater achievement was in the field of industrial management, for here he was the creator of a new science where previously was only tradition and empiricism. Others without number have been organizers of industry and commerce, each working out, with greater or less success, the solution of his own problems, but none perceiving that many of these problems involved common factors and thus implied the opportunity and the need of an organized science. Mr. Taylor was the first to grasp this fact and to perceive that in this field, as in the physical sciences, the 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. Not only did he comprehend this fundamental conception and apply it; he also grasped the significance and possibilities of the problem so fully that his codification of the fundamental principles of the system he founded is practically complete and will be a lasting monument to its founder.

"The benefits of Mr. Taylor's great contributions to applied science in both the arts, metal cutting and industrial management, will be shared increasingly by every industrial community throughout the world, by every organized industry, and equally by the employer and the employee."

"To insure the best results, the organization of productive labor must be directed and controlled by persons having not only good executive ability, and possessing the practical familiarity of a mechanic or engineer with the goods produced and the processes employed, but having also, and equally, a practical knowledge of how to observe, record, analyze and compare essential facts in relation to wages, supplies, expense accounts, and all else that enters into or affects the economy of production and the cost of the product. There are many good mechanical engineers—there are also many good 'business men'—but the two are rarely combined in one person."—H. R. Towne, "The Engineer as an Economist," May, 1886.—The Editors.

Mr. Towne's early recognition of Doctor Taylor's great work is also indicated in his discussion of Doctor Taylor's paper on "The Art of Cutting Metals" before the American Society of Mechanical Engineers in 1907. In Mr. Towne's discussion he said:

"Mr. Taylor's paper on 'The Art of Cutting Metals' is a masterpiece. Based on what is undoubtedly the longest, largest and most exhaustive series of experiments ever conducted in this field, its summary of the conclusions deduced therefrom embodies the most important contribution to our knowledge of this subject.

"About 60 yearsr ago, American invention lifted one of the earliest and most universal of the manual arts from the plane on which it had stood from the dawn of civilization to the high level of modern mechanical industry. This was the achievement of the sewing machine. About 30 years ago, American invention again took one of the oldest of the manual arts, that of writing, and brought it fairly within the scope of modern mechanical development. This was the achievement of the typewriting machine. The art of forming and tempering metal tools undoubtedly is co-eval with the passing of the stone age, and therefore in antiquity is at least as old, if indeed it does not outrank, the arts of sewing and writing. Like them, it has remained almost unchanged from the beginning until nearly the present time. The work of Mr. Taylor and his associates has lifted it at once from the plane of empiricism and tradition to the high level of modern science.

Professor Bob Emiliani
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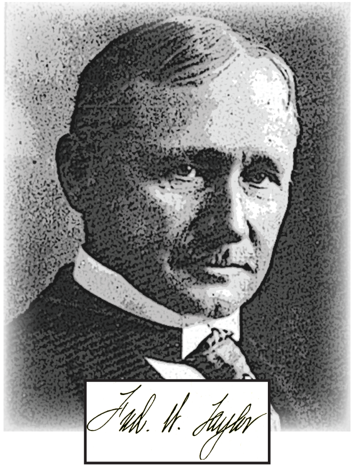
So interesting how each pioneer of progressive management had similar ideas about the fundamental or overarching principles that were necessary to produce a successful new system of management. The principles also incorporated the goals and the needs of the time. What might be the fundamentals principles in the next iteration of progressive management? "Responsibility" and "Respect for Earth"? For more information about Frederick Winslow Taylor see https://bobemiliani.com/a-little-bit-of-knowledge-can-be/. For more information about Frank George Woollard see https://bobemiliani.com/book/principles-of-mass-and-flow-production-book/. For more information about Taiichi Ohno see https://bobemiliani.com/taiichi-ohno-the-businessman/.

Past and Future Pioneers of Modern Progressive Management

Frederick Winslow Taylor



Scientific Management
ca. 1890-1940

Improvement

Cooperation

Frank George Woollard

Flow Production
ca. 1914-1930

Continuous Improvement

Benefit for All

Taiichi Ohno

Toyota Production System
ca. 1950-Present

Continuous Improvement

Respect for Humanity

TBD

Adaptive Management
ca. 202X to ?

Responsibility

Respect the Earth

LinkedIn

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You've got to read this article from 1923. Sounds a lot like Toyota-style leadership, doesn't it? (Document Source: Management, July 1923, Vo. 21, No. 6).

Management
Founded in 1913 as 100%

The Man Who Had to Do Better

Constantly striving to improve things and conditions found final expression in a $2,000,000 a year business

Based on an interview by E. Gould with
C. W. KIRSCH
PRESIDENT, KIRSCH MANUFACTURING CO., STURGIS, MICH.

ONCE upon a time—and this is not a fairy story—there was a farmer boy who was not content to do things just well enough to "get by." Whatever he undertook, he always tried to do it a little better than anyone else.

If he was plowing, his furrow had to be perfectly straight and true, although the grain grows up just as fine and the yield is just as great if the furrow does waver a little.

When he was chopping down a tree, the two gashes he cut into the trunk had to be exactly opposite each other. And if the tree was leaning one way, it was a test of skill and a matter of study to make it fall in a certain direction.

As this boy grew up, his habit of doing things better grew with use. Being mechanically inclined, he soon became sufficiently skilled in a number of different lines to be capable of drawing mechanic's wages in them. This skill he attained, without exactly serving an apprenticeship in any particular trade, by always improving upon the work of other men and displaying inventive ability.

"The Curtain Rod King"

Six months ago this farmer boy—now a middle aged man—completed another factory unit of his own design which is more than just a little better than any other factory building in the country. It has more and better conveniences and luxuries for its workers; and is better and more thoroughly equipped with labor saving devices and automatic machinery.

This factory with its 300 employees is now doing a business of over $2,000,000 a year in curtain rods—nothing but curtain rods! Why? Because the boy who always had to do things better has built a better factory and

The attention of "Management" was attracted to the Kirsch Manufacturing Company by the report that it had set a new precedent in welfare activities. Investigation showed that the company did not go in for "welfare work," as the term is generally understood—that the many advantages provided for its employees were simply the concrete expression of the president's constant effort to "Do it better." Although Mr. Kirsch declared he "did not believe in interviews," he would not refuse to explain the source of the wonderful spirit that pervades his organization

employs a better type of worker to make better curtain rods.

If kings were not in such disrepute, it would be quite proper to call C. W. Kirsch "the curtain rod king." Under the circumstances it would be more fitting—and undoubtedly more to his liking—to present him simply as founder and president of the Kirsch Manufacturing Company of Sturgis, Michigan.

Successful men in general fall into two classes—those willing to take full credit for their success, and those inclined to regard their achievements as only of commonplace importance. Mr. Kirsch belongs to the latter class.

"Do It Better," His Creed

"Perhaps you think I have done something to be proud of," he protests; "but I haven't done a thing any one else couldn't do." And to prove his point he explained how he had always been impelled to do things better—which explained the man, perhaps, but certainly did not prove his point.

One-third of the cost of the newest factory unit was put into "features" for the benefit of the employees. Mr. Kirsch says: "I am more interested in making men than money." With some employers this is only a pose; but the esteem in which Mr. Kirsch is held by his employees and his fellow citizens of Sturgis proves that he is sincere.

Furthermore, Mr. Kirsch thinks in things. Ideas are concrete with him, and his factory is the expression of the man's constant endeavor to make the world a pleasanter and a better place in which to live. If "welfare" work had never been thought of elsewhere, the Kirsch factory would still be a wonderful place in which to work.

Therein lies the difference between Mr. Kirsch and most other men. Many others have of course felt the same urge to do things better, and many have obeyed that urge to their own selfish benefit; but few successful business men have made that "Do it better" idea their religion, and carried it into every phase of their business and personal life.

Most men, probably would say that such an idea was commercially impractical. C. W. Kirsch, originator and owner of a $2,000,-

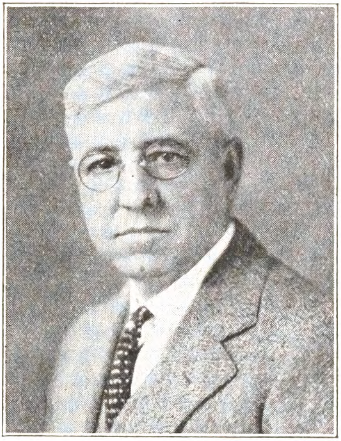
000 a year business, has proved it both practical and profitable.

"How did I come to be recognized as the greatest manufacturer of curtain rods in the world? I thought I saw a way to make curtain rods better and cheaper than they were being made. It is an engineering fact that a flat rod will support a greater weight over a greater distance without sagging than a round rod.

"It is also possible to use the flat rod with simpler fixtures, making them easier for the ordinary man or woman to put up, and doing less damage to the woodwork. I figured, too, that draperies would hang better on a flat rod. So I started to make flat curtain rods.

"Other curtain rod manufacturers thought this new type of rod was a joke. Curtain rods were round, always had been round, and always would be round. You might as well talk of a square foot ball. But we went ahead.

"One day a salesman from an old established curtain rod manufacturing concern said to one of our salesmen: 'It beats hell how long these freak rods of yours stay on the market.' Now they and our biggest competitors are manufacturing imitations of what they called a 'freak rod.'"

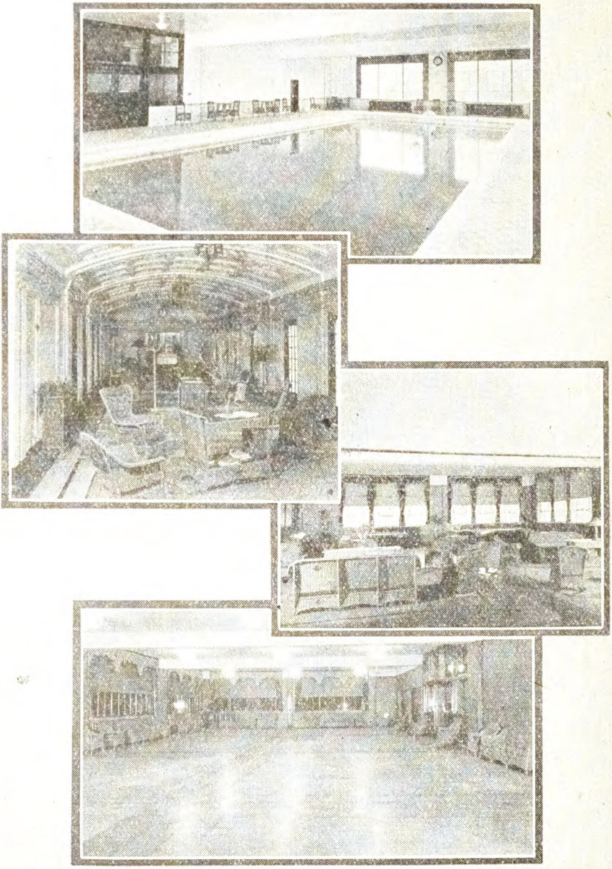


C. W. Kirsch, whose creed in business and personal matters is: "Do it better"

Still Works at the Bench

Originally Mr. Kirsch had several partners; but he soon found that he and his partners had different views on operating a manufacturing establishment. This business failed. Then, with a capital of $700 and an indebtedness of $3,500, Mr. Kirsch undertook to build up a business entirely his own—the Kirsch Manufacturing Company—where he could put into practice his own ideas and ideals of a model manufacturing business.

It was in 1907 that he began to manufacture his flat curtain rods. He started making five or six patterns, but the factory is now producing more than 100 styles. The experimental department is constantly busy making improvements, and adding to the line. Mr. Kirsch himself has a work bench there; in fact, all the special ma-



iews in new factory unit designed by Mr. Kirsch, showing swimming ool, reception room, reading room, and combination ball room and gymnasium

chinery has been designed by him and his associates.

For the first three years Mr. Kirsch found it difficult to market his product. The jobbers would not handle it until he had created a demand for it. So he sent out representatives to call directly on the retailers. Now he has 40 traving salesmen calling on the trade and the jobbers are eager to handle his flat curtain rods.

The original Kirsch advertising appropriation was approximately $7,000 for the year. Now over $150,000 a year is spent in national advertising. Kirsch products are handled in many of the principal foreign markets of the world, and world-wide distribution is growing rapidly.

Taking the "Easiest Way"

Mr. Kirsch experienced the difficulties and discouragements that always beset a new business. "How I worked!" he says; "and yet I enjoyed it!

"I lived the business—and slept it—and ate it. I did every job there was to be done. I have always made it a practice never to ask an employee to do anything I wouldn't do, nor anything I haven't done.

"How did I keep going? I've made my work my play—I enjoy it. And I always do things the easiest way."

He smiled as he said it; and remembering how he had made a game of his boyhood labors, it was easy to understand that the "easiest way" for him was the one that presented the most obstacles and the greatest possibilities.

"There was a time in the early struggles," continued Mr. Kirsch, "that I was badly handicapped for lack of money.

When He Needed Money

"I went to the company's stockholders, but they wouldn't render any financial assistance. I went to the banks. They also refused. I was desperate, and hardly knew what move to make next.

"About this time orders began to come in in considerable number and for the first time business was really encouraging. It became apparent to me that if the business was to continue to grow and develop at that present rate, additional funds were necessary for expansion. I couldn't persuade myself to give up and felt that I had to make another herculean effort to secure additional working capital.

"I called up the cashier of one of the banks; and when he said he would see me, I rushed down there and into his office. I walked over to his desk, and said: 'Mr. Blank, I have at least one fault, and that is, when I make up my mind to do a thing I never let up until it is done.' He looked up at me and saw that I was desperate and added:

Well, what's on your mind now?'

"Then I pounded my fist on his desk and said to him, most emphatically, 'By God, I need money and I'm going to tell you why!'

"He saw the frame of mind I was in and that the business was really going, and was impressed. He promised to call a special directors' meeting that night, and asked me to bring down my order book to show the condition and potentialities of the business.

The Opportune Orders

"I started for the meeting with my order book under my arm and the day's orders stuck in it loosely. I wanted them to fall out and look as large a number as possible.

"I stopped at the post office on my way, and I believe it was due to a kind act of Providence that every salesman I had out—there were six or seven men—had sent in some orders. I put this mail in my pocket.

"Then, after I had showed the directors my order book, and explained to them the future possibilities of the business, I looked down casually at my pocket and pulling out the envelopes said: 'Oh, yes! here's what I got in the mail tonight.'

"After I had submitted to a rigid, sweatbox, bank directors' examination, and had apparently answered their questions satisfactorily, the cashier asked me what security I was willing to give the bank. I replied: 'Everything I own on earth outside of my wife and two babies.' They loaned me the money and we kept going."

His "Come On" Leadership

The continued growth of the business constantly necessitated taking in new workers. And Mr. Kirsch's urge to "Do it better" found outlet in his treatment of his employees. He thought far more of their comfort than of his own.

"In the early days I used to come down to the factory in the morning before breakfast and start the fires. Then I'd sweep out the factory and office before I went home for breakfast. On Sundays I came down and spent a part of the day cleaning up the factory, so that on Monday morning it would be a pleasanter place for my folks to work in.

"There are two ways of conducting a business—the 'go on' or driving method and the 'come on' or leadership method. I have always followed the latter.

"I used to think, years ago, that if I ever became an employer—which wasn't likely—I wouldn't treat my employees as I was sometimes treated.

"The best test, and the most easily understood method of fair dealing with employees, is by the contents of their pay envelopes. They understand that language. And they know as well as you do if they are being justly

(Continued on page 70)

The Man Who Had to Do Better

(*Continued from page 42*)

ıid. *Then* try to improve their orking conditions.

The Power of a Slogan

"During the war we were pretty ısy keeping down costs because e didn't raise our prices much. ut after hostilities had ceased I ecided my time had come.

"When the Armistice was gned I determined to put my an into practice as soon as posble by reducing the working ours by eleven, corresponding to ıe eleventh month, eleventh day ıd eleventh hour—the time the eat World War was ended.

"I called my folks together and ınounced a change from a 60 our to a 49 hour week. We lopted the slogan: 'Greater proıction in 49 hours than in 60 ours—Greater prosperity and ore happiness.'

"We had cards printed with the ogan and put the cards in ather cases and presented one each employee. And we still old to the slogan. Our producon *has* been greater in 49 hours ıan it was in 60.

Pays in Wages, Not "Welfare"

"It has been my observation and xperience, generally, that if you o something for the other fellow ıe chances are that he or she ill do something for you.

"Last year when we put up this ew factory addition, we did everything to make the surroundings pleasant for our employees."

The new building contains a white tile swimming pool; a reading room with piano, victrola and radio; billiard tables and bowling alleys; a combined gymnasium and ballroom; a cafeteria and dining room, and exceptionally attractive offices—in fact, it is a question if any plant in the country provides greater social and recreational advantages for its employees and their families.

These things are not taken advantage of, nor are they made the excuse for keeping down wages. On the contrary, according to the statement of the employees themselves, they are paid increasingly better wages than in other factories of the kind, in spite of the fact that the recreational facilities have been added.

Building Homes and Golf Courses

Mr. Kirsch has just successfully completed a home building program for his employees. The company's architectural department designed and supervised the construction of 75 homes, strictly modern in every detail and ranging from five to eight rooms.

They are being sold to Kirsch employees for a small initial payment and the balance in accordance with the employee's earning capacity, or ability to pay without material discomfort or sacrifice.

When the discussion of a golf course for Sturgis appeared likely to end in talk, Mr. Kirsch ietly bought a suitable tract of nd and presented it and other operty to the club free of arge, provided the course was d out immediately. Otherwise would build it himself for his nployees.

The club accepted his generous fer, and he gave much of his ne and ability in personally supervising the construction of the ub house and course. Mr. rsch was elected first president the country club, and held this ice until the club was on a riving and successful basis. He an enthusiastic and proficient lfer.

Employees Must Be Satisfied

"The main thing," says Mr. rsch, "is not that the business ould continue to grow, but that y employees should be satisfied.

"In fact, if they aren't satisfied d we are convinced that we n't make them so, we insist on eir leaving. They owe it to emselves, to their families and us not to continue in our employ under such circumstances."

How Kirsch employees feel toard the company was demonrated during the period of frened prosperity following the Aristice. The factory was 'way bend on production and word ent out to the salesmen to stop lling for the present because e orders could not be filled on ne.

One salesman asked: "What n we do to help out?" Mr. irsch answered jokingly: "Put on a pair of overalls and get to work."

The next thing he knew the man was back in brand new overalls demanding a job. In a few days nearly all the salesmen were working on production. As a result, the factory congestion was soon relieved.

"Do Something—Even if Wrong"

One of Mr. Kirsch's working principles is: "Do something! The best thing is to do a thing and do it right. The next best thing is to do a thing even though there may be some question as to whether you are right or wrong. The unpardonable thing is not to do anything.

"We expect you to make mistakes; but if you are ever going to learn how to do better, you must keep trying. We expect you to profit by your mistakes; so whether you are right or wrong, do something.

"Even if you happen to do the wrong thing, you are ahead of the fellow who doesn't do anything. Someone has said: 'When you have been going down and down and down and have reached the very bottom, keep on going, because then if you go anywhere it has got to be up!'

"I have reached that point several times. I have been through the mill. But I always kept going. After all is said and done, to keep going is the only way you will ever reach the desired goal—the goal that is worth while striving for."

Professor Bob Emiliani

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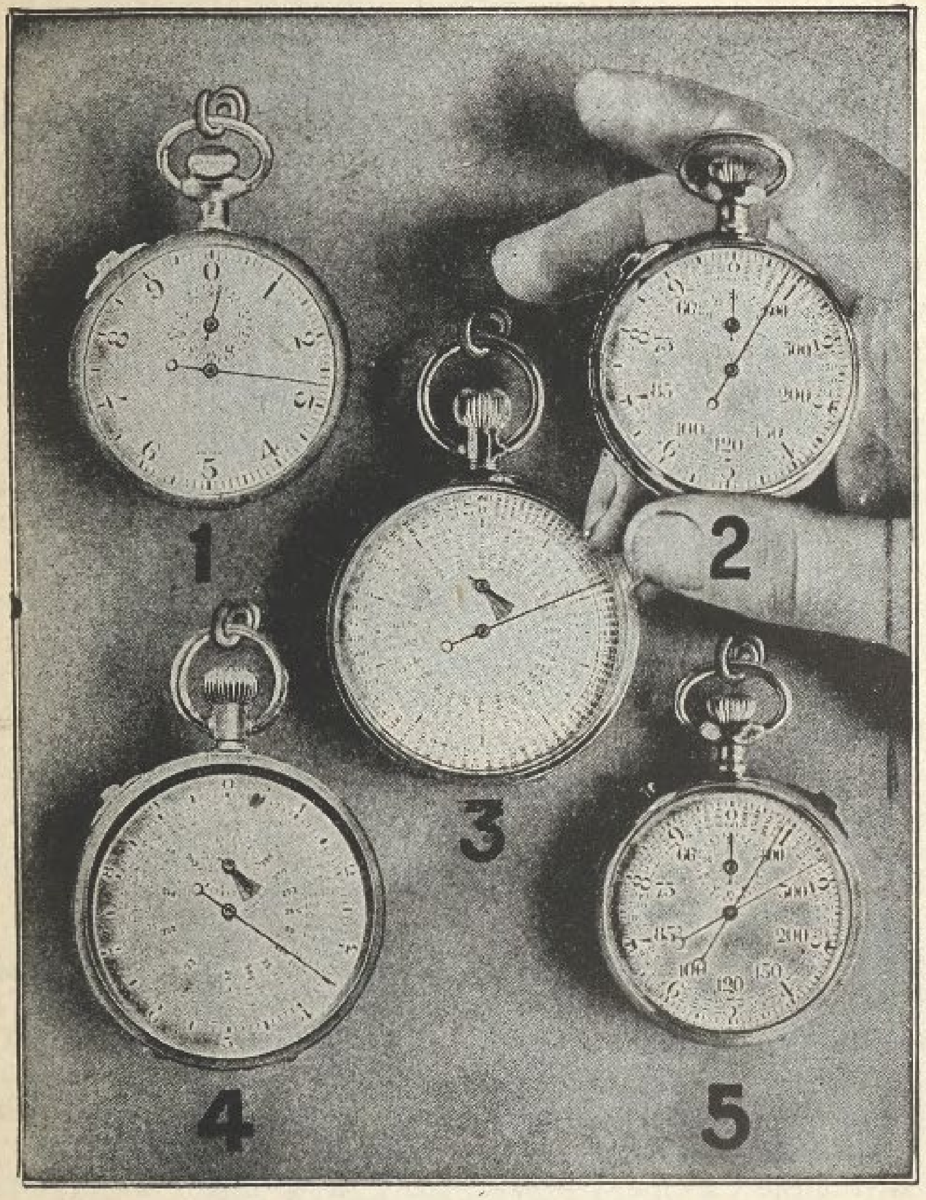
Adverts from 1923. Yes, time study is still applicable to every business -- even today. Don't limit the stopwatch to time study of workers. Use it to time study managers! Their productivity is horrendous. 😱 See https://bobemiliani.com/speed-leadership/

Time Study Never Goes Out of Style • Understand the Work Before You Improve It

TIME STUDY WATCHES

Applicable in Every Business



You can use any one of these watches for every kind of time study. But each has special features that facilitate certain types of work. No. 1 has a plain decimal dial with the "take out time" feature. No. 2 has, in addition, direct readings in production per hour up to 1 minute jobs. No. 3 carries the same readings up to 5 minute jobs, in seconds and half-seconds. No. 4 gives all readings in decimals and shows production figures up to 3 minute jobs with a special arrangement for timing jobs up to 30 minutes. No. 5 is the "split hand" watch with the "take out time" improvements which now permits careful studies of multiple operations and parts of operations.

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It holds the watch at the correct angle to prevent glare and insure accurate readings.

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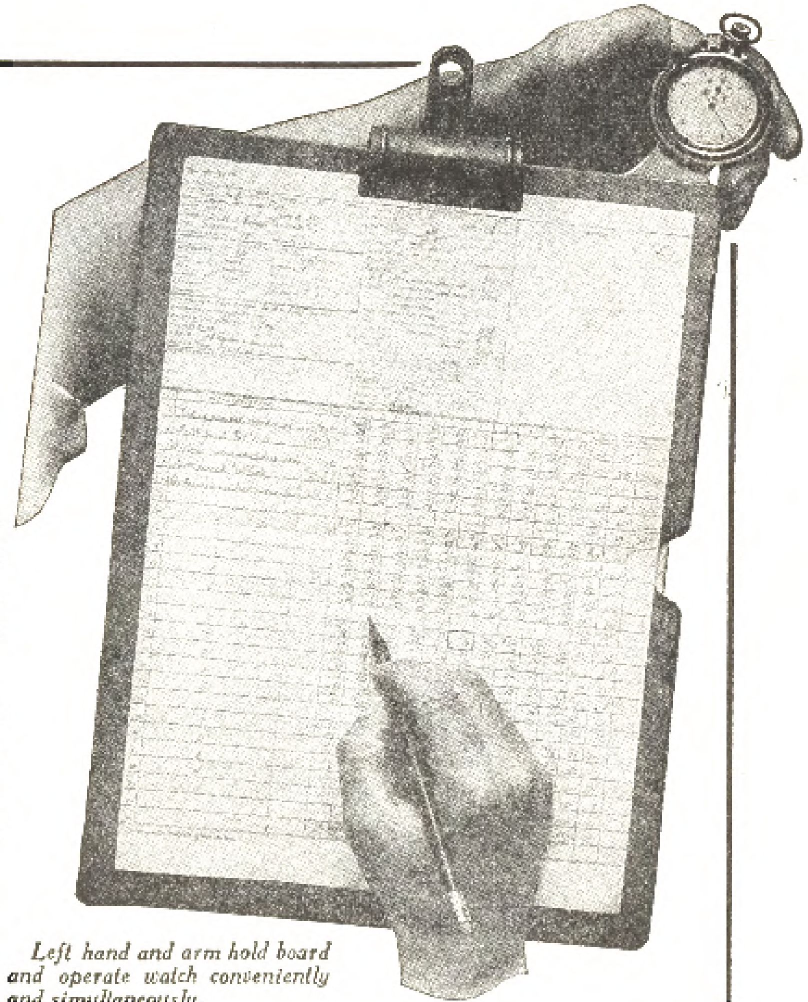

Left hand and arm hold board and operate watch conveniently and simultaneously.

The Data Filing Recess

provided by the space between the surfaces of the board enables the operator to have immediately available on the job all reference sheets such as tables of standards and eliminates necessity of referring to office files for such data when time studies are being made.

This board has been developed out of the personal experience of one of the leading time study engineers in the United States.

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33 N. STATE STREET Established 1877 **CHICAGO**

Image source: *Management*, July 1923, Vo. 21, No. 1 and No. 6

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Another blast from the past. From the 1920 volume of the trade magazine Factory. Does any of it ring true today in relation to Lean management? Yes! My comments are in yellow.

The Long History of Criticizing Scientific Management While Not Knowing What it Really Is

Scientific Management

Some International News on the Taylor System

FOR the first time in nearly two years the Taylor Society has held a meeting. At this meeting announcement was made of the establishment of a permanent office at 29 W. 39th St., New York. This office, according to the announcement, is to become a center of information on scientific management and to connect promising young men with managers seeking such men.

Industrial reconstruction in France seems to be stimulating French interest in scientific management and in industrial efficiency in the United States. During 1919, Dunod et Pinat (Paris), have published a French edition of Gilbreth's "Applied Motion Study," and Payot et Cie (Paris), have a French edition of C. B. Thompson's "Scientific Management." Dunod et Pinat have also published a collection of documents on Scientific Organization and the Taylor System, edited by J. Jaquin. Payot et Cie have a book by Etienne Flagey which presents the results of his personal investigation of industrial engineering in the United States.

A French engineer, P. Charpentier, has a new book "Industrial Organization," published by Dunod et Pinat in 1919. Chapter 6 is on the Taylor System.

There seems to be a feeling among the French at present that reforms in industrial management are the order of the day. Prior to 1914 the French paid little attention to scientific management.

The English attitude toward the Taylor System is still rather cold. A paper on Scientific Management read before the English Institute of Electrical Engineers at Manchester on December 16 resulted in several speakers disapproving of the system. The objections, as they appeared in the *Manchester Guardian*, all seem to indicate that the objectors had no comprehensive idea of what Scientific Management really is.

FACTORY *for* FEBRUARY 15, 1920

How Conservatism in Business Derails Progress in Management Thinking and Practice

Scientific Management

"Scientific Factory Management," a British Book

THE author of this book says that "whilst purposely abstaining from dipping too deeply into details, I have striven to fashion a framework of principles into a structure that will not only bear critical examination, but will also interest and inform." Further along he says "no one who has taken the trouble to acquaint himself with the development of industrial literature during the last dozen years or so can help recognizing the superiority of the American contributions over British." This second statement probably explains the first part of the first statement. Moreover, it may justify the author in filling his book with a review of what has been accomplished by scientific management in the United States, and, incidentally, by a goodly number of people who are not exactly of the Taylor school.

Speaking of his homeland the author says, "In this old country there are some of the best people God ever made—big, clean, straight men. Their main fault is conservatism; their great handicap is defective education; their chief obstacle the cursed conventions that cling like barnacles to the established order." The author's style may do something toward jarring this unfortunate situation.

He says that "antiquated forms of management are holding back British industry. Nor can we be greatly surprised. There are relatively few managers who have studied management in any other school than the University of Hard Knocks, and that is an extortionately wasteful institution. We in industry today should see to it that the country is provided with well-equipped training centers for our successors."

There is nothing new in the book, excepting the interesting sidelights that are thrown on English methods of factory management and the interesting interpretation made by the author of American men and conditions.

Denning, A. D. *Scientific Factory Management*. Nesbit and Company, Ltd. London. 1919.

FACTORY *for* APRIL 15, 1920

Weeding "Fakirs and Incompetents" Out of the Profession of Industrial Engineering

Scientific Management

The Ideal of an Industrial Engineer

THE business that "serves for profit instead of exacting profit, must be the new order of things. . . . . That creativeness, desire for self-expression, joy in accomplishment and pride in work well done, may be fostered within our people; steps must be taken to develop such facilities in the human as will make him more efficient as an individual and as a citizen, as for instance, concentration, interest, judgment, imagination, loyalty, initiative and energy.

"To render service and secure human development, the truth, absolute facts, must be known by all parties in industry. . . . . Management must be used wisely and well, the knowledge based upon facts properly compiled. . . . . The basis of the attainment of our object must be justice, a fair deal to capital, to labor and to management."

The industrial engineer must be better trained, he must pay more attention to the human than heretofore; fakirs and incompetents must be weeded out of the profession; industrial engineers must coordinate their policies and practises, take a larger part in public affairs and get closer to the workers in industry in order to correct many of the misconceptions in their minds.

Knoeppel, C. E. *Publications of the Society of Industrial Engineers*. Vol. III, No. 5. New York.

FACTORY *for* MAY 1, 1920

One Size Does Not Fit All Was Apparent 100 Years Ago

Scientific Management

Promulgation of Standards by the Taylor Society

ONE problem now before the Taylor Society, according to the author, is the promulgation of standards. This might result from a systematic pooling of the knowledge and experience of the members.

"Let us keep well in mind that the Taylor System is not synonymous with a set of forms and practises which can be put into print and enclosed between two covers, and then applied to every concern. It can't be done." The principles of the system are broad, and their application takes into consideration the individual problems of each plant.

FACTORY *for* JUNE 15, 1920

Professor Bob Emiliani

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A 1921 examination of management by Charles Knoeppel (1881-1936). Has much changed in 100 years? Learn why management traditions prevail https://bobemiliani.com/book/triumph-classical-management/

What is Management in Industry?

Placing the Blame and Fixing Responsibility

By C. E. KNOEPPEL

President, C. E. Knoeppel and Company, Inc.

WHEN the editor asked me to give him my idea of an answer to the question—"What is management in industry?" I felt that my views were sufficiently well crystallized to put them readily in writing, but it was only after a few quiet hours in my den that I fully realized there was much more to the question than I had thought. In a reflective attitude, and after a reminiscent journey through the "ins and outs" of a busy career, from laborer and moulder, to consultant in industrial engineering, I saw that my task was to point out, not what management is, but what it is *not*.

As I dreamed along in the silent processes of recalling and passing before my mind's eye the impressions of nearly twenty years, I discovered that I was really visualizing management from three different angles: first, as a worker; second, as a part of management; and third as a staff advisor to management.

An Arraignment of Management

Realizing the seriousness and the probable effect of what I am about to say, nevertheless my contacts with management from these three angles convince me that certain specific charges are in order, namely:

1. That 70 to 80 per cent of the inefficiency in industry has been due, and is now due, to the shortcomings of management.
2. That management has not realized, and does not now realize, that its shortcomings are the cause of our industrial inefficiency.
3. That management has not provided, and is not now providing, the wisest industrial leadership.
4. That management has not accepted, and is not now accepting, to the extent possible, the best staff advice obtainable on technical and managerial matters.
5. That management has not given, and does not now give, due consideration to the fact that it deals with efforts and human beings instead of materials and inanimate things.
6. That management has felt, and now feels, that workers, bankers, and politicians are responsible for the inefficiency of industry.

This I know is a bitter and vigorous arraignment of management, and by management I mean industrial executives from presidents to foremen; and as I said before I fully appreciate the significance of the charges and the possible extent of a backlash. But having thrown my "hat in the ring" it now becomes my task to demonstrate the soundness of these conclusions or, in other words, to take charge of the prosecution.

Granting that we may differ as regards the real and final purpose of industry, all will agree that it is the basic foundation of our civilized existence, and that the products of industry are the results of industrial activities, to the end that a complete life such as ours may be properly maintained.

What is the Product of Industry?

But in a larger sense the products of industry are not the physical things we see, like an automobile, a suit of clothes, a piano, or a box of candy, but the *time* of people; the hours and minutes of those from president to subordinates, foremen, workers, and laborers, whose joint efforts went into their making.

One may say that skill and effort go into the making of products. Quite so. But starting with a given time both skill and effort will decrease that time in proportion as they are separately applied, so that it may be said that time reflects both skill and effort. If workers, bankers, investors, executives, salesmen and users of all the products of industry will but visualize products as "time-composites" that is, simply as a sum total of hours and minutes reflecting skill and effort, a long step will have been taken toward common ground.

One may also say that a large part of what goes into a product of a plant is the material which it purchases. But what is that material? What does it represent? Is it not the hours and minutes of the respective plants that produce it? In the last analysis, therefore, is not any product a "time-result," even to the cutting of trees, the mining of copper or iron ore, the digging of coal, or the making of coke, or manufacturing brick? In other words is it not all human ability—skill and effort—measured in terms of 60 seconds to the minute, 60 minutes to the hour, and 24 hours to the day? Furthermore I care but little whether this time is consumed by a worker in a red shirt, an executive in a white collar, a laborer with calloused and dirty hands, or a clerk with well-kept fingers; for the fact still remains that production is the consumption of time necessary to convert ability into products, the same as coal is destroyed by burning, producing heat, and releasing gases and ash.

This is analogous to the principle of economics that consumption of goods is the destruction of wealth, and the production of goods the creation of wealth. We make that we may destroy and we destroy that we may make, or to put it in another way, industry in its broadest sense deals in conversions, and in exchanges of abilities expressed as time reflecting both skill and effort. Because we cannot therefore economically convert a small ability into a large one, or exchange a thousand hours of work for a hundred hours of work of equal skill and effort, the element of "time conservation" affects industry as does no other one factor.

Conservation really means utilization to the fullest extent, and as the products of industry are "time-results" the matter of time utility is the greatest issue before this country today, especially when we appreciate that there can be mental and physical wastes as well as those of natural resources.

Management Has Failed to Utilize Time

Such reasoning leads to the statement of an important industrial principle around which hinges my entire discussion. It is this—*Time, which reflects skill and effort, is a composite industrial result, the efficiency of which is increased as time is conserved through inducing greater effort or intensifying skill.* Measured against this principle management cannot be said to have made the industrial success commensurate with its ability and its resources. The parable of the talents comes to mind in considering management as rendering an account of its stewardship, and this admonition seems in order:

> For unto everyone that hath shall be given, and he shall have abundance; but from him that hath not shall be taken away even that which he hath.

It behooves management to wake up! To conserve effort! To stabilize! To intensify skill!

The above has been written coldly and dispassionately from my viewpoint as an engineer, of nearly twenty years contact with management, a contact which has resulted in an experience which has helped me to appreciate management's responsibilities, its opportunities, its talents, and, most important of all, its shortcomings. It may be said that I am dealing in abstract philosophy, in high-sounding theories; but even granting for the sake of argument that it is philosophy and theory, is there anything fallacious about the fundamental concept? If not, then my statement regarding management's failure to measure up to its opportunities is all I need prove to vindicate my original contention.

I desire first of all to put before industrial executives this question: Have you conserved to the fullest extent possible the time of your mental and physical workers, the time use of your equipment, tools, and facilities, the time use of your floor space, the time use of your materials in stock and in process, and of the money invested by you and in you? If your answer is "Yes," how will you explain away the enormous wastes in industry which we all know exist? How will you justify yourselves in shifting the blame to other shoulders, and who will you acknowledge, then, as the real leaders in industry whose task it is to conserve? You cannot, of course, answer "No," without admitting the charges I made at the outset.

Placing Blame and Responsibility

And now having raised a reasonable doubt in your minds, I am going to make it easy for you to place blame and responsibility where it properly belongs. Turn for a moment to Tables 1, 2, and 3 and check the items indicated in the proper column where you think responsibility rests.

TABLE 1. INDUSTRIAL TOOLS, FACTORS, AND FACILITIES

Factors	Check Responsibility in Proper Column		
	Executives or Management	Workers	Investors or Bankers
1. Plant location			
2. Plant layout			
3. Selection of equipment			
4. Arrangement of equipment			
5. Maintenance of equipment			
6. Shapes and angles of tools			
7. Forging and grinding of tools			
8. Limits and tolerances			
9. Feeds and cuts			
10. Speeds of machines			
11. Jigs and fixtures			
12. Prints and specifications of product			
13. Interchangeability of product			
14. Standardization of product			
15. Adaptability of product			
16. Design of product			
17. Supply of material			
18. Movement of material			
19. Planning order of work			
20. Inspection			
21. Facilities furnished workers			
22. Working conditions			
23. Providing finance			
24. Building up organization			
25. Providing methods			
26. Selling product			
27. Providing foreman			
28. Engaging workers			

What do the tables reveal, now that they have been checked? Let us probe a little deeper. It is a law of physics that action and reaction are equal. Can this law be applied to industry? It would seem so after a study of Fig. 1, which shows the fluctuation in the production of pig-iron and paper for the 17 years from 1903 to 1919. The questions to answer after reviewing this chart are: Who is responsible for the fluctuations? Who pays for the idleness below normal? Who finances it?

It is obvious that severe losses must naturally accompany the producing of goods below normal. It is also obvious that when producing at or above normal, high prices must be secured to make up for the losses sustained at these low points. It can further be seen from this study that a condition such as pictured, which spells an unstabilized condition in industry, can only mean instability in finance, as well as instability in labor.

My conviction, in fact my prophecy is, that labor is never going to be willing to do its full share in turning out quantity production and using labor-saving machinery to the fullest praticable extent until, through stabilization, we work normally in industry for longer periods, or more intensely, thereby reducing unemployment and seeking to equalize the excessive seasonal high and low demands for labor. And I cannot blame labor for its attitude.

To maintain the *Leviathan* in idleness in New York Harbor is costing our government $780,000 a year. What, then, must be the cost in industry yearly of idle machines, idle floor space, idle cars and locomotives, and idle workers, when operating below normal?

It is safe to say that the losses sustained below the normal line are sufficient to pay handsome profits and the highest wages if the swings could be eliminated.

If we produced pig-iron, coal, coke, plates, shapes, wire products, and other basic commodities in dull times, we would not have abnormally low prices, and we would have these products when the demand came, without the abnormally high prices. What would happen if all the grain elevators and the cold-storage plants of the country should suddenly be destroyed? Or to put it another way: What is to prevent us from handling basic commodities the same as we handle the products we grow or raise and place in elevators and cold-storage plants?

TABLE 2. KNOWLEDGE OF INDUSTRIAL ELEMENTS

Factors	Check Who Should Teach in Proper Column		
	Executives or Management	Workers	Investors or Bankers
1. Difficulties of financing.....			
2. Depreciation as an element of cost..............			
3. Overhead burden and its effect on costs............			
4. Net profits, as distinct from gross profits...........			
5. Economical purchasing.....			
6. Effect of credit policies on bad debt losses..........			
7. Effect of seasonal demand on output and costs........			
8. Effect of depression on business................			
9. Overproduction............			
10. Fear of labor saving machinery................			
11. Supply and demand........			
12. Inflation and deflation......			

Who Must Stabilize Industry?

Now, then, whose task is it to stabilize industry? Is it yours as industrial executives, or the task of the workers, or of the bankers? Surely the worker cannot be blamed for these things, for I myself know what it is, as a moulder, to go home in wet, dirty clothes, after losing my day's earnings through lack of training, or lack of proper direction, or lack of proper working conditions and facilities. Back in those years when I was earning my living with my hands, I made up my mind that a worker had a right to know three things:

1. What he was expected to do.
2. How long he ought to spend in doing it.
3. How much his earnings would be if he did it right and in the time set.

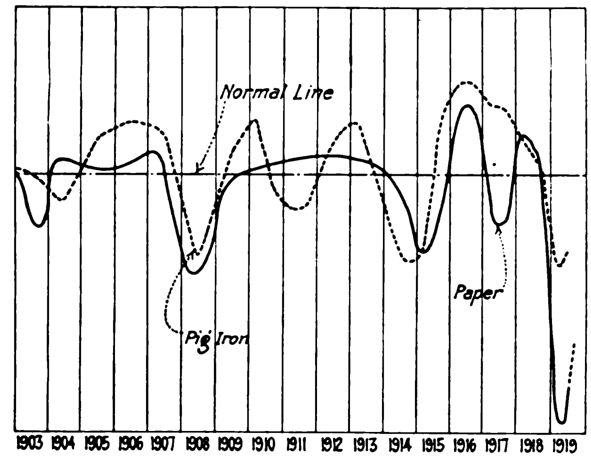


FIG. 1 THE INSTABILITY OF INDUSTRY AS SHOWN BY THE FLUCTUATION IN THE PRODUCTION OF PIG-IRON AND OF PAPER OVER A PERIOD OF 17 YEARS

Who were my teachers in those days? My fellow workers and the leaders of those workers, and who else could I have looked to when I had no control or direction over the tools and facilities of production, when I was unfamiliar with the elements of sound business, and when I was uneducated as to the principles underlying commerce and finance?

TABLE 3. CAUSES OF INDUSTRIAL INEFFICIENCY

Cause	Check Who is Responsible in Proper Column		
	Executives or Management	Workers	Investors or Bankers
1. Idle equipment............			
2. Unused floor space.........			
3. Faulty workmanship.......			
4. Defective materials.........			
5. Low production per hour....			
6. Too much work in process...			
7. Unbalanced inventories.....			
8. Too frequent changes in jobs			
9. High labor turnover........			
10. Untrained workers.........			
11. Lack of hourly standards...			
12. Not enough orders at times; too many at others......			
13. Running out of material....			
14. Fatigue of workers........			

Could I have looked to the owners of the business for enlightenment? No, because I distrusted them and doubted all their promises and my natural impulse was to fear them and this impulse was strengthened by the limitations and viewpoints of my mates.

Could I have looked to my foremen? No, because they scarcely knew more about such things than my fellow workers or I. Moreover, we could not blame a foreman for faults and shortcomings that were continued through no fault of his but which originated higher up and which he himself could not help.

It is perfectly natural that workers should first seek to obtain their education from within their own ranks. No influence is greater than the source of its authority, and influence in industry will therefore be from the worker upward or from the executive downward and it is going to mean a great deal to us in the future as regards the direction of this influence.

Can the investors or bankers be blamed for our industrial shortcomings? No, for they have no control over industrial activities in the way of direction. They work through a board of directors and executives. If on the board of directors, they act in advisory capacities, they formulate new plans and policies, they consider and vote for or against new proposals. But as directors, do they execute? Do they manage? If after leaving a directors' meeting, they actually carry out decisions of the directors, do they not do it as executives and not as directors? I am afraid management cannot brush the charges aside by a mere wave of the hand.

MANAGEMENT IS RESPONSIBLE FOR BUSINESS FAILURES

As additional evidence, however, showing what management is not, let me submit the reasons for failures as compiled by Bradstreet's. These are given as follows:

Incompetence	38.2 per cent.
Inexperience	5.6
Lack of capital	30.3
Unwise credits	1.3
Fraud	7.0
Failure of others	1.7
Extravagance	1.1
Neglect	1.7
Competition	1.1
Specific conditions	11.3
Speculation	0.7
Total	100.0 per cent

Incompetence and inexperience alone count for 43.8 per cent of the failures. If we add fraud, extravagance, neglect, and speculation, we have a total of 54.37 per cent, which can be directly traced to lack of ability, lack of education, or lack of experience, on the part of management. As regards lack of capital, case after case can be shown where wise and intelligent management has been able to secure ample financing. Money always goes where money can be made, the world over. This brings the total up to 84.67 per cent as being causes more or less within the control of management, and leaving 15.4 per cent of the causes beyond its control.

To give management a real conception of the possibilities ahead of it, as reflected by the extent of industrial inefficiency in this country, let us determine the factors in production and estimate their efficiencies.

There are four factors used in producing goods which can be reduced to a time basis, (1) workers, (2) machines, (3) plant as to duration and (4) materials. These are co-ordinated and used by or through industrial executives. Assume that the efficiency as to each is 50 per cent with a starting production of 100 units. Incease the workers' efficiency to 100 per cent and we will produce 200 units. Increase the machine efficiency to 100 per cent and we will produce 400 units. Increase the operation of the plant from 50 per cent to 100 per cent of its possible hours and we will produce 800 units. Increase the efficiency of material to 100 per cent and we will produce 1,600 units.

The starting production, 100 units, divided by the final production, 1600 units, equals 6.25 per cent, which shows that the final efficiency is not the *average* of the four efficiencies of 50 per cent each, but the product obtained by successively multiplying the four percentages.

WASTES REVEALED BY EFFICIENCY ESTIMATES

Table 4 is a statement of high, medium, and low efficiency estimates, and is worthy of careful study. From a study of the table it is apparent that whether productivity can be increased 164.5, 300.0, or 541.0 per cent, waste in all three cases is considered and equated as 100 per cent, which charges management with responsibility for industrial inefficiencies or waste to the extent of 67.6, 69.5, or 70.7 per cent, or in round figures 70 per cent. In preparing these figures it was considered that of the worker's inefficiency, one-half was within control and the other half within the control of management. Of the plant idleness, it was considered that one-half was caused by strikes within the control of the workers, and the other half due to lack of orders, within the control of management, as stabilization will mean more uniform orders and less unemployment.

From the figures above submitted the prosecution here states that management has not been an efficient co-ordinator; it has not been an industrial educator to the extent possible; it has not given us wise industrial leadership; it has not accepted the best staff advice obtainable; it has not properly planned the basis for efficient action; it has not supplied the best foremanship; it has not stabilized industry to the extent that must come; it has not provided solutions for industrial clash and warfare. Will labor unions do these things? Will employers' associations? Will bankers or investors? The answer is an obvious "No," for their viewpoint is restricted and one-sided.

But management sees all sides and works with all groups, therefore management should do these things, can, and must do them, because it is best fitted to do so, from the standpoint of vision and constructive imagination, from training and experience, resources and facilities, and from opportunities which exist or which can be made. And yet unless management does actually take over the real direction of industrial affairs, and unless it provides the wise leadership necessary *some other group will.*

A PROGRAM FOR MANAGEMENT

But feeling confident that there is enough good sense, constructive vision, and executive ability in the ranks of management, to incline it to the first course, and realizing that this criticism should be constructive in its conclusion, let me outline in passing sentence upon management a program and plan of action.

1. Management should use the "looking glass" on itself, very carefully indeed, before deciding on any course of action.

2. Management should consider the logic of the assertion that troubles at the bottom are but a reflection of weaknesses at the top.

3. Management must realize that industry is not alone a profit-making and wage-paying mechanism, but a mechanism set up due to our progress through the ages, to serve the wants of mankind, and consequently a mechanism of service paying good profits and high wages.

4. Management must accept the advice and constructive plans of competent industrial engineers, as advisers and counselors to executives, because of their training and ability to reason and work things out in terms of causes, and effects of facts. In advising management in the future the engineer must become as great a factor as have been the banker and lawyer in the past.

5. Management must furnish a much wiser leadership in industry, because it is the logical and natural co-ordinator of the hour of the worker and the dollar of the investor. To do this it must prepare itself to qualify for this leadership by greater study of industrial matters and by acquiring the habit of looking at all sides of the industrial question.

6. Management must develop a plan of education which will give the workers a new and clear perspective, which will serve to disabuse their minds as regards the fallacies they now believe. To this end executives, and their neighbors who are executives, should hold informal meetings to which workmen should be invited. At these meetings there should be addresses by economists, engineers, big business men, and workers, using the "movies" wherever possible, especially in showing results and relationships in graphic form.

7. Management must also provide:
   - (*a*) Better organization which gives due consideration to directing, formulating, planning, serving and doing
   - (*b*) Knowledge of standard hourly productions
   - (*c*) Means of currently and graphically comparing actual hourly results with attainable standards
   - (*d*) Proper planning and routing of work
   - (*e*) Comprehensive and accurate cost data
   - (*f*) Standardized working conditions

TABLE 4. EXTENT OF AND RESPONSIBILITY FOR INDUSTRIAL INEFFICIENCY

Element	Low Estimate					Medium Estimate					High Estimate				
			Responsibility					Responsibility					Responsibility		
	Efficiency Per Cent	Waste Per Cent	Calling Waste 100 Per Cent	Management	Men	Efficiency Per Cent	Waste Per Cent	Calling Waste 100 Per Cent	Management	Men	Efficiency Per Cent	Waste Per Cent	Calling Waste 100 Per Cent	Management	Men
Workers	50	50	34.5	17.2	17.3	60	40	34.8	17.4	17.4	70	30	35.3	17.6	17.7
Machines	60	40	27.6	27.6		70	30	26.1	26.1		80	20	23.5	23.5	
Plants as to Time Operated (Idleness due to strikes and no orders)	65	35	24.0	12.0	12.0	70	30	26.1	13.0	13.1	75	25	29.4	14.7	14.7
Material	80	20	13.9	13.9		85	15	13.0	13.0		90	10	11.8	11.8	
End Efficiency	15.6					25					37.8				
Waste	84.4					75					62.2				
Possible Efficiency	100					100					100				
Increase in Productivity if Possible Efficiency Could Be Reached	541.0					300.0					164.5				
Total of Wastes		145					115					85			
Equating Wastes to 100 Per Cent (Wastes ÷ Total of Wastes)			100					100					100		
Responsibility of Management and Men for Waste				70.7	29.3				69.5	30.5				67.6	32.4
Ratio of Responsibility as Between Management and Men				2.41	to 1				2.27	to 1				2.09	to 1

(g) Proper compensation in proportion to effort and skill

8. Management should consider advantages to be gained from such factors as:

(a) A research laboratory and a corps of experts to put in the best methods of manufacture
(b) A drafting-room for jigs, temples, special tools, and the like
(c) A field force to study what other manufacturers are doing
(d) A department to study industrial relations
(e) A department to study production rates, methods of planning and routing, what should be paid, bonus and incentive plans and the like.

9. Management must furnish a better degree of foremanship than it has; a trained foremanship, a foremanship made up of leaders, not drivers, who can inspire their following.

10. Management must also provide ways and means whereby workers can have a voice in discussing questions affecting their welfare. The particular plan chosen is less important than frank acceptance of this principle. Labor is becoming a factor of ever-increasing importance and is seeking a new status for itself. If management decides to "get back at labor," without regard to the new order of things, then management is in for trouble.

THE OPEN SHOP AND THE LABOR UNIONS

The open shop agitation is a modern industrial scarecrow and affects employers and labor leaders as the proverbial red rag does the bull.

If the open shop means an equal opportunity for a worker to sell his labor in the best market, without prejudice on the one hand or intimidation on the other, then it is squarely in line with sound public policy and as such the public is behind it solidly. But if it means discrimination by the employer against any worker who persists in his trade union membership, so long as the labor union policy remains clearly American, then such discrimination is unwarranted, un-American, and unsafe for industry.

If the labor unions propose to stand in an arbitrary manner behind the applicant when he seeks work; if labor proposes to force the employer to engage him regardless of his competency; if labor insists on standards of performance lower than can be demonstrated as attainable without injury to worker, then the shoe is on the other foot and the risk of insecurity and inefficiency of industry settles upon the shoulders of labor.

There is no doubt that among many employers the open shop means a closed and exclusively non-union shop. On the other hand there are scheming agitators manipulating honest workers for their own selfish ends, in demanding a strictly closed shop. Both terms are misnomers.

The right thinking employers and labor leaders want a "free" shop; free from intimidations, discriminations, abuse, incompetency, loafing, driving tactics, threats and destructive measures. They want a "wide open shop;" open to opportunity, to ability, to skill, to effort, to willingness to produce, and to bargaining in the best markets. And management had better take steps during 1921 to make its shops "free and wide open."

11. Management must determine and adopt ways and means to stabilize industry, to make the flow of work more uniform throughout the year, to get away from the high and low production peaks, thereby avoiding sharp price swings either upward or downward. In so doing it will do more to stabilize finance and labor than any other means will accomplish. In the manufacture of glass, candy, macaroni, and other diverse lines, stabilization has been worked out. It can be done with profit in other lines, especially as to stable and basic commodities. Storage space and financing will be necessary, but these were supplied in the case of grain elevators and cold-storage plants.

12. And finally, management must take steps to develop a scientific relation between costs and prices, for in most cases, there is no relation between costs and prices in industry as at present conducted. In too many cases, costs loaded with inefficiencies determine prices, whereas prices should reflect normal plant capacities, normal overheads, normal hourly productions, and normal profits. Management must provide the machinery for showing profits and losses due to volume, profits and losses due to purchases, as separate and distinct from profits and losses due to operation and selling.

The twelve points outlined constitute a real program indeed, but my study of the subject since thinking about and attempting to answer the editor's question, inclines me to the conviction that no single one of them can be ignored.

RESPONSIBILITY CANNOT BE SHIRKED

The pressing needs of the moment demand a full consideration of my charges, the arguments advanced to support them, and the constructive program advanced. What industry will be for a generation to come depends on what management does this year and next year. Its responsibility is an enormous one; one that simply must not be shirked.

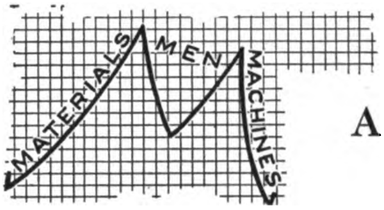
In closing let me say this to the industrial executive: You are the "thinker in business," and leadership must come from those who can plan, organize, and put ideas into effective action. You are the one who can best influence the thoughts and actions of those under you, as they look to you for guidance, advice, counsel, and wise decisions. You are the only one to educate and train, because all the resources for so doing are in your hands. Disagree with me all you want to, but make this analysis serve as the basis for plotting the new course of management for the future, to the end that industry may be made efficient, stable, and productive.

Dare you do anything else than assume full responsibility for the conditions of tomorrow?

Professor Bob Emiliani

Please visit bobemiliani.com

"Plus ça change, plus c'est la même chose" ["the more things change, the more they stay the same"] - Jean-Baptiste Alphonse Karr (1848). Learn why https://bobemiliani.com/book/triumph-classical-management/



Management*

A Review of Ten Years' Progress

By L. P. ALFORD
Editor, MANAGEMENT ENGINEERING

TEN years have passed since the Committee report on The Present State of the Art of Industrial Management was presented to The American Society of Mechanical Engineers. The request is now made for a review of the progress of management during the intervening decade. Unfortunately for the purpose of such a study, eight of these ten years were abnormal, many of the management changes and innovations introduced were of a temporary nature or were mere expedients, and it is difficult to separate them from other and more permanent developments.

The only satisfactory way to treat the review is to base it upon the report of 1912, which was well received and, in large measure, approved. This course has therefore been adopted.

To obtain information on the worth-while changes which have taken place, letters were written to management and industrial engineers, to executives of plants in various lines of industry, and to educators familiar with industrial developments. Many interviews were held with men having industrial and managerial responsibilities. The response to these requests has been most generous. The author is deeply indebted for the information received, and expresses his sincere gratitude to all who have given aid.

The report of 1912 declared the new element in management to be: "The mental attitude that consciously applies the transference of skill to all the activities of industry." It also quoted[1] and endorsed three regulative principles:

1. The systematic use of experience
2. The economic control of effort
3. The promotion of personal effectiveness

New interpretations and expanded meanings have been given to these principles, but they have in nowise been weakened or superseded. One correspondent writes: "Note, for example, the nearly universal acceptance of the principles . . ."

In answer to the question "What steps have been made in the progress of management since 1912?" a wide range of opinion was expressed, as shown by the following sixteen quotations from correspondents' letters. The first gives a particularly well-balanced judgment of the situation:

It seems to me that management has very definitely progressed in the last ten years along certain main lines.

In the first place, good management is more insistent today on knowledge as a basis of judgment, rather than the old judgment based on personal observation. Management is more and more demanding costs, a knowledge of inventories, monthly profit and loss statements, statistics, and records of all kinds as pictures of events on which to base judgment.

In the second place, management is now undergoing a definite metamorphosis in the matter of industrial relations, and managers are waking up to the fact, as a practical element in their business, that they owe more to their employees than mere wages, and that whistle blow and hustle are not all there is to factory operation.

It is this belief and the spirit developing, rather than the volume of the action up to date, which is a matter of very definite progress in the past ten years of management.

Ten opinions, three to the effect that management has retrogressed or made little or limited progress, and seven stating the belief that progress has been made, and mentioning certain details of improvement, are grouped to present a contrasting though, in the main, favorable picture:

1. Management (the directing group) has retrogressed in its acceptance of the principles of management, while labor has materially progressed toward a broader acceptance of these principles.
2. I believe that very little progress has been made in the adoption of scientific management principles in industries outside of metal working with a few notable exceptions.
3. The main advance, and that lamentably slow, has been in putting into practice knowledge already available previous to 1912.
4. During the past ten years we have passed through the period of first glamour, then the reaction of a loss of confidence, and have finally evolved into the general recognition of the legitimate place of a new branch of engineering art and science—management engineering.
5. The important steps in progress in management during the past ten years have been from unintelligent rule-of-thumb management through scientific management to intelligent management. The latter has advanced steadily during the decade.
6. The greatest progressive step has been toward standarization of appliances and methods.
7. The most definite progress made during the past ten years is the universal acceptance of the merits of specialized production and standardization of design. These two steps have opened the way to a third simplification of method.
8. The reaction from destruction and waste incident to warfare and reconstruction has been toward the elimination of waste in industry as a management function. Waste in all forms has been more closely observed than hitherto, especially during the past two years. This effort to do away with waste has led to the fixing of budgets and the determination of cost standards.
9. Important steps in the progress of management since 1912 are:
   (a) Greater use of facts in the establishment of the standards by which business is conducted
   (b) Broader recognition of the principle that industry exists for service to humanity
   (c) Greater appreciation of the importance of regularization or control in the successful conduct of our industries

* Presented before the joint meetings of the A.S.M.E., S.I.E. and Taylor Society during Management Week in New York City, Meriden, Conn.; Elizabeth, N. J.; Birmingham, Ala., and Davenport, Iowa, slightly condensed.

[1] *American Machinist,* vol. 36, p. 857, "The Principles of Management," by Church and Alford.

(d) Wider understanding of the economic value and importance of the management engineer in the operation of business.

10. There has been a great increase in the use of specifications not only to govern purchased materials but also to attain uniformity of process, quality and cost, and thus to insure reliability of product. Many plants now have well-equipped laboratories staffed by scientific men and some regularly employ consulting scientists. In the larger corporations research laboratories are not uncommon. Few of these departments are over ten years old and they evidence a rapidly growing appreciation of pure science as a tool of management.
11. The need of early and reliable figures as a mechanism of management has caused many companies to prepare monthly a complete statement of their business and earnings. A constantly increasing number of companies are publishing annually a detailed statement of their financial condition, and many are publishing such statements quarterly. This voluntary publicity indicates a sincerity and frankness, rare in management, of an earlier decade.

The final quotations in regard to progress, five in number, discriminate between management form and substance. Progress is indicated in both of these aspects:

1. The biggest and most lasting accomplishment in the inculcation of management principles is that, like religious teaching whose significance has been forgotten during years of prosperity, and again in the years of depression following the war, they developed a new significance in the minds of the thoughtful. A principle is not established in the actual social inheritance of the race—as a step forward—until man has applied it to himself and seen whether its application makes him a better man in his social relations. So management principles are being used as yard-sticks to measure individual industrial development. This means that these principles are becoming a subconscious part of the mental equipment of industry, and not only is this real progress, it is fundamental.
2. The development and use of the Gantt chart is the most important step of progress, because it calls attention to the movement of facts, to the necessity of basing decisions on facts rather than on opinions, and because it helps managers to foresee future happenings.

   A second important step is the change in the method of installation from the old type, which organized from the top down to the new type which builds from the bottom up.

   A third important step is the development of the theory that the cost of an article includes only those expenses actually incurred in the production of the article, and that the expenses of maintaining one machine in idleness cannot be charged into the cost of the output of another machine. Along with this theory came the development of a method of arriving at costs of idleness and work.
3. Probably the greatest progress consists in a better understanding of the problems of management with a particular acceptance of the facts to which Taylor called attention, that management is an art which may be practiced advantageously through the application of certain principles and the scientific method. I do not think, as yet, that the great majority of men at the head of industries have anything like an adequate understanding of scientific management, nor that they are able to distinguish between form and substance in this respect. They have, however, apparently emerged from the attitude of opposition and mistrust of so-called scientific management, but are satisfied with a superficial application of the principles of management.
4. The important steps of progress made in management since 1912, I would say, are as follows. The order in which they are named is not significant:

   (a) A greater appreciation of the human factor in industry
   (b) The growing recognition that employees should have a voice in the management as relating to those questions that directly affect them.
   (c) The recognition of the strategic position of shop foremen and the necessity of more carefully selecting and training them
   (d) The increased recognition of the value of fundamental principles
   (e) The recognition of, and in a large degree the adoption of, standard systems of cost accounting from the point of view of timeliness, as a barometer rather than history, as an instrument of production rather than a matter of finance
   (f) A great development in mechanical equipment, combined with improved plant layout and building plants to fit manufacturing process
   (g) A marked advance in sales policies
   (h) A marked advance in substituting the trained, competent engineer for the old "cut-and-dry" type of executive
5. Using figures, which, after all, are most impressive, but basing those figures purely on my impressions, I would say that since 1912 industry has progressed in management by some 30 to 40 per cent in the appreciation of the fact that there is a management problem aside from the old concept, which was that the owner had simply to censor the things that happened within his jurisdiction. I should say that there had been a 20 to 25 per cent endeavor to install the mechanisms of management, considering in this figure the generally known stores systems, operation studies, wage-incentive plans, etc. In some cases, as for instance in stores control, the percentage might run a great deal higher, but I am refraining from increasing my estimate, for it is my belief that these mechanisms that we have installed are, for the most part, of a makeshift character, and that in industry, as a whole, and considering only the larger companies, I doubt if more than five or six per cent are possessed of mechanisms at all acceptable in the final scheme of what management should do and possess.

   As to the real concept existing today of what management is, and what conditions must be considered, influenced, and co-ordinated to bring about the situation which should exist, I doubt if more than one-fifth or one-fourth of one per cent of the companies in this country possess a knowledge or even appreciation of what is real management.

Combining and weighing these carefully prepared statements and adding to them certain well-recognized facts, there emerges a group of factors of varying importance which mark the progress of management during the past decade. These naturally fall into 3 groups, of which the first concerns changes in mental attitude:

1. The ancient controversy as to whether management is a science or an art has subsided, with increased recognition of the scientific basis of management.
2. The attitude of opposition and mistrust toward management and the passionate antagonism to the installation of management methods have, in general, disappeared.
3. Among those responsible for the carrying on of industry there has grown an appreciation of the existence of problems of management. (The appointment of Herbert Hoover as Secretary of Commerce and General Dawes as Director of the Budget reflect an appreciation by the government of the need for management in our national affairs.)
4. Acceptance of the principles of management has broadened among engineers, executives in industry, and educators.

The second group of factors of progress concerns the application of management methods:

1. The engineering or scientific method has extended in industrial cost accounting. Among the developments are uniform coast-accounting systems, the theory and method of determining and applying standard costs, the methods of determining idleness losses, forecasting of sales leading to long-term production schedules, and the budgeting of future expenditures.
2. Appreciation of the possibilities and advantages of standardization, simplification, and elimination of waste has spread rapidly during the past two years.
3. The demand for knowledge, facts, as a basis for judgment has grown insistent in all good management. This has led, among other developments, to a widespread use of specifications and graphics as a means of recording and communicating management knowledge. (The first modern book on graphics in the English language was published as recently as 1910. The Gantt-type control chart has been developed into its present form since 1917.)
4. Management methods have been applied or installed in practically every manufacturing industry, in distributing concerns and in institutions.

The third and final group of these factors concerns especially significant developments, which, after being stated, are subject to explanation and comment.

1. Management activities have broadened far beyond the installation of those mechanisms which are usually associated with the Taylor System, and which were emphasized in the report of 1912.
2. Some eight or ten of the leading American engineering schools have established courses in management since 1912.
3. Appreciation of the importance of the human factor in industry and attempts at its study from a fact basis have been the most striking management development.
4. Management engineers have declared that the service motive must prevail in industry and that all questions concerning human relationship must be considered in a spirit devoid of arbitrariness or autocratic feeling.

MANAGEMENT MECHANISMS

To secure information as to the use of management mechanisms, the question was asked—What (if any) mechanisms of management do you consider as generally accepted (*a*) in principles, (*b*) in practice? From correspondents' replies the following thirteen quotations have been selected:

1. I do not think that any mechanisms of management are as yet generally accepted either in practice or in principle.

2. I do not believe that any of the mechanisms of management are generally accepted in principle or in practice.

3. I know also that even where some of these things (mechanisms of management) have been established and we hear about them and might conclude that the firm using one or more of them is quite advanced, it often is not at all so. The feature described is only an unrelated "stunt," not supported by a complete co-ordinated system of administration and usually begins to go to pieces not long after it is installed.

4. There is at the present time a retrograde movement in regard to the building up of stores and making operation studies. However, as I see it, this is merely a temporary depression in the curve, and I believe that the general tendency of this curve is upward with a very slow ascending grade.

Incentive wage-payment plans have had a temporary setback due to labor conditions caused by the war and to the reluctance of managers, in general, to consider such plans in any other light but of profit to the company. I do not think that the main service, which the incentive plan can give—namely, that of stabilizing relations between employers and employees—has been given sufficient attention by the management.

5. I believe that such mechanisms as balance of stores, routing, operation studies, incentive wage plans, personnel work, etc., are generally accepted in principle, but that efforts to install them frequently (perhaps most of the time) miscarry, and either accomplish little or no good. This is often due to a failure to see to it that details connected with the mechanism are fully understood and looked after.

6. In a general way, the mechanisms of management are widely accepted now in principle and much less widely in practice.

7. Undoubtedly, good storeskeeping is becoming very generally accepted. We know that unless we keep accurate records of the materials used we cannot get the most satisfactory results. I think storeskeeping is accepted both in principle and practice as well as the intelligent study of operations.

8. I believe that balance of stores is accepted in principle and in practice, that is, in so far as a written record of quantities in stores is kept in the office rather than in a storesroom, and that a minimum or order point is predetermined and an order placed when it is reached. It is generally accepted in principle, though not in fact, that an incentive wage-payment plan is desirable and effective. It is accepted in principle that facts are shown on charts better than in tables of figures.

9. In principle, undoubtedly, all of the main mechanisms of management have been thoroughly established.

10. In a great measure all of the mechanisms of management, as developed by Taylor and his immediate associates, have been generally accepted in principle. But while they are being widely applied, my impression is that, in the great majority of the cases, the application is half-baked in character and the results, while they may be satisfactory to the companies concerned, are far from being so satisfactory as they should be, either to the management or to the employees. My experience indicates that in most such cases an application, such as Taylor would have approved, will almost invariably result in increased production ranging from 30 to 100 per cent or more, depending on the nature of the business.

11. The following management mechanisms have been accepted in varying degrees:

Stores Control. In principle and practice very generally.

Operation Standardization. (*a*) In technical aspects, generally in principle, fairly so in practice. (*b*) In personal aspects fairly accepted in principle, to a limited extent in practice. [By (*a*) I mean speeds, feeds, equipment, tools, etc.; by (*b*) motion and time studies of human elements.]

Wage-Payment Incentives. Generally in principle and in practice so far as indirect labor is concerned. But little application has been made to indirect labor.

Cost Accounting. Generally accepted both in principle and practice.
Selection and Training of Employees. Fairly well accepted as to principle, but little in practice.
Purchasing Control. Generally as to both principle and practice.
Scheduling and Planning. Fairly well accepted in principle. Limited in practice in some industries, well established in others.

12. I find mechanisms being accepted one by one—in short, a full realization of the part they are to play in the scheme as a whole. That is to say, I will find a company suddenly appreciative of the value of operation studies. It will thereupon proceed to organize to make operation studies, and for the time being in its new enthusiasm it pursues what threatens to become a hobby rather than a part of its business. This pursuit at times leads into the installation of other mechanisms. It begins to recognize, from the operation of studies, that a balance of stores is essential, and that a wage incentive is desirable. I find, however, that this progress is accidental rather than planned.

13. Mechanisms of management, such as are discussed in the 1912 Report, are generally accepted in principle, but poorly carried out in practice in the majority of establishments. On the other hand, a few, representing the best organizations, have developed these things to a degree which serves as a valuable guide.

Planning and control are used more and more extensively in plant operation. The tendency of the majority, however, is to try to gain the benefits of more intensive control through partial makeshifts which record past accomplishments instead of actually planning the work. The importance of control, in fact, in increasing production through elimination of idle time, men, and machinery, is not yet recognized except in a few markedly successful establishments. The developments along these lines are being undertaken frequently through inexperienced, low-grade men, who adopt mechanisms as such, instead of developing existing methods on fundamental principles.

Balance of stores is accepted almost universally in principle and widely used in practice. Accountants have been quick to recognize its advantages, and have made it an essential part of their accounting mechanism. On the other hand, two of the most vital features for assisting in the control of production the column of "stores apportioned" and the entering of "minimum" quantities of each item permissible, are apt to be omitted.

The development of time study and job analysis, while widespread, has been unsatisfactory; piece rates are more and more universal, but their determination is still largely on a basis of past performance, aided by time studies which simply record these performances in more detail instead of analyzing the operations and determining the methods and units which will give most satisfactory results. There is still lack of appreciation of the fact that the chief aims of time study and job analysis must be:

1. To resolve the operations into such units that they can be recombined to provide for all variables
2. To take advantage of this unit study to eliminate unnecessary operations, substitute improved methods, and remove defects in equipment and in control
3. To enable the workman to earn more money, often with less effort
4. To indicate means for improvement in quality and practicable methods for making the improved quality routine

To these statements of the acceptance of management mechanisms it is possible to add a few quantitative facts. It will be recalled that the field reports of six industries, given in the Report of the Committee on the Elimination of Waste in Industry of the Federated American Engineering Societies, were based on an extensive questionnaire. The replies in four of these industries—metal trades, boot and shoe manufacturing, men's ready-to-wear clothing manufacturing, and printing—have been studied to show the use of mechanisms of management. The facts brought forth are presented in Tables 1 to 6, inclusive. Table 1 records the results for 16 metal trades plants where the entire questionnaire was used; Table 2 is from 12 metal trades plants where a condensed questionnaire was used; Table 3 is from 8 boot and shoe shops; Table 4 is from 9 men's ready-to-wear clothing shops; Table 5 is from 6 printing establishments; Table 6 is a summary for the 51 plants studied.

Turning to Table 6 and arranging the eight mechanisms in the order of the number of plants in which they are installed *in some form,* we have:

Selection and Placement
Incentive Wage Plan
Balance of Stores
Purchase Control
Cost Control
Planning (routing, scheduling)
Time Study
Idle-Time Analysis

TABLE I. REPORT OF THE RESULTS FOR SIXTEEN METAL TRADE PLANTS [1]

Name of Industry: Metal Trades. No. of Questionnaires: 16

Mechanisms of Management	None	Inadequate	Good	Quest Reference
1. Selection and placement..	0	6	10	K7
2. Incentive wage plan......	2	6	8	K13
3. Planning centralized:	3	8	5	U4
(a) Routing, order of work	5	6	5	U4.9
(b) Schedules, machine assignments..........	4	5	7	U5.6.h
4. Time study............	6	2	8	U4.ef
5. Cost control............	4	3	9	U7
6. Idle time analysis:				
(a) Men...............	13	0	3	U8
(b) Machines...........	9	1	6	U3
7. Purchase control........	3	4	9	U11
8. Balance of stores........	2	4	10	U11, 12

[1] The wide diversity in kinds of work, varying from machine-shop to shipyards, must be borne in mind, also a wide variation in size of plants.

TABLE 2. REPORT OF TWELVE METAL TRADES PLANTS WHERE A CONDENSED QUESTIONNAIRE WAS USED[1]

Name of Industry: Metal Trades. No. of Questionnaires: 12

Mechanisms of Management	None	Inadequate	Good	Quest Reference
1. Selection and placement..	0	4	8	No. 10
2. Incentive wage plan......	1	3	8	No. 13
3. Planning centralized:	1	2	9	No. 19
(a) Routing, order of work	2	2	8	No. 19
(b) Schedules, machine assignments..........	1	3	8	No. 19
4. Time study............	2	1	9	No. 19
5. Cost control............	2	6	4	No. 18
6. Idle time analysis:				No. 22
(a) Men...............	8	0	4	
(b) Machines...........	6	0	6	
7. Purchase control[2]........	1	1	10	No. 4
8. Balance of stores........	1	1	10	No. 4

[1]This is additional information from 12 plants assayed more briefly than the 16 of Table 1. A condensed questionnaire was used.
[2]Purchase Control *as such* was not covered in the condensed questionnaire, but this estimate was based on the general stock and stores systems; whether there were maxima and minima in stores, and a control of raw material all through.

Rearranging in the order of the number of plants where the installation is *good*, we have:

Balance of Stores
Incentive Wage Plan
Purchase Control
Selection and Placement
Planning (routing, scheduling)
Time Study
Cost Control
Idle-Time Analysis

The weight of opinion and fact brings the conclusion that certain mechanisms of management have made

TABLE 3. REPORT OF EIGHT BOOT AND SHOE SHOPS

Name of Industry: Boot and Shoe Mfg. No. of Questionnaires: 8

Mechanisms of Management	None	Inadequate	Good	Quest Reference
1. Selection and placement[1]	0	6	2	K7
2. Incentive wage plan[2]	0	0	8	K13
3. Planning centralized:	4	0	4	U4
(*a*) Routing, order of work	4	1	3	U4, g
(*b*) Schedules, machine assignments	3	3	2	U5, 6, h
4. Time study	5	2	1	U4, 3, f
5. Cost control	1	3	4	U7
6. Idle time analysis:				
(*a*) Men	7	1	0	U8
(*b*) Machines	7	1	0	U3
7. Purchase control	1	4	3	U11
8. Balance of stores	1	1	6	U11, 12

[1]Not important, as skilled operatives are always available.
[2]Union control very strong in this industry.

TABLE 4. REPORT OF NINE MEN'S READY-TO-WEAR CLOTHING SHOPS

Name of Industry: Men's Ready-to-Wear Clothing Mfg. No. of Questionnaires: 9

Mechanisms of Management	None	Inadequate	Good	Quest Reference
1. Selection and placement[1]	0	4	5	K7
2. Incentive wage plan[1]	4	2	3	K13
3. Planning centralized:	4	2	3	U4
(*a*) Routing, order of work	4	2	3	U49
(*b*) Schedules, machine assignments	3	2	4	U5, 6h K13
4. Time study	3	3	3	U4, ef
5. Cost control	2	5	2	......
6. Idle time analysis:				
(*a*) Men	6	3	0	U8
(*b*) Machines	8	1	0	U3
7. Purchase control	3	1	5	U11
8. Balance of stores	3	1	5	U11, 12

[1]See footnotes Table 3.

decided headway in acceptance, both in principle and from an assay of four industries the importance of application yields two groups:

1. Balance of Stores
   Incentive Wage Plan
   Purchase Control
   Selection and Placement
2. Cost Control — Planning
   Idle-Time Analysis — Time Study

In the installation of such mechanisms a significant change is becoming evident. In the early days of management the mechanisms concerned the physical means of production. They were originated by the executives and were ordered into the shop.

At a later date, as emphasized in the report of 1912, the value of methods which concerned the worker was appreciated. Training was the first to have any wide-

TABLE 5. REPORT OF SIX PRINTING ESTABLISHMENTS

Name of Industry: Printing. No. of Questionnaires: 6

Mechanisms of Management	None	Inadequate	Good	Quest Reference
1. Selection and placement[1]	0	5	1	K7
2. Incentive wage plan[1]	1	1	4	K13
3. Planning centralized:	3	2	1	U4
(*a*) Routing, order of work	5	0	1	U4g
(*b*) Schedules, machine assignments	3	2	1	U5, 6, h
4. Time study	5	0	1	U4,
5. Cost control	3	2	1	U7
6. Idle time analysis:				
(*a*) Men	5	0	1	U8
(*b*) Machines	2	0	3	U3
7. Purchase control	3	2	1	U11
8. Balance of stores	4	1	1	U11, 12

[1]See footnotes Table 3.

TABLE 6. SUMMARY FOR THE FIFTY-ONE PLANTS STUDIED, FOUR INDUSTRIES

Mechanisms of Management	Boot and Shoe. No. of Plants 8			Men's R. M. Clothing 9			Printing. No. of Plants 6			Metal Trades. No. of Plants 28			Totals 51 Plants		
	No c	Inadequate	Good	None	Inadequate	Good	None	Inadequate	Good	None	Inadequate	Good	None	Inadequate	Good
1. Selection and placement	0	6	2	0	4	5	0	5	1	0	10	18	0	25	26
2. Incentive wage plan	0	0	8	4	2	3	1	1	4	3	9	16	8	12	31
3. Planning centralized	4	0	4	4	2	3	3	2	1	4	10	14	15	14	22
(*a*) Routing, order of work	4	1	3	4	2	3	5	0	1	7	8	13	20	11	20
(*b*) Scheduling, machine assignments	3	3	2	3	2	4	3	2	1	5	8	15	14	15	22
4. Time study	5	2	1	3	3	3	5	0	1	8	3	17	21	8	22
5. Cost control	1	3	4	2	5	2	3	2	1	6	9	13	12	19	20
6. Idle time analysis															
(*a*) Men	7	1	0	6	3	0	5	0	1	21	0	7	39	4	8
(*b*) Machines	7	1	0	8	1	0	3	0	3	15	1	12	33	3	15
7. Purchase control	1	4	3	3	1	5	3	2	1	4	5	19	11	12	28
8. Balance of stores	1	1	6	3	1	5	4	1	1	3	5	20	11	8	32

spread trial. But the attitude was still the developing or forcing of a mechanism from the top downward.

Within the decade under review, another attitude has been adopted in a few instances. It seeks to make the foremen and even the workers consciously parties to the development of the plans before they are put into effect. It endeavors to arouse interest, to inspire achievement, to release creative energy. Its effect is to install methods and mechanisms from the bottom upward with celerity and improvement in personnel relations.

THE HUMAN FACTOR IN INDUSTRY

The report of 1912 presented the human factor in industry, with particular emphasis on the responsibility of managers and executives to train their workers, and the same thought was prominent in the discussion. According to the comment of the Committee in its closure, one of the striking characteristics which had already gripped attention was "the presence throughout the discussion of a human spirit in keeping with the best trend of thought toward social justice," and "the development that has taken place within the last few years leading to a new appreciation of the needs and rights of employees."

Henry P. Kendall, in his discussion of the report,[2] outlined the operation of an employment department which he had initiated. The employment man interviewed applicants, selected workers by tests, placed them in positions for which they were fitted, required medical examinations, kept records of each employee, kept in touch with the foremen in regard to the department skill and earning power of the employees, had charge of discipline and discharge, and gave advice, suggestions, and sympathy to the workers.

These disclosures in outline foreshadowed a great wave of industrial relations work which swept through American industry after the outbreak of war. The movement received its impetus from the demand for workers in a time of extreme shortage, and was influenced by emotionalism and social theory. With the return of a labor surplus in 1921 the unsound features have disappeared, leaving but vestiges of the methods and devices which were initiated in such profusion.

The present situation as regards personnel work is appreciation that personnel problems exist, recognition that their solution is a responsibility of management, and a growing realization that job analysis, selection, placement, and training can be put on a scientific basis.

THE RISE OF WORKS COUNCILS

Associated in thought, though not necessarily a part of any employment or industrial relations plan, is the rise of works councils in American industry. Several hundred have been established during the past decade. In August, 1919, there were 225; in February, 1922, approximately 725.[3] Their development has been in response to a desire on the part of the workers for a means of expressing their beliefs and wishes in regard to matters arising in employment, and on the part of the management for a means of communicating with their employees and gaining and holding their confidence and good-will. The movement but emphasizes the fact that the development of the relationships of employer and employed is a responsibility of management.

Management engineers, as a group, have declared that the service motive must prevail in industry, that everything planned and done must be directed to securing the worthy result of producing useful goods with a minimum expenditure of time, material, and human effort. One of the clearest statements was written by Henry L. Gantt a few weeks before his death:[4]

> We have proved in many places that the doctrine of service, which has been preached in the churches as religion, is not only good economics and eminently practical, but because of the increased production of goods obtained by it, promises to lead us safely through the maze of confusion into which we seem to be headed, and to give us that industrial democracy which alone can afford a basis for industrial peace.

This disinterested purpose has been accepted as an ideal for the entire engineering profession, by becoming the challenging thought in the preamble to the constitution of the Federated American Engineering Societies.

Within the last two years joint activities have been originated among these and other societies, with promise of benefits to all who are connected with management. Included are: Development of a management literature; standardization of management graphics; and development of methods for the measurement of management.

MANAGEMENT RESULTS

The report of 1912 stated that the results of good management had been: "A reduced cost of product, greater promptness in delivery, with the ability to set and meet dates of shipment; a greater output per worker per day with increased wages; and an improvement in the contentment of the workers." There was no evidence at that time that goods had been reduced in price to the consumer.

To a degree this evidence has now been supplied. There are examples where good management has held down prices during a period of inflation, and reduced prices as soon as business conditions changed. These acts benefited the consumer. Therefore the management movement has earned its economic justification.

Management, as developed through a generation of effort, stands today as a great body of knowledge and practice, to facilitate the operation of industry and the conduct of business. Through organization it determines policies, plans basically over long periods of time, and fixes impersonal relationships; through preparation it plans in detail how, when, and by whom work is to be done; through direction it initiates and maintains the processes of production and distribution.

Here, then, is a tremendous, hitherto unknown engineering tool. What is it for? The twofold answer is a spur to every engineering and industrial executive.

Industry and business, as developed in modern civilization, must continue, else infinite misery will overtake the human race. Management is the agency by which community, state, and nation shall endure.

[2] Trans. Am. Soc. M. E., volume 34, p. 1208.

[3] See Reports of the National Industrial Conference Board.

[4] "Organizing for Work," p. 104.

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Professor Bob Emiliani

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From the August 1921 issue of Management Engineering (Volume 1, No. 2, page 104). Few people realize that the modern origins of "management" comes from mechanical engineers. See this LinkedIn post https://lnkd.in/dViHJd3

A Definition of Management

At the organization meeting of the Management Division of The American Society of Mechanical Engineers, held in July, 1920, a request was made for a definition of management, and for a statement of the object or purpose of the newly organized functional group of the Society. The Executive Committee of the Division met these requests in its annual report, as follows:

"The first sentence of the preamble of the constitution of The Federated American Engineering Societies presents a definition of management as a part of a broad definition of engineering, and taking that concept and expanding the language in which it was expressed, we have this definition of management itself:

> "Management is the art and science of preparing, organizing and directing human effort applied to control the forces and to utilize the materials of nature for the benefit of man.

"An interpretation of this definition amid the present needs of engineering and industry brings the belief that dissemination of the knowledge of management will increase and enlarge the many benefits which applied science has already brought to the human race, and thus it leads us to the following statement of the purpose or object of the Management Division:

"Inasmuch as the problems of management are of the utmost complexity and difficulty, the Management Division of The American Society of Mechanical Engineers in seeking to render disinterested service, therefore declares its purpose to be the formulation and declaration of the fundamentals of management, both regulative principles and accepted practice, and the dissemination of management knowledge.

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Lots to learn from management history! This short 1913 paper by Morris Cooke, a close associate of Frederick Winslow Taylor, is for the Scientific Management haters and anti-Taylor bigots, and especially for those who think TPS and its derivative, Lean, stand independently of the innovations made by those who gave us Scientific Management and industrial engineering. Learn more about Morris Cooke https://en.wikipedia.org/wiki/Morris_Llewellyn_Cooke

THE JOURNAL

OF

POLITICAL ECONOMY

VOLUME 21 June 1913 NUMBER 6

THE SPIRIT AND SOCIAL SIGNIFICANCE OF SCIENTIFIC MANAGEMENT

In discussing the spirit underlying such a movement as scientific management, there is a danger of getting off into the realms of the unpractical, and of looking so far ahead as to take away from the present-day value of what may be said. That danger has been kept fully in mind in the preparation of this paper; and, therefore, although at times the statements which are here made may seem a little utopian or visionary, it may be asserted that there are establishments in this country today operating under conditions which approximate those described.

Scientific management has nothing to sell. Scientific management is not something which can be bought in a box. It is not something in the nature of a drug that one takes, and feels better. It is not a card index. It is dependent upon no single mechanism. Nor is it a combination of any number of mechanisms. It is not a system of keeping costs, as our friends in the printing industry sometimes think. Nor is it a method of paying wages, as members of the engineering profession have sometimes held.

We wish to try to remove honest doubts. Those of us who know something of the movement feel a call to add constantly to the number of the recruits who believe in the economic soundness of scientific management and in its ultimate and general adoption. But we do not feel that it is necessary that everybody who hears about it should become a convert to it. There are undoubtedly a great many men and concerns the world over who are better off without scientific management. Therefore our function must be to point out what are its principles and why we believe they must necessarily be effective in increasing production.

In order to have no misunderstanding, let us admit at the start that there is relatively little scientific management anywhere. Even if from 50,000 to 100,000 men are working under its principles, almost 100 per cent of the workers and managers of this country must still be without what is technically known as scientific management. Dean Gay, the head of the Graduate School of Business Administration at Harvard, said several years ago that he estimated it would require two generations for the principles to become at all generally accepted or the methods to be in vogue in any large part of the industrial field. How could it be otherwise? Work has been going on continuously in the metal-working trades for over thirty years, yet there are today relatively few machine-shops organized in such a way as to measure up to the established standards. We have been working for nearly a decade in the printing industry, yet those who know most about what has been accomplished in this field also recognize most distinctly how much farther we shall have to travel before the industry will be affected in any large way. Even if the application of the principles of scientific management is all worked out for a given type of undertaking it is no easy task to introduce these methods into another and similar establishment. As our industries are organized today, not one establishment in ten can have scientific management because not one in ten is willing to live by law. The fact that it is something difficult to attain must be admitted, but that is, of course, no argument against it, because nothing worth having in life comes except by struggle.

This movement fortunately has long since been put on an international basis. Mr. Taylor's works have been translated into French, German, Italian, Dutch, Russian, Lettish, Spanish, and Japanese. There are some establishments in most of these countries in which real progress in scientific management is being made. Better still in most foreign countries one or more prominent citizens—usually of the engineering profession—are advocating the adoption of scientific management as a means toward national progress.

Up to about two years ago there was practically no interest in scientific management. Even in Philadelphia—the home of Frederick W. Taylor, who first formulated and published the fundamental principles on which this science is founded—it was only within strictly technical circles and among his own friends that anything was known of this man, his work, and the great movement he had originated; one which, in the opinion of many of those most competent to judge, will ultimately affect the lives of all men and women. Up to two years ago I do not remember to have seen more than one reference to scientific management in the daily press. It seemed practically impossible to get a hearing for scientific management, except from isolated individuals, who were forced to it on account of the necessities of some particular business or industry in which they happened to be interested.

Since the rate hearing before the Interstate Commerce Commission in Washington, two years ago last November, all this is changed. Mr. Brandeis, in quoting from Mr. Emerson's book on *Efficiency*, the assertion that under scientific management the railroads could save $1,000,000 a day, seemed to afford the average man something definite upon which to speculate. This discussion had doubtless been imminent for some time, and if it had not been precipitated in connection with the work of the railroads, it would have been brought on, sooner or later, in connection with the work of government or some other line of human endeavor. To my mind, it is simply another indication of the passing of what may be called the "craft spirit" in human affairs, and the rise of the scientific spirit, with its broader outlook and its more substantial footing. In the old days of handwork, most of the improvement in the product was directly attributable to progress made by individual workmen. So also in the industrial régime, which some of us think is passing, the improvement in the product is due very largely to progress made within the individual industry.

What I have called the "craft spirit" has sought to accentuate the differences between the chemistry of railroading and the chemistry of bookmaking, for instance. The scientific spirit, while not ignoring the essential differences in the application of a science to different industries, lays its greatest stress on the essential similarities. A railroad machine-shop, a machine-shop in a navy yard, and a machine-shop connected with an industrial establishment, are all viewed by their owners as radically different rather than as essentially similar: simply because the owners are laying stress on the elements in which their shops *are* different. As a matter of fact, an analysis of the factors which go to make up such establishments will show that they are exact counterparts of one another, over, let us say, 95 per cent of their field. This percentage might easily be higher, and it is rarely lower. Therefore, in the future, I take it, the individual industry will look beyond its own borders for help. Scientific management asks of the paper-maker, the college professor, the government official, and the ironmaster that each drop his craft spirit and take on as much as he can of the scientific spirit. Scientific management asks the same of the railroads. All the railroads' problems cannot be solved by railroad men; at least many of them can be solved better by men not solely engaged on railroad work, or men whose training has been obtained, in part at least, in other than railroad work.

In our colleges we teach our engineering students about the strength of materials, the mechanics of materials, and the economy of materials; but we are only beginning to teach them something as to the strength of men, the mechanics of men, the spirit of men; in a word, the economy of men. It is just beginning to dawn on us that there is a philosophy and an art and a science of human labor, with laws as definite as those of any other science. To this science we have given the name "management," and to distinguish it from something else, which in the industrial world has been called management, we call it "scientific management." That this conception is novel may be inferred from the fact that in the German language there are no equivalents even for "management" and "efficiency," and when it came to translating Mr. Taylor's last book into German the translator was forced to use the English words for "scientific management."

What are the ends to be obtained by management? In answering this question Mr. Taylor has pointed out in convincing fashion the futility of considering dividends as in any way a gauge, or even as the direct object of management. He gives two supreme ends toward which everything that is good in management must tend: (1) high wages coupled with low labor cost, and (2) maximum prosperity for all. These are the agencies through which our productive power will grow and ultimately reach its maximum. And it is only through heightened production that the dream of the race will be realized.

Fortunately for us, political economy reflects the best opinion of the modern world when it includes among the legitimate objects of production such items as the "benefits one derives from living in a certain place at a certain time; civil and military security; access to places of amusement and instruction"; bodily health; and even more substantive things, such as music or works of art, or the higher concepts of the mathematician or the man of letters. To have this in mind is essential in any study of our subject, because so many considerations enter into management when it is taken scientifically which either do not affect the balance sheet at all, or affect it adversely. We operate our businesses *to make money* largely because the making of money has been considered one of the best gauges by which the output and the efficiency of the management could be measured. *Production* is really what we are trying to get, and the earning—certainly the declaring of dividends—may from any economic standpoint mean absolutely nothing as to the efficiency of the management. Under certain forms of semi-military industrial control, it is possible, for instance, to get human beings to work twelve hours a day and seven days a week, at a killing pace and for a very low wage. Even this scheme does not always result in dividends, but even if it did we can all be profoundly thankful that it must be considered uneconomic in America today.

What we want in any industrial or other establishment, if we are to reach the highest point in productivity, is to have every individual use his or her highest powers to the best advantage. This is the final goal of scientific management. It is the goal both for the individual and for society. If you can picture a society in which every unit is using his or her highest faculties to the best advantage, you will see that it approximates the millennium.

The moment you adopt this as a standard, however, you must frame your organization so that every employee from the humblest to the highest is given a chance to exercise his highest powers and to exercise them to the best advantage. He must not only not be hindered but he must be helped, and helped to the extent of having pointed out and developed faculties and powers of which he may have been unaware. Under scientific management we think we are learning how to do this. Alfred Marshall has called attention to the fact that perhaps half the brains of the world are in the so-called working classes and that "of this a great part is fruitless for want of opportunity." Under the new methods of scientific management this great storehouse of wealth will be tapped, not we hope for the benefit of the few, but for the benefit of all.

To define scientific management is no easy task. Hugo Diemer, professor of industrial engineering at Pennsylvania State College, says, in a recent book, that Mr. Taylor

considers a manufacturing establishment just as one would an intricate machine. He analyzes each process into its ultimate simple elements and compares each of these simplest steps or processes with an ideal or perfect condition. He then makes all due allowances for rational and practical conditions and establishes an attainable commercial standard for every step. The next process is that of attaining, continuously, the standard, involving both quality and the interlocking, or assembling, of all of these primal elements into a well-arranged, well-built, smooth-running machine.

Mr. Taylor says that the philosophy of scientific management is embraced under these four principles:

First: The development of a science in place of "rule of thumb" for each *element* of the work.

Second: The scientific selection and training of the workman.

Third: The bringing of science and the scientifically trained workman together through the co-operation of the management with the man.

Fourth: An almost equal division of the work and the responsibility between the management and the workmen, the management taking over all work for which they are better fitted than the workmen, while in the past almost all of the work, and the greater part of the responsibility, were thrown upon the workmen.

Quite informally, scientific management may be thus defined:

a) It is a definite working policy applicable wherever human effort is put forth.

b) It is the introduction of the laboratory method in everyday affairs.

c) It is the acceptance of the dictates of science instead of those of personal opinion and tradition.

d) It is the establishment of the fact that not to know is no crime—that the crime is not being willing to find out.

e) It is a type of co-operation more intensive than the world has yet seen.

f) It is filling in—not bridging—the chasm between capital and labor.

g) It is making our industrial life square up with the best we know in our personal and social relations.

h) It involves a very radical change in the attitude both of the men and the management to the work on which they are mutually engaged.

My task is not to deal with the technique which grows out of the adoption of Mr. Taylor's four principles. It is rather to reflect the spirit in which they must be applied if they are to be true agents of efficiency, and then to show how when they are so applied they enhance the joy of living.

Practically everything that is done in developing scientific management in an establishment has for its object the setting of tasks. We have tried to avoid the use of this short and, to some, rather disagreeable sounding word, but the language does not seem to afford one that better describes what we have in mind. A task with us is simply a fair day's work and—let us not forget—one which can be repeated day in and day out, year in and year out, if necessary, without detriment to the physical, mental, and moral well-being of the person performing it. Unless you are able to set tasks, you cannot have scientific management. Now, to set a task requires more than a stop-watch. Before the stop-watch, or before any of the other mechanisms that are found useful in management, comes the building-up of a spirit of mutual confidence and helpfulness. To make my meaning entirely clear, let me say that we never use a stop-watch on an employee except practically at his own request. I do not mean that we wait until the request is framed in so many words, because a good many people on whom we have used a stop-watch with a mutually satisfactory result cannot speak our language. Some of those who can speak our language might *think* the request, without the ability to formulate it in words. Anyone who arbitrarily uses a stop-watch, or any other such mechanism, for getting more work out of an employee, without having in mind that employee's greatest prosperity, and without doing it as much, or more, for the benefit of the employee than for anyone else, is a menace to society.

This place which the stop-watch has in scientific management simply illustrates our attitude toward the workers. We are all workers from the president of the company to the office-boy and the porter, and each one has to be individualized. You cannot have scientific management in one part of an establishment and not have it practically throughout. You cannot have one group of employees impose it on another group. You cannot have "fake" co-operation. To have the president of the company hold that his personal opinions and whims are to be taken into consideration, but that the vice-president and all the rest are to live by law, is to have an unworkable proposition. We do not ask anybody to accept our personal opinions, nor will we accept those of others. Facts must determine each question as it comes up. If you haven't the facts you must get them, whether they can be secured in five minutes at no expense, or whether it takes thirty years and the expenditure of hundreds of thousands of dollars, as it did in the case of the development of the slide rules for machine tools.

I have said that scientific management means the individualizing of the workers, and herein lies the heart of its social significance. As long as William Smith and Molly Brown are simply two units in a group of two hundred, one thousand, or five thousand employees, the individuality and individual welfare of these two workers is of very little moment. When, however, you set out to get from an industrial establishment its maximum production, made up as it is of the maximum production of all the William Smiths and all the Molly Browns, you will never get it unless you study each of them individually.

You must see in the first place that the rewards for high efficiency are not only full, fair, and accurate, but that they follow satisfactory completion of the work in the shortest possible time. It is not enough, as is the case in the profit-sharing plan, to have it come as a bonus at Christmas, twelve months after some of the work was done. Nor does it make for efficiency that Smith gets his whether he had any share in bringing about the result or not. The average job under scientific management takes about three hours to perform. The worker must receive his or her reward for a job efficiently performed within twenty-four hours of its completion. To bring this about requires a type of co-operation and a degree of co-operation that will come only as the result of the most farsighted and kindly interrelation between the different individuals who make up an industrial or other establishment. It is not the kind of co-operation that you get up in a selling force by bringing the men together in a room and filling them full of enthusiasm for increased sales. It can be brought about only after years of effort and following constantly a policy of something more than the square deal. Any effort to introduce scientific management in the absence of a genuine and painstaking co-operative spirit is utterly impracticable.

Scientific management must be relentless in seeing that each worker receives his or her reward and only for work efficiently performed. We must regulate the benefits according to the services rendered. Any system that tries to average up rewards is doomed to failure. At the same time it is the constant aim of scientific management to organize itself so as to be able to help, in the broadest fashion, those who are temporarily or permanently below the average, to be as largely productive as such farsighted assistance can make them. Yet this is not welfare work we are discussing. It is something so immeasurably superior to the best grades of welfare work that the two cannot be compared. It is something that is entirely self-supporting because it really means something to the workers.

Again, scientific management demands the entire elimination of the military system of control. The military system, of course, we inherit from the days when everybody had to "fight for it." It was designed in order to mass one's greatest strength at a given place at a given moment of time. An industrial establishment is not operated for this purpose. What we are trying to bring about in industrial establishments is a steady, even flow of work, done under the minimum of tension and with the least possible discomfort and disorder. We find that to do work under these conditions the military system has no place and that we must functionalize. Under the functional system a man can take orders from more than one person; in fact, most of our work people take direct orders from eight different people, known as functional foremen. Let me show this by describing that functional foreman whose work illustrates my part of this subject perhaps better than any other. We call him the shop disciplinarian. Under scientific management only one man in the establishment has the authority to discipline employees and he disciplines anyone who may need it. The beautiful part of this is that after you have your disciplinarian appointed and the shop reasonably well organized on scientific management lines, the disciplinarian rarely has anything to do. The reason why he has nothing to do is that after he has been at work for any length of time it gets to be "good form" in the shop not to give him any work. The workman who is uncivil to his mates loses standing. As long as the military system is in control, the man who has the rank usually administers more or less discipline to everybody underneath him and this develops resentment and reaction. Altercations are frequent. With the military system it is usually the under dog that gets discharged. After the disciplinarian is installed and you issue instructions that when two workers get at loggerheads they are to send for him, it seems to take all the fun out of it. The disciplinarian is picked because he has good judgment and knows how to smooth out difficulties. In other words, he is a specialist.

Functional management leads ultimately to the democratization of our industries. Whether it be in the city or in the state or in the nation, we are finding out that democracy will not work with a few men controlling all operations, no matter how competent, farsighted, and amiable the few may be. Democracy in government means not only the rule of the people but the participation by the people in their government in the largest possible fashion.

In an industrial establishment the doing-away with the military control, and especially the functionalizing, makes every worker share, according to his ability, in the conduct of affairs. In other words, after scientific management has been introduced, the shop is run by the collective intelligence of the many, rather than under the "I say so" of those who, in the language of the day, own the business. Under this scheme the employees become more attached to a business. There are infrequent changes in the personnel and this aids very materially in wise administration.

After you have individualized your employees you are not entirely without interest in what they do when they are not at work. It is the experience of every man who has set tasks and watched any considerable number of workers perform them, that sometimes they fail to earn their reward, which we call the bonus, and yet no reason for this can be found in the shop. Nine times out of ten you will find a sick child or wife at home, the worker in debt, or some other purely personal reason for working below par. Working without the closest spirit of confidence and co-operation, no opportunity is afforded for finding out these sources of inefficiency. On the other hand, it is only after your organization is working under the conditions of an industrial family that it becomes almost impossible not to know that this man or woman is in debt, that another has sickness at home, or has some other cause of anxiety.

Then you will find that there are a hundred and one kinds of questions which you ask employees before hiring them that you never thought of asking before. There are under this kind of relationship a hundred and one things that you have in your mind as possibly affecting your employees that you never gave thought to before. I can take you to cotton mills in New England where they hardly stop the machinery when a man loses his arm and where the level of morality among employees of both sexes is at a very low ebb. Compare this with a scientifically managed plant, where it is almost as hard to hide sickness and distress as it would be in your own families. It is the duty of an industrial family—not necessarily of the one individual whom we call the employer—to see to it that the level of morality is high and always going higher. This makes for individual efficiency and prosperity; and we are finding out more clearly every day that group prosperity is not possible, without individual prosperity. High wages there must be, but high wages must be accompanied by efficiency or they will avail but little.

Any establishment in which scientific management is being developed must necessarily be an educational institution. If you individualize your employees you must let them rise as far as their physique and mentality will permit. You cannot have annoyed and disaffected employees. We have only two classes of people. There are always those who have reached the limit of their capacity and know it and want to be let alone, fully realizing that they are better off working for you than they could possibly be working for anyone else. The only other group are those who are growing, those who have not yet reached their full capacity. These you must help in every possible way, and if their line of best advancement does not lie within your establishment you must make it one of your most important duties to see to it that they get this chance for advancement somewhere else. Here is one of my principal criticisms of railroad management. The railroads are especially likely to have a third class of people, who have never had what they consider a chance—men who have advanced so far and then have stood still for no reason upon which you can lay your finger. These men feel, whether rightly or wrongly, that they have within them the possibilities of further growth. These men are invariably "against the government," and are a source of weakness in any organization. Something is wrong here. Either they were badly selected or they have been badly trained, or some time since they should have been given a chance elsewhere. Perhaps it is a little of all three.

This paper would be incomplete did I not refer to the attitude of scientific management toward criticism. My eyes were opened to the novelty of our position toward constructive criticism by the way in which my report on *Academic and Industrial Efficiency* was received by the colleges, and more recently by the attitude taken by the railroad world toward scientific management. We feel that everybody in the establishment, from the office-boy up—and those out of the establishment for that matter—should be given the widest opportunity for making suggestions and criticisms. Suggestions that are in any way adopted should be fairly compensated for. The truth is that after scientific management has made any material progress in a plant it becomes increasingly difficult for those not making a special study of any given matter to make suggestions in regard to it. This does not change our attitude toward the desirability of constructive criticism. We are on our knees begging for it, and the man or the woman who takes the trouble to criticize us most freely and frequently is our best friend. It is a far cry from this attitude toward that which obtains in many establishments—I suppose in the majority of establishments—where an employee is liable to be discharged for constantly making suggestions. We do not see in constructive criticism any of the elements of fault-finding. Surely until we are willing to face the truth in our industries, let it come from where it will, we cannot even begin to allege that we are being scientifically managed.

I have said that scientific management is not something that can be bought in a box. Nor can you lay it on like a suit of clothes. You do not "get it" as we are told one gets certain varieties of religious experience. The truth of the matter is that scientific management *gets you*. If one could casually introduce scientific management in an establishment, much as one would introduce a system of bookkeeping, it would hardly warrant our giving it very much attention. Scientific management can be developed in any group of people only through a course of individual and collective discipline that must last over a long period of years.

Finally, let me say that there is nothing to prevent scientific management from becoming a nuisance—even a menace—in an industrial community. But the same criticism can be made of democracy—even of Christianity—if either is allowed to drift from a genuine purpose or into the hands of charlatans. In my opinion, we shall never fully realize either the visions of Christianity or the dreams of democracy until the principles of scientific management have permeated every nook and cranny of the working world.

MORRIS L. COOKE

PHILADELPHIA

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Professor Bob Emiliani
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This was the understanding of waste 100 years ago. "Management has the greatest opportunity and hence responsibility for eliminating waste in industry." Learn why most managers don't see eliminating waste as either an opportunity or their responsibility. See https://bobemiliani.com/book/triumph-classical-management/

The Elimination of Waste in Industry

An Abstract of the Summary Report of a Special Committee of American Engineering Council

The first investigation under the direction of the American Engineering Council was a study into the wastes and restrictions in industry. This was suggested by Herbert Hoover at the time of his inauguration as President of the American Engineering Council. A committee of eighteen engineers was appointed in January, 1921, and a summary of their report was presented to the Executive Board of the Council on June 3. The final report was approved and released for publication on July 15. It is a document of about 140,000 words, divided into three sections: the first, the summary report of the committee as a whole; the second, the reports of the engineers who made field investigations; the third, statistical reports giving a general background for the recommendations offered. As a general interest will center on the summary report this alone has been abstracted below. The matter omitted has been largely cumulative evidence and explanation. The eighteen engineers who form the committee are: J. Parke Channing, chairman; L. W. Wallace, vice-chairman; L. P. Alford, George D. Babcock, Wm. R. Basset, F. G. Coburn, Morris L. Cooke, Harrington Emerson, Ira N. Hollis, Herbert Hoover, Edward Eyre Hunt, C. E. Knoeppel, Robt. Linton, Fred J. Miller, H. V. R. Scheel, Sanford E. Thompson, John H. Williams, Robert B. Wolf.

IN making the studies upon which this report is based and in preparing the report itself there has been no purpose or desire to place blame upon any individual, group, or class. It is believed that the wastes revealed are the inevitable result of methods, tactics, practices, and relationships of long standing in industry, and the committee has merely desired to indicate the main opportunities for eliminating waste and to show whose opportunity or responsibility it may be to adopt proper measures for such elimination.

No attempt has been made to write an academic definition of waste or to speculate in regard to ultimate savings. For the purpose of this report no attempt has been made to consider all economic wastes. Rather, in the committee's investigations industrial waste has been thought of as that part of the material, time, and human effort expended in production represented by the difference between the average attainments on one hand and the performance actually attained on the other as revealed by the detailed reports. In assaying waste in industry the committee has undertaken to evaluate this difference. The limitations of the study are indicated in the following tabulation:

Branch of Industry	No. of Plants Investigated	No. of Plants Furnishing Additional Information
Building Industry	73	33
Men's Ready Made Clothing Manufacturing	9	..
Boot and Shoe Manufacturing	8	34
Printing	6	19
Metal Trades	16	17
Textile Manufacturing	13	..

Each engineer who made a field investigation was thoroughly acquainted with the industry he studied and the choice of the facts to be presented, and the deductions drawn from those facts were made by him on the basis of his expert knowledge and the composite experience and knowledge of the entire committee.

Plan of Study, Questionnaire, Evaluation Sheet

The plan of study followed in each of these six branches of industry was this:

At the outset the members of the committee prepared an analysis of those factors and operations in industry in which waste might be expected to be discovered, provided a comparison was made between average practice and the best known practice. From this analysis a trial questionnaire was prepared to secure information and quantitative data to permit of comparing the record of one plant with another. This trial questionnaire was then used in making a study of one plant in each industry. The results of these trial studies were then brought together, compared, reviewed by the committee and, as a result, a revised questionnaire and an evaluation sheet were prepared, to be used in making the final field studies.

The individual reports forming the third section of this complete report differ in character from the field studies, inasmuch as each is a survey of conditions generally, rather than a study of any one plant or branch of industry. They were compiled from existing information, and each is signed by the one responsible for it. They, therefore, support from a broader point of view many of the specific findings presented in the field reports, and thus give a more general background for many of the recommendations offered.

The Sources and Causes of Waste

Four Aspects of Waste in Industry. Waste in industry is attributable to:

1. *Low production*, caused by faulty management of materials, plant, equipment, and men.

2. *Interrupted production,* caused by idle men, idle materials, idle plants, idle equipment.
3. *Restricted production,* intentionally caused by owners, management, and labor.
4. *Lost production,* caused by ill health, physical defects, and industrial accident.

Responsibility of Management. Management[1] has the greatest opportunity and hence responsibility[2] for eliminating waste in industry. The opportunity and responsibility of labor is no less real though smaller in degree. The opportunity and responsibility chargeable to outside contacts cannot be so clearly differentiated or evaluated. The relative measure of these is shown by the quantities in the following table which come from the composite evaluation sheets in the engineers' field reports:

Industry	Responsibility Assayed Against			Totals
	Management	Labor	Outside Contacts[5]	
	Points[3]	Points[3]	Points[3]	Points[3]
Men's Clothing Mfg	48.33	10.50	4.95	63.78
Building Industry[4]	34.30	11.30	7.40	53.00
Printing	18.00	16.25	23.36	57.61
Boot and Shoe Mfg	30.25	4.75	5.83	40.93
Metal Trades	23.23	2.55	2.88	28.66
Textile Mfg	24.70	4.70	19.80	49.20

From the preceding table are derived percentage values for each of the agencies against which responsibility is assessed, as follows:

Industry	Responsibility Assayed Against		
	Management	Labor	Outside Contacts
	Per cent	Per cent	Per cent
Men's Clothing Mfg	75	16	9
Building Industry	65	21	14
Printing	63	28	9
Boot and Shoe Mfg.	73	11	16
Metal Trades	81	9	10
Textile Mfg	50	10	40

The quantities presented above justify the following statement: Over 50 per cent of the responsibility for these wastes can be placed at the door of management and less than 25 per cent at the door of labor, while the amount assayable against outside contacts is least of all.

[1] The term "management" as used in this part of the report refers to the agency (owners or managers) which exercises the management function in industry. This function is defined in a report approved by the Management Division of The American Society of Mechanical Engineers as:

> "Management is the art and science of preparing, organizing, and directing human effort applied to control the forces, and to utilize the materials of nature for the benefit of man."

[2] The "responsibility" of a given agency as here used does not mean moral responsibility as ordinarily understood, but only that responsibility which arises from the undeniable fact that a given cause of waste can be removed only by a particular agency......"We measure responsibility not by the thing done, but by the opportunities which people have had of knowing better or worse."

[3] The relative responsibilities have been evaluated in "points." A theoretical total of 100 points represents all possible waste. As no plant is, or could be, entirely wasteful, the number of points assigned in any case must be less than 100.

[4] Adjusted by field engineer to a basis comparable with the other field evaluations.

[5] By "outside contacts" is meant the public, trade relationship and other factors.

In every industry studied there are outstanding examples of good management but the bulk of the industry does not approximate this standard. In the clothing industry, for instance, one plant was rated by the engineers 57 points higher than the worst one studied and 42 points better than the average.

The following table gives a comparison for each industry studied of the total number of points assessed as waste in the best plant investigated, compared with the average of all the plants:

Industry	Points Assayed Against The Best Plant Studied	Points Assayed as The Average of All Plants Studied	Ratio: Best to Average
	Points	Points	
Men's Clothing Mfg.	26.73	63.78	1:2
Building Industry	30.15	53.00	1:1¾
Printing	30.50	57.61	1:2
Boot and Shoe Mfg.	12.50	40.83	1:3
Metal Trades	6.00	28.66	1:4½
Textile Mfg	28.00	49.20	1:2½

It must not be assumed that these points or ratios are valid in comparing the waste in one industry with that in another. They are useful only in making a comparison of waste in plants within the industry where they were assessed. Further, the quantities disclosed by the evaluation sheets are only a part of the findings dealt with in this report.

These tables present the consensus of opinion of the engineers engaged in field studies to the effect that the average of management is much below the standards set by certain individual executives who have achieved notable success.

Waste Caused by Low Production

Faulty Material Control. In certain industries the waste of materials is a serious drain on production, a fact which is revealed by a comparative study of plants in the same field. The methods of control which are common in the shoe industry account for the greatest loss in shoe production with the possible exception of seasonal demand and production. Firms leave it to the cutters to economize in leather. Where standards are in use, waste frequently occurs through carelessness and lack of training of cutters. The loss from idleness in shoemaking, occasioned chiefly by waiting for work and material, is estimated to be some 35 per cent of the time.

The average contractor has no calendar of operations except the dates of starting and finishing a job. He largely regulates deliveries of materials by visits to the job, or through statements received from the job superintendent. Haphazard methods of planning result in delays for want of material, or in burdening the job by an oversupply of material. The same practice results in frequent layoffs, causing dissatisfaction, the loss of good mechanics, and a high labor turnover. Still another waste from inadequate material control comes from the speculative purchasing of raw materials. In the clothing industry gambling in cloth is common.

Faulty Design Control. The defective control of design results in a major waste, since it prevents standardization of product. In the building trade, for example, while the standardization of dwellings and other types of buildings is not generally practicable, yet certain details are entirely capable of standardization. Standardization of the thickness of certain walls might mean a saving of some $600 in the cost of the average house. Standardized millwork, such as window frames, doors, and other similar items, would reduce the cost.

In the printing trades there is wide variation in flatbed cylinder presses; there are more than 600 types of folding machines. Formerly each type foundry cast its type on a more or less different body, and although the exchange from the old system to the point system involved an expenditure of some $3,000,000 by the type founders, it is universally conceded that this expenditure has been saved many times over. Such an example points the way to further efforts.

There are approximately 6,000 brands of paper; 50 per cent of which are more or less inactive. The duplication of brands serves no useful purpose and ties up money in unnecessary stock.

Faulty Production Control. The lack of adequate methods of production control is evident in every industry studied. It is one of the outstanding weaknesses. From shop records it is found that the average loss in clothing factories during running time, not including shutdowns, is between 30 and 35 per cent. If we call 80 per cent running time the maximum readily attainable, this means a possible increase of nearly 20 per cent in productive capacity, and a similar increase in plant capacity. Fixing the value of annual output in the men's ready-made clothing industry at $600,000,000 it should be relatively easy to save three-quarters of a million dollars a day, an increase of 40 per cent in effectiveness.

The lack of production control is not a question of large versus small plants. In the metal trades, for example, the engineer declares that the size of the plant does not necessarily determine its efficiency, for some of the large plants as well as some small ones show a large waste factor.

Lack of Cost Control. The majority of industrial plants lack a knowledge of costs and have no cost control. Therefore, there is no adequate method of judging fairly and accurately when improvements are needed and when waste is occurring. Not having the facts prevents prompt correction of defects. The above conditions are disclosed, for example, in the report on the metal trades.

Lack of Research. While certain industries are ahead of the rest in plant research, the need for more intensive research activity is apparent in every industry. One industry which is backward in this respect is clothing. In the majority of men's clothing plants nothing approximating research is practiced to improve materials, processes, equipment, or product.

Faulty Labor Control. With perhaps two or three exceptions, shoeshops have no departments maintaining modern personnel relations with the employees. The cost of training an inexperienced man for cutting upper leather in a well-managed shop is $576; for a semi-experienced man, $450; and to install an experienced man in a different shop costs $50. For the average shop these figures are unquestionably low.

The average labor turnover for the year 1920 in the metal trades plants covered (wherever records were kept, which was the case in less than half of the plants) was 160 per cent—figured in most cases as the ratio between the number of "separations" and the average number of employees on the pay-roll. The highest turnover was 366 per cent.

The building trades have given little consideration to the subject of labor turnover. In construction work it is particularly difficult to estimate the extent, because the actual percentage of turnover constantly varies as the building progresses and the number of men is increased and later decreased.

Ineffective Workmanship. Still another loss resulting in low production arises from inefficient workmanship. For much of this management is responsible through failure to provide opportunities for education or special training. Management cannot, however, do more than provide these facilities, and experience has shown that it is difficult to interest workmen in training courses which are designed to increase effectiveness. Further, much ineffective workmanship arises from lack of interest in work or lack of pride in good workmanship.

Faulty Sales Policies. The cancellation of orders is a condition peculiar to certain industries. It is especially acute in the clothing industry. Purchasers buying on long-time contracts return unsold goods at the end of the season, and claim and receive credit. In normal seasons cancellations have ranged from 3 to 14 per cent, and returns from 5 to 11 per cent in the average shop. In abnormal years, like 1920, cancellations have reached 33 per cent and returns 18 per cent.

WASTES CAUSED BY INTERRUPTED PRODUCTION

Idle Men. The amount of idleness or unemployment in industry can only be evaluated through rough estimates. There is no national machinery for collecting the facts. But in the best years, even the phenomenal years of 1917 and 1918 at the climax of war-time industrial activities, when plants were working to capacity and when unemployment reached its lowest point in 20 years, there was a margin of unemployment amounting to more than a million men. This margin is fairly permanent; seemingly one or more wage-earners out of every 40 are always out of work.

During periods of industrial and business depressions, unemployment reaches its highest peak. Such depressions appear more or less regularly at 7- or 10-year periods and each brings its increase in unemployment and wastage of the productive capacity of industry. In January, 1921, a nation-wide survey of employment made by the U. S. Employment Service of the Department of Labor showed that there were 6,070,648 workers then employed in industry as compared with 9,402,000 in January of 1920, a decrease of 3,331,352 or approximately 35.5 per cent. This survey covered 35 states and 182 industrial cities and centers and may be considered as fairly reflecting conditions at that time.

In addition to minimum and climacteric unemployment, many essential industries show a high unemployment or idleness once a year or oftener. Practically all industries are in a sense seasonal. To present a few examples: The clothing worker is idle about 31 per cent of the year; the average shoemaker spends only 65 per cent of his time at work; the building trade workman is employed only about 190 days in the year or approximately 63 per cent of his time; the textile industry seemingly has regular intervals of slack time; during the past 30 years bituminous coal miners were idle an average of 93 possible working days per year.

Another form of unemployment comes from open conflict between management and labor. Here it should be said that in the past, at least, the amount of waste from the general run of strikes and lockouts through loss of wages and curtailment of production has been less than is popularly supposed. Since most strikes occur in seasonal employments, it can be deduced that output is not necessarily penalized, for it is often possible to make up the losses incurred by strikes through increased production at other times. The year 1912, with 47 per cent of the entire labor force out on strike and with an average loss per man of 40 days, showed an increased output of coal per man per day and per year, and six days' more employment than in 1911, which was relatively strikeless.

Idle Material. The waste of idle material through deterioration, obsolescence, and carrying charges is large, particularly where there are great inventories of both raw material and finished goods. Unbalanced production is another notable cause of idle materials and consequent waste. Examples of avoidable waste such as the following are fairly common:

A shoe factory having a capacity of 2,400 pairs of shoes a day could turn out for a considerable period only 1,900 pairs because of shortage of needed racks. Another factory had 50,000 pairs of shoes tied up in the fitting room instead of the normal 15,000 because of congestion of operations.

Idle Plants and Equipment. Unsound production policies result in wasteful overequipment. Clothing factories are built 45 per cent larger than is necessary; printing establishments are from 50 per cent to 150 per cent overequipped; the shoe industry has a capacity of 1,750,000 pairs of shoes a day, and produces little more than half that number; throughout the metal trades, standardization of products would permit of large reductions in plant and equipment.

Standardization of machine sizes would make possible the use of one machine for a greater variety of different jobs. The printing industry illustrates this point also. A common sight in any large printing establishment is expensive machines covered up and out of use, or inefficiently used for purposes other than that for which they were built. A printer secures a contract and buys a machine to do the work economically. When the work comes up for contract next time, if some other printer secures it, it invariably means another special machine. One concern paid $17,000 for a special press for printing a trading stamp. On losing this job, the press was scrapped, and later sold for $2,000. The contract in the meantime had been awarded to three other printers in succession and each in turn had purchased a new press which he had to scrap or later use disadvantageously.

It has not been possible in this assay to estimate the amount of idle equipment, nor the accompanying waste through maintenance and depreciation charges.

WASTE DUE TO RESTRICTED PRODUCTION

Restrictions by Owners and Management. Some of the evils of restricted production are chargeable to owners and management. In the building trades, contractors, builders, and supply dealers have restricted production by maintaining high prices, collusion in bidding, and unfair practices. At times there has been collusion between employers and labor, tending to raise prices unduly. The waste from these causes has not been measured in this study.

Restrictions by Labor. Restrictions of individual output for which workers are responsible are susceptible of measurement. On the one hand, when workers are scarce the less conscientious workers become independent and slacken speed. On the other hand, the dread of unemployment is so pronounced that employees engaged in seasonal enterprises frequently restrict production to make employment last longer; some workers, moreover, through consideration of their fellow employees, limit production to provide work for them. Important restrictions of output by employees can only result from collective action. In the building trades, for instance, some painters' unions do not permit of the use of a brush wider than 4½ in. for oil paint, although for certain classes of work a wider brush is more economical. Plumbers' and steamfitters' unions prohibit the use of bicycles and vehicles of all sorts during working hours. Members of those unions in some sections of the country demand that all pipe up to 2 in. shall be cut and threaded on the job.

The tools of the engineer are standard weights and measures, scientifically established. Many unions now oppose the use of such standards. Practically all of the printing unions oppose these devices. The restriction of the number of apprentices is a common rule. The engineer in the building trade notes that restriction of apprentices in many cases seems extreme and unfair. All such restrictions, so far as they prohibit the use of the best and most efficient machines, constitute limitations of output. The actions of most unions, however, are confined to the restriction of the use of machinery rather than its prohibition.

The rule requiring that members of one craft union shall not encroach upon the work of another results in large waste and little benefits. Unions frequently require three or four skilled employees to perform various operations on a plain job which a single worker could satisfactorily do by himself. Union carpenters are forbidden to lay bricks, union plumbers are forbidden to do carpentering work, and so forth.

A union rule in the newspaper printing industry requires that all advertising matter coming into the plant in electrotype form must be reset by the compositors. This useless work is sometimes done weeks after the advertisement has appeared.

The following instances further illustrate restriction of output through divisions of labor. Carpenters' helpers are prohibited from using carpenter tools, requiring carpenters to do such work as stripping forms from concrete. Experience shows that helpers can do this more economically and as well. Brick masons insist on washing down and pointing brick work when laborers could do it more economically.

Waste Due to Lost Production

Ill Health. A report on national vitality propared in 1909 for the National Conservation Commission, appointed by President Roosevelt, estimated that there were then about 3,000,000 persons seriously ill at all times in the United States. This meant an average annual loss per person of 13 days owing to illness. It was estimated that 42 per cent of this illness was preventable, and that such prevention would extend the average life by over 15 years. Since that report was issued, an evident reduction in illness has been accomplished, so that today an estimate of between 8 and 9 days is probably nearer the fact.

In discussing public health conditions there is no clear distinction between the standing of the 42,000,000 persons classed as gainfully employed in the United States and those specifically engaged in industry. The 42,000,000 men and women gainfully employed probably lose on an average more than 8 days each annually from illness disabilities, including non-industrial accidents—a total of 350,000,000 days.

Defective Vision and Defective Teeth. Special attention has been given in recent years to the question of defective vision and to that of defective teeth. It is estimated that 25,000,000 workers have defective vision requiring corrections. A very large proportion of workers have defective teeth and mouth infection and workers have defective teeth, mouth infection and other physical defects which reduce their effectiveness.

Industrial Accidents. In 1919 there occurred in industry about 23,000 fatal accidents, about 575,000 nonfatal accidents causing four weeks or more of disability, and 3,000,000 accidents causing at least one day's disability. Figures for 1918 were about 13 per cent higher, and the estimated time lost 296,000,000 days.

RECOMMENDATIONS FOR WASTE ELIMINATION

In preparing this third part of the summary, the committee endeavored to interpret responsibility in terms of what might be done to eliminate waste in industry. The policies and methods recommended are such as are already in successful use in the industries and plants investigated.

Responsibility of Management

Organization and Executive Control. Planning and control should be adopted as fundamentals of good management. For the most part they have not as yet penetrated the mass of American industry.

Production Control. Conscious production control tends to reduce or eliminate waste by shortening the total time of production. It insures that material is delivered where needed, whether it be material in process or a finished product ready for shipment. Material schedules should be installed and used.

Balancing Productive Capacity and Demand. Productive capacity should be conservatively based upon a careful study of normal demand.

Development of Purchasing Schedules. There should be the same careful co-ordination of purchasing functions and control of material purchased and not yet received as is given to that already in the plant.

Elimination of Cancellations and Curtailment of Returns. The practice of cancellation of orders between manufacturer and mill, and between manufacturer and customer, should be eliminated, and there should be a curtailment of the privilege of returning goods ordered and received.

Correlation of Production Schedules with Sales Policies. Production schedules should be based on a carefully formulated sales policy determined from an intensive study of markets.

In many factories, losses of labor and material in spoiled and defective work are unwarrantedly high. The indirect losses, which are harder to detect and measure, are often greater than the direct losses.

Maintenance of Plant and Equipment. Plant and equipment must be maintained continually in working condition.

Uniform Cost Accounting. Generally accepted systems for finding costs should be established in each American industry. In controlling production and in judging fairly and accurately when and where progress and improvement are being made, the lack of a good cost control system is necessarily a source of waste.

Methods of Wage Payment. Methods of wage payment should be adopted, equitable and just in their basis, stimulating to effort on the part of the worker and insuring a proper relationship between effort put forth and results achieved by all who participate in the enterprise.

Standardization of Product. Products should be standardized consistent with progressive development of manufacturing.

Standardization of Materials. Materials should be standardized to the fewest practicable kinds, sizes, and grades.

Standardization of Equipment. At least the details of equipment, including machines and tools, should be standardized so as to permit of the widest interchangeability and maximum usefulness consistent with improvements in design and inventing.

Performance Standardization. Performance standards should be developed as a valuable aid to planning and production control.

Management and Workers. Management has a definite responsibility in selecting, upholding, and maintaining personnel.

Prevention of Accidents. Management has a definite responsibility to prevent industrial accidents. With regard to methods there is an abundance of information.

Research. Industrial research should be consistently carried on, both in the individual plant and by associations.

RESPONSIBILITY OF LABOR

Increasing Production. In discharging its responsibility for eliminating waste in industry, labor should co-operate to increase production.

Standardization of Work. Labor should co-operate to prepare for and even demand the determination of and use of performance standards.

Rules Regarding Restrictions. Labor should change its rules regarding restriction of output, unreasonable jurisdictional classification and wasteful methods of work, thereby removing some sources of waste.

Improving Health and Reducing Accidents. Labor is responsible no less than management for improving the health of the workers and for preventing accidents.

Improving Industrial Relations. Inasmuch as the organization of personnel relationships in industry can only be accomplished through the co-operation of both employer and employee, labor should assist in such work of organization and in maintaining and utilizing the structure developed.

RESPONSIBILITY OF OWNERS

The owners of industry through the banking function or otherwise share in the responsibility for eliminating waste in industry. They have the duty particularly of assisting in stabilizing production.

RESPONSIBILITY OF THE PUBLIC

Need of Public Interest. In the study of industrial waste, there can be no setting apart of the public as a separate group. The public comprises all groups, and the public's responsibility for eliminating waste is large. A campaign to increase the productivity of industry cannot be conducted without widespread interest and support.

Style Changes. In certain industries the consuming public is to a degree responsible for seasonal fluctuations because of the eagerness with which it accepts or adopts changes in style.

Distribution of Demand. The public can assist in stabilizing industry by accepting a sensible distribution of demand throughout the year.

Community Co-operation With Industry. Public and semi-public agencies can assist by definitely encouraging and supporting the efforts for elimination of waste. Bodies such as local chambers of commerce and other civic and community associations can bring influence to bear through local conferences with the different branches of industry.

OPPORTUNITY OF TRADE ASSOCIATIONS

Trade associations should be formed in those industries lacking comprehensive organizations. Trade associations should promote programs for the standardization of cost accounting methods, the introduction of standardized material specifications, the establishment of production standards, and the standardization of equipment, and of finished products.

OPPORTUNITY FOR GOVERNMENTAL ASSISTANCE

National Industrial Information Service. A national industrial information service should be established to furnish timely, regular, and complete information on current production, consumption, and available stocks of commodities, supplementing the work of private agencies.

A National Statistical Service. A national statistical service should be established and maintained covering employment requirements and conditions throughout the country.

Principles for Adjustment and Settlement of Labor Disputes. A body of principles for the adjustment of labor disputes should be accepted which can be developed with experience.

Public Health Policy. A national policy regarding public health should be accepted and put into effect. The reports dealing with health, prepared in connection with this study by a group of physicians, indicate the importance of maintaining the health of industrial workers as a factor in production and as a means of eliminating one form of waste. These reports also declare for an aggressive, continuous, national public health policy.

National Program for Industrial Rehabilitation. The national program for industrial rehabilitation should be encouraged.

Nation-Wide Program of Industrial Standardization. A nation-wide program of industrial standardization should be encouraged by the government in co-operation with industry. In the standardization of design of product, methods of procedure, and number of models, there rests a large opportunity for the reduction of waste.

Revision of Federal Laws. Where Federal laws interfere with the stabilization of industry they should be revised in the interests of the whole people.

DUTY OF ENGINEERS

The duty of engineers is a part of all the responsibilities previously stated in different recommendations. It is peculiarly the duty of the engineers to use their influence individually and collectively to eliminate waste in industry.

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Professor Bob Emiliani
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A great weekend read. C. Bertrand Thompson, an African-American, examines complete success, partial success, and failures of Scientific Management in 107 plants. Thompson was a highly accomplished scientific management practitioner, writer, consultant, and Unitarian Church minister who successfully introduced Scientific Management in France in 1914. He was especially focused on making sure that workers benefitted from Scientific Management in various ways. Learn more about Mr. Thompson's remarkable career https://en.wikipedia.org/wiki/C._Bertrand_Thompson and https://www.emerald.com/insight/content/doi/10.1108/JMH-12-2013-0126/full/html

SYSTEM
THE MAGAZINE OF BUSINESS

VOLUME XXVIII NOVEMBER, 1915 NUMBER 5

Has "Scientific Management" Made Good?

By
C. BERTRAND THOMPSON

"Scientific management" has been much discussed and applied to many concerns since the Eastern rate case hearing attracted wide-spread attention to it during 1910. A most important effect of the discussion and the publicity which have followed the hearing has been the scattering of these applications of "scientific management" among a remarkably broad and diversified list of industries. And now business men in general are curious to know how "scientific management" is getting on, whether it has made good. Of the men intimately associated with Frederick W. Taylor, Mr. Thompson is probably the best equipped to make a critical analysis of the accomplishments of the Taylor system of scientific management. So he has made a study for SYSTEM of the results obtained in this country. His investigation, which he discusses in this article, and the one to follow in SYSTEM for December, required a large part of the last four years. Of course it will be understood that the expression "scientific management" as used in these articles is restricted to the Taylor system itself or, as Mr. Thompson expresses it, to its derived forms

FOR thirty-five years the late Frederick W. Taylor devoted all his genius and all his energy to the development of that type of management which came to be known as "scientific management." For more than twenty years he was continuously engaged in applying his methods to various kinds of manufacturing establishments, and during the last fourteen years of his life he and his co-workers made the new movement the subject of a definite propaganda.

Since the Eastern rate case hearing, in 1910, the term "scientific management" has been a popular expression. Everybody has heard of it, and a few know what it is. Now that Mr. Taylor's personal participation in this work is at an end, it is

THE OUTPUT OF THIS KIND OF WORK HAS BEEN INCREASED AS MUCH AS 300%

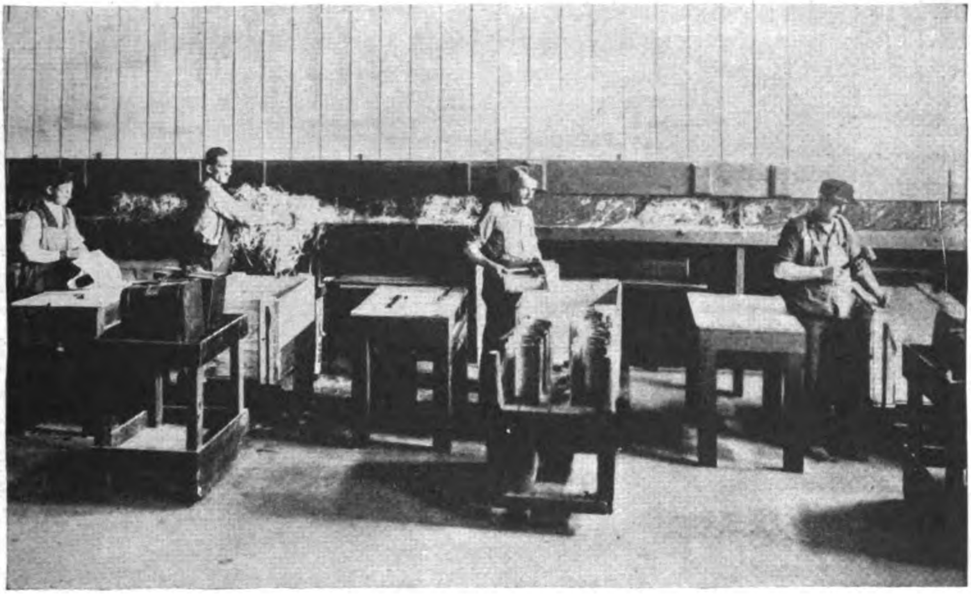
Types of industry which do not call for any marked degree of technical knowledge frequently show astonishing increases in output when placed under "scientific management." These increases have run as high as three hundred per cent. These women are assembling spark plugs. A careful standardization of their movements enables them to work quickly and accurately. The porcelains are taken from a compartment – C – with the right hand and the shells from another – A – with the left, the bushings are in a bin – B – and the assembled plugs are placed in a rack – D – ready for tightening and the final inspection

pertinent to inquire into the exact present status of its development. How many plants are using the Taylor system of industrial management today? What are the results? Has the system made good?

To get answers to these questions I have spent a large part of the last four years investigating personally all the installations of the Taylor system of industrial management in the territory between Maine, Maryland and Chicago, covering twelve states. In addition to personal inspections of the plants involved, there were many conversations with owners, managers, experts, investigators and workmen.

The total number of applications of "scientific management" definitely known to me is 145. This does not exhaust the list, however, as there are some cases in which the client is unwilling that his connection with this movement shall be known, and others in which consultants are reluctant to give information. There is an uncertain number of such instances, probably small, in which either the work has been completed or is still in process.

Of these 145 applications, four are to municipal work, including three instances of consultation and one in which an expert trained in "scientific management" is at the head of a department of public works. Five deal with railroad and steamship companies (exclusive of repair shops, which are classed as industrial), and 136 with industrial plants; 122 factories (in-



-AND THE PRODUCTION SECURED FROM HAND OPERATIONS IMPROVED FROM 60% TO 100%

The application of "scientific management" to hand operations has shown variable results. The extraordinary differences in effectiveness between workers is undoubtedly largely responsible for these variations. The output of bindery operators, for example, has been increased from ten per cent to about three hundred per cent. These men are at work in the packing department of the General Electric Company. The arrangement of the materials and the tools which they use in packing and marking has been carefully studied in order to make all their motions as effective as possible

cluding the repair shops of four railroads) have been assisted, and also four public service corporations, three building and construction companies, one department store, one bank, four publishing houses, and one professional society.

These 122 factories and repair shops constitute practically one per cent of the 12,784 plants which in 1909 employed more than one hundred wage earners. The number of men in these plants, as nearly as I can estimate, is about forty-eight thousand, constituting a trifle over one per cent of the 4,115,843 employed in 1909 in plants employing over one hundred wage earners.

Following is a list of the eighty odd industries involved. A careful study of this should allay any question as to whether or not "scientific management" is applicable to other types of manufacturing plants than machine shops:

Agricultural implements; aluminum castings; automobiles; banking (clerical work); blank book making; bleaching; bookbinding; book cloths; boxes (paper); box machinery; brass castings; brass products; bricklaying; building; canning; chains; clothing (men's, women's, and children's); composing machines; concrete construction; conveyors; cordage; corsets; department stores; desks; dyeing and finishing (textiles); earthwork; electric apparatus; elevators; engines; envelopes; foundry machines and supplies; furniture; gas; glass; gun carriages; handkerchiefs;

hardware; hoists; iron castings; iron and steel tools; light (electric); lithography; locomotives; lumber; machine tools; motors; municipal engineering; musical instruments; optical goods; ordnance; paper; paper pulp; power plants; printing; printing presses; publishing; pumps; railroad cars; railroad operation (steam and electric); railroad repairs; registers; rifles; roller bearings; sashes and doors; saws; scales; scientific and professional instruments; ship building; ship repairs; shoes; silk goods; stationery; steamship operation; steel castings and forgings; steel products, heavy; structural iron; textiles; textile machinery; typewriters; valves and steam fittings; watches; wire goods; and wire weaving machinery.

A reader of SYSTEM may be struck with the fact that to date there is only one department store on this list of applications. It is true that, although the administration of many department stores is far behind that of modern factories, little has been done in this field.

The actual selling of goods presents a problem so complex and with so many variables as to raise a question about the practicability of a complete application of all the present methods of "scientific management." However this question may be answered, the administration of a department store includes many factors besides the selling of goods – such as their purchase, receipt, storage, handling, packing and delivery – which are essentially the same as the corresponding factory problems; and costs relating to them are susceptible to similar treatment. In one department store, to the writer's knowledge, a beginning has been made on this side of the problem.

WHERE "SCIENTIFIC MANAGEMENT" HAS BEEN USED

145 applications in eighty odd industries:

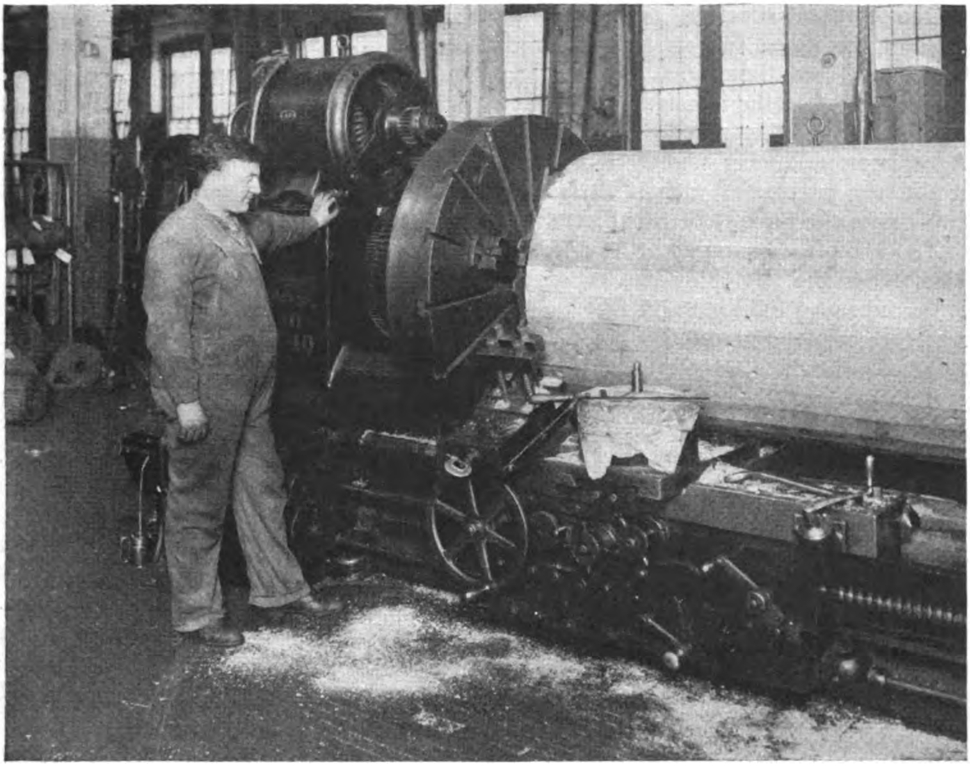
84.1% to factories (including the repair shops of four railroads).
3.4% to railroad and steamship companies (exclusive of their repair shops).
2.8% to municipal work.
2.8% to public service corporations.
2.8% to publishing houses.
2.0% to building and construction companies.
0.7% to a department store.
0.7% to a bank.
0.7% to a professional society.

I have talked with many leading department store managers on this subject and could a tale unfold which would be exceedingly interesting, but somewhat aside from the subject of this article. What we are after now is the result of the industrial applications of the Taylor system.

Everyone is familiar with the type of scientific study illustrated in Mr. Taylor's characteristic case of Schmidt, the pig iron handler, who was investigated, tabulated and reduced to a law by two engineers of national reputation and two college students. So elaborate are the scientific procedures described by Mr. Taylor in his books that a suspicion has arisen that in some cases the interest in perfecting a method by mathematical and experimental means would tend to overshadow the interest in reducing expense or increasing output.

However, a study of the work of the successful practitioners of "scientific management" shows that their investigations have always been guided by financial considerations. As a matter of fact, in the most conspicuous cases, as in Mr. Taylor's experiments on metal-cutting, they have paid for themselves through savings. This coincidence of technological and pecuniary advantage was evident in every plant I investigated.

This analysis of the results actually obtained by "scientific management" may well follow two topics: (1), the development of the various details of administration; and (2), the final effect on the profits of the business as a whole. It is conceivable that isolated instances of improvements in the output and quality may be very striking, while nevertheless the total result may not be substantially better, or may even be worse.



THE PRODUCTION OF SOME WORKERS INCREASES 200%

The most substantial improvements to result from "scientific management" have been secured in machine shop work, where the highly technical nature of the factors involved has given special warrant for the assistance of expert investigators. Nothing is more common than instances of two-fold and three-fold increases in output from the same machine and the same workman, according to Mr. Thompson's investigation among plants which have adopted "scientific management." Increases of even from seven to ten times are not rare. With machines other than machine tools, however, the increases have not been so large

The real test of the success of a system of management, in other words, is not to be found in isolated examples of good work on administrative details, but rather in its net effect on the business as a whole. For obvious reasons it is difficult to get accurate information on this question from private plants. An investigator is struck with the fact that while the managers of private concerns are, as a rule, very free in their discussions of these single instances of improvement, they are reluctant to give the larger figures of expenditures and returns which alone provide the basis for a final appraisal. The most complete and frank discussion of total results is found in the reports of General Crozier, chief of ordnance in the American army, on the operation of the Taylor system in the government arsenals which show, during one year:

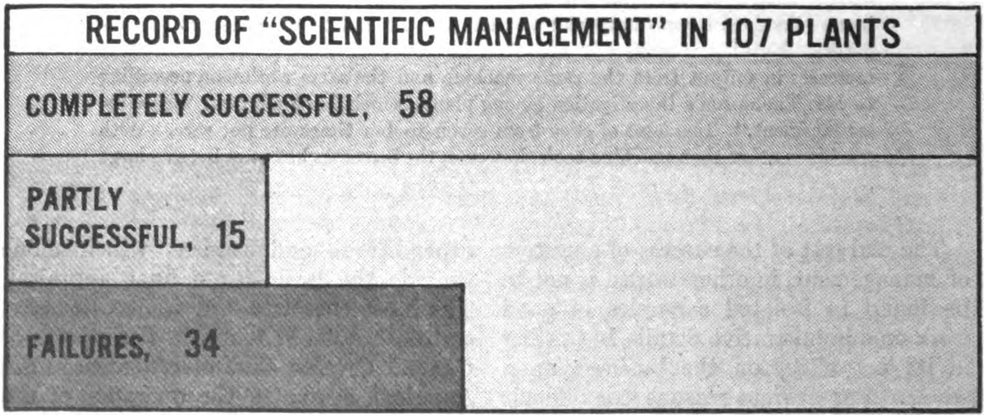
Savings from improved shop management and the premium system...	$240,461.93
Savings resulting from the use of surplus stock....................	122,789.61
Total of savings................	$363,251.54

One private concern, manufacturing molding machines, reports that its product is now three times what it was before it adopted "scientific management," while its total force has remained the same. Another is producing slightly more than it did six years ago with a little over two-thirds the force it then had.

Another plant manufacturing automobiles under the Taylor system reports it is saving seven hundred and fifty dollars per car; while still another factory of this type, in which the application of the system has extended only over one year, reports already a saving of one hundred dollars per car. Another plant, which had passed its dividends for several years, found itself in a position, partly as the result of the development of the system, to declare a dividend of eighteen per cent. A structural iron concern reported that the total cost of installing the system, eighteen thousand dollars, was recovered by it from savings effected within three years. The results of the application of "scientific management" to the Santa Fé Railroad are hotly disputed, but on the whole it seems clear that considerable economies were accomplished.

The gross results, of course, are not always so favorable as those obtained in these plants. There have been partial successes and unquestioned failures, to say nothing of one curious example, a textile machine shop, which, at the end of three years, apparently showed a failure, but to which a sudden access of energy brought a complete and striking success.

Of the 107 industrial plants for which information on this point is available, and in which the work has progressed far enough to warrant the formation of a judgment, fifty-eight may be called complete successes, fifteen partial successes. and thirty-four failures. Twenty-nine of these thirty-four failures are connected with forms of management derived from the Taylor system, which amounts to 38.6 per cent of the applications of such forms. Five are connected with the original Taylor forms, which represents 9.4 per cent of the applications of these original types. Of the seventeen cases now to my knowledge in process, there is good reason to suppose that fifteen will be partial or complete successes, and that two will probably result in failures.



WHAT "SCIENTIFIC MANAGEMENT" HAS ACCOMPLISHED

This chart shows graphically the gross results obtained from "scientific manageagement" in 107 industrial plants. Fifty-four and three-tenths per cent of these cases were successes, fourteen per cent partial successes, and thirty-one and seven-tenths failures. Thirty-eight and six-tenths per cent of the failures used forms derived from the Taylor system and 9.4 per cent the Taylor forms

WHAT "SCIENTIFIC MANAGEMENT" HAS DONE

MACHINE SHOP WORK:
- Output increased 200 per cent to 300 per cent frequently.
- Output increased 200 per cent to 1,000 per cent in some instances.
- Stocks of materials on hand reduced.

BRICKLAYING:
- Output increased 200 per cent to 300 per cent

MACHINES (other than machine tools):
- Payroll decreased.
- Output increased from 30 per cent to 100 per cent.

HAND OPERATIONS:
- Output increased 10 per cent to 300 per cent.
- Valuable material conserved.
- Quality of output bettered.

STOCKS OR MATERIALS:
- Reduced one-tenth in many cases.
- (Materials decreased 33⅓ per cent, output increased 50 per cent, in one instance.)
- Reductions in the varieties of materials carried by means of standardization.
- Development of better materials through standardization.

ROUTING OF WORK IN PROCESS:
- Uniformly improved (an automobile manufacturer reports a saving of $750 on each car)

INSPECTION OF COMPLETED WORK:
- Uniformly helpful to both processes and the final product.

EQUIPMENT:
- More satisfactory equipment frequently developed.

SELLING:
- Little done in distributive fields yet (one small concern has applied "scientific management" to its selling activities with success, however).

FINAL PROFITS:
- Saved three arsenals $323,251.54 in a year.
- Increased output of a plant making molding machines 300 per cent.
- Increased output of another plant slightly and cut its force 30 per cent.
- Saved one automobile concern $100 on each car and another $750
- Helped a concern which had not been paying dividends to pay 18 per cent.

TOTAL RESULTS (out of 107 industrial plants):
- 54.2 per cent complete successes.
- 14.1 per cent partial successes.
- 31.7 per cent (29 of these connected with derived forms of "scientific management") failures.
- 17, also, in process (of these 15 will probably be complete or partial successes).

LABOR:
- Wages never lower than customary.
- Wages increased 10 per cent to 70 per cent for from 50 per cent to 85 per cent of the employees affected, in cases where "scientific management" has been in operation three years or more.
- Health not lowered.
- Accidents not increased.
- Stability of payroll increased.
- Thrift and sobriety probably increased, though in a few instances tendency toward extravagance and dissipation increased.
- Employees developed to the promotion point faster.
- Personal effectiveness of employees increased.
- Technical effectiveness of employees broadened.

An analysis of the causes behind the failures show a noticeable concentration about two factors: (1), the personality of the consulting engineers; and (2), the personality of the managements. Several failures are due to the inexperience and incompetence of the so-called "experts" in charge; others to the experts' lack of adaptability to new conditions or to the personality of the owners; and still others to an unwillingness on the part of the experts to familiarize themselves personally with shop operations.

In at least two cases the experts spoiled their chances of success by indulgence in impractical and expensive experiments. In one instance the wholesale importation of outside men, although it was made necessary, it is true, by the unwillingness of the management to provide men from its own staff, was a large contributing factor.

On the other hand, even more failures are due to the managements themselves. Chief among the causes arising from this source has been the spasmodic way in which owners, without due investigation or realization of what the development of "scientific management" means, have rushed into it only to begin to vacillate before the engineers had had time to produce any substantial results.

In a considerable proportion of the failures there has been marked dissension in the managements, notably in certain instances where the foremen have for a long time enjoyed practical control of the business. This condition is fostered also by absentee control, or control by financiers or lawyers who are unacquainted with the practices of industrial management, and who are, therefore, unable to adjust the inevitable difficulties which in almost every case arise between subordi-

nate officials and the "scientific management" experts.

There must be mentioned also a few cases where the sheer incompetency of the managements made success under any system impossible.

In a fairly large proportion of instances, failure was due to the financial inability of the owners to carry through the development they had begun. Occasionally this has been due to lack of foresight, but, in the majority of cases, the supervening of a period of severe business depression, such as occurred in 1907 and between 1913 and 1914, is to blame.

In one or two instances this difficulty has been complicated by the cessation of sales of the product manufactured, due either to a change of public taste, as in the case of a factory making bicycle roller bearings, or to the weakness of the selling organization, as happened in a garment factory. In but once instance, at least to my knowledge, has the threat of labor difficulties been even partially responsible for failure, and here the situation was so complicated with financial troubles – in 1907 – and the viewpoint of an unsympathetic management, that it is difficult now to determine precisely what weight should be given to this factor.

As may be expected, these causes of failure have, in practically every case, operated in combinations of two or three or more. The striking fact to be drawn from the investigation is that, with one possible exception, the failures have been due entirely to the experts or the managers and owners, or both, and never to difficulty with workmen – and this without regard to whether or not the workers were organized.

TYPICAL WORKERS IN A SCIENTIFICALLY MANAGED PLANT

It is difficult to determine in detail the extent to which the interest, loyalty, sobriety, thrift and ambition of employees is increased under "scientific management." The advocates of "scientific management" feel that such an increase is the natural and usual result of their methods. Mr. Thompson reports that if one judges from a rapid personal inspection of employees at work under "scientific management," there can be no question of their closer application to their tasks. These ten workmen, who are apparently both vigorous and capable, work under "scientific management" at the Philadelphia plant of the Link-Belt Company

Let us turn now to the development of the various details of administration and the share of "scientific management" in improving them:

As might be expected, the most substantial improvements brought about by "scientific management" have been made in machine shop work, where the highly technical nature of the factors involved has given special warrant for the assistance of expert investigators. Nothing is more common than instances of two-fold and three-fold increases in output from the same machine and the same workman. Increases of from seven to ten times are not rare.

On the other hand, a type of industry which would not appear to call for any considerable degree of technical knowledge –bricklaying–has shown equally astonishing results. With machines other than machine tools, however, it has not appeared practicable to secure such large increases in efficiency, except in the direction of reducing the number of men tending one machine or of increasing the number of automatic machines tended by one man.

It is not uncommon to find a man who previously tended two gear-cutting or screw machines now taking care of five; while on the other hand I have seen machines, which formerly required the attention of three men, now adequately cared for by two. With the ordinary run of industrial machines, semi-automatic and each tended by one operator, increases of output appear to range from thirty per cent to one hundred per cent – the majority being, so far as I have been able to find, nearer the lower limit.

The application of these methods to hand operations has shown variable results. The extraordinary differences in effectiveness between different workers handling the same operations are already well known to managers.

Examples are furnished by certain types of workers. The time study and instruction methods of "scientific management" have increased their output from ten per cent to about three hundred per cent, the majority of the cases lying between sixty per cent and one hundred per cent. Instances have been found, as in the case of gold laying in a bookbindery, where economy in the use of material and quality of output were more important than production increases. These factors have been taken into consideration, the bonus arranged accordingly, and the desired improvement in economy and quality attained.

Other details of the Taylor system of "scientific management," though less spectacular, have been highly effective. The characteristic handling of materials, including their purchase, receipt, inspection, storage, issuance and control, has led to important consequences. In all instances of successful applications of the system, delays due to the absence of necessary materials have been practically eliminated. In some cases the variety of materials carried has been reduced ninety per cent.

In almost all cases the quantities of certain materials on hand have been reduced and of others increased, to meet the demands as shown by the record of the issues from the stocks. Occasionally, as in the case of several large machine shops, this has made on the whole a substantial reduction in the quantities and value of the materials on hand and of the space occupied.

One manager said that he now carries one-third as much material, but does fifty per cent more business. In some plants, however, investigation has shown that the storage facilities and the quantities of materials carried were utterly inadequate, and this has led in such cases to important enlargements in the storage space, including even the addition of new buildings and the increase of capital investments. The increases of capital were not proportional, however, to the increases in space, as the changes meant in such cases a greater concentration in storerooms of materials previously scattered over the operating area of the plant. This was accompanied by a standardization of the materials and a reduction in the number of varieties carried, which resulted in an increase in the quantity of the standard, but a decrease in the total of all the materials on hand.

Other important results are found in improvements of the product and a standardization of materials and equipment, The inspection, routing and cost systems characteristic of "scientific management" have certain accomplishments to their credit, too. Then there is also the big question of the effect of "scientific management" on workmen. All of these factors must be carefully considered before a complete answer can be given to our question: Has "scientific management" made good? There is not room to consider them at length here, so I will put them over to the December issue.

HAS "SCIENTIFIC MANAGEMENT" MADE GOOD?

Does it give prompt deliveries, a better product, improved equipment? Does it raise wages, increase proficiency and hold the men?

BY C. BERTRAND THOMPSON *Illustrated with* PHOTOGRAPHS

THIS article, like the one by Mr. Thompson published in SYSTEM for November, is based on an investigation of practically every installation of the Taylor system of scientific management in this country. Because the attention which has been attracted to "scientific management" since it first obtained widespread notice five years ago has come from many industries, this investigation was necessarily extended. It occupied an important part of Mr. Thompson's time for about four years, and took him into twelve states. In analyzing the vast amount of detailed material that resulted, Mr. Thompson has fortunately been able to draw upon first-hand experience, for he is one of the men who were intimately associated with Frederick W. Taylor, and has himself installed "scientific management" in several plants. In future issues SYSTEM plans to give the experiences of some business men with "scientific management" and J. S. Runnells, president of the Pullman Company, has promised the first of these articles for an early issue.

IN LAST month's article under this heading I analyzed the extent to which the Taylor system of scientific management has been applied and told of the gross results obtained. I also described some of the effects the system has had on specific industries and the use of materials.

This information helps to answer our question: Has the Taylor system of scientific management made good? But we also require facts on other detailed effects of "scientific management," and above all data showing how it reacts on workmen. This article is intended to supply this information.

The routing systems prescribed by "scientific management," for instance, occur in many and varying degrees of elaborateness. Many plants, such as certain typewriter factories, manufacture parts for stock, doing only their assembling on order. In such cases the routing of parts is easily standardized and administered; and the routing of the assembly work is almost equally simple.

On the other hand, several plants were found which manufacture from the beginning to the end almost exclusively on order, with the specifications varying for each job. Repair shops are extreme illustrations of this. In such cases the routing system is necessarily elaborate and complex, and yet even in these it is valuable, in the opinion of the managers, for the very reason that the variety and complexity of the orders makes all the greater the danger of unnecessary losses.

As a routing system usually involves the preparation of separate job tickets, inspection orders, and "move orders" for each operation, its complexity is again influenced by the relative length of the separate operations. In one plant, or part of a plant, for instance, the piece or the lot may be at a given machine for from four hours to ten days. If this condition predominates, the number of orders to be written and handled is relatively small – as in machine shops, usually.

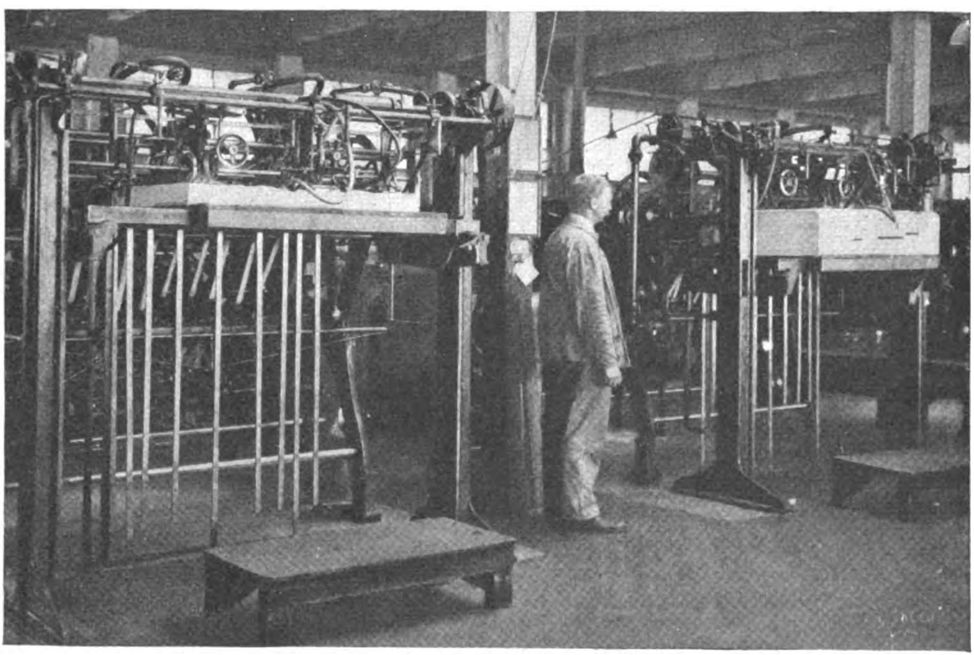
On the other hand, operations on individual orders and at each machine may be very short, ranging from twenty minutes down to two or three minutes, as in a stationery concern or a plant manufacturing small electric apparatus on order. Where operations of this type predominate, the amount of clerical work necessarily is relatively great.

This has, in fact, presented one of the most serious problems that "scientific management" has had to solve. There is usually a choice between an expensive completeness of control and a relatively inexpensive but risky incompleteness.

Evidence of the effectiveness of routing systems installed under "scientific management" is to be found in every instance where the installation has been fully developed. Work goes through with a speed and a certainty unknown to former types of administration.

One automobile manufacturer, who has developed the stores and routing systems of "scientific management," but not the task and bonus plans, says that the routing system alone – a most elaborate one – has unquestionably saved him seven hundred and fifty dollars per car. In other plants the testimony varies (according to the type of industry) as to whether or not the routing system alone has been an economical institution; but where these plants have gone on to the development of task and bonus plans, they are unanimous in their assertion of its value as an indispensable accessory to those features of management.

Mr. Taylor had developed, and used successfully in practice, a thoroughly modern cost system before most of the present cost accountants were born; and today the cost system characteristic of his system is at least abreast of the times, if not ahead of them. "Scientific management," however, lays such stress on the primary importance of improved production, and the secondary importance of the cost statistics relating to production, that it does not talk of its



"SCIENTIFIC MANAGEMENT" ENABLED THIS WORKMAN TO FOLD THREE SHEETS FOR EVERY ONE HANDLED IN THE OLD WAY. MR. THOMPSON FINDS THAT THE WORKERS DO NOT USUALLY QUESTION THE MANAGEMENT'S RIGHT TO A SHARE OF THEIR INCREASED PRODUCTION cost system as an independent entity. In a very few instances it has provided a cost system alone for a client, and apparently to the client's satisfaction.

This same emphasis on production has led, unfortunately, to a neglect of the highly important field of distribution. It has been pointed out many times that those principles characteristic of "scientific management" which have proved themselves capable of such successful application to production, might – and should – be extended with proper modifications to cover the fields of selling and financing.

Important results have followed from the application of the inspection system which has developed under "scientific management," with its emphasis on preventive, rather than remedial, inspection. Another result has been a substantial improvement of the product which seems always

BUNDLING MACHINE OUTPUT IN A MASSACHUSETTS FACTORY INCREASED FIFTY TO ONE HUNDRED PER CENT UNDER SCIENTIFIC METHODS

to have marked the development of "scientific management" methods. Thus, in one instance, an American plant manufacturing roller bearings, which heretofore had been unable to compete with European makes, has so improved the quality of its product as to secure a foothold for it in spite of the foreign competition.

Some of the most interesting results of "scientific management" have been the outcome of its characteristic policy of standardization of materials and equipment. First among these must be mentioned the discovery of high-speed steel by Mr. Taylor and Mr. Maunsel White.

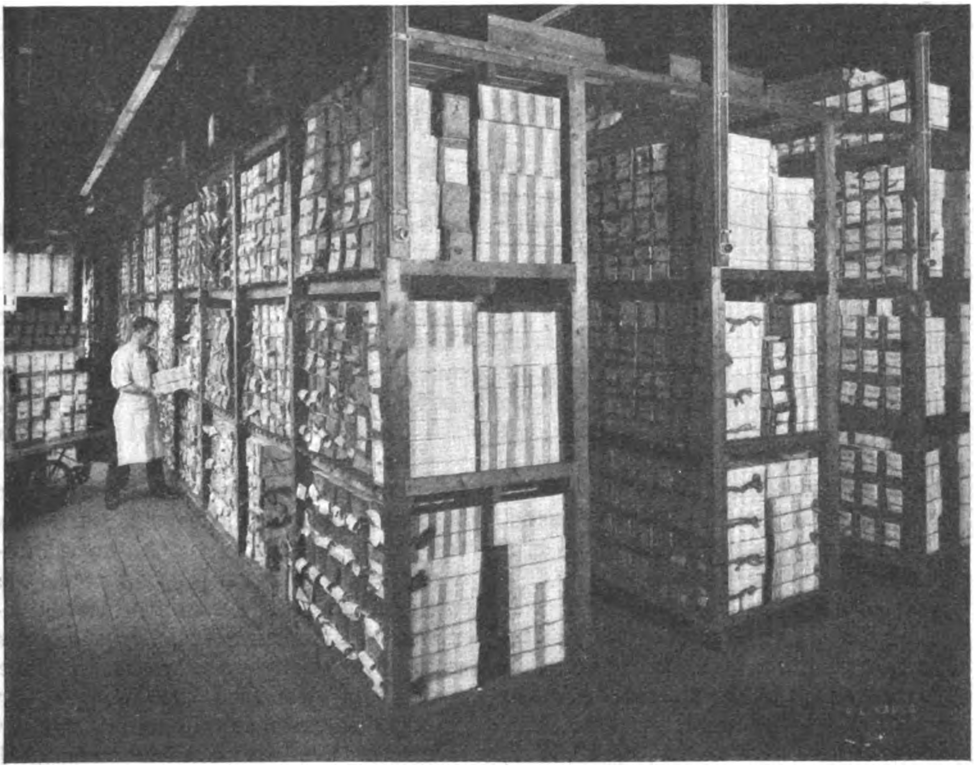
This discovery was a by-product of their effort to standardize the tools with which the task was to be performed. Many illustrations of the same type of accomplishment, on a smaller scale, might easily be given. It is sufficient to say, however, that almost every plant now using "scientific management" in its original form has reduced its main material requirements to specifications, and that in many cases these specifications are for materials standardized and improved to meet particular requirements.

Concurrently with the standardization of materials has gone a standardization of equipment.

The work of Mr. Taylor and Mr. Barth on the standardization of cutting tools, of belting and of machine design is characteristic and famous.

This work is, of course, still going on; and each new industry, and even each new plant, is presenting opportunities, brought out by time study, for the continuous modification and improvement of equipment. The aim here is always to increase the capacity and endurance of the machine and the ease with which it is handled by the operator.

This extends also to small equipment, such as trucks and hand tools. Usually, however, these efforts have been directed almost exclusively toward the immediately productive side of the plant, while the equipment for clerical work has been comparatively neglected, apparently because



"SCIENTIFIC MANAGEMENT" DEMANDS FAR-SIGHTED PURCHASING AND ACCURATE STOREKEEPING SO THAT NO ORDER NEED WAIT ON MATERIALS. THIS STOREROOM WAS ERECTED TO MEET THE REQUIREMENTS OF THE TAYLOR SYSTEM

its contact with the profits is often indirect.

Thus far we have been discussing the results of "scientific management" from the point of view of the employer. A movement, however, which has already affected over sixty-eight thousand employees (including about twenty thousand in transportation activities, in addition to the forty-eight thousand in industrial plants), and which bids fair to extend to a much greater number, must be considered with equal care from the point of view of its influence and effect on the workman.

First, as to wages. In no case that I could find were the basic rates lower than those customarily paid in the industry and locality involved. In every case where the development of the system had progressed to anything like completion, the bonus principle was being effectively applied.

In practice it was found that where the system had been in operation three years or more, from fifty per cent to eighty-five per cent of the employees were earning bonuses ranging from ten per cent to sixty or seventy per cent. In addition to this there was at least one plant, using the Taylor differential piece rate, in which the low rate is ten per cent above that prevailing in the community, while the high rate is forty-three per cent higher.

It is pertinent to inquire, however, whether the increased wages, due to increased output, are obtained at the cost of the health of the employees. This question has been fully investigated and the conclusion reached that not only is their health unimpaired, but that, on the contrary, the conditions under which maximum efficiency is secured have led to improvements in health.

The investigation at the Watertown arsenal was unable to find any case of injuries to health traceable to "scientific management." Since that investigation, it has been alleged that there has been an increase of accidents at the Watertown arsenal. The analysis made by General Crozier shows, however, that the increase in accidents has been among those who are not yet working on the task and bonus provisions of "scientific management." Indeed, among those who are operating under the Taylor system he found, on the contrary, a decreased number of accidents.

This point is so important that it is worth while to give General Crozier's statement regarding it: "Careful record of all accidents is kept at the arsenal. Most of the accidents occur in the machine shop. During the fiscal year ended June 30, 1912, the total number injured in this shop was thirty-four, of which five, or 14.7 per cent, were working on premium at the time.

"During the fiscal year ended June 30, 1913, fifty-seven persons were injured in the machine shop, of which thirteen, or 22.8 per cent, were premium workers. During these two years the number of workmen employed in the machine shop remained about the same, but the amount of premium work increased nearly fourfold. That is, while the amount of premium work increased about three hundred per cent, the percentage of accidents to premium workers increased only 8.1%.

"During the nine months from October to June, 1913, thirty-three machinists were injured, ten of whom, or approximately thirty per cent, were premium workers. During this same period 44.8 per cent of the work in the machine shop was premium work. It thus appears that the percentage of accidents among the premium workers was less than the percentage of premium work; that is, that the greater proportion of accidents during these nine months occurred among the day workers."

The extent to which the interest, loyalty, sobriety, thrift and ambition of employees are increased, as is claimed by the advocates of "scientific management" to be the natural and usual result of their work, is difficult to determine in detail. If one judge from rapid personal inspection of employees at work under "scientific management," there can be no question of their closer application and deeper interest in the tasks they are doing. This interest extends beyond their own work to that of the management.

Inasmuch as the success of the worker in earning the bonus depends partly on the smoothness with which the administrative department is conducted, the foremen and other executives receive numerous and forceful suggestions on this score if anything goes wrong. I have often seen workmen reminding their "bosses," in no uncertain terms, of their failure to live up to their managerial responsibilities. In fact, the authority of the operators within their own sphere is one of the outstanding peculiarities of a plant using "scientific management."

HOW THE TAYLOR SYSTEM OF SCIENTIFIC MANAGEMENT AFFECTS THE LOYALTY OF EMPLOYEES

Perhaps the most striking evidences of loyalty of employees under "scientific management" are the length of time they remain with their plants and the relative infrequency of changes in the payrolls.

With reference to sobriety, experience has shown that immoderate drinkers are incapable of standing up to the work, with the result that they have gradually eliminated themselves from plants using "scientific management." Thrift and ambition are qualities which can not be created by "scientific management," but the opportunity for their exercise may be provided by a favorable environment, an environment including high wages and a recognition of superior ability. Such an en-

SCIENTIFIC STUDY OF MATERIALS AND WASTE DICTATED THE ARRANGEMENT OF THIS BINDERY THE GLASS SCREENS PROTECTING THE DESKS AT WHICH GOLD LEAF IS APPLIED EFFECT A LARGE SAVING OF GOLD EACH YEAR

vironment is provided by "scientific management," and my observations confirm those of other investigators to the effect that the favorable conditions are being taken advantage of.

One is forcibly struck by the notable increase in the personal efficiency of operatives who have worked for any length of time under "scientific management's" task and bonus plans. This is the logical result of the intensified personal instruction given to them by the management.

Another logical consequence of this instruction has been the development of employees to the promotion point faster than it was possible to find openings for them. This condition has occasionally been met by finding them better paid and higher positions in other plants.

Another characteristic result has been the broadening of the technical proficiency of the employee. This follows from the method, sometimes pursued with "scientific management," of training men in several varieties of work, in order to be able to exchange them from one department of the factory to another to meet seasonal fluctuations The possibilities of this policy have not, however, by any means been exhausted.

One might be led to infer from the amount of discussion in the newspapers that there has been considerable trouble between "scientific management" and organized labor. A brief strike at the Watertown arsenal, a few years ago, brought about by a failure to observe the instructions of the "scientific management" expert in charge, provided the opportunity for making the Taylor system an official and quasi-political issue.

This led to numerous congressional and other investigations, and to legislation aimed at the use of the stop watch and the payment of bonus in government plants. All the evidence shows that the net result of the use of the stop watch has been a great improvement in the conditions of the work, the comfort, the health and the satisfaction of the operator; while the advantage of the bonus to the competent worker is too obvious to call for comment.

The fact is that in private plants, where it has not been practical to make a political issue of "scientific management," there has been no trouble with organized labor. There are union men in a very large proportion of the plants now operating under the Taylor system of scientific management and those systems derived from it.

The management asks no questions regarding their affiliations, and the men, organized or otherwise, make no complaints about their work, except such as would arise naturally and normally in the daily operation of any plant. Even the apparent disproportion between the increased output, amounting in some cases to one hundred per cent, and the increased wages, amounting in the majority of instances to thirty per cent, is not made the subject of dispute, as the men are generally intelligent enough to admit the cost of the new system to the management and to agree to the necessity of dividing profits with the management, which takes the risks.

While it is true that, with the single exception of the Watertown incident, there has been no strike connected with the development of the Taylor form of scientific management, it must be admitted that there have been a few instances of "labor troubles" in connection with the installation of certain derived forms, due in general either to the bungling of a subordinate on the job, as in the case of a plush mill, or to the irreconcilable attitude of the union leaders, as in the case of the engineers on the Santa Fé. In other plants there have been conferences in a few instances between the management and the representatives of local unions concerning the details of administration, and arrangements satisfactory to both sides have resulted.

HOW "SCIENTIFIC MANAGEMENT" IS EXTENDED TO DEPARTMENTS USING ORGANIZED LABOR

In a few cases the extension of "scientific management" from unorganized parts of the plant to other departments highly organized has been delayed on account of the fear of opposition from the unions. In several instances the efforts of labor organizers to unionize departments using "scientific management" have failed on account of the satisfaction of the employees with the conditions of their work.

In a plant, where "scientific management" was fully developed and in complete operation, the management, for reasons unconnected with the system or with working conditions, has itself authorized and aided the organization of its employees. In the great majority of applications, however, there is no attention paid to the question of whether or not the employees are unionized; and the local unions, conversely, have ignored the development of "scientific management."

A WORD ABOUT SOME OF THE FAILURES CHARGED AGAINST "SCIENTIFIC MANAGEMENT"

Every day one hears that "scientific management" has been tried in So-and-So's plant, and that it either started a strike or put the company into bankruptcy, or was thrown out after a trial. Investigation shows almost invariably that the plant mentioned never used anything in the slightest degree resembling "scientific management."

In any discussion of the subject it is highly important that "scientific management" plants be identified by their relation to Mr. Taylor, the originator and founder of the Taylor system. If the system in the plant was developed by Mr. Taylor personally, or by any of his assistants or co-workers while associated with him, then the Taylor system may be held responsible for the results; otherwise not.

When this qualification is kept in mind, an impartial investigator must admit that, from the viewpoint of the employer, the employee or the public, the Taylor system is a demonstrated success. If one takes into account its indirect as well as direct results, including the greatly stimulated interest of manufacturers in modern methods and of the public in general efficiency, it will be increasingly realized what a potent factor in modern industrial development Mr. Taylor's work has actually been.

Professor Bob Emiliani

Please visit bobemiliani.com

Frederick Winslow Taylor describes how to change a business from traditional management to Scientific Management, based on his experience doing so in steel and paper companies in the mid-1880s to 1890s. This is an excerpt of his famous 1903 paper, "Shop Management," republished in 1912. Taylor's entire 143 page "Shop Management" paper can be found here (pages 1337-1480) https://archive.org/details/transactionsof24amer/page/1336/mode/2up?view=theater

Industrial Engineering and The Engineering Digest, Vol. XI, No. 4, April 1912

of living naturally rises in the same proportion, and nobody is economically any better off. When production, however, increases along with wages, the cost of living is held down and labor is more prosperous. So also when more is produced for the same wages, the cost of living drops, to the manifest advantage of all labor. The real interest of labor lies, therefore, in the maximum production and the most advantageous distribution of wealth to the proletariat. But the maximum production can be brought about only by unequal distribution, which supplies the necessary incentive to bring out the best effort of the individual worker in every form of active business life. The proletariat is too prone to think that he is the whole thing in the production of wealth, whereas in many lines of trade it costs more to sell than to produce, and still more in interest on the capital invested, which is just as necessary as labor itself. It cannot be denied, however, that good wages help consumption far more than excessive profits in a few hands, and, to maintain a steady market and a good demand for all the products of industry, let us hope that capitalists and the captains of industry will eventually realize that it pays to be liberal to the lower ranks of labor, and so build up a higher type of citizenship, which will produce and consume a larger portion of the good things of life. To this end Scientific Management is moving, and motion study, as a part of it, is helping the good work along.—Wilfred Lewis, in *Engineering*, Jan. 5, 1912.

Changing from Ordinary to Scientific Management[1]

BY FREDERICK W. TAYLOR

Before starting to make any radical changes leading toward an improvement in the system of management, it is desirable, and for ultimate success in most cases necessary, that the directors and the improvement owners of an enterprise shall be made to understand, at least in a general way, what is involved in the change. They should be informed of the leading objects which the new system aims at, such, for instance, as rendering mutual the interests of employer and employee through "high wages and a low labor cost," the gradual selection and development of a body of first-class picked workmen who will work extra hard and receive extra high wages and be dealt with individually instead of in masses; and that this this can only be accomplished through the adoption of precise and exact methods, and having each smallest detail, both as to methods and appliances, carefully selected so as to be the best of its kind. They should understand the general philosophy of the system and should see that, as a whole, it must be in harmony with its few leading ideas, and that principles and details which are admirable in one type of management have no place whatever in another. They should be shown that it pays to employ an especial corps to introduce a new system just as it pays to employ especial designers and workmen to build a new plant; that, while a

[1] The following article is made up of excerpts from Mr. Taylor's paper, "Shop Management," which was read before the American Society of Mechanical Engineers in 1903. This paper is the foundation of the entire Scientific Management movement, and every article on Scientific Management which has appeared in the last few years is either an amplification of some portion of the paper or an illustration of some of the truths contained in it. We have been asked many times within the past couple of years what is involved in the change from ordinary system of management to Scientific Management. We feel that the answer can best be given in the words of Mr. Taylor himself, and we have, therefore, gathered together in the accompanying article the various paragraphs of Mr. Taylor's paper which bear on this very important phase of Scientific Management.—Editor.

new system is being introduced, almost twice the number of foremen are required as are needed to run it after it is in; that all of this costs money, but that, unlike a new plant, returns begin to come in almost from the start from improved methods and appliances as they are introduced, and that in most cases the new system more than pays for itself as it goes along; that time, and a great deal of time, is involved in a radical change in management, and that in the case of a large works, if they are incapable of looking ahead and patiently waiting for from two to four years, they had better leave things just as they are, since a change of system involves a change in the ideas, point of view and habits of many men with strong convictions and prejudices, and that this can only be brought about slowly and chiefly through a series of object-lessons, each of which takes time, and through continued reasoning; and that for this reason, after deciding to adopt a given type, the necessary steps should be taken as fast as possible, one after another, for its introduction. They should be convinced that an increase in the proportion of non-producers to producers means increased economy and not red tape, providing the non-producers are kept busy at their respective functions. They should be prepared to lose some of their valuable men who cannot stand the change and also for the continued indignant protest of many of their old and trusted employees who can see nothing but extravagance in the new ways and ruin ahead. It is a matter of the first importance that, in addition to the directors of the company, all of those connected with the management should be given a broad and comprehensive view of the general objects to be attained and the means which will be employed. They should fully realize before starting on their work and should never lose sight of the fact that the great object of the new organization is to bring about two momentous changes in the men.

Their real instruction, however, must come through a series of object-lessons. They must be convinced that a great increase in speed is possible by seeing here and there a man among them increase his pace and double or treble his output. They must see this pace maintained until they are convinced that it is not a mere spurt; and, most important of all, they must see the men who "get there" in this way receive a proper increase in wages and become satisfied. It is only with these object-lessons in plain sight that the new theories can be made to stick. It will be in presenting these object-lessons and in smoothing away the difficulties so that the high speed can be maintained, and in assisting to form public opinion in the shop, that the great efficiency of functional foremanship under the direction of the planning room will first become apparent.

In reaching the final high rate of speed which shall be steadily maintained, the broad fact should be realized that the men must pass through several distinct phases, rising from one plane of efficiency to another until the final level is reached. First they must be taught to work under an improved system of day work. Each man must learn how to give up his own particular way of doing things, adapt his methods to the many new standards and grow accustomed to receiving and obeying directions covering details large and small which in the past have been left to his individual judgment. At first the workmen can see nothing in all of this but red tape and useless and impertinent interference, and time must be allowed them to recover from their irritation, not only at this but at every stage in their upward march. If they have been classed together and paid uniform wages for each class, the better men should be singled out and given higher wages so that they shall distinctly recognize the fact that each man is to be paid according to his individual worth. After becoming accustomed to direction in minor matters, they must gradually learn to obey instructions as to the pace at which they are to work, and grasp the idea, first, that the planning department knows accurately how long each operation should take; and second, that sooner or later they will have to work at the required speed if they expect to prosper. After they are used to following the speed instructions given them, then one at a time they can be raised to the level of maintaining a rapid pace throughout the day. And it is not until this final step has been taken that the full measure of the value of the new system will be felt by the men through daily receiving larger wages, and by the company through a materially larger output and lower cost of production. It is evident, of course, that all of the workmen in the shop will not rise together from one level to another. Those engaged in certain lines of work will have reached their final high speed while others have barely taken the first step. The efforts of the new management should not be spread out thin over the whole shop. They should rather be focussed upon a few points, leaving the ninety and nine under the care of their former shepherds. After the efficiency of the men who are receiving especial assistance and training has been raised to the desired level, the means for holding them there should be perfected, and they should never be allowed to lapse into their old ways. This will, of course, be accomplished in the most permanent way and rendered almost automatic, either through introducing "task work with a bonus" or the "differential rate." Before taking any steps toward changing methods the manager should realize that at no time during the introduction of the system should any broad, sweeping changes be made which seriously affect a large number of the workmen. It would be preposterous, for instance, in going from day to piece work to start a large number of men on piece work at the same time. Throughout the early stages of organization each change made should affect one workman only, and after the single man affected has become used to the new order of things, then change one man after another from the old system to the new, slowly at first, and rapidly as public opinion in the shop swings around under the influence of proper object lessons. Throughout a considerable part of the time, then, there will be two distinct systems of management in operation in the same shop; and in many cases it is desirable to have the men working under the new system managed by an entirely different set of foremen, etc., from those under the old.

The first step, after deciding upon the type of organization, should be the selection of a competent man to take charge of the introduction of the new system; and the manager should think himself fortunate if he can get such a man at almost any price, since the task is a difficult and thankless one and but few men can be found who possess the necessary information coupled with the knowledge of men, the nerve, and the tact required for success in this work. The manager should keep himself free as far as possible from all active part in the introduction of the new system. While changes are going on it will require his entire energies to see that there is no falling off in the efficiency of the old system and that the quality and quantity of the output is kept up. The mistake which is usually made when a change in system is decided upon is that the manager and his principal assistants undertake to make all of the improvements themselves during their spare time, with the common result that weeks, months and years go by without anything great being accomplished. The respective duties of the manager and the man in charge of improvement, and the limits of the authority of the latter should be clearly defined and agreed upon, always bearing in mind that responsibility should invariably be accompanied by its corresponding measure of authority. The worst mistake that can be made is to refer to any part of the new system as being "on trial." Once a given step is decided upon, all parties must be made to understand that it will go whether anyone around the place likes it or not. In making changes in system the things that are given a "fair trial" fail, while the things that "must go," go all right.

To decide where to begin is a perplexing and bewildering problem which faces the reorganizer in management when he arrives in a large establishment. In making this decision, as in taking each subsequent step, the most important consideration which should always be first in the mind of the reformer, is "what effect will this step have upon the workmen?" Through some means (it would almost appear some especial sense), the workman seems to scent the approach of a reformer even before his arrival in town. Their suspicions are thoroughly aroused, and they are on the alert for sweeping changes which are to be against their interests and which they are prepared to oppose from the start. The first changes, therefore, should be such as to allay the suspicions of the men and convince them by actual contact that the reforms are after all rather harmless. Such improvements then as directly affect the workmen least should be started first. At the same time it must be remembered that the whole operation is of necessity so slow that the new system should be started at as many points as possible, and constantly pushed as hard as possible. A start can be made at once along all of the following lines:

If the works is a large one, the man in charge of introducing the system should appoint a special assistant in charge of each of the above functions, just as an engineer designing a new plant would start a number of draftsmen to work upon the various elements of construction. Several of these assistants will be brought into close contact with the men, who will in this way gradually get used to seeing changes going on and their suspicion, both of the new men and the methods, will have been allayed to such an extent before any changes which seriously affect them are made, that little or no determined opposition on their part need be anticipated. The most important and difficult task of the organizer will be that of selecting and training the various functional foremen who are to lead and instruct the workmen, and his success will be measured principally by his ability to mould and teach these men. They cannot be found, they must be made. They must be instructed in their new functions largely, in the beginning at least, by the organizer himself; and this instruction to be effective, should be mainly in actually doing the work. Explanation and theory will go a little way, but actual doing is needed to carry conviction. To illustrate: For nearly two and one-half years in the large shop of the Bethlehem Steel Co., one speed boss after another was instructed in the art of cutting metals fast on a large motor-driven lathe which was especially fitted to run at any desired speed within a very wide range. The work done in this machine was entirely connected, either with the study of cutting tools or the instruction of speed bosses. It was most interesting to see these men, principally either former gang bosses or the best workmen, gradually change from their attitude of determined and positive opposition to that in most cases of enthusiasm for, and earnest support of, the new methods. It was actually running the lathe themselves according to the new method and under the most positive and definite orders that produced the effect. The writer himself ran the lathe and instructed the first few bosses. It required from three weeks to two months for each man. Perhaps the most important part of the gang boss's and foreman's education lies in teaching them to promptly obey orders and instructions received not only from the superintendent or some official high in the company, but from any member of the planning room whose especial function it is to direct the rest of the works in his particular line; and it may be accepted as an unquestioned fact that no gang boss is fit to direct his men until after he has learned to promptly obey instructions received from any proper source, whether he likes his instructions and the instructor or not, and even although he may be convinced that he knows a much better way of doing the work. The first step is for each man to learn to obey the laws as they exist, and next, if the laws are wrong, to have them reformed in the proper way.

In starting to organize even a comparatively small shop, containing say from 75 to 100 men, it is best to begin by training in the full number of functional foremen, one for each function, since it must be remembered that about two out of three of those who are taught this work either leave of their own accord or prove unsatisfactory; and in addition, while both the workmen and bosses are adjusting themselves to their new duties, there are needed fully twice the number of bosses as are required to carry on the work after it is fully systematized.

Unfortunately, there is no means of selecting in advance those out of a number of candidates for a given work who are likely to prove successful. Many of those who appear to have all of the desired qualities, and who talk and appear the best, will turn out utter failures, while on the other hand some of the most unlikely men rise to the top. The fact is, that the more attractive qualities of good manners, education, and even special training and skill, which are more apparent on the surface, count for less in an executive position than the grit, determination and bulldog endurance and tenacity that knows no defeat and comes up smiling to be knocked down over and over again.

The first of the functional foremen to be brought into actual contact with the men should be the inspector; and the whole system of inspection, with its proper safeguards should be in smooth and successful operation before any steps are taken toward stimulating the men to a larger output; otherwise an increase in quantity will probably be accompanied by a falling off in quality.

Of all the farces in management the greatest is that of an establishment organized along well-planned lines, with all of the elements needed for success, and yet which fails to get either output or economy. There must be some man or men present in the organization who will not mistake the form for the essence, and who will have brains enough to find out those of their employees who "get there," and nerve enough to make it unpleasant for those who fail, as well as to reward those who succeed. No system can do away with the need of real men. Both system and good men are needed, and after introducing the best system, success will be in proportion to the ability, consistency and respected authority of the management.

There has never been a strike by men working under this system, although it has been applied at the Midvale Steel Works for the past twenty years; and the steel business has proved during this period the most fruitful field for labor organizations and strikes. And this notwithstanding the fact that the Midvale Company has never prevented its men from joining any labor organization. All of the best men in the company saw clearly that the success of a labor organization meant the lowering of their wages in order that the inferior men might earn more, and, of course, could not be persuaded to join.

The labor unions—particularly the trades unions of England—have rendered a great service, not only to their members, but to the world, in shortening the hours of labor and in modifying the hardships and improving the conditions of wage-workers.

Some method of disciplining the men is unfortunately a necessary element of all systems of management. It is important that a consistent, carefully considered plan should be adopted for this as for all other details of the art. No system of discipline is at all complete which is not sufficiently broad to cover the great variety in the character and disposition of the various men to be found in a shop.

The writer does not at all depreciate the value of the many semi-philanthropic and paternal aids and improvements, such as comfortable lavatories, eating rooms, lecture halls, and free lectures, night schools, kindergartens, baseball and athletic grounds, village improvement societies and mutual beneficial associations, unless done for advertising purposes. These all tend to improve and elevate the workmen and make life better worth living. Viewed from the managers' standpoint they are valuable aids in making more intelligent and better workmen, and in promoting a kindly feeling among the men for their employers. They are, however, of distinctly secondary importance, and should never be allowed to engross the attention of the superintendent to the detriment of the more important and fundamental elements of management. They should come in all establishments, but they should come only after the great problem of work and wages has been permanently settled to the satisfaction of both parties. The solution of this problem will take more than the entire time of the management in the average case for several years.

The Science of Management in Practice—[1]IV

Symbols—A System Described and Its Uses Outlined

BY FREDERIC A. PARKHURST[2]

4-A. Various Systems of Symbolizing.

The prime object of any system of symbolizing is to provide a character which will assist in the prompt identification of any unit. The second object is to use a character flexible enough to include all branches of a business, within its scope. The present opportunities for the use of a practical, comprehensive scheme of symbols are unlimited.

The author maintains, adverse criticism to the contrary, that a symbol is an identification mark first and foremost. The character must positively differentiate one article or unit from some other. If a simple and not too cumbersome symbol could be devised which would instantly tell by its form or character what it represented, it might be ideal, but so far all efforts along such lines have proved impractical. If we know the number of a house on a given street, for example, 360 West 59th Street, it is not necessary to know whether the house is an old mansard design, an early colonial type, or a modern tenement structure in order to identify it. The address enables us to direct one to this house to find it ourselves with a minimum of effort. The symbol should enable one to identify an article or unit with just as little effort. So, bearing in mind the essential factor of identification, it is obvious that the greatest practical use will be obtained from that scheme of symbols which is founded upon the simplest rules, with as few characters as possible and which has the least variations.

The different schemes of symbols which have been developed from time to time may be classed under the following general headings:

1. Dewey Decimal System.
2. Mnemonic System.
3. Arbitrary System. A modification of this might be called the Group System.

[2] Production Engineer, Ferracute Machine Co., Bridgeton, N. J.

Linked in

Professor Bob Emiliani

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You could substitute the words "TPS" or "Lean" for "Scientific Management." Written 109 years ago, it still rings true today.

Industrial Engineering and The Engineering Digest, Volume XI, No. 4, 1912

A Thought on Scientific Management

BY A DISCIPLE

Managers and level-headed business men are prone to believe that Scientific Management cannot be applied with benefit in their particular business. There can be no question as to their sincerity. Honest men are always open-minded, and will be glad to alter any opinion, based on inadequate or incorrect information. The belief that Scientific Management is not suited to their problem is based on inadequate or incorrect information.

There are two methods by which one may be converted to believe in this new doctrine. One is the good old method of *Faith.* The other is study and experiment. The Disciples do not anticipate accessions by Faith. But the way to an understanding is becoming easier as the literature of the subject increases. The recent article by Mr. Hathaway on time study will be a great help to any one wishing information. But do not expect too much from reading. It will be easier learned, as is chemistry, by experiment.

Few will be able to comprehend the applicability of the principles without actually trying concientiously to apply them. One who wishes to study the subject, should select a simple problem and undertake, as a preliminary, a motion study of this problem. There is a very clear distinction between motion study and time study, as applied by experts. Any one who will make the effort may experiment with motion study and, by continued experimenting, can learn wherein the operating of the particular problem may be improved. A small improvement will furnish an illustration of the principle involved, but the student must not expect that, without experience, he will be able to obtain results which will fully compensate for the energy and time expended. But when the light is seen in one case, he should shift to another problem, and after he has attempted three or four different ones, there should be a return to the first. A further study of this former problem will indicate to the student that he has made mistakes in his first attempt, not necessarily serious, but rather that his data were not complete and accurate, and that, as a consequence, the conclusions based thereon, must be revised.

It will not require a great deal of study on the part of a sincere seeker after truth, to show him that there are many little things which come up, for which he is not able to apply the correct formula. He realizes that he needs instruction from one who knows, and when this time arrives, he will have come to a mental attitude for further development.

Until one actually takes a watch and concientiously studies some particular problem, it will be extremely difficult for him to accept the principles involved. It is not usual for one to accept, on faith alone, facts such as are stated by disciples of Scientific Management. One must understand these principles or accept them on faith, before they can be adopted as truth. They cannot be understood without study of the most elementary parts. It would be no more unreasonable to expect a student to understand the conclusions of higher mathematics, of those arrived at in the chemical laboratory, without preliminary study of elementary principles, than it would be to expect men to understand the details of Scientific Management, and its applicability to a particular problem, without an understanding of motion study, or elementary time study.

Professor Bob Emiliani

Please visit bobemiliani.com

Scientific Management was the first systematic approach to valuing labor. Dr. Lillian Gilbreth's seminal work, "The Psychology of Management," extended that perspective. It was the result of her doctoral work at the University of California circa 1908-1911. The work would be published two years later as a book (she struggled to find a publisher because nobody would publish a book written by a woman; had to use her initials instead of first name to get the work published). You can read the book here https://www.google.com/books/edition/The_Psychology_of_management/_H1oCAHKiHAC?hl More on Dr. Gilbreth here https://en.wikipedia.org/wiki/Lillian_Moller_Gilbreth

Industrial Engineering
and The Engineering Digest
Vol. XI MAY, 1912 No. 5

The Psychology of Management[1]—I

BY L. M. GILBRETH

The Psychology of Management, as here used, means the effect of the mind that is directing work upon that work which is directed, and the effect of this undirected and directed work upon the mind of the worker.

Value of Psychology.—First of all, what is there in the subject of psychology to demand the attention of the manager?

Psychology, in the popular phrase, is "the study of the mind." It has for years been included in the training of all teachers, and has been one of the first steps for the student of philosophy; but it has not, usually, been included among the studies of the young scientific or engineering student, or of any students in other lines than philosophy and education. It is well recognized that the teacher must understand the working of the mind in order best to impart his information in that way that will enable the student to grasp it most readily. It was not recognized that every man going out into the world needs all the knowledge that he can get as to the working of the human mind, in order not only to give but to receive information with the least waste and expenditure of energy, nor was it recognized that in the industrial, as well as the academic, world, almost every man is a teacher.

Value of Management.—The second question demanding attention is, Of what value is the study of management?

The study of management has been omitted from the student's training until comparatively recently, for a very different reason than was psychology. It was never doubted that a knowledge of management would be of great value to anyone and everyone, and many were the queer schemes for obtaining that knowledge after graduation. It was doubted that management could be studied otherwise than by observation and practice.[1a] Few teachers, if any, believed in the existence or possibility of a teaching science of management. Management was assumed by many to be an art; by even more it was thought to be a divinely bestowed gift or talent, rather than an acquired accomplishment. It was common belief that one could learn to manage only by going out on the work and watching other managers, or by trying to manage, and not by studying about management in a class-room or in a text-book; that watching a good manager might help one, but no one could hope really to succeed who had not "the knack born in him."

1a Charles Babbage, "Economy of Manufactures," preface, p. v.

With the advent of Scientific Management, and its demonstration that the best management is founded on laws that have been determined, and can be taught, the study of management in the class-room as well as on the work became possible and actual.[2]

Value of Psychology of Management.—Third, we must consider the value of the study of the psychology of management.[3]

This question, like the one that precedes it, is answered by Scientific Management. It has demonstrated that the emphasis in successful management lies on the ***man***, not on the ***work***; that efficiency is best secured by placing the emphasis on the man, and modifying the equipment, materials and methods to make the most of the man. It has further recognized that the man's mind is a controlling factor in his efficiency, and has, by teaching, enabled the man to make the most of his powers.[4] In order to understand this teaching element that is such a large part of management, a knowledge of psychology is imperative; and this study of psychology as it applies to the work of the manager or the managed, is exactly what the "psychology of management" is.

Five Indications of the Value of Psychology.—In order to realize the importance of the psychology of management. it is necessary to consider the following five points:

1. Management is a life study of every man who works with other men. He must either manage, or be managed, or both; in any case, he can never work to best advantage until he understands both the psychological and managerial laws by which he governs or is governed.

2. A knowledge of the underlying laws of management is the most important asset that one can carry with him into his life work, even though he will never manage any but himself. It is useful, practical, commercially valuable.

3. This knowledge is to be had ***now***. The men who have it are ready and glad to impart it to all who are interested and who will pass it on.[5] The text-books are at hand now. The opportunities for practical experience in Scientific Management will meet all demands as fast as they are made.

4. The psychology of (that is, the mind's place in) management is only one element of management; one of numerous variables.

5. It is a division well fitted to occupy the attention of the beginner, as well as the more experienced, because it is a most excellent place to start the study of management. A careful study of the relations of psychology to management should develop in the student a method of attack in learning his selected life work that should help him to grasp quickly the array of facts that the other variables, as treated by the great managers, bring to him.

Definition of Management.—"Management," as defined by the Century Dictionary, is "the art of managing by direction or regulation."

This same authority differentiates an art from a science in an interesting manner. In the definition are included the two following statements: (1) An art is "a system of rules and traditional methods for facilitating the performance of certain actions." (2) A science is "an art that rests upon a science." The first definition of "art" is a definition of the older type of management. The second defines scientific management. Management includes both thoughts.

Change in the Accepted Meaning.—"Management," until recent years, and the emphasis placed on Scientific Management, was undoubtedly associated, in the average mind, with the *managing* part of the organization only, neglecting that vital part—the best interests of the managed, almost entirely. Since we have come to realize that management signifies the relationship between the managing and the managed in

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[2]Halbert P. Gillette, Paper No. 1, American Society of Engineering Contractors.

[3]Gillette and Dana, "Cost Keeping and Management Engineering," p. v.

[4]F. B. Gilbreth, "Motion Study," p. 98.

[5]F. W. Taylor, "The Principles of Scientific Management" (Harper & Bros.), p. 144.

doing work, a new realization of its importance has come about.[6]

The Three Types of Management.—We may divide all management into three types: (1) Traditional, (2) Transitory, and (3) Scientific.[7]

Traditional Management, the first, has been variously called "Military," "Driver," the "Marquis of Queensberry Type," "Initiative and Incentive Management," as well as "Traditional" management.

Definition of the First (Traditional) Type.—In the first type the power of managing lies, theoretically at least, in the hands of one man, a capable "all-around" manager. The line of authority and of responsibility is clear, fixed and single. Each man comes in direct contact with but one man above him. A man may or may not manage more than one man beneath him, but, however this may be, he is managed by but one man above him.

The Name "Military" Inadvisable.—The direct line of authority suggested the name "Military,"[8] and at the time of the adoption of that name it was probably appropriate as well as complimentary.[9] Appropriate in the respect referred to only, for the old type of management varied so widely in its manifestations that the comparison to the procedure of the Army was most inaccurate. "Military" has always been a synonym for "systematized," "orderly," "definite," while the old type of management was more often quite the opposite of the meaning of all these terms. The term "Military Management," though often used in an uncomplimentary sense, would, to-day, if understood, be more complimentary than ever it was in the past. The introduction of various features of Scientific Management into the Army and Navy—and such features are being incorporated steadily and constantly—is raising the standard of management there to a high degree.

The Names "Driver" and "Marquis of Queensberry" Unfortunate.—The name "Driver" suggests an opposition between the managers and the men, an opposition which the term "Marquis of Queensberry" emphasizes. This term "Marquis of Queensberry" has been given to that management which is thought of as a mental and physical contest, waged "according to the rules of the game." These two names are most valuable pictorially, or in furnishing oratorical material. They are constant reminders of the constant desire of the managers to get all the work that is possible out of the men, but they are scarcely descriptive in any satisfactory sense, and the visions they summon, while they are perhaps definite, are certainly, for the inexperienced in management, inaccurate.

The term "Initiative and Incentive," is used by Dr. Taylor, and is fully described by him.[10] The words themselves suggest, truly, that he gives the old form of management its due. He does more than this. He points out in his definition of the terms the likenesses between the old and the new forms.

The only excuses for the term "Traditional," since Dr. Taylor's term is available, are its brevity and its descriptiveness. The fact that it is indefinite is really no fault in it, as the subject it describes is equally indefinite. The "fringe"[11] of this word is especially good. It calls up ideas of information handed down from generation to generation orally—the only way of teaching under the old type of management. It recalls the idea of the inaccurate perpetuation of the unthinking custom, and the "myth" element always present in tradition—again undeniable accusations against the old type of management. The fundamental idea of the tradition, that it is *oral,* is the

[6] F. W. Taylor, "Shop Management," ¶ 16, Am. Soc. M. E. paper No. 1003.
[7] F. B. Gilbreth, "Cost Reducing System," Chap. I.
[8] Morris Llewellyn Cooke, Bulletin No. 5 of The Carnegie Foundation for the Advancement of Teaching, p. 17.
[9] F. W. Taylor, "Shop Management," ¶ 234, Am. Soc. M. E. paper No. 1003.
[10] F. W. Taylor, "The Principles of Scientific Management," pp. 33-38.
[11] The ideas called to mind by the use of a given word.—Editor.

essence of the difference of the old type of management from science, or even system, which must be written.

Definition of the Second Type of Management.—The second type of management is called "Interim," or "Transitory," management. It includes all management that is consciously passing into Scientific Management and embraces all stages, from management that has incorporated one scientifically derived principle, to management that has adopted all but one such principle.

Definition of the Third Type of Management.—The third form of management is called "Ultimate," "Functional," or "Scientific" management, and might also be called —but for the objection of Dr. Taylor—the "Taylor Plan of Management." This differs from the first two types mentioned in that it is a definite plan of management synthesized from scientific analysis of the data of management. In other words, Scientific Management is that management which is a science, *i. e.,* which operates according to known, formulated, and applied laws.[12]

Preferable Name of the Third Type of Management.—The name "ultimate" has, especially to the person operating under the transitory stage, all the charm and inspiration of a goal. It has all the incentives to accomplishment of a clearly circumscribed task. Its very definiteness makes it seem possible of attainment. It is a great satisfaction to one who, during a lifetime of managing effort, has examined one offered improvement after another to be convinced that he has found the right road at last. The name is, perhaps, of greatest value in attracting the attention of the uninformed, and, as the possibilities of the subject can fulfil the most exacting demands, the attention once secured can be held.

The name "functional" is the most descriptive, but demands the most explanation. The principle of functionalization is one of the underlying, fundamental principles of Scientific Management. It is not as necessary to stop to define it here, as it is to discuss the definition, the principle, and the underlying psychology, at length later.

The name "scientific," while in some respects not as appropriate as are any of the other names, has already received the stamp of popular approval. It describes exactly, as has been said, the difference between the older forms of management and the new. Even its "fringe" of association is, or at least was when first used, all that could be desired; but the name is, unfortunately, occasionally used indiscriminately for any sort of system and for schemes of operation that are not based on time study. It has gradually become identified more or less closely with

1. The Taylor Plan of Management.
2. What we have defined as the "Transitory" plan of management.
3. Management which not only is not striving to be scientific, but which confounds "science" with "system."

Both its advocates and opponents have been guilty of misuse of the word. Still, in spite of this, the very fact that the word has had a wide use, that it has become habitual to think of the new type of management as "scientific," makes its choice advisable. We shall use it, but restrict its content. With us "Scientific Management" is used to mean the complete Taylor plan of management, with no modifications and no deviations.

Relationship Between the Three Types of Management.—From the foregoing definitions and descriptions it will be clear that the three types of management are closely related. Three of the names given bring out this relationship most clearly. These are Traditional (*i. e.,* Primitive), Interim, and Ultimate. These show, also, that the relationship is genetic, *i. e.,* that the second form grows out of the first, but passes through to the third. The growth is evolutional.

Under the first type, or in the first stage

[12] Henry R. Towne's Introduction to "Shop Management" (Harper & Bros.).

of management, the laws or principles underlying right management are usually unknown, hence disregarded.

In the second stage the laws are known and installed as fast as functional foremen can be taught their new duties and the resistance of human nature can be overcome.[13]

In the third stage the managing is operated in accordance with the recognized laws of management.

Possible Psychological Studies of Management.—In making this psychological study of management, it would be possible to take up the three types as defined above, separately and in order, and to discuss the place of the mind in each, at length; but such a method would not only result in needless repetition, but also in most difficult comparisons when final results were to be deduced and formulated.

It would, again, be possible to take up the various elements or divisions of psychological study as determined by a consensus of psychologists, and to illustrate each in turn from the three types of management; but the results from any such method would be apt to seem unrelated and impractical, *i. e.*, it would be a lengthy process to get results that would be of immediate, practical use in managing.

Plan of Psychological Study Used Here.—It has, therefore, seemed best to base the discussion that is to follow upon arbitrary divisions of Scientific Management, that is,

1. To enumerate the underlying principles on which Scientific Management rests.

2. To show how far the other two types of management vary from Scientific Management.

3. To discuss the psychological aspect of each principle.

In this way the reader can gain an idea of

1. The relation of Scientific Management to the other types of management;

2. The structure of Scientific Management;

3. The relation between the various elements of Scientific Management;

4. The psychology of management in general, and of the three types of management in particular.

Underlying Ideas and Divisions of Scientific Management.—These underlying ideas are grouped under nine divisions, as follows: (1) Individuality; (2) Functionalization; (3) Measurement; (4) Analysis and Synthesis; (5) Standardization; (6) Records and Programs; (7) Teaching; (8) Incentives; and (9) Welfare.

It is here only necessary to enumerate these divisions. Each will be made the subject of a chapter.

These divisions lay no claim to being anything but underlying ideas of Scientific Management that embrace varying numbers of established elements that can easily be subjected to the scrutiny of psychological investigation.

The discussion will be as little technical as is possible, will take nothing for granted, and will cite references at every step. This is a new field of investigation, and the utmost care is necessary to avoid generalizing from insufficient data.

Derivation of Scientific Management.—There has been much speculation as to the age and origin of Scientific Management. The results of this are interesting, but are not of enough practical value to be repeated here. Many ideas of Scientific Management can be traced back, more or less clearly and directly, to thinkers of the past; but the Science of Management, as such, was discovered, and the deduction of its laws, or "principles," made possible when Dr. Frederick W. Taylor discovered and applied Time Study. Having discovered this, he constructed from it and the other fundamental principles a complete whole.

Mr. George Iles, in that most interesting and instructive of books, "Inventors at Work,"[14] has pointed out the importance of

[13] F. W. Taylor, "The Principles of Scientific Management," p. 123.
[14] Doubleday, Page & Co.

measuring devices and methods to development in any line of progress or science. Contemporaneous with, or previous to, the discovery of the device or method, must come the discovery or determination of the most profitable unit of measurement which will, of itself, best show the variations in efficiency from class. When Dr. Taylor discovered units of measurements for determining, prior to performance, the amount of any kind of work that a worker could do and the amount of rest he must have during the performance of that work, then, and not until then, did management become a science. On this hangs the science of management.[15]

Outline of Method of Investigation.—In the discussion of each of the nine divisions of Scientific Management, the following topics must be treated:

1. Definition of the division and its underlying idea.
2. Appearance and importance of the idea in Traditional and Transitory Management.
3. Appearance and importance of the idea in Scientific Management.
4. Elements of Scientific Management which show the effects of the idea.
5. Results of the idea upon work and workers.

These topics will be discussed in such order as the particular division investigated demands. The psychological significance of the appearance or non-appearance of the idea, and of the effect of the idea, will be noted. The results will be summarized at the close of each chapter, in order to furnish data for drawing conclusions at the close of the discussion.

Conclusions to be Reached.—These conclusions will include the following:

1. "Scientific Management" is a science.
2. It alone, of the Three Types of Management, is a science.
3. Contrary to a widespread belief that Scientific Management kills individuality, it is built on the basic principle of recognition of the individual, not only as an economic unit but also as a personality, with all the idiosyncrasies that distinguish a person.
4. Scientific Management fosters individuality by functionalizing work.
5. Measurement, in Scientific Management, is of ultimate units of subdivision.
6. These measured ultimate units are combined into methods of least waste.
7. Standardization under Scientific Management applies to all elements.
8. The accurate records of Scientific Management make accurate programs possible of fulfilment.
9. Through the teaching of Scientific Management the management is unified and made self-perpetuating.
10. The method of teaching Scientific Management is a distinct and valuable contribution to education.
11. Incentives under Scientific Management not only stimulate but benefit the worker.
12. It is for the ultimate as well as immediate welfare of the worker to work under Scientific Management.
13. Scientific Management is applicable to all fields of activity, and to mental as well as physical work.
14. Scientific Management is applicable to self-management as well as to managing others.
15. It teaches men to co-operate with the management as well as to manage.
16. It is a device capable of use by all.
17. The psychological element of Scientific Management is the most important element.
18. Because Scientific Management is psychologically right, it is the ultimate form of management.
19. This psychological study of Scientific Management emphasizes especially the teaching features.
20. Scientific Management simultaneously
   a. Increases output and wages and lowers costs.
   b. Eliminates waste.
   c. Turns unskilled labor into skilled.

[15] F. W. Taylor, "The Principles of Scientific Management," p. 137.

d. Provides a system of self-perpetuating welfare.

c. Reduces the cost of living.

f. Bridges the gap between the college-trained and the apprenticeship-trained worker.

g. Forces capital and labor to co-operate and to promote industrial peace.

(*To be continued.*)

The Principles of Industrial Lighting—III

Industrial Lighting Requirements and the Reflector (continued)

BY THOMAS W. ROLPH

Reflectors

The illumination requirements of industrial lighting would be but poorly met, did we not have reflectors to aid us. A consideration of the types of reflectors available, their characteristics and relative advantages forms a logical sequence to a consideration of the illumination requirements. Before taking up the reflector proper, however, it is well to consider the fundamental light-activities on which reflectors are based.

When a ray of light strikes or passes into a solid body there are three changes which it may undergo. These are reflection, refraction and impedance. Reflection always follows the law that the angle of incidence is equal to the angle of reflection. Reflection may be regular or irregular, and Fig. 6 illustrates the two types. In both cases the above law is followed, but in the case of irregular reflection the irregular surface causes light to be incident at many different angles, resulting in a spreading of the reflected light. Any matte surface will give irregular reflection. Refraction, or the bending of a light-ray on its passing from one medium into another of different density, follows a law which requires the extent of this bending to vary with the angle of incidence and the relative densities of the two media. Impedance, as the name implies, refers to resistance to the passage of light through a medium. Its only effect is the partial or total absorption of the light. These three effects—reflection; refraction, and impedance—combine and interact to form all the phenomena on which reflectors are based.

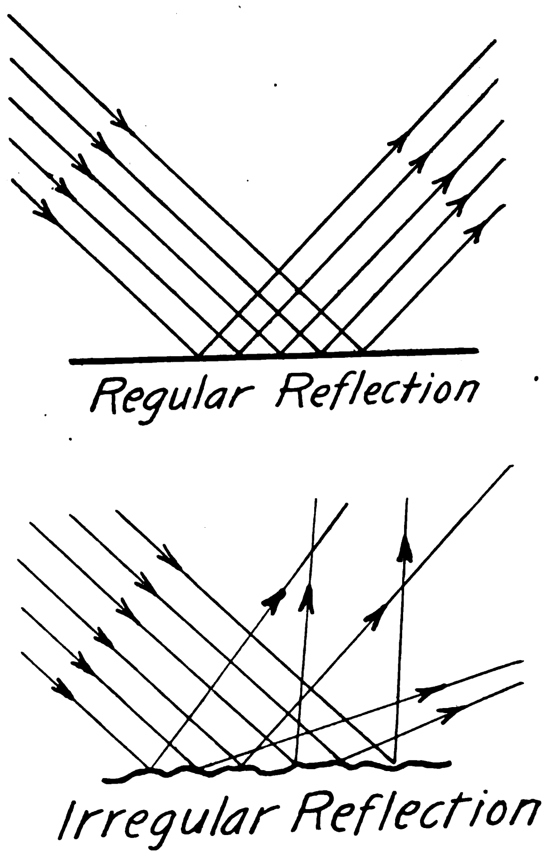

FIG. 6—REGULAR AND IRREGULAR REFLECTION

Industrial Engineering

and The Engineering Digest

Vol. XI JUNE, 1912 No. 6

The Psychology of Management[1]—II

BY L. M. GILBRETH

INDIVIDUALITY

For our purpose, we may define the study of individuality as a consideration of the individual as a unit with special characteristics. The recognition of individuality is the subject of this chapter. The utilization of this individuality in its deviation from class, is the subject of the chapter that follows, Functionalization.

Individuality as Considered by Psychology.—Psychology has not always emphasized the importance of the individual as a unit for study. Prof. Ladd's definition of psychology, quoted and endorsed by Prof. James, is "the description and explanation of states of consciousness, as such."[16] "By states of consciousness," says James, "are meant such things as sensation, desires, emotions, cognitions, reasonings, decisions, volitions, and the like." This puts the emphasis on such divisions of consciousness as "attention," "interest" and "will."

With the day of experimental psychology has come the importance of the individual self as a subject of study,[17] and psychology has come to be defined, as Calkins defines it, as a "science of the self as conscious."[18]

We hear much in the talk of today of the "psychology of the crowd," the "psychology of the mob," and the "psychology of the type," etc., but the mind that is being measured, and from whose measurements the laws are being deduced and formulated, is at the present the *individual* mind.[19]

The psychology which interested itself particularly in studying such divisions of mental activity as attention, will, habit, etc., emphasizes more particularly the likenesses of minds. It is necessary to understand thoroughly all of these likenesses before one can be sure what and how important the differences are, because it is the differences that are most often actually utilized by management. These must be determined in order to compute and set the proper individual task for the given man from standard data of the standard, or first-class, man.

In any study of the individual, the following facts must be noted:

(1) The importance of the study of the individual, and the comparatively small amount of work that has as yet been done in that field. (2) The difficulty of the study, the necessity for great care, not only in the study itself, but in deducing laws from it. (3) The necessity of considering any one individual trait as modified by all the other traits of the individual. (4) The importance of the individual as distinct from the type.

Individuality Seldom Recognized Under

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[16]William James, "Psychology, Briefer Course," p. 1.

[17]Hugo Münsterberg, "American Problems," p. 34.

[18]Mary Whiton Calkins, "A First Book in Psychology," p. 1.

[19]James Sully, "Teacher's Handbook of Psychology," p. 14.

Traditional Management.—Under Traditional management there was little or no systematized method for the recognition of individuality or individual fitness.[20] The worker usually was, in the mind of the manager, one of a crowd, his only distinguishing mark being the amount of work which he was capable of performing.

Selecting Workers Under Traditional Management.—In selecting men to do work, there was little or no attempt to study the individuals who applied for work. The matter of selection was more of the process of "guesswork" than of exact measurement, and the highest form of test was considered to be that of having the man actually tried out by being given a chance at the work itself.

In the most progressive type of Traditional Management there was usually a feeling, however, that if the labor market offered even temporarily a greater supply than the work in hand demanded, it was wise to choose those men to do the work who were best fitted for it, or who were willing to work for less wages. It is surprising to find in the traditional type, even up to the present day, how often men were selected for their strength and physique, rather than for any special capabilities fitting them for working in, or at, the particular line of work to be done. Under Traditional Management the output of the men was not usually separated, nor was the output recorded separately, as can be done even with the work of gangs.

Few Individual Tasks Under Traditional Management.—Seldom, if ever, was an individual task set for a worker on day work, or piece work, and even if one were set, it was not scientifically determined. The men were simply set to work alone or in gangs, *as the work demanded*, and, if the foreman was overworked or lazy, allowed to take practically their own time to do the work. If, on the other hand, the foreman was a "good driver," the men might be pushed to the utmost limit of their individual undirected speed, regardless of their welfare.

Little Individual Teaching Under Traditional Management.—Not having a clear idea either of the present fitness and the future possibilities of the worker, or the requirements of the work, no intelligent attempt could be made at efficient individual teaching. What teaching was done was in the form of directions for all, concerning the work in general, the directions being given by a foreman, the holding of whose position often depended more upon whether his employer made money than upon the way his men were taught or worked.

Cause of These Lacks Under Traditional Management.—The fault lies not in any desire of the managers to do poor or wasteful work, or to treat their workers unfairly, but in a lack of knowledge and of accurate methods for obtaining, conserving and transmitting knowledge. Under Traditional Management no one individual knows precisely what is to be done; seldom knows how it can best be done, never knows how much work each individual can do.[21] Understanding neither work nor workers, it can not adjust one to the other so as to obtain the least waste. Having no conception of the importance of accurate measurement, it has no thought of the individual as a unit.

Individuality Recognized Under Transitory Management.—Recognition of individuality is one of the principles first apparent under Transitory Management. This is apt to demonstrate itself first of all in causing the outputs of the workers to "show up" separately, in recording these separated outputs, and in rewarding each worker for his individual output.

The benefits of introducing these features first are that the worker, (1) seeing his individual output, is stimulated to measure it, and (2) receiving compensation in accordance with his output, is satisfied; and (3)

[20] H. L. Gantt, "Work, Wages and Profits," p. 52.
[21] F. W. Taylor, "Shop Management" (Harper & Bros.), p. 25.

observing that records are necessary to determine the amount of output and pay, is glad to have accurate measurement and the other features of Scientific Management introduced.

Individuality a Fundamental Principle of Scientific Management.—Under Scientific Management the individual is the unit to be measured. Functionalization is based upon utilizing the particular powers and special abilities of each man. Measurement is of the individual man and his work. Analysis and synthesis build up methods by which the individual can best do his work. Standards are of the work of an individual, a standard man, and the task is always for an individual, being that percentage of the standard man's task that the particular individual can do. Records are of individuals, are made in order to show and reward individual effort. Specific individuals are taught those things that they, individually, require. Incentives are individual, both in cases of rewards and of punishments, and, finally, it is the welfare of the individual worker that is considered, without the sacrifice of any for the good of the whole.

Individuality Considered in Selecting Workers.—Under Scientific Management individuality is considered in selecting workers as it could not be under either of the other two forms of management. (1) The work is more specialized, hence requires more carefully selected men. (2) With standardized methods comes a knowledge to the managers of the qualifications of the "standard men" who can best do the work and continuously thrive. (3) Motion study, in its investigation of the worker, supplies a list of variations in workers that can be utilized in selecting men.[22]

Variables of the Worker.—This list now includes 50 or 60 variables, and shows the possible elements which may demand consideration. When it is remembered that the individual selected may need a large or small proportion of most of the variables in order to do his particular work most successfully, and that every single one of these variables, as related to the others, may in some way affect his output and his welfare in doing his assigned work, the importance of taking account of individuality in selection is apparent.

Method of Selection Under Ultimate Management.—Under Ultimate Management, the minds of the workers—and of the managers, too—will have been studied, and the results recorded from earliest childhood. This record, made by trained investigators, will enable vocational guidance directors to tell the child what he is fitted to be, and thus to help the schools and colleges to know how best to train him; that is to say, to provide what he will need to know to do his life work, and also those cultural studies that his vocational work may lack, and that may be required to build out his best development as an individual.

Thus the field of Scientific Management can be narrowed to determining and preparing standard plans for standard specialized men, and selecting men from competent applicants to fill these places.

As will be shown at greater length under "Incentives," Scientific Management aims in every way to encourage initiative. The outline here given as to how men must, ultimately, under Scientific Management, be selected, serves to show that, far from being "made machines of," men are selected to reach that special place where their individuality can be recognized and rewarded to the greatest extent.

Selection Under Scientific Management To-day.—At the present day, the most that Scientific Management can do, in the average case, is to determine the type of men needed for any particular kind of work, and then to select that man who seems, from such observations as can be made, best to conform to the type. The accurate knowledge of the requirements of the work and the knowledge of variables of the worker, make even a cur-

[22] F. B. Gilbreth, "Motion Study," p. vii.

sory observation more rich in results than it would otherwise be. Even such an apparently obvious observation as that the very fact that a man claims that he can do the work, implies desire and will on his part to do it that may overcome many natural lacks —even this is an advance in recognizing individuality.

The result of this scientific selection of the workman is not only better work, but also, and more important from the psychological side, the development of his individuality. It is not always recognized that the work itself is a great educator, and that acute cleverness in the line of work to which he is fitted comes to the worker.

Individuality Developed by Separating Outputs.—Under Scientific Management the work of each man is arranged either so that his output shows up separately and on the individual records, or, if the work is such that it seems best to do it in gangs, his efficiency can often be so recorded that the individual's output can be computed from the records without the old method of determining by averaging the outputs of the gang.

Purpose of Separating Outputs.—The primary purpose of separating the output is to see what the man does, to record this, and to reward the man according to his work; but this separating of output has also an individual result, which is even more important than the result aimed at, and that is the development of the individual.

Under Traditional Management and the usual "day work," much of the work is done by gangs and is observed or recorded as of gangs. Only now and then, when the work of some particular individual shows up decidedly better or worse than that of his fellows, and when the foreman or superintendent, or other onlooker, happens to observe this, is the individual appreciated, and then only in the most inexact, unsystematic manner. Under Scientific Management, making individual output show up separately allows of individual recording, tasks, teaching and rewards.

Effect on Athletic Contests.—Also, with this separation of the work of the individual under Scientific Management comes the possibility of real, scientific, "athletic contests." The athletic contest, which proves itself so successful in Traditional Management, even when the men are grouped as gangs and their work is not recorded or thought of separately, proves itself quite as efficient or more efficient under Scientific Management, when the work of the man shows up separately. It might be objected that the old gang spirit, or it might be called "team" spirit, would disappear with the separation of the work. This is not so, as will be noted by a comparison to a baseball team, where each man has his separate place and his separate work and where his work shows up separately with separate records, such as "batting average" and "fielding average." Team spirit is the result of being grouped together against a common opponent, and it will be the same in any sort of work when the men are so grouped, or given to understand that they belong on the same side.

The following twelve rules for an Athletic Contest under Transitory System are quoted as exemplifying the benefits which accrue from Individuality: 1. Men must have a square deal. 2. Conditions must be similar. 3. Men must be properly spaced and placed. 4. Output must show up separately. 5. Men must be properly started. 6. Causes for delay must be eliminated. 7. Pacemaker must be provided. 8. Time for rest must be provided. 9. Individual scores must be kept and posted. 10. "Audience" must be provided. 11. Rewards must be prompt and provided for all good scores—not for winners only. 12. Appreciation must be shown.[23]

This list shows the effects of many fundamental principles of Scientific Management, but we note particularly here that over half the rules demand as a prerequisite that outputs be separated.

[23] F. B. Gilbreth, "Cost Reducing System," Chap. III.

None of the benefits of the Athletic Contest are lost under Scientific Management. The only restrictions placed are that the men shall not be grouped according to any distinction that would cause hatred or ill feeling, that the results shall be ultimately beneficial to the workers themselves, and that all high scores shall win high prizes.

As will be brought out later under "Incentives," no competition is approved under Scientific Management which speeds up the men uselessly, or which brings any ill feeling between the men or any feeling that the weaker ones have not a fair chance. All of these things are contrary to Scientific Management, as well as contrary to common sense, for it goes without saying that no man is capable of doing his best work permanently if he is worried by the idea that he will not receive the "square deal," that some one stronger than he will be allowed to cheat or to domineer over him, or that he will be speeded up to such an extent that while his output will increase for one day, the next day it will decrease because of the effect of the fatigue of the day before.

The field of the contests is widened, as separating of the work of the individual not only allows for competition between individuals, but for the competition of the individual with his own records. This competition is not only a great, constant and helpful incentive to every worker, but it is also an excellent means of developing individuality.

Advantages to Managers of Separating Output.—The advantages to the managers of separating the work are that there is a chance to know exactly who is making the high output, and that the spirit of competition which prevails when men compare their outputs to their own former records, or others, leads to increased effort.

Advantages to Workers of Separating Output.—As for advantages to the men:

By separation of the individual work, not only is the man's work itself shown, but at the same time the work of all other persons is separated, cut away and put aside, and he can locate the man who is delaying him, by, for example, not keeping him supplied with materials. The man has not only an opportunity to concentrate, but every possible incentive to exercise his will and his desire to do things. His attention is concentrated on the fact that he as an individual is expected to do his very best. He has the moral stimulus of responsibility. He has the emotional stimulus of competition. He has the mental stimulus of definiteness. He has, most valued of all, a chance to be an entity rather than one of an undiscriminated gang. This chance to be an individual, or personality, is in great contradistinction to the popular opinion of Scientific Management, which believes it turns men into machines.

With the separation of the work comes not only the opportunity for the men to see their own work, but also to see that of others, and there comes with this the spirit of imitation, or the spirit of friendly opposition, either of which, while valuable in itself, is even more valuable as a stimulus, putting life into the work such as there never could be when the men were working together, more or less objectless, because they could not see plainly either what they were doing themselves, or what others were doing.

Separation of the output of the men gives them the greatest opportunity to develop. It gives them a chance to concentrate their attention on the work in hand, because it is not necessary for them to waste any time to find out what that work is. Their work stands out by itself; they can put their whole minds to that work; they can become interested in that work and its outcome, and they can be positive that what they have done will be appreciated and recognized, and that it will have a good effect, with no possibility of evil effect, upon their chance for work and their chance for pay and promotion in the future. Definiteness of the boundaries, then, is not only good management in that it shows up the work and that it allows each man to see and each man over him or observing him to see exactly what has been done—it has also an excellent effect upon the worker's mind.

Individuality Developed by Recording Output Separately.—The spirit of individuality is brought out still more clearly by the fact that under Scientific Management, output is recorded separately. This recording of the outputs separately is, usually, and very successfully, one of the first features installed in Transitory Management, and a feature very seldom introduced, even with unconsciousness of its worth, in day work under Traditional Management. It is one of the great disadvantages of many kinds of work, especially in this day, that the worker does only a small part on the finished article, and that he has a feeling that what he does is not identified permanently with the success of the completed whole.

With the feeling that his work is recorded comes the feeling that the work is really worth while, for even if the work itself does not last, the records of it are such as can go on.

Records Give Individuals a Feeling of Performance.—With recorded individual output comes also the feeling of permanence, of credit for good performance. This desire for permanence shows itself all through the work of men in Traditional Management, for example, in the stone cutter's art, where the man who had successfully dressed the stone from the rough block was delighted to put his own individual mark on it, even though he knew that that mark probably would seldom, if ever, be noticed again by anyone after the stone was set in the wall. It is an underlying trait of the human mind to desire this permanence of record of successful effort, and fulfilling and utilizing this desire is a great gain of Scientific Management.

It is not only for his satisfaction that the worker should see his records and realize that his work has permanence, but also for comparison of his work not only with his own record, but with the work of others. The value of these comparisons, not only to the management but to the worker himself, must not be underestimated. The worker gains mental development and physical skill by studying these comparisons.

Advantages to Worker of Making His Own Records.—These possibilities of mental development are still further increased when the man makes his own records. This leads to closer attention, to more interest in the work, and to a realization by the man of what the record really means, and what value it represents. Though even a record that is made for him and is posted where he can see it, will probably result in an increase in his earnings, no such progress is likely to occur as when the man makes his own record, and must be conscious every moment of the time exactly where he stands.

Possibilities of Making Individual Records.—Records of individual efficiency are comparatively easy to make when output is separated. But even when work must be done by gangs or teams of men, there is provision made in Scientific Management for recording this gang work in such a way that either the output or the efficiency or both, of each man shows up separately. This may be done in several ways, such as, for example, by recording the delays caused by each man, and from this computing individual records. This method of recording is psychologically right, because the recording of the delay will serve as a warning to the man, and as a spur to him not to cause delay to others again.

The forcefulness of the "don't" and the "never" have been investigated by educators. Undoubtedly the "do" is far stronger, but in this particular case the command deduced from the records of delay to others is, necessarily, in the negative form, and a study of the psychological results proves most instructive.

Benefits to Managers of Individual Rec-

ords.—The value of the training to the foremen, to the superintendents and to the managers higher up, who study these records, as well as to the timekeepers, recorders and clerks in the time and cost department who make the records, is obvious. There is not only the possibility of appreciating and rewarding the worker, and thus stimulating him to further activity; there is also, especially in the transitory stage, when men are to be chosen on whom to make time study observations, an excellent chance to compare various methods of doing work and their results.

Incentives with Individual Records.—The greatest value of recorded outputs is in the appreciation of the work of the individual that becomes possible. First of all, appreciation by the management, which to the worker must be the most important of all, as it means to him a greater chance for promotion and for more pay. This promotion and additional pay are amply provided for by Scientific Management, as will be shown later in discussing Incentives and Welfare.

Not only is the work appreciated by the management and by the man himself, but also the work becomes possible of appreciation by others. The form of the record as used in Scientific Management, and as introduced early in the transitory stage, makes it possible for many besides those working on the job, if they take the pains to consult the records posted in a conspicuous place on the work, to know and appreciate what the worker is doing. This can be best illustrated, perhaps, by various methods of recording output on contracting work—out-of-door work.

The flag flown by the successful contestants in the athletic contests, showing which gang or which individual has made the largest output during the day previous, allows everyone who passes to appreciate the attainment of that particular worker, or that group of workers.

The photographs of the "high-priced men," copies of which may be given to the workers themselves, allow the worker to carry home a record and thus impress his family with what he has done. Too often the family are unable by themselves to understand the value of the worker's work, or to appreciate the effect of his home life, food, and rest conditions upon his life work, and this entire strong element of interest of the worker's family in his work is often lost.

Relation of Individual Records to Scientific Management in General.—Any study of records of an individual's work again makes clear that no one topic of Scientific Management can be noted without a consideration of all other elements. The fact that under Scientific Management the record with which the man most surely and constantly competes is his own, as provided for by the individual instruction card and the individual task; the fact that under Scientific Management the man need be in no fear of losing his job if he does his best; the fact that Scientific Management is founded on the "square deal"—all of these must be kept constantly in mind when considering the advantages of recording individual output, for they all have a strong psychological effect on the man's mind. It is important to remember that not only does Scientific Management provide for certain directions and thoughts entering the man's mind, but that it also eliminates other thoughts which would surely have a tendency to retard his work. The result is output far exceeding what is usually possible under Traditional Management, because drawbacks are removed and stimuli added.

The outcome of the records and their related elements in other branches of Scientific Management, is to arouse interest. Interest arouses abnormally concentrated attention, and attention is the cause of genius. This again answers the argument of those who claim that Scientific Management kills individuality and turns the worker into a machine.

Individual Task Under Scientific Management.—Individuality is also taken into consideration when preparing the task. This task should always be for an individual, even in the case of the gang instruction card. It usually recognizes individuality, in that

(1) It is prepared for one individual only, when possible.

(2) It is prepared for the particular individual who is to do it.

The working time, as will be shown later, is based upon time-study observations on a standard man, but when a task is assigned for a certain individual, that proportion of the work of the standard or first-class man is assigned to that particular given man who is actually to do it, which he is able to do. It is fundamental that the task must be such that the man who is actually put at it, when he obeys orders and works steadily, can do it; that is, the task must be achievable, and achievable without such effort as would do mental or physical injury to the worker. This not only gives the individual the proper amount of work to do, recognizes his particular capabilities and is particularly adapted to him, but it also eliminates all dread on the score of his not being appreciated, in that the worker knows that if he achieves or exceeds his task he will not only receive the wage for it, but will continue to receive that wage, or more, for like achievement. The rate is not cut. Under the "three-rate with increased rate system," which experience has shown to be a most advanced plan for compensating workmen, the worker receives one bonus for exactness as to methods, that is, if he does the task exactly as he is instructed to do it as to methods; and an extra bonus if he completes his task in the allotted time. This not only assures adequate pay to the man who is slow, but a good imitator, but also to the man who, perhaps, is not such a good imitator, and must put attention on the quality rather than the quantity of his performance.

Individuality Emphasized by Instruction Card.—This individual task is embodied in an individual instruction card. In all work where it is possible to do so, the worker is given an individual instruction card, even though his operations and rest periods are also determined by a gang instruction card. This card not only tells the man what he is to do, how he can best do it, and the time that it is estimated to take him to do it, but it bears also the signature of the man who made it. This in order that if the worker cannot fulfil the requirements of the card he may lose no time in determining who is to give him the necessary instructions or help that will result in his earning his large wages. More than this, he must call for help from his assigned teachers, as is stated in large type on a typical instruction card, as follows: "When instructions cannot be carried out, foreman must at once report to man who signed this card."

The signature of the man who made the card not only develops his sense of individuality and responsibility, but helps to create a feeling of inter-responsibility between the workers in various parts of the organization.

The Gang Instruction Card.—A gang instruction card is used for such work only as must be done by a group of men all engaged at the work at once, or who are working at a dependent sequence of operations, or both. This card contains but those portions of the instructions for each man which refer to those elements which must be completed before a following element, to be done by the next man in the sequence, can be completed. Because of the nature of the work, the gang instruction card must be put in the hands of a leader, or foreman, whether or not it is also in the hands of each of the individuals. The amount of work which can be required as a set task for each individual member of the gang, the allowance for rest for overcoming fatigue, the time that the rest periods must occur, and the proper pay, are fully stated on the individual instruction cards.

Methods of Teaching Foster Individu-

ality.—Under Scientific Management teaching is not only general, by "Systems" or "Standard Practice," but also specific. Specialized teachers, called, unfortunately for the emphasis desired to be put on teaching, "functional foremen," help the individual worker to overcome his peculiar difficulties. This teaching not only allows every worker to supplement his deficiencies of disposition, or experience, but the teachers' places give opportunities for those who have a talent for imparting knowledge to utilize and develop it.

Individual Incentive and Welfare.—Finally, individual incentive and individual welfare are not only both present, but interdependent. Desire for individual success, which might lead a worker to respond to the incentive till he held back perhaps the work of others, is held in balance by interdependence of bonuses. This will be explained in full in the chapters on Incentives and Welfare.

SUMMARY.

Result of Idea of Individuality upon Work.—To recapitulate: Under Traditional Management, because of its frequent neglect of the idea of individuality, work is often unsystematized, and high output is usually the result of "speeding up" only, with constant danger of falling off in quality and injury to men and machinery.

Under Transitory Management, as outputs are separated, separately recorded, and as the idea of Individuality is embodied in selecting men, setting tasks, the instruction cards, periods of rest, teaching, incentives and welfare, output increases without undue pressure on the worker.

Under Scientific Management, with the various elements which embody individuality fully developed, output increases, to the welfare of worker, manager, employer, and consumer, and with no falling off in quality.

Effect upon the Worker.—The question of the effect upon the worker of emphasis laid upon individuality, can, perhaps, best be answered by asking and answering the following questions:

(1) When, where, how, and to what extent is individuality considered? (2) What consideration is given to the relation of the mind to the body of the individual? (3) What is the relative emphasis on consideration of individual and class? (4) To what extent is the individual the unit? (5) What consideration is given to idiosyncrasies? (6) What is the effect toward causing or bringing about development, that is, broadening, deepening and making the individual more progressive?

Extent of Consideration of Individuality. (1) Under Traditional Management consideration of individuality is seldom present, but those best forms of Traditional Management that are successful are so because it is present. This is not usually recognized, but investigation shows that the successful manager, or foreman, or boss, or superintendent succeeds either because of his own individuality or because he brings out to good advantage the individual possibilities of his men. The most successful workers under Traditional Management are those who are allowed to be individuals and to follow out their individual bents of greatest efficiency, instead of being crowded down to become mere members of gangs, with no chance to think, to do, or to be anything but parts of the gang.

Under Transitory Management, and most fully under Scientific Management, the spirit of individuality, far from being crowded out, is a basic principle, and everything possible is done to encourage the desire to be a personality.

Relation of Mind to Body.—Under Traditional Management, where men worked in the same employ for a long time, much consideration was given to the relation of the mind to the body. It was realized that men must not be speeded up beyond what they could do healthfully; they must have good sleeping quarters and good, savory and appetizing food to eat, and not be fatigued unnecessarily, if they were to become successful workers. More than this, philanthropic employers often attempted to supply many kinds of comfort and amusement.

Under Transitory Management the physical and mental welfare are provided for more systematically.

Under Scientific Management consideration of the mind and body of the workman, and his health, and all that that includes, is a subject for scientific study and for scientific administration. As shown later, it eliminates all discussion and troubles of so-called "welfare work," because the interests of the employer and the worker become identical, and everything that is done becomes the concern of both.

Scientific Management realizes that the condition of the body, affects every possible mental process. It is one of the great advantages of a study of the psychology of management, that the subject absolutely demands from the start, and insists on, in every stage of the work, this relationship of the body to the mind, and of the surroundings, equipment, etc., of the worker to his work.

It is almost impossible, in management, to separate the subject of the worker from that of his work, or to think of the worker as not working, except in such a sense as "ceasing from work," "about to work," "resting to overcome fatigue of work," or "resting during periods of unavoidable delays." The relation of the worker to his work is constantly in the mind of the manager. It is for this reason that not only does management owe much to psychology, but that psychology, as applied to any line of study, will ultimately be recognized as owing much to the science of management.

Relative Emphasis on Individual and Class.—Under Traditional Management the gang, or the class, usually receives the chief emphasis. If the individual developed, as he undoubtedly did, in many kinds of mechanical work, especially in small organizations, it was more or less because it was not possible for the managers to organize the various individuals into classes or gangs. In the transitory stage the emphasis is shifting. Under Scientific Management the emphasis is most decidedly and emphatically upon the individual as the unit to be managed, as has been shown.

Individual as the Unit.—Under Traditional Management the individual was seldom the unit. Under Transitory Management the individual is the unit, but there is not much emphasis in the early stages placed upon his peculiarities and personalities. Under Scientific Management the unit is always the individual, and the utilizing and strengthening of his personal traits, special ability and skill is a dominating feature.

Emphasis on Idiosyncrasies.—Under Traditional Management there is either no consideration given to idiosyncrasies, or too wide a latitude is allowed. In cases where no consideration is given, there is often either a pride in the managers in "treating all men alike," though they might respond better to different handling, or else the individual is undirected and his personality manifests itself in all sorts of unguided directions, many of which must necessarily be wasteful, unproductive, or incomplete in development. Under Scientific Management, functionalization, as will be shown; provides for the utilization of all idiosyncrasies and efficient deviations from class, and promotion is so planned that a man may develop along the line of his chief ability. Thus initiative is encouraged and developed constantly.

Development of Individuality.—The development of individuality is more sure under Scientific Management than it is under either of the other two forms of management, (a) because this development is recognized to be a benefit to the worker and to the employer and (b) because this development, as a part of a definite plan, is provided for and perfected scientifically.

(To be continued.)

by the use of the automatic controller follows:

1. Reduction in electrical repairs. The use of automatic controllers cuts down the abuse of the motors and hence lessens the number of burnt out armatures, broken shafts, etc. Of course one point must be borne in mind in this respect, and that is that unless the automatic controller is made as simple as possible and the ordinary motor inspector can understand it, there is liable to be a loss of time in the end due to the greater length of time that is taken in locating any trouble, which may more than take up the amount of time saved by the reduction in the number of breakdowns.

2. Reduction in mechanical delays. The automatic controller saves all the machinery that receives its power from the motor as well as the motor itself.

3. Increased capacity. The automatic controller allows the motor to work at its maximum efficiency at all times and this in conjunction with the reduction in time lost in breakdowns increases the output of the plant.

The Psychology of Management[1]--III

BY L. M. GILBRETH

Functionalization

Definition of Functionalization.—A function, says the Century Dictionary, is "The fulfilment or discharge of a set duty or requirement; exercise of a faculty or office, or power of acting; faculty; that power of acting in a specific way which appertains to a thing by virtue of its special constitution; that mode of action or operation which is proper to any organ, faculty, office structure, etc." Functionalization as here used means the state of being divided into functions, or being functionalized.

In investigating the principle of functionalization as embodied in various forms of Management, we must note that, while Management can, and does under Scientific Management, attempt to functionalize *work* as far as possible, it will be impossible to come to ultimate results until a psychological study of the requirement of the work *from* the worker, and results of the work *on* the worker is made.[24]

Functionalization in Management.—"Functional Management consists," to quote Dr. Taylor, "in so directing the work of management that each man from the assistant superintendent down shall have as few functions as possible to perform. If practicable, the work of each man in the management should be confined to the performance of a single leading function."

A study of functionalization as applied to management must answer the following questions: 1. How is the work divided? 2. How are the workers assigned to the work? 3. What are the results of the work? 4. What are the results to the worker?

Traditional Management Seldom Functionalizes.—Under Traditional Management the principle of functionalization was seldom applied or understood. Even when the manager tried to separate planning from performing, or so to divide the work that each worker could utilize his special ability, there were no permanently beneficial results, because there was no standard method of division.

The Work of the Foreman Not Properly Divided.—The work of a foreman was not divided, but the well-rounded man, as Dr. Taylor says,[26] was supposed to have: 1. Brain; 2. Education; 3. Special or technical knowledge, manual dexterity or strength; 4. Tact; 5. Energy; 6. Grit; 7. Honesty; 8. Judgment, or common sense, and 9. Good health.

Dr. Taylor says: "Plenty of men who possess only three of the above qualities can be hired at any time for laborer's wages. Add four of these qualities together, and you get a higher-priced man. The man combining five of these qualities begins to be hard to find, and those with 6, 7 and 8 are almost impossible to get."

Yet, under Traditional Management, these general qualities and many points of specific training were demanded of the foreman. Dr. Taylor has enumerated the qualifications or the duties of a gang boss in charge of lathes or planers.[27] Careful reading of this enumeration will show most plainly that the demands made were almost impossible of fulfilment.[28]

Another list which is interesting is found in "Cost Reducing System," a long list of the duties of the ideal superintendent or foreman in construction work.[29]

Qualifications and Duties of First-class Foreman

A first-class foreman must have bodily strength; brains; common sense; education; energy; good health; good judgment; grit; manual dexterity; special knowledge; tact, and technical knowledge. He must be able to concentrate his mind upon small things; able to read drawings readily; able to visualize the work at every stage of its progress, and even before it begins; a master of detail; honest; master of at least one trade.

His duties consist of considering broad policies; considering new applicants for important positions; considering the character and fitness of the men; determining a proper day's work; determining costs; determining the method of compensation; determining the sequence of

[24]Hugo Münsterberg, "American Problems," p. 35.

[25]Gillette and Dana, "Cost-keeping and Management Engineering," p. 1.

[26]"Shop Management," Harper edition, ¶221, p. 96.

[27]"Shop Management," Harper edition, ¶¶221-231, pp. 96-98.

[28]Compare H. L. Gantt, A. S. M. E. Paper No. 1002, ¶9.

[29]Compare H. P. Gillette, "Cost Analysis Engineering," pp. 1-2.

events for the best results; disciplining the men; dividing the men into gangs for speed contests; fixing piece and day rates; getting rid of inferior men; handling relations with the unions; hiring good men; installing such methods and devices as will detect dishonesty; instructing the workman; keeping the time and disciplining those who are late or absent; laying out work; looking ahead to see that there are men enough for future work; looking ahead to see that there is enough future work for the men; making profits; measuring each man's effort fairly; obtaining good results in quality; paying the men on days when they are discharged; paying the men on pay day; preventing soldiering; readjusting wages; retaining good men; seeing that all men are honest; seeing that men are shifted promptly when breakdowns occur; seeing that repairs are made before breakdowns occur; seeing that repairs are made promptly after breakdowns occur; seeing that the most suitable man is allotted to each part of the work; seeing that the work is not slighted; setting piecework prices; setting rates; setting tasks; supervising timekeeping; teaching the apprentices; teaching the improvers; teaching the learners.

In studying these lists we note: 1. That the position will be best filled by a high and rare type of man. 2. That the man is forced to use every atom of all of his powers and at the same time to waste his energies in doing unimportant, pay-reducing, routine things, many of which could be done by clerks. 3. That in many cases the work assigned for him to do calls for qualifications which are diametrically opposed to each other. 4. That psychology tells us that a man fitted to perform some of these duties would probably be mentally unfitted for performing others in the best possible way that they could be performed.

Work Not Well Done.—Not only does the foreman do under Traditional Management a great deal of work which can be done by cheaper men, but he also wastes his time on clerical work in which he is not a specialist; this could be done better by a cheaper man, and it takes more of his time than he ought to devote to it.

The theoretical defects of the old type of management, often seen before the advent of the trained engineer on the work, include: 1. Lack of planning ahead. 2. An overworked foreman. 3. No functionalizing of the work. 4. No standards of individual efficiency. 5. Unmeasured individual outputs. 6. No standard methods. 7. No attempt at teaching. 8. Inaccurate directions. 9. Lack of athletic contests. 10. No high pay for extra efficiency. 11. Poor investigation of workers' special capabilities.

In spite of the fact that under unfunctionalized management the foreman has far more to do than he can expect to do well, the average foreman thinks that he belongs to a class above his position. This is partly because the position is so unstandardized that it arouses a sense of unrest, and partly because he has to spend much of his time at low-priced functions.

Under the feeling of enmity, or, at least, of opposition, which often exists, openly or secretly, between the average Traditional Management and the men, the foreman must ally himself with one side or the other. If he joins with the men, he must countenance the soldiering which they find necessary in order to maintain their rates of wages. Thus the output of the shop will seldom increase, and his chance for appreciation and promotion by the management will probably be slight and slow. His position as boss, combined with that of ally of the men. is awkward.

If he allies himself to the management, he must usually become a driver of the men if he wishes to increase output. This condition will never be agreeable to him unless he has an over-supply of brute instincts.

The Workers Not Best Utilized.—Under the best types of Traditional Management we do find more or less spasmodic attempts at the functionalization of the worker. When there was any particular kind of work to be done, the worker who seemed to the manager to be the best fitted was set at that kind of work. For example, if there was a particular heavy piece of work, he might say, "Let A do it because he is strong." If there was a particularly fine piece of work to be done, he might say, "Let B do it because he is specially skilled." If there was a piece of work to be done which required originality, he might say, "Let C do it for the reason that he is inventive and resourceful"; but, in most cases, when the particular job on hand was finished, the worker selected to do it returned to other classes of work, and such special fitness or capability as he possessed was not systematically utilized, nor automatically assigned to his special function, neither was such experience as he had gained systematically conserved. Moreover, no such study of the work to be done had been made as would prove that the assignment of that particular worker to the work was right. The psychology of this was entirely wrong; not only had no such study of the general and particular characteristics, traits, faculties, and talents of the man been made as would prove that he was the right man to be assigned, but the mere fact that he possessed one quality necessary for the work, if he really did possess it, was no sign that the other qualities which he possessed might not make him the wrong man to be chosen. Even if the man did happen to be assigned to work for which he was particularly suited, unless provision were made to keep him at such work only, to keep him well supplied with work, to allow him time for rest, and to provide proper pay, he could not utilize his capabilities to the fullest extent.

Transitory Management Functionalizes.—Under Transitory Management, management becomes gradually more and more functionalized. With separated outputs and separate records, the worker's capabilities become apparent, and he can be assigned to the standardized positions which gradually evolve. Every recognition of individuality carries with it a corresponding functionalization of men and work.

Functionalization a Fundamental of Scientific Management. — With Scientific Management comes the realization that only with close study and with functionalization can that provision and assignment of the work which is best for both work and worker be obtained. The principle is applied to every part of management, and results in: 1. Separating the planning from the performing. 2. Functionalizing foremen. 3. Functionalizing workers. 4. Assigning competent workers to fitting work.

Separating the Planning from the Performing.—The emphasis on separating the planning from the performing in Scientific Management cannot be overestimated. It is a part of Dr. Taylor's fourth principle of Scientific Management: "Almost equal division of the work and the responsibility between the management and the workmen."[30] The greatest outputs can be achieved to the greatest benefit to managers and men when the work is divided, the management undertaking that part of the work that it is best fitted to do, the workmen performing that part which they are best fitted to do.

The Work of the Planning Department.—It has been determined by actual experience that the line of division most agreeable to the managers and the workmen, and most productive of co-operation by both, as well as most efficient in producing low costs, is that which separates the planning from the performing. Under Scientific Management the Planning Department relieves the men of determining: 1. What work is to be done. 2. The sequence in which it is to be done. 3. The method by which it shall be done. 4. Which men shall do it. 5. The time that it shall take. 6. The exact quality of product. 7. The amount of additional pay that shall be given for doing it.

Work of the Workers.—The men are simply given standard tasks to do, with teachers to help them, and a standard wage according to performance as a reward. There are but three things expected of them: 1. Coöperation with the management in obtaining the prescribed work, method and quality. 2. The exercise of their ingenuity in making improvements after they have learned the standard prescribed practice. 3. The fitting of themselves for higher pay and promotion.

Functionalized Foremanship.—The work that under Scientific Management is usually done by one man, the foreman, is subdivided into eight or more functions. These functions are assigned to the following functional foremen:[31]

PLANNING DEPARTMENT

1. Order-of-work and route man.
2. Instruction card man.
3. Cost and time clerk.
4. Disciplinarian.

PERFORMING DEPARTMENT

5. Gang boss.
6. Speed boss.
7. Repair boss.
8. Inspector.

Each of the above functions may be in charge of a separate man, one man may be in charge of several functions, or several men may do the work of one function, the work being divided between them in some cases by further functionalizing it, and in others by separating it into similar parts. Which of these conditions is most effective depends on the size of the job, or the nature of the job to be done. The important question is not the number of men doing the planning, but the fact that every foreman, so far as is possible, is assigned to the special kind of work that he is best fitted to do with the greatest elimination of unnecessary waste.

Changes in the Functions of the Foreman.—A foreman, under Scientific Management, must have three qualifications. He must be: 1. A specialist at the work that he is to do. 2. A good observer, able to note minute variations of method, work, and efficiency. 3. A good teacher.

A comparison of these qualifications with those of the foreman under Traditional Management, will show as important changes: 1. The particular place in the field of knowledge in which the foreman must specialize. 2. The change in the type of criticism expected from the foreman. 3. The far greater emphasis placed on duties as a teacher.

Basis of Division into Functions.—Under Scientific Management divisions are made on the basis of underlying ideas. Functions are not classified as they are embodied in particular men, but men are classified as they embody particular functions. This allows of standardization, through which alone can progress and evolution come quickest. It is comparatively easy and simple to standardize a function. It is extremely difficult and complex to standardize an individual. This standardizing of the function, however, in no wise stunts individuality. On the contrary, it gives each individual a chance to utilize his particular faculty for obtaining the greatest efficiency, pleasure and profit.

Place of Operation of the Functions.—Four functions of the eight find their place in the planning department. The other four are out on the work. This division is, however, largely a matter of convenience. In the descriptions that follow, each function is represented as embodied in one man, this aiding simplicity and clearness in description.

The Order-of-Work and Route Clerk.—The Order-of-Work and Route Clerk lays out the exact paths of each piece of work, and determines the sequence of events and a general outline of performance.[32] With the requirements of the work in mind, the most efficient day's work for each worker is determined. The paths and sequences of transportation are outlined by means of route charts and route sheets showing graphical and detailed directions, which are the means by which the foremen of the other functions are enabled to co-operate with other foremen and with the workers.

The work of this function requires a practical man, experienced on the class of work to be executed, who is also familiar with the theories of Scientific Management in general, and the work of the other foremen

[30] "The Principles of Scientific Management." p. 37.

[31] "Shop Management," Harper edition, ¶245, p. 104.

[32] For an excellent example of graphical routing, see Charles Day, "Industrial Plants," Chap. VII.

in particular, and who has the faculty of visualization and well-developed constructive imagination. He must also have at his command in systematic form and available for immediate use, records of previous experience.

The Instruction Card Clerk.—The Instruction Card Clerk prepares written directions for the workers as to what methods should be used in doing the work, the sequence of performance of the elements of the method, the time that each element should take for its performance, the time allowed for rest for overcoming fatigue caused by its performance, and the total elapsed time allowed for performing all of the work on the instruction card in order to obtain the unusually high additional wages as a reward for his skill and co-operation.

The work of this function requires the best available (but not necessarily the fastest), practical experienced man in the trade described, who also has had sufficient experience in motion study and time study to enable him to write down the best known method for doing the work described, and also prophesying the correct time that the work and rest from its resulting fatigue will take. He must supplement the instruction card with such sketches, drawings and photographs as will best assist the worker to visualize his work before and during its performance.

Function of Time and Cost Clerk.—The work done by the Time and Cost Clerk calls for accuracy and a love of statistical detail. It will help him if he knows the trades with which he is co-operating, but he will be promoted fastest who has a knowledge of the theory of management, coupled with the theory and practice of statistics and accountancy, for the true costs must include knowledge of costs of materials, and the distribution of the overhead burden of running expenses and selling.

Function of the Disciplinarian.—The function of the Disciplinarian must be discussed at length, both because of the psychological effect upon the men of the manner of the discipline and of the disciplinarian, and because of the fact that the disciplinarian is the functional foreman of the four in the planning department who comes in most personal contact with the workers, all of the other foremen, and the superintendent.

Defects of Disciplining Under Traditional Management. — Under Traditional Management, the disciplining is done by the foreman; that is, the punishment is meted out by the man who has charge of all activities of the men under him. This is actually, in practice and in theory, psychologically wrong. If there is one man who should be in a state of mind that would enable him to judge dispassionately, it is the disciplinarian. The man to be disciplined is usually guilty of one of six offenses: 1. An offense against an employee of a grade above him. 2. An offense against an employee of the same grade. 3. An offense against an employee of a grade below him. 4. Of falling short in the quality of his work. 5. Of falling short in the quantity of his work. 6. An offense against the system (disobeying orders), falling down on schedule, or intentionally not co-operating.

The employee over him, or the foreman, to whom he is supposed to have done some injustice, would be in no state of mind to judge as to the man's culpability. In the case of an offense against an employee of the same grade, the best that the injured employee could do would be to appeal to his foreman, who oftentimes is not an unprejudiced judge, and the multiplicity of whose duties give him little time to give attention to the subject of disciplining.

If the offense is against quantity or quality of work, again the old-fashioned foreman, for lack of time, and for lack of training and proper standards of measurement, will find it almost impossible to know how guilty the man is, and what form of punishment and what amount of punishment or loss of opportunity for progress will be appropriate.

Changes in Disciplinarian's Function Under Scientific Management.—All this is changed under Scientific Management. The disciplinarian is a specially appointed functional foreman, and has few other duties except those that are directly or indirectly connected with disciplining. He is in touch with the requirements of the work, because he is in the Planning Department; he is in touch with the employment bureau, and knows which men should be employed; he has a determining voice in deciding elementary rate fixing and should always be consulted before wages are changed or a reassignment of duties is determined. All of these are great advantages to him in deciding justly and appropriately punishments and promotions, not for the workers alone, but also for the foremen and the managers.

Duties of the Disciplinarian.—The disciplinarian keeps a record of each man's virtues and defects; he is in position to know all about the man; where he comes from; what his natural and acquired qualifications are; what his good points, possibilities and special fitness are; what his wages are, and his need for them. All that it is possible for the managers to know of the men is to be concentrated in this disciplinarian. He is, in practice, more the counsel and advocate of the worker than an unsympathetic judge, as has been shown when it is said that his chief function is that of "diplomat" and "peacemaker." His greatest duty is to see that the "square deal" is meted out without fear or favor to employer or to employee.

Importance of Psychology in Disciplining.—Not only does the position of disciplinarian under Scientific Management answer the psychological requirements for such a function, but also the holder of the position of disciplinarian must understand psychology and apply, at least unconsciously, and preferably consciously, the known laws of psychology if he wishes to be successful.

The disciplinarian must consider not only what the man has done, and the relation of this act of his to his other acts; he must also investigate the cause and the motive of the act, for on the cause and motive, in reality, depends more than on the act itself. He must probe into the physical condition of the man as related to his mental acts. He must note the effect of the same kind of discipline under different conditions; for example, he must note that, on certain types of people disciplining in the presence of other people has a most derogatory effect, just as rewards before people may have a most advantageous effect. Upon others, discipline that is meted out in the presence of other people is the only sort of discipline which has the desired effect. The sensitiveness of the person to be disciplined, the necessity for sharp discipline, and for that particular sort of discipline which may require the element of shame in it, must all be considered. He must be able to discover and note whether the discipline should be meted out to a ringleader, and whether the other employees, supposed to be blameworthy, are really only guilty in acquiescing, or in failing to report one who has really furnished the initiative. He must differentiate acts which are the result of following a ringleader blindly from the concerted acts of disobedience of a crowd, for the "mob spirit" is always an element to be estimated and separately handled.

The position of disciplinarian requires a man who has a keen sense of justice, who has had such experience as to enable him to smooth out difficulties until all are in a frame of mind where they can look upon their own acts and the acts of others calmly. He must be able so to administer his duties that each decision inspires the realization that he acted to the best of his knowledge and belief. He must be one who is fearless, and has no tendency to have favorites. He must have a clear knowledge of the theories of Scientific Management, in order that he can fill the position of enforcer of its laws.

(*To be continued*)

Steam Boiler Efficiency and the Most Economical Method for Absorbing Heat from Gases of Combustion

The cost of generating steam consists of (1.) the expense for fuel; and (2.) the expense for interest, depreciation, labor and other fixed charges upon the boiler, boiler setting, grate, draft apparatus and fittings. If the amount of boiler surface employed to develop one boiler horse power be increased, the amount of heat recovered from each pound of fuel will, within the limits of ordinary operation, also increase and the gases will be discharged to the stack at a lower temperature. See Fig. 1.

However, as the cost of steam is reduced by increasing the efficiency of heat absorption, the fixed charges on the boiler and its appurtenances are raised. The rate at which heat is absorbed by any element of the boiler surface depends upon the temperature difference between the contents of the boiler and the gases of combustion in contact with that part of the boiler. If the heat absorbed by any particular part of the boiler is worth more than the fixed charges corresponding, that particular element of heating surface is paying for itself. As the temperature of the gases approaches that of the steam and water within the boiler, a point is reached where the heat absorbed will no longer pay the fixed charges upon additional boiler surface.

This limit will depend upon the price of fuel, the charges upon boiler surface and the proportion of the whole time that the boiler is used. According to Fig. 2, for plants operating 10 hours per day, 300 days per year, and using $3.00 coal, the limit is reached when the temperature difference between the gases and the steam is reduced to 285 deg. F.

Assuming steam at 150 lb. gage pressure, corresponding to a temperature of 366 deg. F., the lowest temperature to which it will pay to reduce the flue gases under the above conditions is 650 deg. F. Reference to Fig. 1 shows that it will

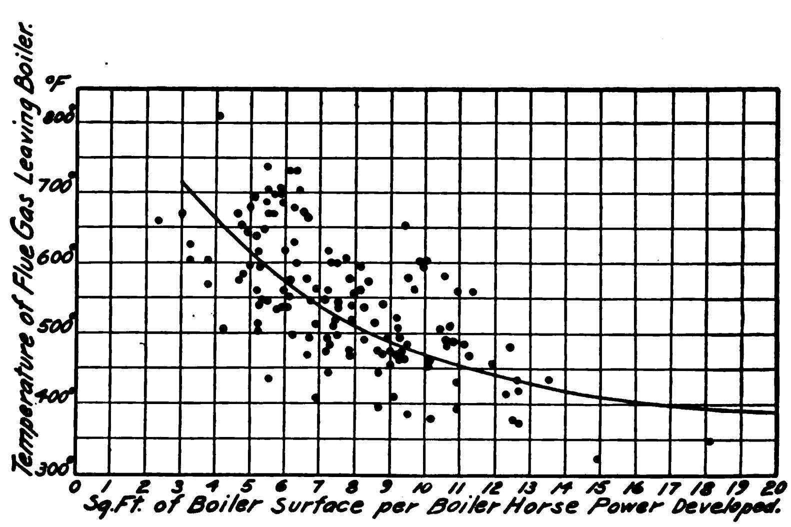

FIG. 1—CHART SHOWING FLUE GAS TEMPERATURES CORRESPONDING TO DIFFERENT RATES OF DRIVING BOILER HEATING SURFACE. EACH POINT REPRESENTS AN INDIVIDUAL TEST

SHORTAGE LIST   Form FAP 52a   FERRACUTE MACHINE CO.

.... Sheets, Sheet ....   DATE .... 191 ...

ORDER-OF-WORK CLERK'S Record of JOB ....

The following LIST includes ONLY those pieces which are not yet completed or ready to .... This job is SCHEDULED for .... to start .... 191 ...., and SHIPMENT has been promised for .... 191 ... .

Quantity	ARTICLE	SYMBOL	PURCHASE or JOB No.	UNCOMPLETED OPERATIONS											
				DP	WI	PF	MP								

FIG. 31—SHORTAGE LIST—(Size 9 x 12 in.)

clerk to fill out his shortage list for each particular job. This need not necessarily be done immediately after the start of the job unless it is a rush order or for extremely early delivery. The shortage list is intended to show only those pieces which are not completed and ready to assemble or ship. The items thereon are made up from the schedule cost sheet and the condition of each item is noted at the time the shortage list is made out. The area to the right of each item is blocked off in colored pencil up to the first uncompleted operation. Each operation listed has a separate column giving both the work number and the machine or bench at which the work is to be done. The order-of-work clerk then checks these lists over daily and in connection with the erection chart showing the planning for the next succeeding several weeks is able to tell exactly what parts are being delayed or which are behind in completion. With this information before him, it is a simple matter to refer to the planning board and by re-sorting the work orders at the various machines and benches insure the completion of the tardy operations in ample time for the schedule requirements. This record is primarily a graphical one and as fast as each operation is completed the schedule clerk sees that the completed operation is blocked off on the shortage list. It is only necessary to glance quickly over the different lists to tell what proportion of operations is uncompleted. Reference to the planning board immediately shows the layout for the future work involved on each job. After the parts shown on the shortage list are completed and ready for assembling or shipment, the shortage list may be destroyed, as it will not again be required.

(To be continued.)

The Psychology of Management[1]--IV

Functionalization (continued)

BY L. M. GILBRETH

The Gang Boss.—The duties of the gang boss are to see that the worker has plenty of work ahead, to see that everything that he will need with which to do the work is at hand, and to see that the work is actually "set," or placed, and performed correctly.

This position calls for a practical demonstrator, who must himself be able and willing actually to prepare and help on the work. It calls particularly for a man with teaching ability, with special emphasis on ability to teach with great exactness the prescribed method and to follow the orders of the planning department implicity.

The Speed Boss.—The speed boss is responsible for the methods of doing work with machinery. He has charge of overseeing the work, and teaching the worker, during the entire time that the work is being done. He must be prepared constantly to demonstrate at any time not only *how* the work is done, but also that it can be done in the specified time. This position calls for a man who is able personally to carry out the detailed written orders of the instruction card in regard to speeds, methods of operation, quality and quantity.

He must be proficient in the art of imparting his knowledge to other workmen, and at the same time be able to secure the prescribed outputs and quantities. He need not be the fastest worker in the shop, but he should be one of the most intelligent workers and best teachers, with a keen desire to co-operate both with the workers and with the other foremen.

The Repair Boss.—The repair boss has charge of the plant and its maintenance. He must have a natural love of order and of cleanliness, and a systematic type of mind. The position calls for a man with an experience that will enable him to detect liability of breakdowns before they actually occur. He must be resourceful in repairing unexpected breakdowns in an emergency, and be able at all times to carry out literally the directions given on the instruction cards of the planning department.

The Inspector.—The function of inspector under the scientific or Taylor plan of management is most important, especially in connection with the "first inspection." During the manufacture of the first piece, and after, the inspector passes and reports upon it before the worker proceeds. Here the worker gets a return in person for each successive act on the first piece he makes under a new instruction card, or a new worker under an old instruction card. Ambiguity of instructions, if present, is thus eliminated, and wrong actions or results are corrected before much damage to material has been done and before much time and effort have been wasted. The first erroneous cycles of work are not repeated, and the worker is promptly shown exactly how efficiently he has succeeded in determining the requirements of his instructions.

The inspector is responsible for the quality of the work. He fulfills the requirements of Schloss, who says, in speaking of the danger (under some managements) that the foreman will sacrifice quality to speed, if he gets a bonus for quantity of output: "The best safeguard against this serious danger would be found in the appointment of a distinct staff of inspectors whose duty it should be to ascertain, as the work proceeds, that the stipulated standards of excellence are at all times scrupulously maintained." This position of inspector requires an observant man who naturally is inclined to give constructive rather than destructive criticism. He should be a man who can co-operate with the workman and foreman to rescue condemned or damaged material with the least expenditure of time, effort or expense.

Functionalizing the Worker.—Under Scientific Management, the worker as well as the foreman, is a specialist. This he becomes by being relieved of everything that he is not best fitted to do, and allowed to concentrate upon doing, according to exact and scientifically derived methods, that work at which he is an expert.[33]

Relieving the Worker of the Planning.—The planning is taken away from the worker, not because it is something too choice, sacred or entertaining for him to do, or something which the managers desire to do themselves, but because it is best, for the workers themselves as well as for the work, that the planning be done by specialists at planning.

Master Planning a Life Study.—The best planner is he who—other things being equal—is the most ingenious, the most experienced and the best observer.

The art of observing is founded on a study of fundamental elements. In order that planning may be done best, the entire sequence of operations must be laid out previous to starting work, so that the ideas of value of every element of every subdivision of the process of working may be corrected to act most efficiently in relation with each and all of the subsequent parts and events that are to follow. This planning forwards and backwards demands an equipment of time, study and motion study records such as can be used economically only when all the planning is done in one place, with one set of records. The planner must be able to see and control the whole problem in all of its aspects.

For example, the use that is to be made of the work after it is completed may entirely change the methods best used in doing it. Thus, the face of a brick wall that is to be plastered should not have the nicely ruled joints required on a face that is not to be plastered. On the contrary, the roughest, raggedest joints will make the plaster adhere the best.

Wastefulness of Individual Planning.—Even if it were possible so to arrange the work of every worker that he could be in close proximity to the equipment for planning and could be given the training needed, individual planning for "small lots" with no systematized standardization of planning-results would be an economic waste that would cause an unnecessary hardship on the worker, the employer and the ultimate consumer. Individual planning could not fit the broad scheme of planning, and at best would cause delays and confusion, and make an incentive to plan for the individual self, instead of planning for the greatest good of the greatest number.

Again, even if it were possible to plan best by individual planning, there is a further waste in changing from one kind of work to another. This waste is so great and so obvious that it was noticed and recognized by the earliest manufacturers and economists.

Hardship to the Worker of Individual Planning.—To obtain the most wages and profits there must be the most savings to divide. These cannot be obtained when each man plans for himself (except in the home trades), because all large modern operations have the quantity of output dependent upon the amount of blockades, stoppages and interferences caused by dependent sequences. It is not, therefore, possible to obtain the most profit or most wages by individual planning. Planning is a general function, and the only way to obtain the best results is by organized planning, and in seeing that no planning is done for one worker without proper consideration of its effect upon the outputs of all the other men.

Provision for Planning by All under Scientific Management.—Much has been said about the worker's "God-given right to think," and about the necessity for providing every worker with an opportunity to think.

Scientific Management provides the fullest opportunities for every man to think, to exercise his mental

[33] "The constant repetition of the same process necessarily produces in the workman a degree of excellence and rapidity in his particular department, which is never possessed by a person who is obliged to execute many different processes."—G. Babbage, "Economy of Manufactures," p. 172.

faculties, and to plan: (1) In doing the work itself, as will be shown at length in chapters that follow; and (2) outside of the regular working hours, but in connection with promotion in his regular work.

Scientific Management provides always, and most emphatically, that the man shall have hours free from his work in such a state that he will not be too fatigued to do anything. Furthermore, if he work as directed, his number of working hours per day will be so reduced that he will have more time each day for his chosen form of mental stimulus and improvement.

Functionalizing the Work Itself.—The work of each part of the planning and performing departments may be functionalized, or subdivided, as the result of motion study and time study. The elementary timed units are combined or synthesized into tasks made to fit the capabilities of specialized workers. It is then necessary to: (1) List the duties and requirements of the work; (2) Decide whether the piece can be best handled as one, or subdivided into several further subdivisions, or functions, or even subfunctions, for two or more function specialists.

For the sake of analysis, all work may be considered as of one of two classes: (1) The short-time job; (2) The long-time job. These two divisions are handled differently, as follows:

The Short-Time Job.—On the short-time job that probably will never be repeated, there is little opportunity and no economic reason for specially training a man for its performance. The available man best suited to do the work with little or no help should be chosen to do it. The suitability of the man for the work should be determined only by applying simple tests, or, if even these will cause costly delay or more expense than the work warrants, the man who appears suitable and who most desires the opportunity to do the work can be assigned to it.

If the job is connected with a new art, a man whose habits will help him can be chosen. For example, in selecting a man to fly, it might be found advantageous to give a trick bicycle rider the preference.

There is no other reason why the man for the short job should not be fitted as well to his work as the man for the long job, except the all-important reason of cost for special preparation. Any expense for study of the workers must be borne ultimately both by worker and management, and it is undesirable to either that expense should be incurred which will not be ultimately repaid.

The Long-Time Job.—The long-time job allows of teaching; therefore, the men for it may be carefully studied. Usually that man should be chosen who, with all the natural qualifications and capabilities for the job, except practical skill, requires the *most* teaching to raise him from the lower plane to that highest mental and manual plane which he is able continuously to fill successfully. In this way each man will be developed into a worker of great value to the management and to himself.

The man who is capable and already skilled at some work is thus available for a still higher job, for which he can be taught. Thus the long job affords the greatest opportunity for promotion. The long-job justifies the expenditure of money, effort and time by management and men, and is the ideal field for the application of scientific selection and functionalization.

Summary

Effect of Functionalization upon the Work.—Under Traditional Management, there was little or no definite functionalization. If the quantity of output did increase, as the result of putting a man at that work for which he seemed best fitted, there was seldom provision made for seeing that the quality of product was maintained by a method of constructive inspection that prevented downward deviations from standard quality, instead of condemning large quantities of the finished product.

Under Transitory Management, the department of inspection is one of the first functions installed. This assures maintained quality, and provides that all increase in output shall be actual gain.

Under Scientific Management, functionalization results in increased quantity of output,[34] with maintained and usually increased quality.[35] This results in decreased cost. The cost is sufficiently lower to allow of increased wages to the employees, a further profit to the employer, and a maintained, or lowered, selling price. This means a benefit to the consumer.

It may be objected that costs can not be lowered, because of the number of so-called "non-producers" provided for by Scientific Management. In answer to this it may be said that there are no non-producers under Scientific Management. Corresponding work that under Scientific Management, is done in the planning department, must all be done somewhere and in a less systematic manner, even under Traditional Management.[36] The planning department simply does this work more efficiently, with less waste. Moreover, much work of the planning department, being founded on elementary units, is available for constant use. Here results an enormous saving by the conservation and utilization of planning effort.

Also, standard methods are more apt to result in standard quality and in fewer rejections of output that is below the requisite standards than is the case under Traditional Management.

Effect of Functionalization upon the Worker.—Under Traditional Management, even if the worker often becomes functionalized, he seldom has assurance that he will be able to reap the harvest from remaining so; and even so, neither data nor teaching are provided to enable him to fulfill his function most successfully.

Under Transitory Management the worker becomes more and more functionalized as the results of mo-

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[34] H. L. Gantt, "Work, Wages and Profits," p. 19.

[35] "The greatest improvements in the productive powers of labor, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labor."—Adam Smith, "Wealth of Nations," pp. 2-4.

[36] H. K. Hathaway. "The Value of 'Non-Producers' in Manufacturing Plants," *Machinery*, Nov., 1906, p. 134.

tion study and time study make clear the advantages of specializing the worker.

Effects upon the Scientifically Managed Worker.—Under Scientific Management the effects of functionalization are so universal and so far-reaching that it is necessary to enumerate them in detail.

Worker Relieved of Everything but His Special Functions.—Functionalization, in providing that every man is assigned a special function, also provides that he be called upon to do work in that function only, relieving him of all other work and responsibility. Realization of this elimination has a psychological effect on action and habits of thinking.[37]

Places are Provided for Specialists.—Functionalization utilizes men with decided bents, and allows each man to occupy that place for which he is fitted.[38] Assignment to functions is done according to the capabilities and desires of those who are to fill them.

Specializing is Encouraged.—It is most important to remember that the man with any special talent[39] (or talents), individuality, or special fitness is much more sure, under Scientific Management, of obtaining and retaining the place that he is fitted for than he ever could have been under Traditional Management; for, while many fairly efficient men can be found who can fill a general position, a man with the marked desirable trait necessary to fill a distinct position requiring that trait will be one of few, and will have his place waiting for him.

One-Talent Men Utilized.—With functionalization, men who lack qualifications for the position which they may at the start endeavor to fill, may be transferred to other positions where the qualities they lack are not required. If a man has but a single talent, Scientific Management provides a place where that can be utilized.

For example, men who cannot produce the prescribed output constantly, are placed on other work. The slow, unskilled worker who has difficulty in learning, may be put upon work requiring less skill, or where speed is not required so much as watchfulness and faithfulness. The worker who is slow, but exceptionally skilled, has the opportunity to rise to the position of the functional foreman, especially in the planning department, where knowledge, experience and resourcefulness, and especially ability to teach, are much more desired than speed and endurance. Thus there are places provided, below and above, that can utilize all kinds of abilities.

"All-Round" Men are Utilized.—The exceptional man who possesses executive ability in all lines and balance between them all, is the ideal man for a manager, and his special "all-round" ability would be wasted in any position below that of a manager.

Stability Provided For.—Every man is maintained in his place by his inter-responsibility with other men. If he is a worker, every man's work is held to standard quality by the inspector, while the requirements and rewards of his function are kept before him by the instruction card man, the rate fixer and the disciplinarian.

Promotion and Development Provided For.—Functionalization provides for promotion by showing every man not only the clearly circumscribed place where he is at work, but also by showing him the definite place above him to which he may be promoted, and by teaching him how he can fill it. This allows him to develop the possibilities of his best self by using and specially training those talents which are most marked in him.

Functional foremanship allows a larger number to become foremen, and to develop the will and judgment which foremanship implies.

Men in the Organization Preferred to Outsiders.—Men in the organization are preferable to outsiders as functional foremen and for promotion. Not only does a worker's knowledge of his work help him to become more efficient when he is promoted to the position of foreman, but his efficiency as a teacher is also increased by the fact that he knows and understands the workers whom he is there to teach.

All Men are Pushed Up.—Scientific Management raises every man as high as he is capable of being raised; it does not speed him up, but pushes him up to the highest notch which he can fill. Shop experience has shown that the demand for efficient men in the planning department is greater than the supply; also, that men in the planning department who fit themselves for higher work can be readily promoted to positions of greater responsibility, either inside or outside the organization.

Years of Productivity Prolonged.—Under functionalization the number of years of productivity of all, workers and foremen alike, are increased. The specialty to which the man is assigned is his natural specialty, thus his possible and profitable working years are prolonged, because he is working at that for which he is naturally fitted.

Moreover, as the work of teaching is one at which the teacher becomes more clever and more valuable as time goes on, the functional foreman has that much more chance to become valuable as years go by.

Change in the Worker's Mental Attitude.—The work under functionalization is such as to arouse the worker's attention and hold his interest.[40] But the most important and valuable change in the worker's feelings is the change in his attitude toward the foremen and the employer. From "natural enemies" under typical Traditional Management, these all now become friends, with the common aim, co-operation, for the purpose of increasing output and wages and lowering costs. This change of feeling results in an appreciation of the value of teaching, and also in promoting industrial peace.

(To be continued.)

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[37] Gillette & Dana, "Cost-keeping and Management Engineering," p. 11.

[38] M. L. Cooke, "Bulletin No. 5 of The Carnegie Foundation for the Advancement of Teaching," p. 15.

[39] Adam Smith, "Wealth of Nations," p. 5.

[40] H. L. Gantt, "Work, Wages and Profits," p. 120.

At about 3600 deg. F. almost all known substances are plastic, molten, or gaseous, and are conductors of electricity. Magnetism ceases to exist at a temperature of about 1500 deg. F.

The Psychology of Management[1]--V

Measurement

BY L. M. GILBRETH

Measurement Important in Psychology.—Measurement has always been of importance in psychology; but it is only with the development of experimental psychology and its special apparatus, that methods of accurate measurements are available which make possible the measurement of extremely short periods of time. These enable us to measure the variations of different workers as to their abilities and their mental and physical fatigue,[41] to study mental processes at different stages of mental and physical growth; to compare different persons under the same conditions, and the same person under different conditions; to determine the personal coefficient of different workers, specialists and foremen, and to formulate resultant standards.

Methods of Measurement in Psychology.—Prof. George M. Stratton, in his book "Experimental Psychology and Culture," says: "In mental measurements there is no pretense of taking the mind's measure as a whole, nor is there usually any immediate intention of testing even some special faculty or capacity of the individual. What is aimed at is the measurement of a limited event in consciousness, such as a particular perception or feeling. The experiments are addressed, of course, not to the weight or size of such phenomena, but usually to their duration and intensity.[42] The actual laboratory work in time-measurement, however, has been narrowed down to determining, not the time in general that is occupied by some mental action, but rather the shortest possible time in which a particular operation can be performed under the simplest and most favorable circumstances.[43]

Scientific Management cannot hope to furnish psychology with either data or methods of measurement. It can and does, however, open a new field for study to experimental psychology, and shows itself willing to furnish the actual working difficulties or problems, to do the preliminary investigation, and to utilize results as fast as they can be obtained.

Measurement Important in Management.—The study of individuality and of functionalization has made plain the necessity of measurement for successful management. Measurement furnishes the means for obtaining that accurate knowledge upon which the science of management rests, as do all sciences—exact and inexact.[44] Through measurement, methods of less waste are determined and standards are made possible; and management becomes a science as it derives standards, and progressively makes and improves them, and the comparisons from them, accurate.

The great problem of measurement in management is determining how many hours should constitute the working day, and at what gait the men can work and continuously thrive. The solution of this problem involves the study of the men, the work, and the methods, which study must become more and more specialized, but the underlying aim is to determine standards and individual capacity.[45]

Capacity.—There are at least four views of a worker's capacity: 1. What he thinks his capacity is; 2. What his associates think his capacity is; 3. What those over him think his capacity is; 4. What accurate measurement determines his actual capacity to be.

Ignorance of Real Capacity.—Dr. Taylor has emphasized the fact that the average workman does not know either his true efficiency or his true capacity.[46] The experience of others has also gone to show that even the skilled workman has little or inaccurate knowledge of the amount of output that a good worker can achieve at his chosen vocation in a given time.[47] The average manager is usually even more ignorant of the capacity of the workers than are the men themselves.[48] This is because of the prevalence of "soldiering," and the actual necessity for it, under some forms of management, for the worker's best interest. Even when the manager realizes that soldiering is going on, he has no way, especially under ordinary management, of determining its extent.

Under Traditional Management there was little measurement of a man's capacity. The emphasis was entirely on the results. There was, it is true, in everything beyond the most elementary of Traditional Management, a measurement of the result. The manager did know, at the end of certain periods of time, how much work had been done. This was an important thing for him to know. If his cost ran too high, and his output fell too low, he investigated. If he found a defect, he tried to remedy it; but much time had to be wasted in this investigation, because often he had no idea where to start to look for the defects.

He might investigate the men, he might investigate the methods, he might investigate the equipment, he might investigate the surroundings, and so on, and very often in the mind of the Traditional manager, there was not even this most elementary division. If things went wrong, he simply knew that "Something is wrong somewhere," and it was the work of the foremen to find out where the place was, or so to speed up the men that the output should be increased and the cost low-

[41] Hugo Münsterberg, "American Problems," p. 34.

[42] G. M. Stratton, "Experimental Psychology and Its Bearings upon Culture," p. 37.

[43] *Ibid*, p. 38.

[44] M. L. Cooke, Bulletin No. 5 of The Carnegie Foundation for the Advancement of Teaching, p. 7.

[45] H. L. Gantt, "Work, Wages and Profits," p. 15.

[46] "Shop Management" (Harper Edition), ¶29, p. 25.

[47] H. L. Gantt, A. S. M. E. Paper No. 928, ¶6.

[48] "Shop Management" (Harper Edition), ¶61, p. 33.

ered. Whether the defects were really remedied, or simply concealed by temporarily speeding up, was not seriously questioned.

Transitory Management Realizes Value of Measurement.—One of the first improvements introduced when Traditional Management gives place to the transitory stage is the measurement of the separated output of individual workers. These outputs are measured and recorded. The records for extra-high outputs are presented to the worker promptly, so that he may have a keen idea constantly of the relation of effort to output, while the fatigue and the effort of doing the work is still fresh in his mind.

The psychology of a prompt reward will be considered later at length, but it cannot be emphasized too often that the prompter the reward, the greater the stimulus. The reward will become associated with the fatigue in such a way that the worker will really get, at the time, more satisfaction out of his fatigue than he will discomfort. This record of efficiency is often so presented to the workers that they get an excellent idea of the numerical measure of their efficiency and its trend. This is best done by a graphical chart.

The records of the outputs of others on the same kind of work done concurrently, or a corresponding record on work done previously, will show the relative efficiency of any worker as compared with the rest. These standards of comparison are a strong incentive and, if they are shown at the time that such work is done, they also become so closely associated not only with the mental but the bodily feeling of the man that the next time the work is repeted, the thoughts that the same effort will probably bring greater results, and that it has done so in the past with others, will be immediately present in the mind.

Measurement is Basic under Scientific Management.—Under Scientific Management, measurement is basic. Measurement is of the work, or outputs, of the methods, the tools, and of the worker, with the individual as a unit and motion study and time study as the methods of measurement.

Measurement is a most necessary adjunct to selecting the workers and the managers and to assigning them to the proper functions and work. They cannot be selected to the greatest advantage and set to functionalized work until (*a*) the unit of measurement that will of itself tend to reduce costs has been determined; (*b*) methods of measurement have been determined; (*c*) measurement has been applied; and (*d*) standards for measurement have been derived.

Under Scientific Management, Measurement Determines the Task.—An important aim of Measurement under Scientific Management is to determine the Task, or the standard amount of any kind of work that a first-class man can do in a certain period of time. The "standard amount" is the largest amount that a first-class man can do and continuously thrive.

The "first-class" man is the man who can eventually become best fitted, by means of natural and acquired capabilities, to do the work. The "certain period of time" is that which best suits the work and the man's thriving under the work. The amount of time allowed for a task consists of three parts: 1. Time actually spent at work. 2. Time for rest for overcoming fatigue. 3. Time for overcoming delays.

Measurement must determine what percentage of the task time is to be spent at work, and what at rest, and must also determine whether the rest period should all follow the completed work, or should be divided into parts, these parts to follow certain cycles through the entire work period.

Qualifications of the Observer or Measurer.—The observer should be a man selected for the position on account of his special natural fitness and previous experience. The natural qualities of the successful hunter, fisherman, detective, reporter and woodsman for observation of minute details are extremely desirable.

Other natural qualifications required to an efficient observer are that of being (*a*) an "eye worker"; (*b*) able to concentrate attention for unusually long periods; (*c*) able to get every thought out of a simple written sentence; (*d*) keenly interested in his work; (*e*) accurate; (*f*) possessed of infinite patience.

The observer should, preferably, have the intimate knowledge that comes from personal experience of the work to be observed, although such a man is often difficult if not impossible to obtain.

The position of observer illustrates another of the many opportunities of the workman for promotion from the ranks to higher positions when they are capable of holding the promotion. Naturally, other things being equal, no man is so well acquainted with the work to be observed as he who has actually done it himself, and if he have also the qualifications of the worker, he will be able to go at once from his position in the ranks to that of observer, or time study man. The observer must also familiarize himself with the literature regarding motion study and time study, and must form the habit of recording systematically the minutest details observable. The effect upon the man making the observation of knowing that his data, even though at the time they may seem unimportant, can be used for the deduction of vital laws, is plain. He naturally feels that he is a part of a permanent scheme, and is ready and willing to put his best activity into the work.

Unbiassed Observation Necessary.—In order to take observation properly, the investigator should be absolutely impartial, unprejudiced, and unbiassed by any preconceived notions. Otherwise, he will be likely to think that a certain thing ought to happen. Or he may have a keen desire to obtain a certain result to conform to a pet theory. The elimination of any charting by the man who makes the observations, or at least its postponement until all observations are made, will tend to decrease the dangers of unconscious effect of what he considers the probable curve of the observations should be.

As has been well said, watching the curve to be charted before all of the data have been obtained develops a distinct theory in the mind of the investigator and is apt to "bend the curve" or, at least, to develop a feeling that if any new or special data do not agree with the tendency of the curve—so much the worse for the reputation of the data for reliability.

Observed Worker Should Realize the Purpose of the Measurement.—The observed worker should be made to realize the purpose and importance of the measurement. The observing should always be done with his full knowledge and hearty co-operation. He will attain much improvement by intelligent co-operation with the observer, and may, in turn, be able to be promoted to observing if he is interested enough to prepare himself after hours.

No worker should ever be observed, timed and studied surreptitiously. In the first place, if the worker does not know that he is being observed, he cannot co-operate with the observer to see that the methods observed are methods of least waste. Therefore, the motion study and time study records that result will not be fundamental standards in any case and will probably be worthless.

In the second place, if the worker discovers that he is being observed secretly, he will feel that he is being spied upon and is not being treated fairly. Even should the worker thus observed not think that he was being watched in order to force him, at a later time, to make higher outputs, after he has once learned that he is being watched secretly, his attention will constantly be distracted by the thought that perhaps he is being studied and timed again. He will be constantly on the alert to see possible observers. This may result in "speeding him up," but the speed will not be a legitimate speed that results to his good as well as to that of his employer.

Worst of all, he will lose confidence in the "squareness" of his employer. Hence he will fail to co-operate, and one of the greatest advantages of Scientific Management will thus be lost.

An Expert Best Worker to Observe.—The best worker to observe for time study is he who is so skilled that he can perform a cycle of prescribed standard motions automatically, without mental concentration. This enables him to devote his entire mental activity to deviating the one desired variable from the accepted cycle of motions.

The difficulty in motion study and time study is not so often to vary the variable being observed and studied, as it is to maintain the other variables constant. Neither skill nor appreciation of what is wanted is enough alone. The worker who is to be measured successfully must: 1. Have the required skill; 2. Understand the theory of what is being done; 3. Be willing to co-operate.

Accurate measurement of individuals, in actual practice, brings out the fact that lamentably few persons are accustomed to be, or can readily be, measured. It has been a great drawback to the advance of Scientific Management that the moment a measurer of any kind is put on the work, either a device to measure output or a man to measure or to time reactions, motions, or output, the majority of the workers become suspicious. Being unaccustomed to being measured, they think, as is usually the case with things to which we are unaccustomed, that there is something harmful to them in it. This feeling makes necessary much explanation which in reality should not be needed.

Motion Study and Time Study Are the Methods of Measurement Under Scientific Management.—Under Scientific Management, the measuring is done by motion study and time study, which measure the relative efficiency of various men, of various methods, or of various kinds of equipment, surroundings, tools, etc. Their most important use is as measuring devices of the men. They have great psychological value in that they are founded on the "square deal" and the men know this from the start. Being operated under laws, they are used the same way on all sorts of work and on all men. As soon as the men really understand this fact, and realize (1) that the results are applied to all men equally; (2) that all get an ample compensation for what they do; (3) that under them general welfare is considered; the objections to such study will vanish.

Motion Study and Time Study Defined.—Motion study is the dividing of the elements of the work into the most fundamental subdivisions possible, studying these fundamental units separately and in relation to one another; and from these studied, chosen units, when timed, building up methods of least waste.

Time study consists of timing the elements of the best method known, and, from these elementary unit times, synthesizing a standard time in which a standard man can do a certain piece of work in accordance with the finally accepted method.

Motion study and time study measure individual capacity or efficiency by providing data from which standards can be made. These standards made, the degree to which the individual approaches or exceeds the standard can be determined.

Motion study and time study are devices for measuring methods. By their use, old methods are "tried out," once and for all, and their relative value in efficiency, determined. By their use, also, new methods are "tried out."

Any new method suggested can be tested in a short time. Such elements of it as have already been tested, can be valued at the start, the new elements introduced can be motion studied and time studied, and waste eliminated as far as possible, with no loss of time or thought.

Comparison of Methods Fosters Invention.—The value of such comparative study can be seen at a glance. When one such method after another is tried out, not only can one tell quickly what a new method is worth, but can also determine what it is worth compared to all others which have been considered. This is because the study is a study of elements, primarily, and not of methods as a whole. Not only can suggested methods be estimated, but also new methods which have never been suggested will become apparent themselves through this study. Common elements, being at once classified and set aside, the new ones will make themselves prominent, and better methods for doing work will suggest themselves, especially to the inventive mind.

Time and motion study are measuring devices for ascertaining the relative merits of different kinds of equipment, surroundings and tools. Through them, the exact capacities of equipment or of a tool or machine can be discovered at once, and also the relative value in efficiency. Also motion study and time study determine exactly how a tool or a piece of equipment can best be used.

The Scope of Time and Motion Study Is Unlimited.—It is a great misfortune that the worker does not understand, as he should, that motion study and time study apply not only to his work, but also to the work of the managers. In order to get results from the start, it often happens that the work of the worker is the first to be so studied, but when Scientific Management is in full operation, the work of the managers is studied exactly to the same extent, and set down exactly as accurately as the work of the worker himself.

Detailed Records Necessary.—Motion study and time study records must go into the greatest detail possible. If the observations are hasty, misdirected or incomplete they may be quite unusable and necessitate going through the expensive process of observation all over again. Dr. Taylor has stated that during his earlier experiences he was obliged to throw away a large quantity of time study data, because they were not in sufficient detail and not recorded completely enough to enable him to use them after a lapse of a long period from the time of its first use. No system of time study, and no individual piece of time study, can be considered a success unless by its use at any time, when new, or after a lapse of years, an accurate prediction of the amount of work a man can do can be made.

All results attained should invariably be conserved, whether they appear at the moment to be useful or valuable or not. In the past it has been found in time study, as in the investigations of all other sciences, that apparently unimportant details of to-day are of vital importance years after.

Specialized Study Imperative.—As an illustration of the field for specialized investigation which motion study and time study present, we may take the subject of fatigue. Motion study and time study aim to show, to review: 1. The least fatiguing method of getting least waste. 2. The length of time required for a worker to do a certain thing. 3. The amount of rest and the time of rest required to overcome fatigue.

Dr. Taylor spent years in determining the percentage of rest that should be allowed in several of the trades, beginning with those where the making of output demands weight hanging on the arms; but there is still a great amount of investigation that could be done to advantage to determine the most advisable percentage of rest in the working day of different lengths. Such investigation would probably show that many of our trades could do the same amount of work in fewer hours, if the quantity and time of rest periods were scientifically determined.

Again, there is a question of the length of each rest period. It has been proven that in many classes of work, and especially in those where the work is interrupted periodically by reason of its peculiar nature, or by reason of inefficient performance in one of the same sequence of dependent operations, alternate working and resting periods are best. There is to be considered in this connection, however, the recognized disadvantage of reconcentrating the attention after these rest periods. Another thing to be considered is that the rate of output does not decline from the beginning of the day, but rather the high point of the curve representing rate of production is at a time somewhat later than at the starting point.

Selection of Best Unit of Measurement Necessary and Important.—Selecting the unit of measurement that will of itself reduce costs is a most important element in obtaining maximum efficiency.[49-50] This is seldom realized.[51] Where possible, several units of measurements should be used to check each other.[52] One alone may be misleading, or put an incentive on the workers to give an undesirable result.

The rule is, always select that unit of output that will, of itself, cause a reduction in costs.

For example: In measuring the output of a concrete gang, counting cement bags provides an incentive to use more cement than the instruction card calls for. Counting the batches of concrete dumped out of the mixer, provides an incentive to use rather smaller quantities of broken stone and sand than the proportions call for,—and, furthermore, does not put the incentive on the men to spill no concrete in transportation; neither does it put an incentive to use more lumps for Cyclopean concrete.

Measuring the quantity actually placed in the forms puts no incentive to watch bulging forms closely.

While measuring outputs by all these different units of measurements would be valuable to check up accuracy of proportions, accuracy of stores account, and output records, the most important unit of measurement for selection would be, "cubic feet of forms filled," the general dimensions to be taken from the latest revised engineer's drawings.

SUMMARY.

Results of Measurement to the Work.—Under Traditional Management, even the crudest measurement of output and cost usually resulted in an increase in output. But there was no accuracy of measurement of individual efficiency, nor was there provision made to conserve results and make them permanently useful.

Under Transitory Management and measurement of individual output, output increased and rewards for the higher output kept up the standard.

Under Scientific Measurement,—measurement of the work itself determines: 1. What kind of workers are needed; 2. How many workers are needed; 3. How best to use them; Motion Study and Time Study meas-

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[49] R. T. Dana, "Handbook of Steam Shovel Work," p. 161.

[50] H. P. Gillette, Trans. A. S. E. C., vol. I, p. 71.

[51] F. W. Taylor, A. S. M. E. Paper No. 1119, ¶68.

[52] Hugo Münsterberg, "American Problems, p. 37.

urement: 1. Divide the work into units; 2. Measure each unit; 3. Study the variables, or elements, one at a time; 4. Furnish resulting timed elements to the synthesizer of methods of least waste.

The accurate measuring devices which accomplish measurement under Scientific Management prevent breakdowns and accidents to life and limb. For example: (1) The maintained tension on a belt bears a close relation to its delay periods. (2) The speed of a buzz planer determines its liability to shoot out pieces of wood to the injury of its operator, or to injure bystanders. Scientific Management, by determining and standardizing methods and equipment, both, provides for uninterrupted output.

Effect on the Worker.—Under Traditional Management there is not enough accurate measurement done to make its effect on the worker of much value. Under Transitory Management, as soon as individual outputs are measured, the worker takes more interest in his work, and endeavors to increase his output.

Under Scientific Management measurement of the worker tells: (1) What the workers are capable of doing; (2) What function it will be best to assign them to and to cultivate in them.

This accurate measurement increases the worker's efficiency in that it enables him to eliminate waste. "Cut and try" methods are eliminated. There is no need to test a dozen methods, a dozen men, a dozen systems of routing, or various kinds of equipment more than once,—that one time when they are scientifically tried out and measured. This accurate measurement also eliminates disputes between manager and worker as to what the latter's efficiency is.

Efficiency Measured by Time and Motion Study.—Time and Motion Study (*a*) measure the man by his work; that is, by the results of his activities; (*b*) measure him by his methods; (*c*) measure him by his capacity to learn; (*d*) measure him by his capacity to teach.

Now measurement by result alone is very stimulating to increasing activities, especially when it shows, as it does under Scientific Management, the relative results of various people doing the same kind of work. But it does not, itself, show the worker *how* to obtain greater results without putting on more speed or using up more activities. But when the worker's methods are measured, he begins to see, for himself, exactly why and where he has failed.

Final Outcome Beneficial to Managers and Men.—Through measurement in Scientific Management, managers asquire: (1) Ability to select men, methods, equipment, etc.; (2) Ability to assign men to the work which they should do, to prescribe the method which they shall use, and to reward them for their output suitably; (3) Ability to predict. On this ability to predict rests the possibility of making calendars, chronological charts and schedules, and of planning determining sequences of events, etc., which will be discussed at length later.

Ability to predict allows the managers to state "premature truths," which the records show to be truths when the work has been done. It must not be forgotten that the managers are enabled not only to predict what the men, equipment, machinery, etc., will do, but what they can do themselves.

The Effect on the Men is That the Worker Co-operates.—1. The worker's interest is held. The men know that the methods they are using are the best. The exact measurements of efficiency of the learner—and under Scientific Management a man never ceases to be a learner—give him a continued interest in his work. It is impossible to hold the attention of the intelligent worker to a method or process that he does not believe to be the most efficient and least wasteful.

Motion study and time study are the most efficient measuring devices of the relative qualities of differing methods. They furnish definite and exact proof to the worker as to the excellence of the method that he is told to use. When he is convinced, lack of interest due to his doubts and dissatisfaction is removed.

2. The worker's judgment is appealed to. The method that he uses is the outcome of co-operation between him and the management. His own judgment assures him that it is the best, up to that time, that they, working together, have been able to design.

3. The worker's reasoning powers are developed. Continuous judging of records of efficiency develops high class, well developed reasoning powers.

4. The worker fits his task, therefore there is no need of adjustment, and his attitude toward his work is right.

5. There is elimination of soldiering, both natural and systematic.[53-54]

All Knowledge Becomes the Knowledge of All.—Two outcomes may be confidently expected in the future, as they are already becoming apparent wherever Scientific Management is being introduced: The worker will become more and more willing to impart his knowledge to others. When the worker realizes that passing on his trade secrets will not cause him to lose his position or, by raising up a crowd of competitors, lower his wages, but will, on the contrary, increase his wages and chances of promotion, he is ready and willing to have his excellent methods standardized.

Measurement of Individual Efficiency Will Be Endorsed by All.—The worker will ultimately realize that it is for the good of all, as well as for himself, that individual efficiency be measured and rewarded.

It has been advanced as an argument against measurement that it discriminates against the "weaker brother," who should have a right to obtain the same pay as the stronger, for the reason that he has equal needs for this pay to maintain life and for the support of his family.

Putting aside at the moment the emotional side of this argument, which is undoubtedly a strong side and a side worthy of consideration, with much truth in it, and looking solely at the logical side, it cannot do the "weaker" brother any good in the long run, and it does the world

(*Continued on page* 121.)

[53] F. W. Taylor, "Shop Management" (Harper Edition), ¶ 46, p. 30.
[54] F. W. Taylor, "A Piece Rate System," A. S. M. E. Paper No. 647, ¶22.

Industrial Engineering
and The Engineering Digest

A Monthly Journal Devoted to the Advancement of Engineering Knowledge and the Science of Management, for Engineers, Designers, Constructors, Managers and General Superintendents.

PUBLISHED MONTHLY BY

THE TECHNICAL LITERATURE COMPANY

90 WEST STREET, NEW YORK

WM. KENT, President HARWOOD FROST, Vice-President C. M. SAMES, Sec'y

WATSON S. ANTHONY Advertising Manager J. F. WALDRON, Western Representative 1117 Schiller Bldg., Chicago

London: A. CONSTABLE & CO., Ltd., 10 Orange St., Leicester Sq., W. C.

EDITORS { WILLIAM KENT (Chief) ROBERT THURSTON KENT CHARLES M. SAMES

SUBSCRIPTION PRICE, Postage Prepaid: United States, Cuba and Mexico, $2.00; Canada, $3.25; Foreign Countries, $2.60. Single Copies, 20 cents.

Entered as second-class matter Jan. 20, 1910, at the Post Office, New York, N. Y., under Act of Mar. 3, 1879

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DISEASE STATISTICS IN FACTORIES

We invite attention to the article on drinking water for industrial plants which appears on another page of this issue. In it the author makes a good suggestion regarding the collection of statistics of disease among workmen, with a view to ascertaining those causes which debilitate the workers, and providing a remedy therefor.

The author's theory is that water-borne bacteria are responsible for most of the ills which affect workmen, and this theory can be proved or disproved by the collection of disease statistics from a large number of industries in different localities, provided with different classes of water supply.

It is beyond question that the health of workmen is apparently lower in summer than in winter, and this apparently bears out the author's theory that the quality of the water is the principal cause of illness, for vastly larger quantities are consumed in the summer than in the cooler months of the year.

The suggestion is made that Industrial Engineering undertake the collection of such statistics. This we will gladly do, if some practicable scheme for doing it can be worked out. Meantime, we invite correspondence with manufacturers who have paid attention to the drinking water supply of their workers. We would like to have their opinions as to the results of supplying good water to their men, and a comparison of the general health and efficiency of their work force before and after the provision of the good water.

Such an investigation is right in line with the policy of this paper—namely, the increase in the efficiency of the factory plant and work force. Anything which will improve the health or increase the comfort of the employee, such as good light, ventilation, proper sanitary arrangements, etc., will increase his efficiency, and falls within our domain. We hope that we may shortly be able to announce the details of an investigation such as has been proposed.

The Psychology of Management

(Continued from page 120.)

much harm, to have his work over-estimated. The day is coming when the world will demand that the quantity of the day's work shall be measured as accurately where one sells labor, as where one sells sugar or flour. Then, pretending that one's output is greater than it really is, will be classed with similar "divers weights and divers measures," with their false standards. The day will come when the public will insist that the "weaker brother's" output be measured to determine just how weak he is, and whether it is weakness, unfitness for that particular job, or laziness that is the cause of his output being low. When he reaches a certain degree of weakness, he will be assisted with a definite measured quantity of assistance. Thus the "weaker brother" may be readily distinguished from the lazy, strong brother, and the brother who is working at the wrong job. Measurement should certainly be insisted on, in order to determine whether these strong brothers are doing their full share, or whether they are causing the weaker brothers to over-exert themselves.

No one who has investigated the subject properly can doubt that it will be better for the world in general to have the output of every man properly measured and estimated, regardless of whether the weak and

It will be seen that the extra heating main in the power house adds no complication. In future power house plans, it will be desirable to immediately have designs so arranged that this new bleeder proposition may at any time be introduced without any material alteration. As a public utility, district heating may grow rapidly in popularity and far-sighted managements will no doubt prepare themselves for this development. When coal prices rise, this state of affairs will be hastened. The automatic bleeder turbine unit costs but approximately 7½ per cent more than the standard condensing machine, and it may, therefore, be the better part of wisdom in many cases to install such a type of machine, notwithstanding the fact that no heating system may exist at present or be immediately projected. Moreover, with a unit of this construction, its properties should possess no small value as it should suffer least from obsolescence.

The Psychology of Management[1]--VI

Analysis and Synthesis

BY L. M. GILBRETH

"Analysis," says the Century Dictionary, "is the resolution or separation of anything which is compound, as a conception, a sentence, a material substance or an event, into its constituent elements or into its causes."

"Synthesis" is "a putting of two or more things together; composition; specifically, the combination of separate elements or objects of thought into a whole, as of simple into compound or complex conceptions, and individual propositions into a system."

Use of Analysis and Synthesis by Psychology.—Analysis is defined by Sully as follows: "Analysis" is "taking apart more complex processes in order to single out for special inspection their several constituent processes." He divides elements of thought activity into (*a*) Analysis: Abstraction; (*b*) Synthesis: Comparison. Speaking of the latter he says: "The clear, explicit detachment in thought of the common elements which comparison secures, allows of a new reconstructive systhesis of things as made up of particular groupings of a number of general qualities."

Any study of management which aims to prove that management may be, and under Scientific Management is, a science, must investigate its use of analysis and of synthesis.[55] Upon the degree and perfection of the analysis depend the permanent value and usefulness of the knowledge gained. Upon the synthesis, and what it includes and excludes, depends the efficiency of the results deduced.

Under Traditional Management, analysis and synthesis are so seldom present as to be negligible. Success or failure are seldom if ever so studied and measured that the causes are well understood. Therefore no standards for future work that are of any value can be established. It need only be added that one reason why Traditional Management makes so little progress is because it makes no analyses that are of permanent value. What data it has are available for immediate use only. Practically every man who does the work must "start at the beginning," for himself. If this is often true of entire methods, it is even more true of elements of methods. As elements are not studied and recorded separately, they are not recognized when they appear again, and the resultant waste is appalling. This waste is inevitable with the lack of co-operation under Traditional Management and the fact that each worker plans the greater part of his work for himself.

Division of output appears early in Transitory Management, but it is usually not until a late stage that motion study and time study are conducted so successfully that scientifically determined and timed elements can be constructed into standards. As everything that is attempted in the line of analysis and synthesis under Transitory Management is done scientifically under Scientific Management, we may avoid repetition by considering Scientific Management at once.

Relation of Analysis and Synthesis in Scientific Management to Measurement and Standardization.—Analysis considers the subject that is to be measured—be it individual action or output of any kind—and divides it into such a number of parts, and parts of such a nature, as will best suit the purpose for which the measurement is taken. When these subdivisions have been measured, synthesis combines them into a whole.[56] Under Scientific Management, through the measurements used, synthesis is a combination of those elements only which are necessary, and which have been proved to be most efficient. The result of the synthesis is standardized, and used until a more accurate standard displaces it.

Under Scientific Management analysis and synthesis are methods of determining standards from available knowledge; measurement furnishes the means. It is the duty of the analyst to divide the work that he is set to study into the minutest divisions possible. What is possible is determined by the time and money

[55] H. Le Chatelier, Discussion of A. S. M. E. Paper No. 1119, p. 303.
[56] H. L. Gantt, "Work, Wages and Profits," p. 35.

that can be set aside for the investigation.

The Nature of the Work Must Determine the Amount of Analysis Practicable. — In determining the amount of time and money required, it is necessary to consider: (1) The cost of the work if done with no special study; (2) how many times the work is likely to be repeated; (3) how many elements that it contains are likely to be similar to elements in work that has already been studied; (4) how many new elements that it contains are likely to be available in subsequent work; (5) the probable cost of the work after it has been studied, (*a*) the cost of doing it, and (*b*) the cost of the investigation; (6) the loss, if any, from delaying the work until after it has been studied; (7) the availability of trained observers and measurers, analysts and synthesists; and (8) the available money for carrying on the investigations. These questions at least must be answered before it is possible to decide whether study shall be made or not, and to what degree it can be carried. It is obvious that in all observation in the industrial world, cost must be the principal determining feature. Once the cost can be estimated, and the amount of money that can be allowed for the investigation determined, it is possible at least to approximate satisfactory answers to the other questions. How closely the answers approximate depends largely on the skill and experience of the analyst.

The greater number of times the work is to be repeated, the less the ultimate cost. The more elements contained similar to elements already determined, the less the additional cost, and the less the time necessary. The more elements contained that can be used again, even in different work, the less the ultimate cost. The better trained the analyst, the less the immediate or additional cost and time. Much depends on the amount of previous data at hand when the investigation is being made, and on the skill and speed of the analyst in using these data.

In practice the process of division continues as long as it can show itself to be a method for cost reducing. Work may be divided into processes; each process into subdivisions; each subdivision into cycles; each cycle into elements; each element into time units; each time unit into motions, and so on, indefinitely, toward the indivisible minimum.[57]

At any of these stages of division the results may be taken as final for the purpose of the study, and the operations, or final divisions of the work at that stage, may be measured. To obtain results with the least expenditure of time, the operations must be subjected to motion study before they are timed, as well as after. This motion study can be accurate and of permanent value only in so far as the divisions are final. The resulting improved operations are then ready to be timed.

Ultimate Analysis the Field of Psychology.—When the analyst has proceeded as far as he can in dividing the work into prime factors, the problem continues in the field of psychology. Here the opportunities for securing further data become almost limitless.

It is the justification for analysis to approach the ultimate as nearly as possible, that the smaller and more difficult of measurement the division is, the more often it will appear in various combinations of elements. The permanence and exactness of the result vary with the effort for obtaining it.

Qualifications of an Analyst.—To be most successful, an analyst should have ingenuity, patience, and that love of dividing a process into its component parts and studying each separate part that characterizes the analytic mind. The analyst must be capable of doing accurate work and orderly work.

To get the most pleasure and profit from his work he should realize that his great, underlying purpose is to relieve the worker of unnecessary fatigue, to shorten his work period per day, and to increase the number of his days and years of higher earning power. With this realization will come an added interest in his subject.

It is not enough that the worker should understand the methods of measurement. He can get most from the resultant standards and will most efficiently co-operate if he understands the division into elements to be studied.

The Synthesist's Work Is Selection and Addition.—The synthesist studies the individual results of the analyst's work, and their interrelation, and determines which of these should be combined, and in what manner, for the most economic result His duty is to construct that combination of the elements which will be most efficient.

But the most important part of the synthesist's work is the actual elimination of elements which are useless and the combination of the remaining elements in such a way that a far better method than the one analyzed will result.

The result of synthesis is the basis for the task; it becomes the standard that shows what has actually been done, and what can be expected to be repeated. It is important to note the relation between the task and synthesis. When it becomes generally understood that the "task" under Scientific Management is neither an ideal which exists simply in the imagination, nor an unachievable high estimate of what can be expected, but is actually the sum of observed and timed operations, then much objection to it will cease.

As is the case with most objections to Scientific Management, or its elements, ignorance is the chief obstacle to the introduction and success of the task idea. This ignorance is prevalent among managers as well as workers. Scientific Management can and does succeed even when the workers are ignorant of many of its fundamental principles, but it will never make the strides that it should until every man working under it, as well as all outside, understand *why* it is doing as it does, as well as *what* is done. This educational campaign could find no better starting point than the word "task," and the "task idea."

The Word Task is Unfortunate.[58] —The Century Dictionary, among five definitions, defines "task" as

[57] F. B. Gilbreth, "Cost Reducing System."
[58] James M. Dodge, Discussion of A. S. M. E. Paper No. 1119, p. 284.

"work undertaken; an undertaking." Only this meaning covers in any way what is meant by the task in Scientific Management.

The ideas included in the other four definitions are most unpleasant. The thought of labor; the thought that labor is imposed; the thought that the imposition is definite; that duty makes it necessary that it be done; that it is burdensome; that it is toilsome—these are most unfortunate ideas and have been associated with the word so long in the human mind that it will be a matter of years before a new set of associations can be formed which will be pleasant, and which will render the word "task" attractive and agreeable to the worker and to the public in general.

However, there seems to be no better word forthcoming, and one can follow the example of the masters in management, who have accepted this word, and have done their best to make it attractive by the way they themselves have used it.

Opinions as to a preferable word will doubtless vary, but it is self-evident that the word "task" has already become so firmly established in Scientific Management that any attempt to change it would result in confusion. It is far better to concentrate on developing a new set of associations for it in as many minds as possible.

Decided Advantage to the Use of the Word Task.—Perhaps in one way it is fortunate that the use of the word "task" does coincide more or less with the use of that word under Traditional Management. Under Traditional Management the task is the work to be done. It may be just as well that the same word should be used under Scientific Management, in order that both the worker and the investigator may realize that, after all, *the work that is to be done* is in its essentials exactly the same. With this realization from the beginning, the mind of the worker or investigator may be the more predisposed to note the eliminations of waste and the cutting down of time, effort and fatigue under the scientifically derived methods.

Definition of Task as Used in Scientific Management.—The task under Scientific Management differs from the task under Traditional Management in that (1) the tools and surrounding conditions with which the work shall be done are standardized; (2) the method in which the work shall be done is prescribed; (3) the time that the work shall take is scientifically determined; (4) an allowance is made for rest from fatigue; and (5) the quality of the output is prescribed. When to this is added the fact that the method is taught, and that the reward is ample, fixed, prompt and assured, the attractive features of the task under Scientific Management have been made plain.

Task Idea Applies to Work of Everyone.—Under Scientific Management there is a task for every member of the organization, from the head of the management to the worker at the most elementary work. This is too often not known, or not appreciated by the worker, who feels that what is deemed best for him should be good for everyone. The mental attitude will never be right till all understand that the task idea will increase efficiency when applied to any possible kind of work. With the application of the task idea to all will come added co-operation.

Task Idea Applies to the Work of the Organization.—The work which is to be done by the organization should be considered the task of the organization, and this organization task is studied before individual tasks are set. The methods used in determining this organization task are analysis and synthesis, just as in the case of the individual task.

The individual tasks are considered as elements of the organization task. The problem is to determine the best arrangement of these individual tasks, the best schedule and routing. The individual task may be thought of as something moving that must be gotten out of the way.

Management has been called largely a matter of transportation. It may be "transportation" or moving of materials, revolution of parts of fixed machinery, or merely transportation of parts of one's body in manual movements.[59] In any case, the laws governing transportation apply to all. This view of management is most stimulating to the mind. A moving object attracts attention and holds interest. Work that is interesting can be accomplished with greater speed and less fatigue. Thinking in terms of the methods of Scientific Management as the most accurate and efficient in transporting the finished output and its "chips,"[60] will be a great aid towards attaining the best results possible by means of a new viewpoint for constructive criticism.

Qualifications of the Synthesist.—The synthesist must have a constructive mind, for he determines the sequence of events as well as the method of attack. He must have the ability to see the completed whole which he is trying to make, and to regard the elements with which he works not only as units, but in relation to each other. He must feel that any combination is influenced not only by the elements that go into it, but by the interrelation between them. This differs for different combinations as in a kaleidoscope.

The synthesist must never be thought of as a destructive critic. He is, in reality, a conserver of all that is valuable in old methods. Through his work and that of the analyst, the valuable elements of traditional methods are incorporated into standard methods. These standard methods will doubtless be improved as time goes on, but the valuable elements will be permanently conserved.

The valuable inventions referred to as the result of measurement are the work of the synthetic mind. It discovers new, better methods of doing work, and this results in the invention of better means, such as tools or equipment.

Relation of Invention to Scientific Management Important.—There has been much discussion as to the relation of invention to Scientific Man-

[59] F. B. Gilbreth, "Motion Study."
[60] James M. Dodge.

agement. It has been claimed by many otherwise able authorities that many results credited to Scientific Management are really the results of new machinery, tools or equipment that have been invented.[91] Scientific Management certainly can lay no claim to credit for efficiency which comes through inventions neither suggested nor determined by it. But the inventions from whose results Scientific Management is said to have borrowed credit are usually not only direct results of Scientific Management, but probably would not have sprung from any other source for years to come.

Synthesist a Discoverer of Laws.—It is the synthetic type of mind that discovers the laws. For example, it was Dr. Taylor, with the aid of a few of his specially trained co-workers, who discovered the following governing laws: (1) law of percentage of rest for overcoming fatigue; (2) law of classification of work according to percentage of fatigue caused; (3) laws for making high-speed steel; (4) laws relating to cutting metals; (5) laws that will predict the right speed, feed and cut on metals for the greatest output; (6) laws for predicting maximum quantity of output that a man can achieve and thrive, and (7) laws for determining the selection of the men best suited for the work.

Having constructed the standard tasks and standard methods, which are new, the synthesist must remember to introduce his new task or method with as few new variables as possible. He should so present it that all the old knowledge will come out to meet the new, that all the brain paths that have already been made will be utilized, and that the new path will lead out from paths which are well known and well traveled.

Summary

Effect of Analysis and Synthesis on the Work.—As the outcome of analysis and synthesis is standardization, so the effect of them upon work is standard work. Quantity of output can be predicted; quality of output is assured.

Effect on the Worker.—The effect of analysis and synthesis upon the worker is to make him realize that the methods which he is using are right, and that, because of this, his work must be of value. The more the worker is induced to co-operate in the determination and the combination of elements, the more will he share with the investigators the satisfaction in getting permanent results. The outcome of this co-operation will, again, result in more perfect future results, and so on, progressively.

(To be continued.)

The Selection of Mill Sites[1]

BY ALBERT L. SCOTT[2]

The importance of location is becoming more generally recognized as successful manufacturing grows more difficult, and will continue to be of commanding interest as long as one site varies from another in operating value. Just as in other things, there are general maxims developed as a result of experience, which if followed will reflect favorably upon the success of the manufactory, and which, if disregarded, will tend to lessen its profits.

What is the object of a mill? Primarily, to make money for its owners, and all other considerations are generally sacrificed to that. But in addition, thought must be given not only to making money *per se,* but also to that more indirect form of money making, care for the health and comfort of the operatives. A healthful mill location and comfortable conditions of working and living for the operatives will bring in profits for the mill, none the less real because they are indirect. Too frequently mills are located with too little regard to outside physical conditions, to say nothing of proper housing for the employees. Plenty of land should go with an ideal mill site. The location should be, if possible, high and sightly, so the breezes of heaven may blow over it and the last rays of sunlight reach it. These advantages are more obtainable now than formerly, since, in these days of electric transmission and economical steam units, sites are possible for mills which a generation ago would not have been feasible, owing to limitations of water power or water supply.

In choosing a mill site, the manufacturer must not only keep abreast of the times, but he must look into the future. As many general elements of success as possible should be centered in the mill site, so that notwithstanding changes in manufacturing conditions, the mill will contain in its location the essentials of success. Lack of means, especially in new mills, is a frequent cause of improper or inadequate provision for the future, but every effort should be made to so finance the mill as to provide an adequate site.

There are three features to be considered in locating a mill. One is its general location; the second is its situation in some particular town or country spot, and the third is the particular and exact location on a plat of ground. It is true that the requisites of a good mill site vary from generation to generation and even from decade to decade, but in every period the three general features mentioned above must be considered, even though the conditions which made a site attractive at one era might make it valueless at another.

General Location

It would seem upon first thought as if this question of general mill

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[1] Abstract of a paper read before the meeting of the National Association of Cotton Manufacturers, New London, Conn., Sept. 9-11, 1912.

[2] Treasurer, Lockwood, Greene & Company, Boston, Mass.

[91] *Engineering* (London), Sept. 15, 1911.

location should be given most painstaking thought. On the contrary, I doubt whether any part of mill locating is more subject to prejudice or accident.

For a particular industry that the writer has in mind the general region between Knoxville and Chattanooga, Tenn. seemed on the whole, the best in the country; but because of the distance from New York and the fact that the manufacturer and selling agent wished to live in New England, the ideal general location was not utilized.

Formerly there were wide divergences in legal hours of labor, general legislation, wages, etc., between different sections. But the divergences are tending to equalize. The hours of labor are no longer in South Carolina than in New England and labor legislation is remarkably similar in many states, both North and South. Aside from local conditions peculiar to some part of a general section, the tendency is for manufacturing conditions to approach an equilibrium. The South, owing to its warmer climate, can probably always pay less wages than New England, New York State or Philadelphia. She has secured this advantage up to the present, at least, accompanied by a lower general standard of efficiency in her plants.

It seems clear that the decision as to the general locality may be very largely a matter of personal preference or of accident, although now with the development of a given industry the limits of the general sections of the country where manufacturing is, in a large way carried on are fairly clearly defined.

The decision as to the general location once made, however, the manufacturer cannot entirely humor his fancy as to the *kind* of goods he will make. For certain classes of goods, nearness to the seashore is advanced as an advantage on account of natural humidity thus secured. This argument does not appear very important, however, since artificial humidification has become so highly developed an art. In general, certain communities seem to be adapted to certain lines of manufacturing, probably because the town started making some particular class of goods. Once started, the tendency was to continue to make the goods with which the employees were familiar.

Location in a Particular Town or Country Community

The second feature of mill location is placing it in some particular town or community after its general location has been determined. There is more elasticity of thinking in this part of mill location than in the former. A Southern manufacturer residing in Spartanburg, let us say, might forego operating a mill in that particular city in his general section, if conditions were more favorable in Georgia, but he would hardly build a new mill in Maine, in another general section. In other words, the town location is generally in the same general section as are the other mills of the company or in which the management resides.

In choosing a particular town for a new mill the personality of the management comes in, since generally the founder of the mill wishes it near his home. This is especially true in sections of the country where the chief mill executive lives at or near the mill rather than in some central city, a system of mill management which to the writer's mind has much to commend it.

The residence of the chief mill executive in the same community as his mills, tends to strengthen the bond between management and operative. The management can also throw its influence on the side of law and order and good citizenship, a feature much needed in mill communities. The prevalence of law and order in a community is one of the great factors in a mill's success, and should be carefully considered when any particular town is under discussion as a mill location. For this reason and to protect the mill from law suits and excessive taxation it is often a very good thing for a mill to be built at or near the home town of the chief executive. In the case of existing mills desiring to enlarge, a site is generally chosen near the existing plants, especially if labor conditions warrant. There are, however, conspicuous examples of a contrary policy, but in all such cases the occasion for the move is largely to tap new sources of labor and secure better operating conditions. Such mills brave the dangers of divided management in order to secure other advantages.

Particular Location on a Certain Site

But it is in the matter of the particular location upon a spot that the least prejudice comes in, and here questions are usually decided absolutely on their merits. Occasionally too great regard is paid to some one particular feature of mill location to the subordination of others. At one time most mills were driven from water wheels and it was necessary to locate them on low ground near the water, no matter how dark or inaccessible the site might be. So wedded are we to precedent and things that were, that even to-day mills are occasionally located on low ground because of nearness to water, when every other consideration makes for a different site. In general, except for bleacheries or finishing plants, or a mill where unusual quantities of water are used, it is easier to bring water to a mill than it is to bring a mill to water, and in these days of electric transmission, vastly easier to bring power to a factory than the factory to a dam site.

In making a specific location of the buildings on any mill site there are a few great principles to be observed. The first, at this time, is to be near an adequate supply of suitable labor. This transcends all other considerations whatsoever, and all other questions are subordinated to it. Water can be brought long distances, goods, cotton and coal can be hauled, but labor absolutely must be had. Sometimes it is not well to locate a mill too near the homes of the operatives if the site be low or hot or unhealthful. It may pay to move a little to get better working conditions. But whatever decisions are made should be made with an eye single to that one thing, an adequate supply of suitable labor with operating conditions such that the works will run well.

Possibly next after the question of labor supply comes the question of adequate transportation. A mill should be easily accessible, not only for freight but for passengers. A mill easy to get to will generally be better managed than an inaccesible property. It should have adequate side track facilities, if possible connecting to more than one railroad. Coal should be unloaded by gravity and cotton and goods transported by cars as far as possible. The cheapest way for a mill to move freight is to have the railroad do it.

Next in importance come light, air and drainage. A mill should, if possible, be on an elevation. Its broad sides should face north and south so as to give the freest entrance to light from the south, and also to catch in warm weather the prevailing breezes. The drainage should be away from the mill, for the easy care of sewage and surface water and to minimize danger of disease. A mill should, among other things, *look well.* The employees like to work in a good looking enterprise. Sun, air and sightly location operate on the feelings of the operatives like clean windows and paint. It helps create *esprit de corps.*

Last in importance, I should place nearness to water. Water is indeed an absolute essential to a mill, but it is distributed so prodigally that it is practically omnipresent. It is generally therefore near by and can be easily brought to the mill in quantities sufficient for our present economical power plants. As compared to the other qualifications for a successful mill site, immediate nearness to it is unimportant. Water should always be brought to the mill, if from a moderate distance, and reservoirs, if necessary for condensing and fire protection, constructed, rather than sacrifice a sightly location to go to a stream level. Very frequently a mill can be placed near water or springs and still be on high ground. That is an ideal which should always be sought for.

Even when these general considerations are clearly in the mind of the management, it is not always easy to secure the exact location to bring best results. An undeveloped site seen through underbrush or trees or covered with buildings presents to the average man but few theoretical aspects. It is quite customary therefore to call in at this point an engineer to map out the property and to put the theory of mill location into actual practice. A complete survey should be made, showing outlines of the property, highways, water supply, sewers, lights, etc. If much water is to be used, its handling must be worked out. If the mill is to be run by a steam plant, reservoirs must be located, coal trestles determined, side tracks decided upon. This may be done by securing accurate levels at frequent intervals all over the site and then carefully locating mill, warehouses, power plant, water supply, sewerage, side tracks village streets, etc., all on a preliminary outline plan based on the information gained in the survey. It is only by some such method that the plant may be seen as a whole, its future development planned, and false steps, so far as possible, avoided. It is the experience of every mill engineer that more trouble in administration or costs of construction or difficulties in extension comes from poor planning at the beginning of the enterprise than from any other one source.

Transportation

Competition in railway service is desirable but often hard to secure, especially in New England. Arrangements should be made with the railroad in advance as to rates on coal, cotton and goods, the mill site should be chosen so as to make side tracks for coal and cotton available with a minimum of trucking and a point should be chosen with convenient passenger schedules to the nearest center. This latter point is more important than most people think. A mill hard to get to, no matter how ideal its particular location may be, is always at a disadvantage with some easily accessible mill. Any of you who have had to administer an inaccessible mill will recognize the truth of this statement.

It is probably not so much the general location as the particular location which influences the fate of a mill, and the merits of the particular location are so welded with the activities of the management that it is next to impossible to separate them. But given able management the mill located with a far-seeing eye to the future, with proper consideration to healthfulness and ease of operation, will assuredly pass a plant not so fortunately placed.

A report of the Boston Manufacturers' Mutual Fire Insurance Co. for June, 1912, shows a total of 74 fires in the selected risks which this company insures. The total fire loss in the 63 cases where the property was protected by automatic sprinklers was $11,013.00, or an average of $175.00 per fire. In the 11 cases where the property was not protected by automatic sprinklers the losses aggregated $41,131.00, or an average of $3739.00 per fire. The ratio shows that the average loss where there were no sprinklers was more than 21 times the loss where sprinklers were installed.

In a paper entitled "High-speed Electrical Machinery," read by F. H. Clough before the Rugby Engineering Society, the author draws attention to the fact that on account of the large volumes of air passing through all high-speed machinery, and also the large number of small air ducts, there is a great tendency for dirt to accumulate inside the machine, and in nearly all cases filters are now used, which clean the air of suspended dust before it passes into the machine. The amount of air will vary with the size, speed, and type of machine in question. It is stated that it will be found that about 6000 cu. ft. of air per min. will be required for a 1000-K.W. alternator with an efficiency of 94 per cent, and the air passages both inside the machine and in the ducts must be proportioned to carry this amount of air.—*The Engineer* (London).

Pyrometer tubes made of alundum (fused silica) are more refractory and have a higher heat conductivity than porcelain or fire-clay tubes.

The Psychology of Management[1]--VII

Standardization

BY L. M. GILBRETH

"A standard" says the Century dictionary, "is that which is set up as a unit of reference; a form, type, example, incidence, or combination of conditions accepted as correct and perfect and hence as a basis of comparison. A criterion established by custom, public opinion or general consent; a model[61]." We must note particularly that the standard is a "unit of reference," that it is a "basis of comparison," and that it is "a model." These three phrases describe the standard in management, and are particularly emphasized by the use of the standard in Scientific Management.

Standards Derived from Actual Practice.—Management derives its standards not from theories as to best methods, but from scientific study of actual practice[62]. As already shown, the method of deriving a standard is (1) to analyze the best practice known into the smallest possible elements; (2) to measure these elements; (3) to synthesize the necessary standard elements into the standard; and (4) to adopt the least wasteful elements as standard elements.

A standard remains fixed only until a more perfect standard displaces it. The data from which the standard was derived may be reviewed because of some error, because a further subdivision of the elements studied may prove possible, or because improvements in some factor of the work, *i. e.,* the worker, material, tools, equipment, etc., may make a new standard desirable.

Psychology a Final Appeal as to Permanent Value of Any Standard.—The standard under management, even under Scientific Management, can lay no claim to being perfect. It can never nearly approach perfection until the elements are so small that it is practicable to test them psychologically and physiologically.

Purpose of Standardization.—The purpose of standardizing is the same under all types of management; that is, it is the elimination of waste. In much progressive Traditional Management there is an appreciation of the necessity of standardizing tools and equipment, that is to say, of having these on the "duplicate part system," that assembling may be done quickly and repairs made without delay. The manager notices some particularly successful man, or method, or arrangement of tools, equipment, or the surroundings, and decides to have a record made thereof that the success may be repeated. These records, if made in sufficient detail, are valuable. The difficulty is that so often the man making the records does not observe all the variables. Hence the very elements which caused the success may be overlooked entirely.

Under Transitory Management Standardization Becomes Constantly More Important.—Not until motion study and time study have been introduced can the full benefits of standardization be attained. But as soon as the Transitory Stage of Management appears, the importance of standardization is realized. This is brought about largely through the records of individual outputs, which constantly call attention to the necessity of making available to all the methods, tools and equipment of the most successful workers.

The rules which embody successful practice become more profitable as the necessity for more detailed recording of all the variables becomes possible. An appreciation of what scientific motion study and time study will ultimately do, affects the minds of the management until the workers are given directions as to methods to be used, and the incentive of extra pay for following directions.

"Systems" Show an Appreciation of Psychology.—The "systems," or collections of written directions, that are evolved at this stage have a permanent value. This is especially true when the directions, often called "rules," contain the reason for the rule. There is a decided awakening to the importance of psychology in this appeal to the reason of the worker. He is not affronted by being forced to follow directions for which he is given no reason and which he has no reason to believe have been scientifically derived. These rules, in a certain typical case, are stated in simple language, some in the form of commands, some in the form of suggestions, and are obviously so prepared as to be understood and obeyed by the workers with the least possible amount of effort, opposition and time. As ample opportunity is given for suggestions, the worker's attention and interest are held, and any craving he may have for self-expression is gratified.

Relation of Systems to Standards Should be Emphasized.—The worker is too often not made to understand the relation of systems to standards. The average worker does not object to a system, because he realizes that it is a collection of his best, least wasteful methods of doing work. When he can be convinced that standards are only efficient elements of his own methods scientifically studied and combined, his natural opposition to them will be overcome.

Perhaps one thing that makes typical "systems" so attractive is the personal note that they contain. Il-

[61] Compare R. T. Dana and W. L. Saunders, "Rock Drilling," chap. xvi.

[62] The idea of perfection is not involved in the standard of Scientific Management. See M. L. Cooke, Bulletin No. 5 of the Carnegie Foundation for the Advancement of Teaching, p. 6.

lustrated with pictures of successful work that the workers themselves have done, often containing pictures of the men themselves that illustrate successful methods, with mention of the names of men who have offered valuable suggestions or inventions, they make the worker feel his part in successful results. They conserve the old spirit of co-operation between the master and his apprentices.

The conditions of modern industry make it extremely difficult to conserve this feeling. Scientific Management is successful not only because it makes possible a more effective co-operation than has ever existed since the old "master-and-apprentice" relation died out, but also because it conserves in the systems the interim channel for personal communication between the various members of the organization.

One great problem which those introducing Scientific Management have to face, is exactly how to make the worker understand the relation of the new type of management to the old. The usefulness of the written system in use in most places where it is planned to introduce Scientific Management as a means of making the worker understand the transition has, perhaps, not been appreciated. The development of the standard from the system is easy to explain. This being done, all parts of Scientific Management are so closely related that their interrelation can be readily made apparent.

It is the worker's right, as well as privilege, to understand the management under which he works, and he only truly co-operates, with his will and judgment as well as with his hands, when he feels that his mind is a part of the directing mind.

Successful Standardization Demands Complete Conformity to Standards.—The entire organization from the highest to the lowest must conform to standards. It is out of the question to permit the deviations resulting from individual initiative. Individual initiative is quite as objectionable in obtaining the best results—that is, high wages and low production cost, as service would be on a railroad if each locomotive engineer were his own train despatcher, determining at what time and to what place he would go.

There is a distinct place for initiative in Scientific Management, but that place is not outside of the planning department, until the planning department's method has been proved to be fully understood by achievement. The standards must be made by the men for whom this work is set aside, and they must be followed absolutely by the worker. He is willing to follow them, under Scientific Management, because he realizes that a place for his suggestions is supplied, and that, if his suggestions are accepted, they will be incorporated into the new standards which must then be followed by all thereafter.

It is important to note that standardizing is applied to the work of all. This, if understood by all, will do away with all question of discrimination or the lack of a "square deal." It will make the worker feel ready to follow his standard exactly, just as he knows the manager is following his.

Standardization conserves individual capacity by doing away with the wasteful process of trial and error of the individual workman. It develops individuality by allowing the worker to concentrate his initiative upon work which has not before been done, and by providing incentive and reward for inventions.

Under Scientific Management Nomenclature is Standardized.—Under Standardization in Scientific Management the standardization of the nomenclature—the names and the terms used, must be noted. The effect of this upon the mind is excellent, because the use of a word very soon becomes a habit—its associations become fixed. If different names are used for the same thing—that is, if different names are used indiscriminately, the thing itself becomes hazy, in just such a degree as it possesses many names. The use of the fixed term, the fixed word, leads to definiteness always. Just so, also, the mnemonic symbol system in use by Scientific Management, leads to swift identification of the subdivision of the classification to which it is applied, and to elimination of waste in finding and remembering where to find any particular thing or piece of information desired. By it may be identified "the various articles of manufacture and papers relating to it, as well as the operations to be performed on each piece and the various charges of the establishment."

These mnemonic symbols save actual motions and time in speaking and writing, and save time in that they are so designed as to be readily remembered. They also save time and effort in that the mind accustomed to them works with them as collective groups of ideas, without stopping to elaborate them into their more detailed form.

Relation Between the Standard Man, the First-Class Man, the Given Man and the Task.—The standard man is the ideal man to observe, and with whom to obtain the best motion study and time study. He is the fastest worker, working under the direction of the man best informed in the particular trade as to the motions of best present practice, being timed by a time-study expert.

The "first-class man" under Scientific Management is the man who is best fitted by nature and by training to do the task permanently or until promoted.

The "given man" is the man who is actually put to work at the task, whether or not he is well fitted for its performance.

The "task" is that percentage of the standard man's work which the given man, to whom the task is to be assigned, can do continuously and thrive, which he can do easily enough to win his bonus without injuring himself, temporarily or permanently, in any way.

Writing, the Standard Means for Conveying Information.—Under Scientific Management, and even in the early stages of Transitory Management, writing is the standard means of conveying information. All orders, without exception, should be in writing. This insures that the "eye workers" get their directions in the most impressive form; does away with the need of constant oral repetition; eliminates confusion; insures a clear impression in the mind of the giver as well as of the receiver of the order as to exactly what is wanted; and provides a record of all orders given. Putting the instructions in writing in no way precludes utilizing the worker's natural aptitude to learn by imitation, for he also always has the opportunity to watch and imitate the workings of the functional teachers as well as his scientifically taught fellow-workers.

The Instruction Card the Standard Method of Conveying Instructions as to the Task.—The records of the work of the standard man are contained in data of the motion study and time study department. These records, in the form in which they are to be used by the man who is to perform the task, are, for the benefit of that man, incorporated in what is known as the instruction card.

The instruction card is a set of directions for the man, telling him what he is to do, how he is to do it, how long it should take him to do it, and what he will receive for doing it, and giving him an opportunity to call for and obtain assistance the *instant* that he finds he cannot do it, and to report back to the managers as to how he has succeeded in the performance.

There are three types of instruction cards which may be described as follows:

Type 1.—Largely geographical telling: (*a.*) Where to work; (*b.*) From whom to take orders; (*c.*) What to do.

Type 2.—Typical engineer's specification, telling: (*a.*) Results desired; (*b.*) Qualities of products.

Type 3.—A list of elementary, step-by-step instructions, subdivided into their motions, with time allowed for each timable element, preferably for each motion, and a division between (*a.*) Getting ready; (*b.*) Making or constructing; (*c.*) Clearing up. This is the only type used by Scientific Management.

Directions, Pay Allowance and Time Allowance Essential.—The instruction card under Scientific Management must contain directions, and state the pay allowance and time allowance. Directions as to how the work shall be done eliminate waste by cutting out all wrong methods and by exactly prescribing the right method. The setting of a time in which the work is to be done, is a great stimulus to the worker, and is also necessary, because upon the attainment of this set time depends the ability of the managers to pay the bonus to the worker, and also to maintain a schedule, or time table, that will make possible the maintaining of necessary conditions for others, in turn, to earn their bonuses. It cannot be too often emphasized that the extra wages are paid to the men out of the savings, and are absolutely dependent upon the fact of there being savings. It is only when the worker does the work within the time prescribed, that the managers do save enough to warrant the payment of the extra wages that compensate the man for doing the stipulated quantity of work.

The instruction card contains a statement of the wage or bonus that will be earned for the complete performance of the task set therein, thus furnishing an incentive at the time that the work is done.

Standard Division of Instruction Card Necessary.—There are many reasons for dividing an instruction card in the present standard way: (*a*) To reduce the amount of time-study observation necessary; (*b*) To reduce the difficulties of synthesizing the time-studied element; (*c*) To locate quickly just where the worker needs help and instruction to enable him to achieve his task; (*d*) To keep up the interest of the worker by having short time elements with which to measure his relative ability; (*c*) To present the subject-matter of instruction in such natural subdivisions that resting places are automatically provided, which allow the mind to recover from its absorption in each subdivision; this provides definite stopping places between correlated units of instruction, holding the attention as a complete unit against distraction,—and a complete resting place between subdivisions that permits the mind to relax and wander without losing complete grasp of each unit as a whole.

Detailed Instructions Educative.—The greater the perfection of the detail of the instruction card, the greater the educative value of this plan of management.

Those inexperienced in Scientific Management have complained that the detail of instruction cards is tiresome. The advantages of the detailed instruction card are more than might appear on the surface. Not only does the man whose attention is easily distracted keep to his work better if he is told every possible detail, but also the cards when filed can be taken out again, and every detail and item of the method reviewed at length and revised if necessary. The experienced worker who gets to know the instruction by rote is not bothered by extreme detail. On the contrary, he grasps it at a glance, and focuses his mind upon any new feature and upon the speed and exactness of muscular action needed for compliance with the card.

Language of Instruction Card Important.—The language of the instruction card is of sufficient importance to warrant careful consideration. It would be helpful if the instruction card clerk and the man who is to use the instruction cards were both masters of English, but this is hardly to be expected. The best substitute for such special English training is a "system" for the use of the instruction card clerk that will give him some outline of English, which will, by degrees, make his wording terse, simple and unambiguous. He should be impressed with the value of short sentences, and of sentences that will require no punctuation other than a period at the end. The short sentence is the most important step toward brevity, conciseness and clear thinking.

The second most important feature is that the instruction card clerk always uses the same wording for the same instructions. Repetition of phrasing is a virtue, and the use of the same word for the same thing and the same meaning repeatedly is very desirable. The wording, phrasing and sentencing should be standard wherever possible. After a short time a phrase or sentence that is often repeated will be recognized as quickly as will a word or a letter. Men who cannot read or write at all are comparatively few. Men who can read and write but little are many. It is entirely possible to teach such men standard groupings, which they can recognize on the instruction card and use in a very short time.

Just as mnemonic symbols save time and effort, so standard phrasing aids toward finding out what is to be done, and remembering how it is to be done[63]. Both of these can be accomplished if the standardization is so complete that directions can be read and remembered almost at a glance[64]. To be most effective, directions should be in the imperative form, and in specific terms.

As for the form and shape, as Dr. Taylor says, "anything that will transmit ideas by sketch or wording will serve as an instruction card." He advises, however, that advantage be taken of the saving in time to be gained by having the instruction cards as nearly alike as possible. They may, for convenience sake, vary as to length, but in width, ruling, spacing and wording they should be standard.

Standard Surroundings Valuable.—Standard environment, or surroundings, of the worker are valuable for two reasons: (1) Because they directly increase output, by eliminating everything which might distract attention or cause needless fatigue; by assisting in the attainment of more output, by having the best possible surroundings for greater output. (2) Because, knowing that everything has been done to make his work possible and easy, the worker feels this atmosphere of possibility and ease around him, and the suggestive power of this is strong.

Proper Placing of Workers Eliminates Distracted Attention.—Workers must be placed so that they do not see intermittently moving objects out of the corners of their eyes. In the early history of man it was continuously necessary to watch for first evidence of things behind one, or at a distance, in order to be safe from an enemy. From generations of survival of the most fit there have developed human eyes most sensitive to moving objects that are seen out of the corner of the eye. Even civilized man has his attention distracted quickest, and most, by those moving objects that he sees the least distinctly, and furthest to one side from the direction in which he is looking.

There is a great difference in this power of sensitiveness of the corners of some workers' eyes from that of others. The first move of Scientific Management is to place and arrange all workers, as far as possible, in such a position that nothing to distract them will be behind them, and later to see that the eyes of workers are tested, and that those whose eyes are most sensitive may be placed accordingly.

The necessity of removing all things which will distract the attention is as great for the brain worker as for the shop or construction worker. All papers, in fact, everything except that on which the worker is working, that attract the eye, and hence the attention, should be cleaned from the desk. The capability of being distracted by the presence of other things varies in all workers.

Benefits of Eliminating "Decision of Choice."—There is always time lost by "decision of choice." The elimination of this is well illustrated by the bricks piled on the packet, which decide for the bricklayer which brick is next, making an obvious sequence; hence the saving of time of decision regarding motions, also the saving coming from the play for position. Oftentimes a handicap of slow mental action can be compensated, in a measure, by planning ahead in great detail. In this way, there is absolutely no time left to be wasted in "decision of choice." The worker goes from one step to another. As these steps are arranged logically, his mind does not tend to wander away, but keeps on in an uninterrupted sequence to the goal.

Standard Equipment Important.—As for equipment, the phenomena of habits are one of the most important features of the psychology of management and the possibilities of the elimination of unnecessary waste resulting from taking advantage of this feature is possible only when the equipment, surroundings and methods of the worker are standardized. Therefore the insistance upon standardization, even down to the smallest things, is vital for achieving the greatest output.

For example, suppose the keys of the monotype machine, piano or typewriter were not located permanently in the same relative position. Consider the loss of time in not being able to use habits in finding each key. Such an arrangement sounds ridiculous on the face of it, yet it is a common practice for many operators, especially of monotype machines, to make a complete mental decision as to the muscles and fingers with which they will strike the desired key.

Imagine the records of output of a typist who was using a different keyboard every day, if there were that many kind of keyboards. It is easy for any one to conceive the great advantages of standard keyboards for such machines, but only those who have made a study of output of all kinds of workers can fully realize that similar differences in sizes of output are being produced by the workers of the country for lack of similar standardization of working conditions and equipment.

Utmost Standardization Does Not Make "Machines" of the Workers Operating Under It.—To those who believe that standardization makes machines out of the workers themselves, attention is called to the

[63] C. B. Going, "Methods of the Santa Fe," p. 66.

[64] For desirability of standard signals, see R. T. Dana's "Handbook of Steam Shovel Work," p. 32.

absence of such effect upon the typist compared with the scribe, the monotype and linotype operator as compared with the compositor, and the mechanical computing machine operator as compared with the arithmetician.

Standard Methods Demand Standard Tools and Devices.—Habits cannot be standardized until the devices and tools used are of standard patterns. It is not nearly so essential to have the best tools as it is to have standard tools[65]. Tools once adopted as standard should not be changed until the improvement, or greater efficiency from their use, will compensate for the loss during the period of forming new habits in order to handle strange tools. Good habits are as difficult to break as bad ones, the only difference being that one does not usually desire to break good ones. Naturally, if a new device is introduced, what was an excellent habit for the old device becomes, perhaps, a very bad habit for the new device. There must come a time before the manipulation of the new device has become a habit when output will go down and costs will go up. It is necessary, before introducing this device, to investigate whether the ultimate reduction of costs will be sufficient to allow for this period of lower production. It is not fair, however, to the new device or method really to consider its record until the use of it has become such a habit with the workers as was the use of the old device.

No one who has not made a study of cutting tools can realize the crying need for standardizing in that field. Dr. Taylor says, writing in the revised "Shop Management" of 1911; "Hardly a shop can be found in which tools made from a dozen different qualities of steel are not used side by side, in many cases with little or no means of telling one make from another"[66]. The effect of the slightest variation in the shape or the method of handling the tool upon the three dimensions of the work that the tool can do in a given time, is astounding[67]. More important from the psychological point of view, is the effect upon the mind of the worker of seeing such unstandardized equipment; of having to stop to select the particular tool that he desires, and thus having his attention distracted from his work; and of knowing that his act of judgment in so selecting is of no permanent value, as the next time he needs a similar tool he will probably have to reselect.

Standard Clothing a Crying Need.—There is a great need to-day for standardization in the field of clothing. The idea prevalent that wearing apparel is attractive only when it is "different," is unfortunate in its influence upon the cost of living. How much more unfortunate is it when it affects the mind of the worker, and leads him to look upon standard working clothes with distaste.

To a careful observer, there is nothing more disheartening than a study of workers' clothes, especially the clothes of women workers. Too warm clothes where work requiring high temperature is done, with no provision for adding needed wraps for the trip home; high-heeled shoes where the worker must stand at her task for hours at a time; tight waists and ill-fitting skirts, where every muscle should have free play —these are but examples of hundreds of places where reforms are needed.

Little or no blame attaches to the worker for this state of affairs Seldom, if ever, does the management attempt to standardize working clothes. Moreover, the underlying idea is not made clear that such clothes bear no resemblance to the meaningless uniforms which are the badge and symbol of service. They resemble rather the blouse or pinafore of the artist, the outfit of the submarine diver or the fireman.

Under Ultimate Management the most efficient clothing for any kind of work will be standardized. The expense of such articles of clothing as will add to the quantity of quality of output will, directly or indirectly, be borne by the management, just as it now bears the expense for equipment and tools. These essentials being supplied, and the underlying dignity and importance of standardization understood, the worker will gladly conform, and supply the minor accessories.

It is of the utmost importance that such standardization, when adopted, should apply to the clothing of all, managers as well as employees. When the old pride in the "crafts" returns, or when efficiency is as universal in the industrial world as it is in the world of sport, then one may look for results.

The effect which such standardized clothing would have on the physical and mental well-being of the wearers can scarcely be overestimated. Fatigue would be eliminated, and the old "joy in working" might return. Not being based upon looks alone, though the esthetic appeal should not be neglected, the worker's ability to work more and better with greater content of mind would be the criterion.

Standard Methods Eliminate Fatigue.—Standard methods eliminate fatigue. All methods should, therefore, as far as possible, be made up of standard elements under standard conditions, with standard devices and appliances, and they should be standardized from the standpoint of all of our senses as to color, shape, size, weight, location, position and surface texture, that the worker may grasp at a single thought, by means of each or all his senses, that no special muscles or other fatiguing processes need be operated to achieve the standard result desired.

It must be remembered that all work should be so arranged that the muscle that moves the position or shape of the eye or the size of its pupil, should not be operated except when necessary. Care in planning can oftentimes standardize conditions so as to relieve these and other muscles, which grow tired easily, or transfer this work to other muscles which are not so easily tired. Not

[65] F. W. Taylor, "Shop Management" p. 285; (Harper edition), pp. 123-124.
[66] F. W. Taylor, "Shop Management" (Harper edition), pp. 124-125.
[67] F. W. Taylor, "On the Art of Cutting Metals," A. S. M. E. Paper No. 1119.

only do the reactions from such standards require less bodily effort, but it also requires less mental effort to work under methods which are standardized. Therefore, both directly and indirectly, the worker benefits by the standardization.

Scientific Management provides and prescribes rest for overcoming fatigue of the worker more scientifically and economically than he could possibly provide it for himself. The additional fatigue from handling additional weights causes fatigue to increase with the weight, but not in direct proportion to the extra weight handled. When the correct weight of the unit to be handled has been determined, additional weight will cause fatigue greater in proportion than the extra weight handled.

If possible, rest from fatigue is so arranged as to interfere with work the least. The necessary rest periods of the individuals of a gang should come at that period of the cycle that does not cause any allowance to be made for rest in between the performance of the dependent operations of different members of the gang. Such an arrangement will enable the worker to keep a sustained interest in the work.

Under Scientific Management Quality Is Standardized.—Scientific Management determines exactly what quality as well as what quantity of work is needed, and the method prescribed is that one not only of lower costs, but which fits the particular need of the particular occasion most accurately.

Workers are kept under pressure for quality, yet the pressure is not irksome, because the worker understands exactly what quality is desired, and what variations from exactness are permitted.

All dimensions on the drawings of work should have either a letter or symbol or plus or minus sign. There is much to be said about the effect this has on the worker. (1) It gives him immediate knowledge of the prescribed quality demanded; (2) he does not have to worry as to the maximum variation that he can make without interfering with his bonus; and (3) there is no fear of criticism or discharge for using his own faulty judgment.

Scientific Management Has a Standard "Method of Attack."—We must note next the Standard "method of attack" in Scientific Management. It is recognized that sensations are modified by those that come before, by those that come simultaneously, and by those that follow. The psychic effect of each and every kind of sensation depends upon what other sensations have been experienced, are being experienced at that time, or will presently be experienced. The scientific manager realizes this, and provides for the most desirable sequence of sensations. Then having seen, to the best of his ability, that the sensation occurs at the time which he desires it to occur, he provides for concentration upon that one sensation and elimination of all other thoughts or desires.

The method of attack of Scientific Management is to eliminate all possible bodily and mental exertion —to cut down motions, to cut down even sensations and such mental acts as visualizing. The object is, not so much to eliminate these motions and these sensations, and this visualizing from the life of the worker, as simply to use up less energy in producing the output. This allows the worker an extra supply of energy upon which to fall back to produce greater output and to get greater wages. If his energy is not all utilized in his working hours, then there is that much more left for him to enjoy his own leisure time.

(To be continued.)

Applying the Science of Management to Selling

BY J. GEORGE FREDERICK[1]

It is now known that selling is considerably more of a concrete science than old-time sales managers and salesmen have believed it. This is largely due to the fact that the application of broad education to the modern commercial problems has driven out the exaggerated ego which was the prominent part of salesmanship in the past.

One definite cause of the greater application of science to selling has been that the extension of markets throughout the broad length of the land has made it necessary to have intelligent planning from a central source, and to have it done with the utmost pains and analysis. In the old days, salesmen were simply given samples, a circle was drawn around a sales territory and they were told to go and produce results. The result was that frequently these salesmen believed that their own peculiar personal genius was wholly responsible for any success they had, and that they possessed a species of mysterious "black art" in selling.

Manufacturers soon learned two things about this old method: (1) that any time such salesmen became dissatisfied, they could seriously injure the business, because they got it more on a personal basis than on the merit of the goods; and (2) that they had no accurate measurement whatever of the ultimate possibilities of a given piece of territory, nor a real estimate of the measure of a salesman's ability.

This was due, too, to the fact that salesmen rendered no reports; that prospects were not recorded at the home office; that the relative "tensile" strength of a given piece of territory (meaning its respective power, or consumption possibilities or competitive situation was not known. This sort of condition simply had to break the houses which were content with a moderate amount of success, but they are now being replaced in many cases with newer concerns with newer and more

[1] Vice-Pres. The Business Bourse; Editor *The Efficiency Magazine.*

The Psychology of Management[1]--VIII

Records and Programs

BY L. M. GILBRETH

Definition of Record.—A record is "something set down in writing or delineated for the purpose of preserving memory; specifically a register; an authentic or official copy of any writing, or an account of any fact and proceedings, whether public or private, usually entered in a book for preservation; also the book containing such copy or account."[68]

Few Written Records Under Traditional Management.—For the purposes of this preliminary study, emphasis will be laid on the fact that the record is written. Under Traditional Management there are practically no such labor records. What records are kept are more in the nature of "bookkeeping records." In many cases, under Traditional Management, not even such records of profit or loss from an individual piece of work were kept, the manager in extreme cases "keeping his books in his head," and having only the vaguest idea of the state of his finances.

Importance of Records Realized Under Transitory Management.—The recognition of the value of records is one of the first indications of Transitory Management. Since this stage of management has Scientific Management in view as "a mark to come to," the records evolved and used are not discarded by Scientific Management, but are simply perfected. Therefore, there is no need to discuss these transitory records, except to say that, from the start, *quality* of records is insisted upon before quantity of records.

Under Scientific Management there are no "bookkeeping records" kept of costs as such. Instead, there are "time and cost records," so-called, of the efficiency of performance. From these, costs can be deduced at any time. Items of cost without relation to their causes, on work that is not to be repeated, have little value. Cost records, as such, usually represent a needless, useless expenditure of time and money. It must be emphasized that Scientific Management can in no way be identified with "cost keeping," in the sense that that is understood to mean recording unrelated costs. Under Scientific Management costs are a by-product of the system, not a direct product.

Records Must Lower Costs and Simplify Work.—The quantity of records made depends on the amount, diversity and state of development of the work done. No record should be made which does not, directly or indirectly, actually reduce costs or increase efficiency. The purpose of the records is to simplify work. Only when this is recognized, can the records made be properly judged. Numerous as they may at times seem to be, their number is determined absolutely by the satisfactory manner in which they: (1) Reduce costs; (2) Simplify work; (3) Increase efficiency.

Records of Work and Workers.—Records may be of the work or of the worker,[69] that is to say, of material used, tools used, output produced, etc., or of individual efficiency, in one form or another. Records of efficiency may be of workers, of foremen, and of managers, and a record may be made of any man in several capacities; for example, a record is kept of a functional foreman in the form of the work of the men who are under him. Another record might be kept of him as a worker himself; for example, the time may be taken that it took him to teach others their duties, or the time to learn what was to be done on any new work, etc.

Records of initiative are embodied in the suggestion card. Even under advanced Traditional Management the cards are furnished to the men upon which to write any ideas as to improvements. These suggestions are received, and, if accepted, are rewarded.

Under Scientific Management such suggestions become more valuable, for they are based upon standards. If accepted, they signify not only a real, but a permanent improvement. Their greatest value, however, is in the stimulus that they furnish to the worker, in the information that they furnish the management as to which workers are interested, and in the spirit of co-operation that they foster.

The worker receives not only a money reward, but also publicity, for it is made known which worker has made a valuable suggestion. This indicates that the worker has shown good judgment. His interest is thus stimulated, his attention is held to his work, and the habit of initiative comes to him. That this habit of initiative can be fostered, is shown by the fact that in many sorts of work the same man constantly makes suggestions. It becomes a habit with him to look for the new way, and as he is constantly rewarded, the interest is not allowed to diminish.

Records of Good Behavior.—Records of good behavior are incorporated in the "white list" file. The white list file contains the names of all men who have ever been employed who merit a recommendation, if they should go to work for others, and would deserve to be given work as soon as possible, if they came back. This white list file should be filled out with many details, but even if it contains nothing but a record of the names, and the addresses where the men can be reached when new work starts up, it has a stimulating effect upon the worker. He feels again the element of permanence; there is a place for individuality, and

[68]Century Dictionary.
[69]H. L. Gantt, A. S. M. E. Paper No. 1002, ¶ 2.

not only does the manager have the satisfaction of actually having this list, and of using it, but a feeling that his men know that he is in some way recognizing them, and endeavoring to make them and their good work permanent.

Records of Achievement.—Records of achievement vary with the amount and nature of the work done. Such records are, as far as possible, marked upon programs. Wherever possible the worker makes his own records. Even when this is not advisable, he is informed of his record at as short intervals as are practicable.[70]

Records Made on the "Exception Principle."—Much time is saved by separating records for the inspection of the man above, simply having him examine the exceptions to some desired conditions — the records which are exceptionally good, or the records which are exceptionally bad. This not only serves as a reward to the man who has a good record, and a punishment for the man who has had a bad record, but it also enables the manager to discover at once what is wrong and where it is wrong, and to remedy it.

The value of the exception principle can hardly be overestimated. It would be of some value to know of exceptionally good or poor work, even if the cause were not known. At least one would be made to observe the sign post of success, or of danger. But, under Scientific Management, the cause appears simultaneously with the fact on the record, thus not only indicating the proper method of repeating success, or avoiding failure, in the future, but also showing, and making clear, to the worker himself, the direct relation of cause to effect.

The records mentioned above are only a few of the types of records under Scientific Management. Discussion has been confined to these, because they have the most direct effect upon the mind of the worker and the manager. Possible records are too numerous, and too diverse, to be described and discussed in detail. We need only further discuss the making of records, and their effects.

SUMMARY

Results of Records to the Work.[71]—The results of recording are the same under all forms of management, if the records are correct. Output increases where records are kept. Under Traditional Management there is the danger that pressure for quantity will affect quality, especially as no exact records of the resultant quality are kept. Under Transitory and Scientific Management, quality is maintained or improved, both because previous records set the standard, and because following records exhibit the quality.

Self-Knowledge Attained Through Records.—Through records of output, and especially through charts of such records, the worker may, if he be naturally observant, or if he be taught to observe, gain a fine knowledge of himself.

The constant exhibit of cause and effect of the relation of output to, for example, the drinking of alcoholic beverages; to smoking; to food values; to nutrition; to family worries, and to other outside influences. In fact, the effects of numerous different modes of living are shown promptly to the worker in the form of records.

Two things should here be noted:

(1) The necessity of having more accurate records of the worker and the work, that the relation of cause to effect may be more precise and authentic. (2) The necessity for so training the worker, before, as well as after, he enters the industrial world, that he can better understand and utilize the lessons taught by his own records and those of others.

Educative Value of Worker Making His Own Record.—Under Scientific Management in its most highly developed form, the worker makes his own records on his return cards and hands them in. The worker thus not only comes to realize, by seeing them and by writing them down what his records are, but he also realizes his individual position to-day compared to what it was yesterday, and compared to that of his fellows in the same line of work. Further, he gains accuracy, he gains judgment, he gains a method of attack. He realizes that, as the managers are more or less recorders, he, in recording himself, is vitally connected with the management. It is, after all, more or less an attitude of mind which he gains by making out these records himself. It is because of this attitude of mind, and of the value which it is to him, that he is made to make out his own record under the ultimate form of management, even though at times this may involve a sacrifice of the time in which he must do it.

We cannot emphasize too often in this connection the far-reaching psychological effect upon the worker of exact knowledge of the comparative efficiency of methods. The value of this is seldom fully appreciated; for example, we are familiar with the examples where the worker has been flattered until he believes that he cannot make mistakes or do inefficient work. This is most often found where the glowing compliments to the manufacturing department, found in the advertising pages of the magazine and in the praises sung in print by the publicity department, oftentimes end in an individual overconfidence. This unjustified self-esteem is soon shattered by accurate records.

On the other hand, hazing of the new worker and the sneers of the jealous, accompanied by such trite expressions as "You can't teach an old dog new tricks," have often destroyed self-confidence in a worker who, in the absence of accurate records of his efficiency, is trying to judge himself at new methods. The jibes and jokes at the new man at the new work, and especially at the experienced efficient man at unfamiliar work, cease, or at least are wholly impotent, so far as discouraging the man is concerned, provided the worker sees by the records of a true measuring device or method, that his work compares favorably with others of the same experience, done under the same conditions.

"Program" is defined[72] as "A method of operation or line of procedure prepared or announced be-

[70] Gillette and Dana. "Cost-Keeping and Management Engineering." p. vii.
[71] H. L. Gantt, A. S. M. E. Paper No. 1002. p. 1336.
[72] Century Dictionary.

forehand. An outline or abstract of something to be done or carried out."

The word "program" has two meanings in management.

(1) The work, as it comes to the management to be done.

(2) The work as it is planned out by the managers, and handed over to the worker to be done.

Program as here used is a plan for doing work—the plan which the planning department lays out and hands over for the workers to do.

Under Traditional Management No Accurate Program Is Possible.—Under Traditional Management the plan is at best a repetition of records of unscientifically planned work. The most that the managers can do is to lay out the time, after consulting previous elapsed time records, in which they hope and expect the various parts of the work to be done. Methods are not prescribed, so there is no assurance that the calendar will be followed, for the times are set by guess or, at best, by referring to old unscientifically made records.

Under Transitory Management Calendars Can Be Designed.—Under Transitory Management, with the introduction of records of how the work has been done best at various times, come methods and a possibility of a more exact calendar. There is some likelihood under Transitory System of the work being done on time, as the method has been considered, and, in many cases, is specified.

Under Scientific Management Accurate Calendars Possible.—Under Scientific Management programs are based on accurate records scientifically made and standardized, and a calendar may be made that can be conformed to with exactness.

Programs a Matter of Routing.—The problems of a program under Scientific Management are two, both problems of routing. (1) To route materials to the work place. (2) To route the worker to the placed materials.

At first glance it might seem simpler to consider the worker as static and the materials as in motion. The "routing" of the worker is really often not a question of motion at all, as the worker, if he were operating a machine, for example, would not change his position enough to be considered between various pieces of work except to rest from fatigue. The word "routing" is used figuratively as regards the worker. He is considered as transported by the management through the day's work. But, whether the work or the worker, or both, move, programs must so plan the progress of each in detail for as many days ahead as possible, that the most efficient outcome will ensue.

Routing of Work.—The work is routed through schedules of materials to buy, schedules of material to handle, and schedules of labor to be performed. The skilled worker finds all the materials for his work ready and waiting for him when he arrives at the task, this being provided for by programs made out many tasks ahead.

Routing of Workers.—The workers themselves are routed by means of the route sheet, route chart, pin plan and bulletin board. The devices for laying out the work of the workers appeal to the imagination as well as the reason. The route chart is a graphical representation of a large river, starting with the small stream—the first operation gathering to itself as the tributaries the various other operations till it reaches its full growth, the completed work.

The pin plan, with each pin or flag representing a worker, or work place, and following his progress on a plan of the work, presents a bird's eye view in miniature of the entire working force; and the bulletin board, with its card that represent work ahead, not only eliminates actual delay of shifting from one task to another, but also permits studying out one task while doing another, and destroys all fear of delay between jobs.

Results of Progress to the Work.—Under Traditional Management the tentative calendar might cause speed, but could not direct speed. Under Traditional Management, elimination of waste by prescribed methods and routing will increase output. This increase becomes greater under Scientific Management. Standardized routing designs the shortest paths, the least wasteful sequence of events, the most efficient speed, the most fitting method. The result is more and better work.

Results of Programs to the Worker.—A program clarifies the mind, is definite. The Traditional worker was often not sure what he had better do next. The worker under Scientific Management knows exactly what he is to do, and where and how he is to do it.

The attention is held, and a field of allied interests is provided for possible lapses, as are also methods for recalling attention.

The program provides for a look ahead. This ability to foresee also leads to a feeling of stability. The knowledge that there is a large amount of work ahead, ready to be attacked with no delay, eliminates anxiety. This allows of concentration on the work in hand and a feeling that, this work being properly done, one is free to turn to the next piece of work with the absolute assurance that what has been done will be satisfactory.

Importance of This Relation.—The relation between records and programs in the various types of management is most important, for the progress from one type to another may be studied as exemplified in the change in these relations.

In order to understand more plainly the complexity of this relation, we will not confine ourselves here to the narrower definition of a record as a written account, but will consider it to mean a registering of an experience in the mind, whether this expresses itself in a written record or not. A program will, likewise, be a mental plan.

Many Possible Types of Records and Programs.—In order to understand the number of different types of records and programs that can be made for a worker, the table herewith that follows may be examined. It exemplifies twelve possible records and twelve possible programs.

Interrelation of These Types.—There will usually be a fundamental difference, at the outset, in the minds of the man working for himself and the man working for others, for the

TABLE I.—TWELVE POSSIBLE RECORDS AND PROGRAMS THAT CAN BE MADE FOR THE WORKER

I. Records.	1. Man working for himself		1. Unconscious record.	
			2. Conscious record, not written.	
			3. Written record.	
			4. Standardized record.	
	2. Man working for another.	a.—One of a gang b.—Individual output.	1. Unconscious record.	(a) Made by man. (b) Made by manager.
			2. Conscious record, not written.	(a) Made by man. (b) Made by manager.
			3. Written record.	(a) Made by man. (b) Made by manager.
			4. Standardized record.	(a) Made by man. (b) Made by manager.
II. Program.	1. Man working for himself		1. Unconscious program.	
			2. Conscious program.	
			3. Written program.	
			4. Standardized program.	
	2. Man working for another.	a.—One of a gang. b.—Individual output.	1. Unconscious program.	(a) Made by man. (b) Made by manager.
			2. Conscious program, not written.	(a) Made by man. (b) Made by manager.
			3. Written program.	(a) Made by man. (b) Made by manager.
			4. Standardized program.	(a) Made by man. (b) Made by manager.

man working for himself will be of a more independent cast of thought. There will be no question as to the man's output showing up separately, unless he chooses to prevent this by having others work with him. Neither will there be any question but that, if a record is made, he makes it himself. There would be four kinds of records—an unconscious record, a conscious record not written, a written record and a standardized record. The "unconscious record" would be, in reality, no record at all. Somewhere in the man's mind there would be a record of what he had done, but, except as a "fringe of consciousness," it would not particularly influence his program. What we mean by a "conscious record" would be more of a set habit, the man knowing that he had done the work in a certain way. This would begin to influence, more or less, his program, and also his knowledge of his capacity for work. With a written record would come a thorough knowledge on his part of what he had done and how he had done it, and we must note that with this written record comes the possibility for some sort of a set program, the man knowing what it will be possible to do, and how he had best do it. With the standardized record comes the standardized method.

When we consider the man working for another, he may either be one of a gang, or one whose work is considered as that of an individual. In either case, any of the four sorts of records can be made of his work that have been already described for the man working for himself. Each one of these records may be made by the man, or by the management; for with the man working for another, naturally the second mind, that of the other, or the manager, enters in, and a great many more combinations are possible.

For example, there might be an unconscious record made by the man and a conscious record, or a written record, made by the manager. There might be a conscious record made by the man, but an unconscious or a written record made by the manager, etc. There are too many combinations made to be here considered. Each one of these combinations would have a definite and a different effect, both upon the mind of the man, and upon the mind of the manager; and also upon their relation to each other. The second half of this chart is similar, but treats of programs, as many variables enter in here.

When we consider that each type of record bears a relation to each type of program, the complexity of the problems involved become apparent. This will be better shown in Table II.

Illustrations of This Complexity.—Table II represents the man working for himself, with subdivisions under it showing the possible relationships between his record and his program. We find that these are ten, reaching all the way from the unconscious record and unconscious program of the migrating transitory laborer to the standardized record and the standardized program of the capitalist who manages himself scientifically.

Each one of these represent a distinct psychological stage. The progression may not be regular and smooth as is here given; it may be a jump, possibly even from one to nine. It may, however, be a slow progression from one stage to another, largely to be determined by the type of mind that is considered, and the opportunities for develop-

TABLE II.—POSSIBLE RELATIONSHIPS BETWEEN THE RECORD OF A MAN WORKING FOR HIMSELF AND HIS PROGRAM

I.—Man working for himself.......	1. Unconscious record, unconscious program. 2. Conscious record, unconscious program. 3. Unconscious record, conscious program. 4. Conscious record, conscious program. 5. Unconscious record, written program. 6. Written record, unconscious program. 7. Conscious record, written program. 8. Written record, conscious program. 9. Written record, written program. 10. Standardized record, standardized program.

ment along scientific lines which are afforded.

The chart does not indicate, as perhaps it should, the fact that the relationship between an unconscious record and an unconscious program is slight, while the relation between a written program and a written record is very close indeed. In Table IV this will be indicated.

made through these steps, either taking one step after another slowly or making the various possible jumps—long and short.

If Table III had no other purpose, it would be useful to suggest to the student the wide tracts which still remain for study and development. It must not be thought that any of the steps omitted from this chart are

TABLE III.

II.—Man working for another......	1. One of a gang—unconscious record, unconscious program, on part of both manager and man. * * * * * * N.—Individual output—standardized record and program, known to, or made by, both manager and man.

Elimination of Waste Possible.—Table III, that of the man working for another, attempts to do no more than indicate the first and last steps of a long series, beginning with the man—one of a gang, an unconscious record, and an unconscious program, on the part of both the manager and the man, and going down to the final stage of individual output, with the written record and program known to both manager and man. It would be a most interesting problem to work out the various steps stretching between these two, and the various ways in which progression might be

not in existence. Every single possible combination of record and program is in existence to-day, and must be studied by the manager of men.

Not until these are all discovered, described and standardized, the progression noted, and standard progressions outlined, can methods of least waste be adopted.

The Program Derived from the Record.—Having considered the various records and programs and their relation, we will now consider the four stages of the record: (1) unconscious, (2) conscious, (3) written, and (4) standardized, and trace the derivation of the program from each stage. (See Table IV.)

Unconscious Records Mean Indefinite Programs.—First, then, suppose that the records are unconscious. What does this imply? It implies in the first place that the worker has no idea of his capacity; never having thought of what he has done, he has no idea what can be done, neither has he a comparative idea of methods, that is, of how to do it. It is impossible for a definite program to be laid out by such a worker; that is to say, no predictions by him as to the time of completing the work are possible. Neither could a method be derived by him from his previous work.

Note here the alarming amount of waste. All good methods which the worker may possibly have acquired are practically lost to the world, and perhaps also to him. Not only this, but all bad methods which he has fallen into will be fallen into again and again, as there are no warning signs to keep him out of them.

As there is no possibility of an accurate chronological chart, the worker may undertake more than he can do, thus delaying work which should have been done by others. On the other hand, he may underestimate his capacity, and be left idle because work he should have

TABLE IV.

I. Record unconscious.	Program cannot be definite. Method is indefinite.
II. Record conscious.	Program becomes more definite. Method becomes more definite.
III. Record written.	Program yet more definite. Method definite.
IV. Record standardized.	Program standardized, *i. e.*, Results predictable. Method standard.

done has been assigned to others. Either of these leads to a sense of insecurity, to wavering attention, to "hit-or-miss" guess-work, "rule-of-thumb methods." etc., which are the signs of Traditional Management.

With Conscious and Written Records Come Definite Programs.—We turn now to the case where the record is conscious, that is, where the worker keeps in mind exactly what he has done. With this conscious record the idea of capacity develops. The man realizes what he can do. So also, the idea of method develops, and the man realizes how he can do the work. Third, there comes gradually an idea of margin; that is, of a possible way by which capacity can be increased for a higher speed, or methods can be slightly varied to meet any particular deviation in the work to be done.

From this ability to estimate capacity, and to plan the method ahead, comes the ability to lay out a more definite program. When the record becomes written, the exactness of the program increases. Methods also become written, and, though accurate prediction is not possible, such prediction is more and more nearly approached. This increasing accuracy in the work of Transitory System in all its stages.

Standard Records Permit of Standard Programs.—In the last case, the record is standardized, that is, the result of the method of processes of analysis and synthesis. Through this process, as has been shown, the reason for success is discovered and rendered usable. The programs becomes standard, results can be predicted accurately, and methods by which these results can be best obtained are also standard.

It may at first escape notice that these standardized records, of the ultimate or scientific management type, imply *not* a greater rigidity, but a greater elasticity. This because of the nature of the elements of the records, which may, in time, be combined into a great number of different, predictable programs.

Results of Relations Between Records and Programs on the Work.—The most noteworthy result of the closer relations between records and programs which appear during the evolution of Scientific Management, is the fact that they cause constant simplification. The more carefully records are standardized, the simpler becomes the drafting of the program. As more and more records become standard, the drafting of programs becomes constantly an easier and cheaper process.

Programs Become Records.—Under Traditional Management the record that follows a program may appear very different from the program. Under Scientific Management the record that follows a program most closely resembles the program. Improvements are not made between the program and the following record—they find their place between the record and the following program. Thus programs and records may be grouped in pairs, by similarity, with a likelihood of difference between any one pair (one program plus one record) and other pairs.

Result on the Worker.—The greatest effect, on the worker, of these relations of record to program under Scientific Management, is the confidence that he gains in the judgment that is an outcome of Scientific Management. When the worker sees that Scientific Management makes possible accurate predictions of times, schedules, tasks, and performances; that the methods prescribed invariably enable him to achieve prescribed results, his confidence in Scientific Management grows. So also does the manager's confidence in Scientific Management grow; and in this mutual confidence in the system of management is another bond of sympathy.

(To be continued.)

Standard Speeds and Feeds on Machine Tools

The speeds and feeds used on machine tools in this country have been largely revised in the past ten years. Two causes have contributed to this: The invention of high-speed steel which made obsolete every machine tool in the world, with the consequent necessity of redesigning all tools sufficiently strong and with such speed and feed mechanisms as would enable the utmost advantage to be taken of the new tool steel; second, the publication of "On the Art of Cutting Metals," which recorded the experimental work of Taylor, which extended over a quarter of a century, and which was the first and only attempt to reduce machine work to a scientific basis. In the "Art of Cutting Metals" were presented those standard shapes of lathe and planer tools which had been developed as the most efficient, and the speeds and feeds at which these tools would give the maximum production. These tools not only revolutionized machine-tool practice but started the revolution in industrial management with which every reader of Industrial Engineering is now familiar, for with a standard lathe or planer tool, used in a standardized machine tool it became possible to predict how long a given job should take and to set a definite task for the worker. Comparatively little has been done as yet on a scientific investigation of milling tools, but the idea of setting tasks, based on known performances, has extended to milling machines, and in fact to all other classes of work.

The idea of task management is firmly established in this country. Its growth abroad has been relatively slower, but it is now taking root. The importance of establishing standard feeds and speeds is well recognized, and an article in a recent number of *The Engineer* exemplifies this fact. The article in recommended. This intensity under localized-general illumination is obtained for 36-in. goods by means of one 60-watt tungsten lamp with extensive reflectors suspended from the middle of each loom in the weave alley, and a 40-watt tungsten lamp with extensive reflector from the middle of the warp alley. For 54-in. goods a 40-watt tungsten lamp is retained in the warp alley as above, but the single 60-watt tungsten lamp is replaced by two 60-watt lamps suspended over each end of the loom, on the weave side. The same arrangement is recommended for weaving silk goods. In the cotton mill weaving light goods the illuminating intensity recommended is 2 to 4 foot-candles. With localized-general illumination, this intensity can be secured with a 60-watt tungsten lamp in an extensive reflector suspended at the intersection of the weave alley and the aisle between alternate machines. For weaving 74-in. goods, a single tungsten filament 40-watt lamp in an extensive reflector suspended at the end of the weave alley, between each pair of machines, will accomplish the same results. For weaving dark goods, a lighting intensity of from 3 to 5 foot-candles is required. This is accomplished under localized-general illumination by means of the same arrangement as given for light-color goods, excepting that the next larger size lamp is used.

For inspecting textiles, an intensity of 5 to 10 foot-candles is required. In the woolen mill, the perching operation on light goods requires a lighting intensity of 8 to 15 foot-candles, secured by localized-general or general illumination in which a 100-watt tungsten filament lamp with intensive reflector from each perching frame is used. For perching the dark goods, the illuminating intensity should range from 10 to 20 foot-candles. A 150-watt tungsten lamp with an intensive reflector is placed over each perching frame.

(To be continued.)

The Psychology of Management[1]--IX

Teaching under Scientific Management

BY L. M. GILBRETH

"Teaching" is "the act or business of instructing."[73] Synonyms are "training" and "education." "To teach" is defined as: (1) "To point out, direct, show"; "to tell, inform, instruct, explain; (2) to show how (to do something); hence, to train; (3) to impart knowledge or practical skill to"; "to guide in learning, educate."

"To educate" means "to instruct, to teach methodically, to prescribe to; to indoctrinate." "To educate," says the same authority, "is to develop mentally or morally by instruction; to qualify by instruction and training for the business and duty of life."

Under Traditional Management No Definite Plan of Teaching.—Under Traditional Management there is either no definite scheme of teaching by the management itself, or practically none. In the very highest examples of the traditional plan the learner may be "shown how," but this is not usually done in a systematic way, and under so-called Traditional Management is seldom in the form of written instructions.

No Specified Time for, or Source of, the Teaching.—Under Traditional Management there is no particular time in which this teaching goes on—no particular time allowed for the worker to ask for the instruction, nor is there any particular source from which he obtains the instructions. There is, moreover, almost every hindrance to his getting any more instruction than he absolutely must have in order to do the work. The persons to whom he can appeal for further information might discharge him for not already knowing. An important fact bearing on this subject is that it is not to the pecuniary advantage of any particular person to give this teaching. If the man be a fellow-worker, he will want to do his own work without interruption. He regards his particular skill as more or less of a trade secret, and desires to educate no more people than necessary to be as clever as he is. Of course, the worker necessarily improves under any sort of teaching, and if he has a receptive or an inventive mind, he must progress constantly, either by teaching himself or by the instruction, no matter how haphazard.

The consensus of opinion would seem to prove that an apprentice of only a generation ago was too often hazed, was discouraged from appealing to the workers near him, or to his foremen for assistance or advice; was unable to find valuable literature for home-study on the subject of his trade. The experience of many apprentices was, doubtless, different from this, but the mental attitude of the journeymen who were the only teachers must have tended toward some attitude of doubt or hesitancy in the apprentice.

Mental Attitude of the Worker-Teacher.—Under the old plan of management, the apprentice must appear to the journeyman as more or less of a supplanter. From the employee's standpoint it was most desirable that the number of apprentices be kept down, as an over-supply of labor almost invariably resulted in a lowering of wages. The quicker and better the apprentice was taught, the sooner he became an active competitor. There seldom existed under this type of management many staff positions to which the workers could hope to be promoted, certainly none where they could utilize to the

[1]Copyright 1912, by L. M. Gilbreth.
[73]Century Dictionary.

fullest extent their teaching ability. There was thus every reason for a journeyman to regard the teaching of apprentices as unremunerative, irksome, and annoying.

Attitude of the Learner.—The attitude of the typical learner was frequently one of hesitancy and self-distrust, if not of fear, though conditions were so varied as almost to defy classification. One type of apprentice was expected to learn merely by observation and imitation. Another was practically the chore boy of the worker who was assigned to teach him. A third was under no direct supervision at all, but was expected to "keep busy," finding his work by himself. A fourth was put through a severe and valuable training by a martinet teacher.

It is greatly to the credit of the worker under this type of management that he was, in spite of all drawbacks, occasionally a painstaking teacher, to the best of his lights. He insisted on application, and especially on quality of work. He unselfishly gave of his own time and skill to help the apprentice under him. Unfortunately, through no fault of the worker-teacher, the teaching was usually done according to wrong methods. Quality of resulting output was so emphasized that neither speed nor correct motions were given proper consideration.

The reason for this was that the worker had no training to be a teacher. First, he had no adequate idea of his own capabilities, and of which parts of his own method were fit to be taught. Secondly, he did not know that correct motions must be insisted on first, speed next, and quality of output third; he did not know that if the motions were precise, the quality would be first. Further, he had no pedagogical training.

Lack of Standards an Underlying Fault.—All shortcomings in the old-time teaching may be traced to lack of standards. The worker had never been measured, hence had no idea of his possible efficiency. No standard methods made plain the manner in which the work should be done. Moreover, no standard division and assignment of work allowed of placing apprentices at such parts of the work that quality could be given third place. No standard requirements had determined the worker's fitness as a teacher, nor the specialty that he should teach, and no incentive held his interest to the teaching. These standards the worker-teacher could not provide for himself, and the wonder is that the teaching was of such a high character as it was.

Under Traditional Management, teaching of adults was slight. There was little incentive either to teacher or to learner, and it was difficult for an adult to change his method.[74] Moreover, it would be difficult for a worker using one method to persuade one using another that the first worker's method was the better, there being no standard. Even if the user of the better method did persuade the other to follow it, the final result might be the loss of some valuable elements of the poorer method that did not appear in the better.

Teaching More Important Under Transitory System.—Under Transitory Management the importance of teaching becomes at once more apparent. This, both by providing for the teaching of foremen and journeymen as well as apprentices, and by the providing of written systems of instructions as to the best practice. The worker has access to all the sources of information of Traditional Management, and has, besides these, in effect, systematically derived standards to direct him.

The use of written systems enables every worker to receive instruction at any time, to feel free to ask it, and to follow it without feeling in any way humiliated.

The result of the teaching of these systems is a decided improvement in methods. If the written systems are used exclusively as a source of teaching, except for the indefinite teachers of the Traditional Management, the improvement becomes definitely proportioned to the time which the man spends upon the studying, and to the amount of receptive power which he naturally has.

The worker has these incentives to follow the systems: (1) He is required to render reasons in writing for permanent filing, for every disobedience of system. (2) As soon as work is placed on the bonus basis, the first bonus that is given is for doing work in accordance with the prescribed method.

Even before the bonus is paid, the worker will not vary for any slight reason, if he positively knows at the time that he must account for so doing, and that he will be considered to have "stacked his judgment" against that of the manager. Being called to account for deviations gives the man a feeling of responsibility for his act, and also makes him feel his close relationship with the managers.

There is, under this type of management, no set time for the study of the systems.

Systems Are Inelastic.—Being written, these systems have all the disadvantages of anything that is written. They require considerable adaptability on the part of the man who is using them. He must consider his own mind and the amount of time which he must put on studying; he must consider his own work, and the adapting of that method to his work while still obeying instructions. In the case of the system being in great detail, he can usually find a fairly detailed description of what he is going to do and can use that. In the case of the system being not so complete, if his work varies, he must show intelligence in varying the system, and this intelligence often demands a knowledge which he does not have, and knows not where to obtain.

The time necessitated by the worker's laying out details of his method is taken from the total time of his working day, and cuts down his total product. Moreover, if no record is kept of the details of his planning, the next worker on the same kind of work must repeat the investigation.

[74] F. B. Gilbreth, "Bricklaying System," ¶¶541-595.

Teaching Most Important Under Scientific Management.—Teaching is a most important element under Scientific Management, not only because it increases industrial efficiency, but also because it fosters industrial peace.[75]

As we have seen, Scientific Management has as a basic idea the necessity of divided responsibility, or functionalization. This, when accompanied by the interdependent bonus, creates a need to teach and a need to learn. Scientific Management separates the planning from the performing in order to centralize and standardize knowledge in the planning department, thus making all the knowledge of each available to all. This puts at the disposal of all more than any could have alone. The importance of having this collected and standardized knowledge conveyed to the worker can not be overestimated. Through this knowledge the worker is able to increase his output, and thus insure the lowered costs that provide the funds with which to pay his higher wages, to increase his potential as well as actual efficiency, and best to co-operate with other workers and with the management.

Importance of Teaching Element the Best Claim to Permanence of Scientific Management.—Upon the emphasis which it places on teaching rests a large part of the claim of Scientific Management for permanence.[76] We have already shown the derivation of the standards which are taught. We have shown that the relation between the planning and performing department is based largely on means and methods for teaching. We have only to show here that the teaching is done in accordance with those laws of psychology that are the laws of pedagogy.

The methods of teaching under Scientific Management were not devised in response to theories of education. They are the result of actual experience in most successfully getting work done. The teachers, the methods and the devices for teaching all grew up to meet needs, as did the other elements of Scientific Management.

Change from Teaching Under Traditional Management. — Mr. Gantt says, "The general policy of the past has been to drive; but the era of force must give way to that of knowledge, and the policy of the future will be to teach and to lead, to the advantage of all concerned."[77] This "driving" element of Traditional Management is eliminated by Scientific Management.

So also is eliminated the old belief that the worker must go through all possible experiences in order to acquire judgment as to best methods. If the worker must pass through all the stages of the training of the old-fashioned mechanic—and this is seriously advocated by some, he may fail to reach the higher planes of knowledge afforded by training under Scientific Management, by reason of sheer lack of time. If, therefore, by artificial conditions caused by united agreement and collective bargaining, workmen insist upon having forced upon them the old-school training, they will lose just so much of the benefits of training under those carefully arranged and carefully safeguarded processes of industrial investigation in which modern science has been successful. To refuse to start in where others have left off, is really as wasteful as it would be to refuse to use mathematical formulas because they have been worked out by others. It might be advocated that the mind would grow by working out every possible mathematical formula before using it, but the result would be that the student would be held back from any further original investigation. Duplicating primary investigations might be original work for him, but it would be worthless so far as the world is concerned. The same is absolutely true in management. If the worker is held back by acquiring every bit of knowledge for himself, instead of taking the work of others as the starting point, the most valuable initiative to the world will be lost.

Bad Habits the Result of Undirected Learning.—Even worse than the waste of time would be the danger of acquiring habits of bad methods; habits of unnecessary motions; habits of inaccurate work; habits of inattention. Any or all of these might develop. These are all prevented under Scientific Management by the improved methods of teaching.

Valuable Elements of Traditional Management Conserved.—There are, however, many valuable elements of the old Traditional system of teaching and of management which should be retained and not be lost in the new. For example, the greatest single cause of making men capable under the old plan was the foreman's unconscious ability to make his men believe, before they started a task, that they could achieve it.

It must not be thought that because of the aids to the teachers under Scientific Management the old thought of personality is lost. The old ability to convince a man to the belief that he can do a thing, to inspire him with confidence in his foreman, the confidence in himself, and a desire to do things, is by no means lost, and must be most carefully preserved under Scientific Management.

Scope of Teaching Under Scientific Management.—Under Scientific Management teaching must cover: (1) Teaching of right methods of doing work; (2) Teaching of right habits of using the right methods.

The teacher must so impart the knowledge that judgment can be acquired without the learner, being obliged himself to experience all the elements of the judgment.

The needs for this teaching have been stated, but may be recapitulater here: (1) The worker may not observe his own mistakes. (2) The worker has no opportunity under the old industrial conditions to standardize his own methods. (3) The worker must know standard practice. (4) Waste can be eliminated by teaching. (5) Right habits can be instilled.

[75] H. K. Hathaway, "Prerequisites to the Introduction of Scientific Management." *Engineering Magazine,* April, 1911, p. 141.

[76] H. L. Gantt, A. S. M. E. Paper No. 928, p. 372.

[77] H. L. Gantt, "Work, Wages and Profits," p. 116.

Sources of Teaching Under Scientific Management.—The sources of teaching under Scientific Management if the worker chooses to use them, are: (1) Friends or relatives; (2) Fellow workers; (3) Literature of the trade; (4) Night schools and study; (5) The management.

Methods of Teaching Under Scientific Management.—The methods of teaching under Scientific Management are:

(1) Written Methods, including: *a.* Instruction cards telling *what* is to be done and *how.* *b.* Systems, explaining the *why.* *c.* Drawings, charts, plans, photographs, all illustrating methods. *d.* Records made by the worker himself.

(2) Oral methods, including the teaching of the functional foremen.

(3) Object lessons, including *a.* Exhibits. *b.* Working models. *c.* Demonstrations by the teacher. *d.* Worker demonstrates under supervision.

Ultimately, the elements of all methods are derived from a study of workers. The worker should be enabled to realize this. Only when he feels that he is a part of what is taught, and that the teachers are a means of presenting to him the underlying principles of his own experience, will the worker be able to co-operate with all his energy.

Instruction Cards are Directions.—Instruction cards are direct instructions for each piece of work, giving, in most concise form, closely defined descriptions of standard practice, and directions as to how each element of the standardized task is to be performed.

These instruction cards not only teach the worker directly how best to do his work, but also teach him indirectly how to become a leader, demonstrator, teacher and functional foreman. Study of them may lead to an interest in, and a study of, elements, and to preparation for becoming a member of the planning department. The excellent method of attack of the instruction card cannot fail to have some good effect, even upon such workers as do not consciously note it.[78]

Systems are Reasons and Explanations.—Systems are collections of detailed reasons for, and explanations of, the decisions embodied in the directions of the instruction cards. There is a system showing the standard practice of each kind of work.

Under really successful management, it is realized that the worker is of an inquiring mind, and unless this inquiring tendency is recognized, and his curiosity is satisfied, he can never do his best work. Unless the man knows why he is doing the thing, his judgment will never reinforce his work. He may conform to the method absolutely, but his work will not enlist his zeal unless he knows just exactly why he is made to work in the particular manner prescribed. This giving of the "why" to the worker through the system, and thus allowing his reason to follow through all the details, and his judgment to conform absolutely, should silence the objections of those who claim that the worker becomes a machine, and that he has no incentive to think at his work. On the contrary, it will be seen that this method furnishes him with more viewpoints from which he can consider his work.

The instruction cards are supplemented with drawings, charts, plans and photographs—any or all, in order to make the directions of the instruction cards plainer.

Stereoscopic photographs are especially useful in helping non-visualizers, and in presenting absolutely new work. The value of the stereoscopic photograph as an educator is as yet but faintly appreciated.

Self-Made Records Educative.—The educative value of the worker's making his own records has never been sufficiently appreciated. Dr. Taylor insists upon this procedure wherever possible.[79] Not only does the worker learn from the actual marking in of the spaces reserved for him, but he also learns to feel himself a part of the record-making division of the management. This proof of the "square deal," in recording his output, and of the confidence in him, cannot fail to enlist his co-operation.

Oral Instruction Comes from the Functional Foremen.—The functional foremen are teachers whose business it is to explain, translate and supplement the various written instructions when the worker either does not understand them, does not know how to follow them, or makes mistakes in following them.

Oral instruction under Scientific Management has at least four advantages over such instruction under Traditional Management: (1) The instructor is capable of giving instruction. (2) The instructor's specialty is giving instruction. (3) The instruction is a supplement to written instructions. (4) The instruction comes at the exact time that the learner needs it.

The successful teacher must understand the minds of his men, and must be able to present his information in such a way that it will be grasped readily. Such knowledge of psychology and pedagogy as he possesses he may acquire almost unconsciously (1) from the teaching of others; (2) from his study of instruction card and systems, and (3) from actual practice in teaching.

The advantages of a study of psychology itself, as it applies to the field of teaching in general, and of teaching in the industries in particular, are apparent. Such study must, in the future, become more and more prevalent.

Advantage of Functional Foreman Teacher over Teacher in the Schools.—The functional foreman teacher has an advantage over the teacher in the schools, in that the gap between him and those he teaches is not so great. He knows, because he remembers, exactly how the worker must have his information presented to him. This gap is narrowed by functionalizing the oral teaching, by using it merely as a supplement to the written teaching, and by supplementing it with object lessons.

[78] H. L. Gantt, A. S. M. E. Paper No. 928, p. 342.

[79] F. W. Taylor, "Shop Management," §289 (Harper edition, pp. 127-128).

[80] H. K. Hathaway, *Engineering Magazine*, April, 1911, p. 144.

The teacher must have an intimate practical knowledge of the art or trade that he is to teach. The most profound knowledge of psychology will never be a substitute for the mastery of the trade as a condition precedent to turning out the best craftsmen. This is provided for by securing teachers from the ranks of the workers.[80]

He must have more than the traditional knowledge of the trade that he is to teach; he must have also the knowledge that comes only from scientific investigation of his trade. This knowledge is ready and at hand in the standards of Scientific Management that are available to all for study.

The teacher must also have an intimate acquaintance with the records of output of the method he is to teach as compared with those of methods held in high esteem by the believer in the old methods; for it is a law that no teacher can be efficient in teaching any method in which he does not believe, any more than a salesman can do his best work when he does not implicitly believe in the goods that he is selling.

The best teacher is the one who is an enthusiast on the subject of the work itself, who can cause contagion, or imitation of his state of mind, by love of the problems themselves.

The most valuable teacher is one who can arouse his pupils to such a state of interest in the economic values of the methods of Scientific Management, that all other objects that would ordinarily distract or hold their attention will be banished from their minds. They will then remember each step as it is introduced, and they will be consumed with interest and curiosity to know what further steps can be introduced that will still further eliminate waste.

Object Lesson May Be a "Working Model."—The object lesson may be a "fixed exhibit" or a "working model" of the work that is to be done. Successful and economical teaching may be done with such a model, which is especially valuable where the workers do not speak the same language as the teacher, where many workers are to perform exactly similar work, or where the memory, the visualizing and the constructive imagination are so poor that the model must be referred to constantly. Models naturally appeal best to those who take in information easiest through the eyes.

Object Lessons May Be Demonstrations by the Teacher.—The teacher may demonstrate the method to the worker. This also is a successful method of teaching those who speak a different language, or of explaining new work, though it calls for a better memory than does the "working model." The model, however, shows desired results; the demonstration, desired methods.

Demonstration Method the Chief Method of Teaching by Foremen.—The demonstration method is the chief method of teaching by the foremen under Scientific Management, and no method is rated as standard that cannot be successfully demonstrated by the teacher at any time on request.

If the worker is of the type that can learn only by actually doing the work himself, he is allowed to demonstrate the method under supervision of the teacher.[81]

Under Scientific Management all of these forms of teaching are available constantly. The instruction card and accompanying illustrations are given to the worker before he starts work, and are so placed that he can consult them easily at any time during the work. So, also, if object lessons are used, they are given before work commences, and repeated when necessary.

The teacher is constantly available for oral instruction, and the systems are constantly available for consultation.

Methods of Teaching Under Scientific Management Psychologically Right.—In order to prove that teaching under Scientific Management is most valuable, it is necessary to show that it is psychologically right, that it leads to mental development and improvement. Under Scientific Management, teaching (1) Uses and trains the senses. (2) Induces good habits of thinking and acting. (3) Stimulates attention. (4) Provides for valuable associations. (5) Assists and strengthens the memory. (6) Develops the imagination. (7) Develops judgment. (8) Utilizes suggestion. (9) Utilizes "native reactions." (10) Develops the will.

Teaching Under Scientific Management Trains the Senses.—Scientific Management, in teaching the man aims, so far as possible, to train all of his senses. Not only does each man show an aptitude for some special sense training,[82] but at certain times one sense may be stronger than another. At the time that a certain thing becomes of interest, and becomes particularly interesting to one sense, that sense is particularly keen.

Scientific Management cannot expect, without more detailed psychological data than are as yet available, to utilize these periods of sense predominance adequately. It can, and does, aim to utilize such senses as are trained, and to supply defects of training of the other senses.

The importance of sense training can scarcely be overestimated. Through his senses, the worker takes in the directions as to what he is to do, and on the accuracy with which his senses record the impressions made upon them, depends the mental model which he ultimately follows, and the accuracy of his criticism of the resulting physical object of his work. Through the senses, the worker sets his own task, and inspects his work.

The relative training given to the various senses depends on the nature of the work. When the ear is the tester of efficiency, as it often is with an engineer, emphasis is laid on training the hearing. In work where touch is important, emphasis is on such training as will develop that sense.[83]

As Many Senses as Possible Are Appealed To.—Scientific Management has made great progress in

[81] W. D. Ennis, "An Experiment in Motion Study," INDUSTRIAL ENGINEERING, June, 1911, p. 462.

[82] C. S. Myers, M. D., "An Introduction to Experimental Psychology," Chap. V, p. 73.

[83] F. B. Gilbreth, "Bricklaying System," Chap. I, the Training of Apprentices.

appealing to as many senses as possible in its teaching.

In teaching, Scientific Management has, in its teachers, animate and inanimate, great possibilities of appealing to many senses simultaneously. The instruction card may be (1) read to oneself silently—eyes appealed to; (2) read to oneself aloud—eyes and ears appealed to, also muscles used trained to repeat; (3) read aloud to one—ears; (4) read aloud to one and also read silently by one—eyes and ears; (5) read aloud, and at the same time copied—eyes, ears, muscles of mouth, muscles of hand; (6) read to one, while process described is demonstrated; (7) read to one while process is performed by oneself.

These are only a few of the possible combinations, any of which are used, as best suits the worker and the work.[84]

Untrained Worker Requires Appeal to Most Senses.—The value of appeal to many senses is best realized in teaching an inexperienced worker. His senses help to remind him what to do, and to "check up" his results.

In the case of work that must be watched constantly, and that involves continuous processes, it may prove best to have directions read to the worker. So, also, the gang instruction card may often be read to advantage to the gang, thus allowing the next member or group of members to rest, or to observe, while directions are taken in through the ears only. In this way time is allowed to overcome fatigue, yet the work is not halted.

Importance of Habits.—Prof. William James says, "An acquired habit, from the physiological point of view, is nothing but a new pathway of discharge formed in the brain, by which certain incoming currents ever after tend to escape."[85]

And again, "First, habit simplifies our movements, makes them accurate, and diminishes fatigue,[86] [87] and habit diminishes the conscious attention with which our acts are performed." Again he says (page 144), "The great thing, then, in all education, is to make our nervous system our ally instead of an enemy; as it is to fund and capitalize our acquisitions, and live at ease upon the interest of the fund. For this we must make automatic and habitual, as early as possible, as many useful actions as we can, and guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague."

These quotations demonstrate the importance of habit. How deep these paths of discharge are, is illustrated by the fact that often a German, having spent the early years of his school life in Germany, will, even after learning to speak, read, write and think in English, find it difficult to figure in anything but German.

The aim of teaching under Scientific Management, as has been said, is to create good habits of thinking and good habits of doing.

Standards Lead to Right Methods of Thinking and Acting.—The standards of Scientific Management, as presented to the worker in the instruction card, lead to good habits, in that they present the best known method of doing the work. They thus aid the beginner, in that he need waste no time searching for right methods, but can acquire right habits at once. They aid the worker trained under an older, supplanted method, in that they wage a winning war against old-time, worn-out methods and traditions. Old motor images, which tend to cause motions, are overcome by standard images, which suggest, and pass into, standard motions. The spontaneous recurring of images under the old method is the familiar cause of inattention and of being unable to get down to business, and the real cause of the expression "You can't teach old dogs new tricks." On the other hand, the spontaneous recurrence of the images of the standard method is the cause of the greater speed of movement of the experienced man, and these images of the standard methods do recur often enough to drive out the old images, and to enable all men who desire, to settle down and concentrate upon what they are doing.

Through the standards the bad habit is broken by the abrupt acquisition of a new habit. This is at once practiced, is practiced without exception, and is continually practiced until the new habit is in control.[88]

These same standards, as presented in teaching, allow of the speediest forming of habits, in that repetition is exact and frequent, and is kept so by the fact that the worker's judgment seconds that of the teacher. The chief function of the teacher during the stage that habits are being formed is the instilling of good habits.

Methods of Instilling Good Habits.—The teacher instills good habits by insisting on: (1) Right motions first, that is, the correct number of correct motions in the proper sequence. (2) Speed of motions second, that is, constantly increasing speed. (3) Constantly improving quality.[89]

Benefits of Teaching Right Motions First.—Through teaching right motions first, reactions to stimuli gain in speed. The right habit is formed at the outset. With the constant insistence on these right habits that result from right motions, there will come, naturally, an increase in speed, which should be fostered until the desired ultimate speed is reached. The result of absolute insistence on right motions will be prescribed quality, because the standard motions prescribed were chosen because they best produced the desired result.

Concentrating the mind on the next motion causes speed of motions. Under Scientific Management, the underlying thought of sequence of motions is so presented that the worker can remember them, and make them in the shortest time possible. The standard methods, being associated from the start with right habits of motion only, cause an almost automatic response. There are no discarded habits to delay response.

(To be continued.)

[84] Compare with an actor learning a part.
[85] "Psychology" (Briefer Course), p. 134.
[86] "Psychology" (Briefer Course), p. 138.
[87] William James, "Psychology" (Advanced Course), p. 112.
[88] Prof. Bain, as quoted in James's "Psychology" (Briefer Course), pp. 145-147.
[89] F. B. Gilbreth, "Bricklaying System," pp. 18 and 19.

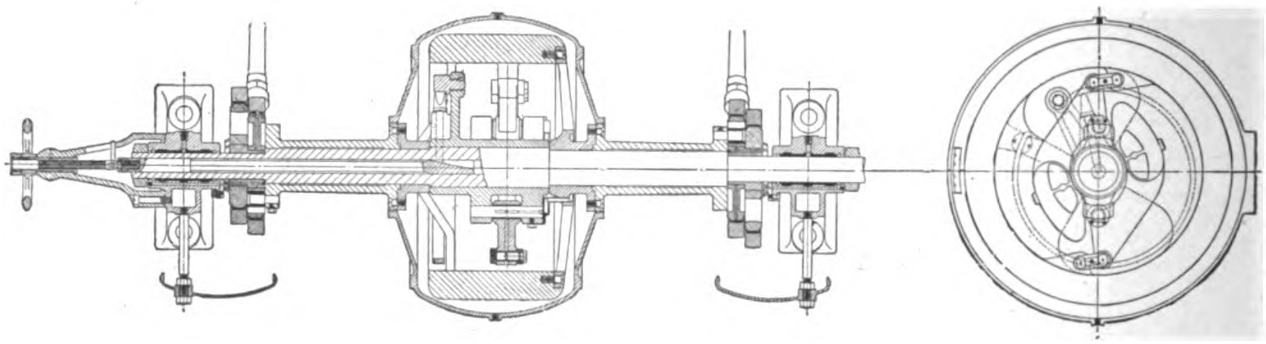

FIG. 4—THE LENTZ GOVERNOR

energy of motion as soon as the slightest change of load (and consequently of speed) occurs. As the inertia forces and the centrifugal forces act in the same sense, their combination produces a governor of a very sensitive and instantaneous action.

It is possible to change the speed of the engine while in motion by means of a radial pin which presses against the governor spring and changes its tension. This pin is moved by means of a shaft and hand wheel at the end of the lay shaft.

Extensive tests have been carried out on a Lentz simple engine having a 15-in. diameter cylinder and 21-in. stroke. This engine showed a steam consumption of 19.2 lb. per I.H.P. per hour with an average steam pressure of 145 lb. gage, an average superheat of 47 deg. F., and a back pressure exhaust of 2 lb. This performance gives a Rankine efficiency of practically 76 per cent.

A tandem compound engine carefully tested gave the following results. The first test with saturated steam, 170 lb. gage boiler pressure, and 26 in. vacuum, gave 366 I.H.P. with a steam consumption of 12.3 lb. per I.H.P.-hour. The second test, with the same conditions as before but with superheated steam of 150 deg. F. showed a steam consumption of 10.4 lb. per I.H.P. per hour. These results were obtained from an entirely new engine within two days of first running.

The Lentz semi-fixed engine, a combination of an engine with boiler, superheater, condenser, air pump, feed-water heater and feed pump, is a compact, high-class and self-contained power plant which is extensively used in isolated plants in Europe and South America. On account of its compact arrangement and the absence of any piping and losses incurred by it, the economy of these engines is remarkable. Tests by Prof. Grassmann, of the Technical College of Carlsruhe, Germany, of a 200-H.P. unit showed a steam consumption of 7.4 lb. and a coal consumption of 0.92 lb. per B.H.P., figures which probably stand as world records. The mechanical efficiency of the engine was 93 per cent and the combined efficiency of boiler and superheater 82 per cent.

The Psychology of Management[1]--X

Teaching under Scientific Management (continued)

BY L. M. GILBRETH

Oftentimes the power to refrain from action is quite as much a sign of education and training as the power to react quickly from a sensation. Such conduct is called, in some cases, "steady nerves." The forming of right habits is a great aid toward these steady nerves. The man who knows that he is taught the right way, is able almost automatically to resist any suggestions which come to him to carry out wrong ways. So the man who is absolutely sure of his method will not be tempted to make those extra motions which, after all, are merely an exhibition in his hand of the vacillation that is going on in his brain, as to whether he really is handling an object in exactly the most efficient manner or not.

"The education of hand and muscle implies a corresponding training of reasoning and will; and the co-ordination of movements accompanies the co-ordination of thoughts."[90]

The standards of Scientific Management educate hand and muscle; the education of hand and muscle trains the mind; the mind improves the standards. Thus we have a complete cycle.

Judgment Results with No Waste of Time.—Judgment is the outcome of learning the right way, and knowing that it is the right way. There is none of the lost time of "trying out" various methods that exists under Traditional Management. This power of judgment will not only enable the possessor to decide correctly as to the relative merits of differ-

[1]Copyright, 1913, by L. M. Gilbreth.

[90]M. W. Calkins, "A First Book in Psychology," p. 354.

ent methods, but also somewhat as to the past history and possibilities of different workers.

This, again, illustrates the wisdom of Scientific Management in promoting from the ranks, and thus providing that every member of the organization shall, ultimately, know from experience how to estimate and judge the work of others.

Habits of Attention Formed by Scientific Management.—The good habits which result from teaching standard methods result in habits of attention. The standards aid the mind in holding a "selective attitude,"[91] by presenting events in an orderly sequence. The conditions under which the work is done, and the incentives for doing it, provide that the attention shall be "lively and prolonged."

The Instruction Card Creates and Holds Attention.—As has been already said in describing the instruction card under Standardization, it was designed—as a result of investigations as to what would best secure output—to attract and hold the attention.[92] Providing, as it does, all the directions that an experienced worker is likely to need, he can confine his attention solely to his work and his card, and usually, after the card is once studied, to his work alone. The close relations of the elements of the instruction card afford a field for attention to lapse and be recalled in the new elements that are constantly made apparent.

Oral Individual Teaching Fosters Concentrated Attention.—The fact that under Scientific Management oral teaching is individual not only directly concentrates the attention of the learner upon what he is being taught, but also indirectly prevents distraction from fear of ridicule of others over the question, or embarrassment in talking before a crowd.

The Bulletin Board Furnishes the Element of Change.—In order that interest or attention may be held, there must be provision for allied subjects on which the mind is to wander. This, under Scientific Management, is constantly furnished by the collection of jobs ahead on the bulletin board. The tasks piled up ahead upon this bulletin board provide a needed and ready change for the subject of attention or interest, which conserves the economic value of concentrated attention of the worker upon his work. Such future tasks furnish a sufficient range of subjects for wandering attention to rest the mind from the wearying effect of over-concentration, or forced attention. The assigned task of the future systematizes the stream of attention, and an orderly scheme of habits of thought is installed. When the scheme is an orderly shifting of attention, the mind is doing its best work, for without such a definite orderly scheme for shifting the attention and interest, the attention will shift to useless subjects and the result will be scattered.

Incentives Maintain Interest.—The knowledge that a prompt reward will follow success, stimulates interest. The knowledge that this reward is sure, concentrates attention and thus maintains interest.

In the same way, the assurance of promotion, and the fact that the worker sees those of his own trade promoted, and knows it is to the advantage of the management, as well as to his advantage, that he also be promoted, also maintains interest in the work. The interest is extended to the work of others, not only by the interrelated bonuses, but also by the fact that every man is expected to train up a man to take his place before he is promoted.

Close Relationship of All Parts of Scientific Management Holds Interest.—The attention of the entire organization, as well as of the individual worker, is held by Scientific Management and its teaching because all parts of Scientific Management are related, and because Scientific Management provides for scientifically directed progression. Every member of the organization knows that the standards which are taught by Scientific Management contain the permanent elements of past successes, and provide for such development as will assure progress and success in the future. Every member of the organization realizes that upon his individual co-operation depends, in part, the stability of Scientific Management, because it is based on universal co-operation. This provides an intensity and a continuity of interest that would still hold, even though some particular element might lose its interest.

Scientific Management Restricts Associations.—By its teaching of standard methods, Scientific Management restricts association, and thus gains in the speed with which associated ideas arise.[93] Insistence on causal sequence is a great aid. This is rendered by the systems which give the reasons and make the standard method easy to remember.

Scientific Management Presents Scientifically Derived Knowledge to the Memory.—Industrial memory is founded on experience, and that experience which is submitted by teaching under Scientific Management to the mind is in the form of scientifically derived standards. These furnish (*a*) data that are correct; (*b*) images that are an aid in acquiring new habits of forming efficient images; (*c*) standards of comparison, and constant demands for comparison; (*d*) such arrangements of elements that reasoning processes are stimulated; (*e*) conscious, efficient grouping; and (*f*) logical association of ideas.

Best Periods for Memorizing Utilized.—As for education of the memory, there is a wide difference of opinion among leading psychologists in regard to whether or not the memorizing faculty as a whole can be improved by training; but all agree that those things which are specially desired to be memorized can be learned more easily, and more quickly under some conditions than under others.

For example, there is a certain time of day, for each person, when the memory is more efficient than at other times. This is usually in the morning, but is not always so. The period when memorizing is easiest is taken advantage of, and, as far as possible, new methods and new instruction cards are passed out at that time when the worker is

[91] James Sully, "The Teacher's Handbook of Psychology," p. 119.

[92] Attracting the attention is largely a matter of appealing to what is known to interest; for example, to a known ambition.

[93] G. M. Stratton, "Experimental Psychology and Culture," p. 42.

naturally best fitted to remember what is to be done.

Individual Differences Respected.—It is a question that varies with different conditions whether the several instruction cards beyond the one he is working on shall be given to the worker ahead of time, that he may use his own judgment as to when is the best time to learn, or whether he shall have but one at a time, and concentrate on that. For certain dispositions, it is a great help to see a long line of work ahead. They enjoy getting the work done, and feeling that they are more or less ahead of record. Others become confused if they see too much ahead, and would rather attack but one problem at a time. This fundamental difference in types of mind should be taken advantage of when laying out material to be memorized.

Aid of Mnemonic Symbols to the Memory.—The mnemonic classifications furnish a place where the worker who remembers but little of a method or process can go and recover the full knowledge of that which he has forgotten. Better still, they furnish him the equivalent of memory of other experiences that he has never had, and that are in such form that he can connect this with his memory of his own personal experience.

The ease with which a learner or skilled mechanic can associate new, scientifically-derived data with his memory because of the classifications of Scientific Management, is a most important cause of workers being taught quicker and being more intelligent under Scientific Management than under any other type of management.

The results of cultivating the memory under Scientific Management are cumulative. Ultimately, right habits of remembering result that aid the worker automatically so to arrange his memory material as to utilize it better.[94]

Scientific Management Provides Material for Images.—As was shown under the discussion of the appeals of the various teaching devices of Scientific Management, provision is made for the four classes of imagination of Calkins:[95] (1) visual, (2) auditory, (3) tactual, and (4) mixed.

Scientific Management realizes that one of the special functions of teaching the trades is the systematic exercising and guiding of imaginations of apprentices and learners. As Prof. Ennis says, "Any kind of planning ahead will result in some good," but to plan ahead most effectively it is necessary to have a well-developed power of constructive imagination. This consists in being able to construct new mental images from old memory images; in being able to modify and group images of past experiences, or thoughts, in combination with new images based on imagination and not on experience. The excellence of the image arrived at in the complete work is dependent wholly upon the training in image-forming in the past. If there has not been a complete economic system of forming standard habits of thought, the worker may have difficulty in controlling the trend of associations of thought images, and difficulty in adding entirely new images to the groups of experienced images and the problem to be thought out will suffer from wandering of the mind. The result will be more like a dream than a well-balanced mental planning. It is well known that those apprentices—and journeymen as well—are the quickest to learn, and are better learners, who have the most vivid imagination. The best method of teaching the trade, therefore, is the one that also develops the power of imagination.

Scientific Management assists productive or constructive imagination by providing standard units or images from which the results may be synthesized. It also, through the unity of the instruction card, allows of imagination of the outcome from the start.

Judgment the Result of Faithful Endeavor.—Judgment, or the "mental process which ends in an affirmation or negation of something,"[96] comes as a result of experience, as is admirably expressed by Prof. James: "Let no youth have any anxiety about the upshot of his education, whatever the line of it may be. If he keep faithfully busy each hour of the working day, he may safely leave the final result to itself. He can with perfect certainty count on waking up some fine morning to find himself one of the competent ones of his generation in whatever pursuit he may have singled out. Silently, between all the details of his business, the *power of judging* in all that class of matter will have built itself up within him as a possession that will never pass away. Young people should know this truth in advance. The ignorance of it has probably engendered more discouragement and faint-heartedness in youths embarking on arduous careers than all other causes put together."[97]

Under Scientific Management this judgment is the result of teaching of standards that are recognized as such by the learner. Thus much time is eliminated, and the apprentice under Scientific Management can work with all the assurance as to the value of his methods that characterized the seasoned veterans of older types of management.

The judgment that is supplied by Scientific Management is also used as a spring toward action.[98] Scientific Management appeals to the reason, and workers perform work as they do because, through the Systems and otherwise, they are persuaded that the method they employ is the best.

The Power of Suggestion is Utilized.[99]—The dynamic power of ideas is recognized by Scientific Management in that the instruction card is put in the form of direct commands[100] which naturally lead to immediate action. So, also, the teaching—written, oral and objective, as such, can be directly imitated by the learner.[101]

The worker is expected to follow the suggestion of Scientific Management without delay, because he be-

[94] Wm. James, "Psychology" (Advanced Course), vol. i, p. 667.

[95] "A First Book in Psychology," p. 25.

[96] James Sully, "The Teacher's Handbook of Psychology," p. 290.

[97] "Psychology" (Briefer Course), p. 150.

[98] Compare W. D. Scott, "Influencing Men in Business," chap. ii.

[99] Ibid, chap. iii.

[100] W. D. Scott, "The Theory of Advertising," p. 71.

[101] W. D. Scott, "Increasing Human Efficiency in Business," p. 41.

lieves in the standardization on which it is made, and in the management that makes it. But the systems afford him an opportunity of reviewing the reasonableness of the suggestion at any time, and his constructive criticism is invited and rewarded.

The suggestion must be followed at the time it is given, or its value as a suggestion is impaired. This is provided for by the underlying idea of co-operation on which Scientific Management rests, which molds the mental attitude of the worker into that form where suggestions are quickest grasped and followed.[102]

"Native Reactions."—Prof. James enumerates the "native reactions" as (1) fear, (2) love, (3) curiosity, (4) imitation, (5) emulation, (6) ambition, (7) pugnacity, (8) pride, (9) ownership, (10) constructiveness.[103] These are all considered by Scientific Management. Such as might have a harmful effect are supplanted, others are utilized.

The native reaction most utilized by the first managers of armies and ancient works of construction was that of fear. This is shown by the ancient rock carvings, which portray what happened to those who disobeyed.[104]

Fear of personal bodily injury is not usual under modern Traditional Management, but fear of less progress, less promotion, less remuneration, or of discharge, or of other penalties for inferior effort or efficiency, is still prevalent.

Under Scientific Management the worker may still fear that he will incur a penalty, or fail to deserve a reward, but the honest, industrious worker experiences no such horror as the old-time fear included. This is removed by his knowledge (1) that his task is achievable, (2) that his work will not injure his health, (3) that he may be sure of advancement with age and experience, and (4) that he is sure of the "square deal." Thus such fear as he has, has a good and not an evil effect upon him. It is an incentive to co-operate willingly. Its immediate and ultimate effects are advantageous.

Love or Loyalty.—The worker's knowledge that the management plans to maintain such conditions as will enable him to have the four assurances enumerated above leads to love, or loyalty, between the workers and employers.[105] Far from Scientific Management abolishing the old personal and sympathetic relations between employers and workers, it gives opportunities for such relations as have not existed since the days of the guilds and the old apprenticeship.[106]

Mr. Wilfred Lewis, in describing the installation of Scientific Management in his plant, says: "We had, in effect, been installing at great expense a new and wonderful means for increasing the efficiency of labor, in the benefits of which the workman himself shared, and we have today an organization second I believe to none in its loyalty, efficiency and steadfastness of purpose."[107] This same loyalty of the workers is plain in an article in INDUSTRIAL ENGINEERING on "Scientific Management as Viewed from the Workman's Standpoint," where various men in a shop having Scientific Management were interviewed.[108] After quoting various workers' opinions of Scientific Management and their own particular shop, the writer says: "Conversations with other men brought out practically the same facts. They are all contented. They took pride in their work, and seemed to be especially proud of the fact that they were employed in the Link-Belt shops."[109]

The manner of teaching under Scientific Management fosters such loyalty. Only through friendly aid can both teacher and taught prosper. Also, the perfection of the actual workings of this plan of management inspires regard as well as respect for the employer.

Curiosity.—Scientific Management arouses the curiosity of the worker by showing, through its teaching, glimpses of the possibilities that exist for further scientific investigation. The insistence on standard methods of less waste arouses a curiosity as to whether still less wasteful methods cannot be found.

This curiosity is useful as a trait of the learner, the planner and the investigator. It can be well utilized by the teacher who recognizes it in the learner, by an adaptation of methods of interpreting the instruction card that will allow of partially satisfying, and at the same time further exciting, the curiosity.

In selecting men for higher positions and for special work, curiosity as to the work, with the interest that is its result, may serve as an admirable indication of one sort of fitness. This curiosity, or general interest, is usually associated with a personal interest that makes it more intense and more easy to utilize.

Imitation.—It was a popular custom of the past to look down with scorn on the individual or organization that imitated others. Scientific Management believes that to imitate, with great precision, the best, is a work of high intelligence and industrial efficiency.

Teaching under Scientific Management induces both spontaneous and deliberate imitation. The standardization prevalent, and the conformity to standards exacted, provide that this imitation shall follow directed lines.

Under Scientific Management the worker will spontaneously imitate the teacher when the latter has been demonstrating. This leads to desired results. So, also, the worker imitates, more or less spontaneously, his own past methods of doing work. The right habits early formed by Scientific Management insure that the results of such imitation shall be profitable. Deliberate imitation is caused more than anything else by the fact that the man knows if he does the thing in the way directed his pay will be increased.

Such imitation is also encouraged by the fact that the worker is made to believe that he is capable, and has the will to overcome obstacles. He knows that the management believes

[102]F. W. Taylor, "The Principles of Scientific Management," p. 26.

[103]"Talks to Teachers," chap. vii.

[104]Knight's "Mechanical Dictionary," vol. iii, p. 2204.

[105]For examples see W. D. Scott, "Increasing Efficiency in Business," chap. iv.

[106]R. A. Bray, "Boy Labor and Apprenticeship," chap. ii, and especially p. 8.

[107]Wilfred Lewis, "Proceedings of the Congress of Technology, 1911." p. 175.

[108]INDUSTRIAL ENGINEERING, November, 1910, p. 377.

[109]The Link-Belt Co., Philadelphia, Pa.

he can do the work, or the instruction card would not have been issued to him. Moreover, he sees that the teacher and demonstrator is a man promoted from his rank, and he is convinced, therefore, that what the teacher can do he also can do.[110]

It is of immense value in obtaining valuable results from imitation that Scientific Management provides standards. Under Traditional Management, it was almost impossible for a worker to decide which man he should imitate. Even though he might come to determine, by constant observation, after a time which man he desired to imitate, he would not know in how far he would do well to copy any particular method. Recording individually measured outputs under Transitory Management allows of determining the man of high score, and either using him as a model or formulating his method into rules. Under Scientific Management the instruction card furnishes a method which the worker knows that he can imitate exactly with predetermined results.

Imitation, as provided for by teaching under Scientific Management, and the admiration for the skillful teacher or the standard imitated naturally stimulate emulation. This emulation takes three forms: 1. Competition with the records of others; 2. Competition with one's own record; and 3. Competition with the standard record.

Ambition is Aroused.—The outcome of emulation is ambition. This ambition is stimulated by the fact that promotion is so rapid, and so outlined before the worker, that he sees the chance for advancement himself, and not only advancement that means more pay, but advancement also that means a chance to specialize on that work which he particularly likes.

Pugnacity.—Pugnacity can never be entirely absent where there is emulation. Under Scientific Management it is used to overcome not persons, but things. Pugnacity is a great driving force. It is a wonderful thing that under Scientific Management this force is aroused not against one's fellow-workers, but against one's work. The desire to win is aroused against a large task, which the man desires to put behind him. Moreover, there is nothing under Scientific Management which forbids an athletic contest. While the workers would not, under the ultimate form, be allowed to injure themselves by overspeeding, a friendly race with a demonstration of pugnacity which harms no one is not frowned upon.

Pride.—Pride in one's works is aroused as soon as work is functionalized. The moment a man has something to do that he likes to do, and can do well, he takes pride in it. So, also, the fact that individuality and personality are recognized, and that his records are shown, makes pride serve as a stimulus. The outcome of the worker's pride in his work is pride in himself. He finds that he is a part of a great whole, and he learns to take pride in the entire management—in both himself and the managers, as well as in his own work.

Ownership.—It may seem at first glance that the instinct of ownership is neglected and becomes stunted under Scientific Management, in that all tools become more or less standardized and the man is discouraged from having tools peculiar in shape or size, for whose use he has no warrant except long familiarity.

Careful consideration shows that Scientific Management provides two opportunities for the worker to conserve his instinct for ownership: (1) During working hours, where the recognition of his personality allows the worker to identify himself with his work, and where his co-operation with the management makes him identified with its activities; (2) Outside the work. He has, under Scientific Management, more hours away from work to enjoy ownership, and more money with which to acquire those things that he desires to own.

The teacher must make clear to him both these opportunities, as he readily can, since the instinct of ownership is conserved in him in an identical manner.

Constructiveness.—Every act that the worker performs is constructive, because waste has been eliminated, and everything that is done is upbuilding. Teaching makes this clear to the worker. Constructiveness is also utilized in that exercise of initiative is provided for. Thus the instinct, instead of being weakened, is strengthened and directed.

Importance of Training the Will.—The most necessary and most complex and difficult part of Scientific Management is the training of the will of all members of the organization. Prof. Read states in his Psychology five means of training or influencing the will. These are:[111] "1. The help furnished by supplying the mind with a useful body of ideas; 2. The building up in the mind of the proper interests, and the habit of giving the attention to useful and worthy purposes; 3. The establishment of a firm association between ideas and actions, that is, the formation of a good set of habits; 4. The strength of purpose or power of imitation; 5. The matter of discipline."

Teaching under Scientific Management does supply these five functions and thus provides for the strengthening and development of the will.

Apprentices are Easily Handled.—Teaching apprentices is a comparatively simple proposition, far simpler than under any other type of management. Standard methods enable the apprentice to become proficient long before his brother under the old type of teaching could. The length of training required depends largely on how fingerwise the apprentice is.

Older Workers Must Be Handled With Tact.—With adult workers the problem is not so simple. Old wrong habits, such as the use of ineffective motions, must be eliminated. Physically, it is difficult for the adult worker to alter his methods. Moreover, it may be most difficult to change his mental attitude, to convince him that the methods of Scientific Management are correct. A

(Continued on page 76.)

110 Compare with the elderly colored woman who took her sons from a northern school, where the teacher was white, in order to send them to a southern school having a colored teacher, that they might feel, as they looked at him, "What *that* nigger can do *this* nigger can do."

111 "An Introductory Psychology," pp. 297-303.

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Incentives

BY L. M. GILBRETH

Definition of Incentive.—An "incentive" is "that which moves the mind or stirs the passions; that which incites or tends to incite to action; motive, spur."[112]

Importance of the Incentive.—The part that incentive plays in the doing of all work is enormous. This is true in learning, and also in the performance of work which is the result of this learning; manual work, and mental work as well. The business man finishes his work early that he may go to the baseball game; the boy at school rushes through his arithmetic that he may not be kept after school; the size of the pieceworker's pay depends upon the quantity and quality he can produce. These all illustrate the importance of the incentive as an element in the amount which is to be accomplished.

Two Kinds of Incentives.—The incentive may be of two kinds: (1) It may be a return, definite or indefinite, which is to be received when a certain portion of the work is done; (2) It may be an incentive due to the working conditions themselves.

For example: Two persons engaged in the same sort of work, start a race to see who can accomplish the most in the shortest space of time, or who can produce the best quality. The incentive may be in the form of some definite aim or goal which is understood by the worker himself, or it may be in some natural instinct which is roused by the work, either consciously to the worker, consciously to the man who is assigning the work, consciously to both, or consciously to neither one. In any of these cases it is a natural instinct that is being appealed to, and that induces the man to do more work, whether he sees any material reward for that work or not.

Definitions of Two Types.—We may call the incentive which utilizes the natural instinct, "direct incentive," and the incentive which utilizes this secondarily, through some set reward or punishment "indirect incentive." This, at first sight, may seem a contradictory use of terms—it may seem that the reward would be the most direct of incentives; yet a moment's thought will cause one to realize that all the reward can possibly do is to arouse in the individual a natural instinct which will lead him to increase his work.

The indirect incentives divide themselves into two classes, reward and punishment.

Reward and Punishment.—A reward is a "return, recompense, the fruit of one's labor or works; profit," with synonyms, "pay, compensation, remuneration, requital and retribution." [112] Note particularly the word "retribution," for it is this aspect of reward, that is, the just outcome of one's act, that makes the reward justly include punishment. The word "reward" exactly expresses what management would wish to be understood by the incentive that it gives to its men to increase their work.

"Punishment" is "pain, suffering, loss, confinement, or other penalty inflicted on a person for a crime or offense by the authority to which the offender is subject," with synonyms, "chastisement, correction, discipline."[112]

The word punishment is most unfortunate when applied to what Scientific Management would mean by a penalty, though this word also is unfortunate. There is, however, no better word to cover the general meaning. Furthermore, the idea of pain and suffering, which Scientific Management aims to and does eliminate, is present in some of the older forms of management. Therefore the word punishment must stand.

There can be no doubt that a reward is an incentive. There may well be doubt as to whether a punishment is an incentive to action or not. To be active is certainly the opposite of being at rest. This being true, punishment is just as surely an incentive to action as is reward. The man who is punished, in every case will be led to some sort of action. Whether this really results in an increase of output or not, simple determines whether the punishment is a scientifically prescribed punishment or not. If the punishment is of such a nature that the output ceases because of it, or that it incites the man punished against the general good, then it does not in any wise cease to be an active thing, but it is simply a wrong and unscientifically assigned punishment, that acts in a detrimental way.

Soldiering Alone Cuts Down Activity.—It is interesting to note that the greatest cause for cutting down output is related more closely to a reward than a punishment. Under such managements as provide no adequate reward for all, and no adequate assurance that all can receive extra rewards permanently without a cut in the rate, it may be advisable for the worker's best interests to limit output in order to keep the wages up, and soldiering results. It is plain, however, that soldiering here is the result of a cutting down of action, and it is self-evident that anything which cuts down action is harmful, not only to the individual himself, but to society at large.

Nature of Rewards and Punishments. Under all types of management, the principal rewards consist of promotion and pay, pay being a broad word used here to include regular wages, a bonus, shorter hours, other forms of remuneration or recompense; anything which can be given to the man who does the work to benefit him and increase his desire to continue doing the work. Punishments may be negative, that is, they may simply take the form of no reward; or they may be positive, that is, they may include fines, discharge, assignment to less remuner-

1 Copyright, 1913, by L. M. Gilbreth.
112 Century Dictionary.

ative or less desirable work, or any other thing which can be given to the man to show him that he has not done what is expected of him and, in theory at least, to lead him to do better.

Nature of Direct Incentives.—Direct incentives will be such native reactions as ambition, pride and pugnacity; will be love of racing, love of play, love of personal recognition; will be the outcome of self-confidence and interest.

The Reward Under Traditional Management Unstandardized.—As with all other discussions of any part or form of Traditional Management, the discussion of the incentive under Traditional Management is vague from the very nature of the subject. "Traditional" stands for vagueness and for variation, for the lack of standardization, for the lack of definiteness in knowledge, in process, in results. The rewards under Traditional Management, as under all types of management, are promotion and pay. It would be an almost unthinkably poor system of management, even under Traditional Management, which did not attempt to provide for some sort of promotion of the man who did the most and best work; but the lack of standardization of conditions, of instructions, of the work itself, and of reward, makes it almost impossible not only to give the reward, but even to determine who deserves the reward. Under Traditional Management, the reward need not be positive, that is, it might simply consist in the negation of some previously existing disadvantage. It need not be predetermined. It might be nothing definite. It might not be so set ahead that the man might look forward to it. In other words, it might simply be the outcome of the good, and in nowise the incentive for the good. It need not necessarily be personal. It could be shared with a group, or gang, and lose all feeling of personality. It need not be a fixed reward or a fixed performance; in fact, if the management were Traditional, it would be almost impossible that it would be a fixed reward. It might not be an assured reward, and in most cases it is not a prompt reward. These fixed adjectives describe the reward of Scientific Management—positive, predetermined, personal, fixed, assured and prompt. A few of these, or none, might apply to the reward under Traditional Management.

Reward a Prize Won by One Only.—If this reward of promotion or pay was given to some one under Traditional Management, it usually meant that others thereby lost it; it was in the nature of a prize which one only could attain, and which the others, therefore, would lose, and such a lost prize is, to the average man, for the time at least, a dampener on action. The rewarding of the winner, to the loss of all of the losers, has been met by the workmen getting together secretly, and selecting the winners for a week or more ahead, thus getting the same reward out of the employer without the extra effort.

Punishment Under Traditional Management Wrong in Theory.—The punishment, under Traditional Management, was usually much more than negative punishment; that is to say, the man who was punished usually received much more than simply the negative return of getting no reward. To-day, under Traditional Management, punishment consists of: (1) Fines, which are usually cutting down of wages, the part deducted remaining with the company; (2) Discharge; (3) Assignment to less pleasant or less desirable work. This assignment is done on an unscientific basis, the man being simply put at something which he dislikes, with no regard as to whether his efficiency at that particular work will be high.

Results Are Unfortunate. The punishment, under Traditional Management, usually is meted out by the foreman, as one of his many duties. He is apt to be so personally interested, and perhaps involved in the case, that his punishment will satisfy some wrong notions, impulse of anger, hate, or envy in him, and will arouse a feeling of shame, wounded pride, or unappreciation, in the man to whom punishment is given.

Direct Incentives Not Scientifically Utilized.—As for what we have called direct incentive, the love of racing was often used under Traditional Management through athletic contests. The faults in these were that the men were not properly studied, so that they could be properly assigned and grouped; care was not always exercised that hate should not be the result of the contest; the contest was not always conducted according to the rules of clean sport; the men slighted quality in hastening the work, and the results of the athletic contests were not so written down as to be thereafter utilized. Love of play may have been developed unconsciously, but it was not often studied. Love of personal recognition was probably often utilized, but not scientifically. Neither was there anything in Traditional Management to develop self-confidence, or to arouse and maintain interest in any set fashion. Naturally, if the man were in a work which he particularly liked, which under Traditional Management was a matter of luck, he would be more or less interested in it, but there was no scientific way of arousing or holding his interest. Under Traditional Management, a man might take pride in his work, as did many of the old bricklayers and masons, who would set themselves apart, after hours if necessary, lock themselves in, and cut bricks for a complicated arch or fancy pattern; but such pride was in no was fostered through the efforts of the management.

Pugnacity was aroused, but it might have an evil effect as well as a good, so far as the management had any control. Ambition, in the same way, might be stimulated, and might not. There is absolutely nothing under Traditional Management to prevent a man being ambitious, gratifying his pride, and gratifying his pugnacity in a right way, and at the same time being interested in his work. There was nothing, however, under Traditional Management which provided for definite and exact methods for encouraging these good qualities, seeing that they developed in a proper channel, and which provided for scientifically utilizing the outcome again and again.

Pay for Performance Provided For by Transitory Management.—Under Transitory Management, as soon as practicable, one bonus is paid for doing work according to the method prescribed. As standardization takes place, the second bonus for completing the task in the time set can be paid. As each element of Scientific Management is introduced, incentives become more apparent, more powerful, and more assured.

Direct Incentives More Skillfully Used.—With the separating of output and the recording of output separately, love of personal recognition grows, self-confidence grows, interest in one's work grows. The athletic contest is so conducted that love of speed, love of play, and love of competition are encouraged; the worker constantly feels that he can indulge in these, as he is assured of "fair play."

Incentives Under Scientific Management Constructive.—Psychologically and ethically, it is most important that it be understood that Scientific Management is not in any sense a destructive power. Only that is eliminated which is harmful, or wasteful, or futile; everything that is good is conserved, and is utilized as much as it has ever been used before, often much more than it has ever been utilized. The constructive force, under Scientific Management, is one of its great life principles. This is brought out very plainly in considering incentives under Scientific Management. With the scientifically determined wage, and the more direct and more sure plan of promotion, comes no discarding of the well-grounded incentives of the older types of management. The value of a fine personality in all who are to be imitated is not forgotten, the importance of using all natural stimuli to healthful activity is appreciated. Scientific Management uses all these, in so far as they can be used to the best outcome for workers and work, and supplements them by such scientifically derived additions as could never have been discovered under the older types.

Characteristics of the Reward—Rewards, under Scientific Management are:

(*a*) Positive; that is, the reward must be a definite, positive gain to the man, and not simply a taking away of some thing which may have been a drawback.

(*b*) Predetermined; that is, before the man begins to work it must be determined exactly what reward he is to get for doing the work.

(*c*) Personal; that is, individual, a reward for that particular man for that particular work.

(*d*) Fixed, unchanged. He must get exactly what it has been determined beforehand that he shall get.

(*e*) Assured; provision must be made for this reward before the man begins to work, so that he may be positive that he will get the reward if he does the work. The record of the organization must be that rewards have always been paid in the past, therefore probably will be in the future.

(*f*) The reward must be prompt; as soon as the work has been done, the man must get the reward. This promptness applies to the announcement and the receipt of the reward. The man must know at once that he has earned the reward.

Positive Reward Arouses Interest and Holds Attention.—The benefit of the positive reward is that it arouses and holds attention. A fine example of a reward that is not positive is that type of "welfare work" which consists of simply providing the worker with such surroundings as will enable him to work decently and without actual discomfort. The worker, naturally, feels that such surroundings are his right, and in no sense a reward and incentive to added activity. The reward must actually offer to the worker something which he has a right to expect only if he earns it; something which will be a positive addition to his life.

The predetermined reward allows both manager and man to concentrate their minds upon the work. There is no shifting of the attention while the worker wonders what the reward that he is to receive will be. It is also a strong factor for industrial peace, and for all the extra activities which will come when industrial conditions are peaceful.

The personal reward is a strong incentive toward initiative, towards the desire to make the most of one's individuality. It is an aid toward the feeling of personal recognition. From this personal reward come all the benefits which have been considered under individuality.[113]

The fact that the reward is fixed is a great eliminator of waste, both to the man and to the manager. Not only does the man concentrate better under the fixed reward, but the reward, being fixed, need not constantly be redetermined.

The assured reward leads to concentration, even perhaps more so than the fact that the reward is determined. In case the man was not sure that in the end he would get the reward, he would naturally spend a great deal of time wondering whether he would or not. Moreover, no immediate good fortune counts for much as an incentive if there is a prospect of bad luck following in the immediate future.

Need for Promptness Varies.—The need for promptness of the reward varies. If the reward is to be given to a man of an elementary type of mind, the reward must be immediately announced and must be actually given very promptly, as it is impossible for anyone of such a type of intellect to look forward very far.[114] A man of a high type of intellectual development is able to wait a longer time for his reward, and the element of promptness, while acting somewhat as an incentive, is not so necessary.

Under Scientific Management, with the ordinary type of worker on manual work, it has been found most satisfactory to pay the reward every day, or at the end of the week, and to announce the score of output as often as every hour. This not only satisfies the longing of the normal mind to know exactly where it stands, but also lends a fresh impetus to repeat the high record. There is also, through the prompt

113 H. P. Gillette, "Cost Analysis Engineering," p. 3.

114 F. W. Taylor, A. S. M. E. Paper No. 647, ¶¶ 33 and 59.

reward, the elimination of time wasted in wondering what the result will be, and in allaying suspense. Suspense is not a stimulus to greater activity, as anyone who has waited for the result of a doubtful examination can testify, it being almost impossible to concentrate the mind on any other work until one knows whether the work which has been done has been completed satisfactorily or not.

There are many kinds of life work and modes of living so terrible as to make one shudder at the thoughts of the certain sickness, death, or disaster that are almost absolutely sure to follow such a vocation. Men continue to work for those wages that lead positively to certain death, because of the immediateness of the sufficient wages, or reward. This takes their attention from their ultimate end. Much more money would be required if payment were postponed, say, five years after the act, to obtain the services of the airman, or the worker subject to the poisoning of some branches of the lead and mercury industries.

If the prompt reward is incentive enough to make men forget danger and threatened death, how much more efficient is it in increasing output where there is no such danger!

There are cases where the prompt reward is not to be preferred, because the delayed reward will be greater, or will be available to more people. Such is the case with the reward that comes from unrestricted output.

For example, the immediacy of the temporarily increased reward caused by restricting output has often led the combinations of working men to such restriction, with an ultimate loss of reward to worker, to employer, and to the consumer.

Rewards Possible of Attainment by All.—Every man working under Scientific Management has a chance to win a reward. This means not only that the man has a "square deal", for the man may have a square deal under Traditional Management in that he may have a fair chance to try for all existing rewards. Under Scientific Management there is more than this. By the very nature of the plan the rewards are possible of achievement by all; any one man, by winning, in no way diminishes the chances of the others.

Rewards of Management Resemble Rewards of Workers.—So far the emphasis, in the discussion of reward, has been on the reward as given to the worker, and his feeling toward it. The reward to the management is just as sure. It lies in the increased output, and therefore the possibility of lower costs and of greater financial gain. It is as positive; it is as predetermined, because before the reward to the men is fixed the management realizes what proportion that reward will bear to the entire undertaking, and exactly what profits can be obtained. It is a fundamental of Scientific Management that the management shall be able to prophesy the outputs ahead. It will certainly be as personal, if the management side is as thoroughly systematized as is the managed; it will be as fixed and as assured, and it certainly is as prompt, as the cost records can be arranged to come to the management every day, if that is desired.

Results of Such Rewards.—There are three other advantages to management which might well be added here. First, that a reward such as this attracts the best men to the work; second, that the reward, and the stability of it, indicates the stability of the entire institution, and thus raises its standing in the eyes of the community as well as in its own eyes; and third, that it leads the entire organization, both managed and managing, to look favorably at all standardization. The standardized reward is sure to be attractive to all. As soon as it is realized that the reason that it is attractive is because it is *standardized*, the entire subject of standardization rises in the estimation of every one, and the introduction of standards can be carried on more rapidly, and with greater success.

Rewards may be divided into (1) promotion, and (2) pay. Under Scientific Management promotion is assured for every man, and, as has been said, this promotion does not thereby hold back others from having the same sort of promotion. There is an ample place, under Scientific Management, for every man to advance.[115] Not only is the promotion sure, thus giving the man absolute assurance that he will advance as his work is satisfactory, but it is also gradual.[116] The promotion must be by degrees, otherwise the workers may get discouraged from finding their promotion has come faster than has their ability to achieve, and the lack of attention, due to being discouraged, may be contagious. It is therefore of vital importance that the worker be properly selected, in order that, in his advancement and promotion, he shall be able to achieve his task after having been put at the new work. He must be advanced and promoted in a definite line of gradual development, in accordance with a fully preconceived plan. This plan should be definitely worked out and set down in writing, similar to the plan on the instruction card of one of his tasks.

Promotion May Be to Places Within or Without the Business.—In many lines of business, the business itself offers ample opportunity for promoting all men who can "make good" as rapidly as they can prepare themselves to positions over others, and to advancement; but under Scientific Management provision is made even in case the business does not offer such opportunities.[117] This is done by the management finding places outside their own organization for the men who are so trained that they can be advanced.

While at first glance it might seem a most unfortunate thing for the management to have to let its men go, and while, as Dr. Taylor says, it is unfortunate for a business to get the reputation of being nothing but a training school, on the other hand, it has salutary effect upon the men to know that their employers are so disinterestedly interested in them that they will provide for the

(Continued on page 121.)

115 Hugo Diemer, "Factory Organization and Administration," p. 5.

116 James M. Dodge, A. S. M. E. Paper No. 1115, p. 723.

117 F. W. Taylor, 'Shop Management."

The Psychology of Management[1]--XII

Incentives (continued)

BY L. M. GILBRETH

Subdivisions of "Pay".—Under "Pay" we have included eight headings: (1) Wages; (2) Bonus; (3) Shorter hours; (4) Prizes other than money; (5) Extra knowledge; (6) Method of attack; (7) Good opinion of others; and (8) Professional standing.

Relation Between Wages and Bonus.—Wages and bonus are closely related. By wages we mean a fixed sum, or minimum hourly rate, that the man gets in any case for his time, and by bonus we mean additional money that he receives for achievement of method, quantity or quality. Both might very properly be included under wages, or under money received for the work, or opportunities for receiving money for work, as the case might be. In the discussion of the different ways of paying wages under Scientific Management, there will be no attempt to discuss the economic value of the various means; the different methods will be simply stated, and their psychological significance will be, as far as possible, given.

Before discussing the various kinds of wages advised by the experts in Scientific Management, it is well to pause a moment to name the various sorts of methods of compensation recognized by authorities. David F. Schloss, in his "Method of Industrial Remuneration," divides all possible ways of gaining remuneration into the following three classes:

(1) The different kinds of wages: (*a*) time wage; (*b*) piece wage; (*c*) task wage; (*d*) progressive wage; (*e*) collective piece wage; (*f*) collective task wage; (*g*) collective progressive wage; (*h*) contract work; and (*i*) co-operative work.

(2) Profit sharing.

(3) Industrial co-operation.

It is only necessary to quote him here as to the relationship between these different forms, where he says (p. 11), "The two leading forms of industrial remuneration under the Wages system are time wages, and piece wages. Intermediate between these principal forms, stands that known as task wage, while supplemental to these two named methods, we find those various systems which will here be designated by the name of Progressive Wages."[118-119]

Day Work Never Scientific.—"The simplest of all systems," says Dr. Taylor in "A Piece Rate System" (¶10), while discussing the various forms of compensation, "is the Day Work plan, in which the employees are divided into certain classes, and a standard rate of wages is paid to each class of men." He adds: "The men are paid according to the position which they fill, and not according to their individual character, energy, skill and reliability." The psychological objection to day work is that it does not arouse interest or effort or hold attention, nor does it inspire to memorizing or to learning.

It will be apparent that there is no inducement whatever for the man to do more than just enough to retain his job, for he in no wise shares in the reward for an extra effort, which goes entirely to his employer. "Reward," in this case, is usually simply a living wage—enough to inspire the man if he needs the money enough to work to hold his position, but not enough to incite him to any extra effort.

It is true that, in actual practice, through the foreman or some man in authority, the workers on day work may be "speeded up" to a point where they will do a great deal of work; the foreman being inspired, of course, by a reward for the extra output, but, as Dr. Taylor says (¶17, "A Piece Rate System"), this sort of speeding up is absolutely lacking in self-sustaining power. The moment that this rewarded foreman is removed, the rate of work will again fall down. Therefore, day wage has almost no place in ultimate, scientifically managed work.

Piece Work Provides Pay in Proportion to Work Done.—Piece Work is the opposite of time work, in that under it the man is paid, not for the time he spends at the work, but for the amount of work which he accomplishes. Under this system, as long as the man is paid a proper piece rate and a rate high enough to keep him interested, he will have great inducements to work. He will have a chance for individuality, a chance for competition, a chance for personal recognition. His love of reasonable racing will be cultivated. His love of play may be cultivated.

All of these incentives arise because the man feels that his sense of justice is being considered; that if the task is properly laid out, and the price per piece is properly determined, he is given a "square deal" in being allowed to accomplish as great an amount of work as he can, with the assurance that his reward will promptly come to him.

Piece work becomes objectionable only when the rate is cut. The moment the rate is cut the first time, the man begins to wonder whether it is going to be cut again, and his attention is distracted from the work by his debating this question constantly. At best, his attention wanders from one subject to the other, and back again. It cannot be concentrated on his work. After the rate has been cut once or twice—and it is sure to be cut unless it has been set from scientifically derived elementary time units—the man loses his entire confidence in the

1 Copyright, 1913, by L. M. Gilbreth.

118 See also C. U. Carpenter, "Profit Making in Shop and Factory Management," pp. 113-115.

119 For an extended and excellent account of the theory of well-known methods of compensating workmen, see C. B. Going, "Principles of Industrial Engineering," chap. viii.

stability of the rate, and, naturally, when he loses this confidence, his work is done more slowly, due to lack of further enthusiasm. On the contrary, as long as it is to his advantage to do the work and he is sure that his reward will be prompt, and that he will always get the price that has been determined as right by him and by the employers for his work, he can do this work easily in the time set. As soon as he feels that he will not get it, he will naturally begin to do less, as it will be not only to his personal advantage to do as little as possible, but also very much to the advantage of his fellows, for whom the rate will also be cut.

Task Wage Contains No Incentive to Additional Work.—What Schloss calls the Task Wage would, as he well says, be the intermediate between time or day wage and piece wage; that is, it would be the assigning of a definite amount of work to be done in definite time, and to be paid for by a definite sum. If the task were set scientifically, and the time scientifically determined, as it must naturally be for a scientific task, and the wage adequate for that work, there would seem to be nothing about this form of remuneration which could be a cause of dissatisfaction to the worker. Naturally, however, there would be absolutely no chance for him to desire to go any faster than the time set, or to accomplish any more work in the time set than that which he was obliged to, in that he could not possibly get anything for the extra work done.

Worth of Previous Methods in the Handling.—It will be noted in the discussion of the three types of compensation so far discussed, that there is nothing in them that renders them unscientific. Any one of the three may be used, and doubtless all are used in works which are attempting to operate under Scientific Management. Whether they really are scientific methods of compensation or not, is determined by the way that they are handled. Certainly, however, all that any of these three can expect to do is to convince the man that he is being treated justly. If he knows what sort of a contract he is entering into, the contract is perfectly fair, provided that the management keeps its part of the contract and pays the agreed wage.

In proceeding, instead of following the order of Schloss, we will follow the order, at least for a time, of Dr. Taylor in "A Piece Rate System"; this for two reasons: first, for the reason that "A Piece Rate System" is later than Schloss's book; in the second place, we are following the Scientific Management side, in distinction to the general economic side laid down by Schloss.

The Gain Sharing Plan.—The Gain Sharing Plan was invented by Mr. Henry R. Towne, and used by him with success in the Yale & Towne works. This is described in Paper No. 341, read before the American Society of Mechanical Engineers in 1888, and also in the "Premium Plan," Mr. Halsey's modification of gain sharing, described by him in Paper No. 449, entitled "The Premium Plan of Paying for Labor," read before the American Society of Mechanical Engineers in 1891. In describing the Profit Sharing Plan, Mr. Halsey says: "Under it, in addition to regular wages, the employees were offered a certain percentage of the final profits of the business. It thus divides the savings due to increased production between employer and employee."

Objections to the Gain Sharing Plan.—We note here the objections to this plan: First, "The workmen are given a share in what they do not earn; second, the workmen share regardless of individual deserts; third, the promised rewards are remote; fourth, the plan makes no provision for bad years; fifth, the workmen have no means of knowing if the agreement is carried out." Without discussing any further whether these are worded exactly as all who have tried the plan might have found them, we may take these on Mr. Halsey's authority and discuss the psychology of them. If the workmen are given a share in what they do not earn, they have absolutely no feeling that they are being treated justly. This extra reward which is given to them, if in the nature of a present, might much better be a present out and out. If it has no scientific relation to what they have gotten, if the workmen share regardless of individual deserts, this, as Dr. Taylor says (¶27, "A Piece Rate System"), is the most serious defect of all, in that it does not allow for recognition of the personal merits of each workman. If the rewards are remote, the interest is diminished. If the plan makes no provision for bad years, it cannot be self-perpetuating. If the workmen have no means of knowing if the agreement will be carried out, they will be constantly wondering whether it is being carried out, and their attention will wander.

The Premium Plan.—The Premium Plan is thus described by Mr. Halsey: "The time required to do a given piece of work is determined from previous experience, and the workman, in addition to his usual daily wages, is offered a premium for every hour by which he reduces that time on future work, the amount of the premium being less than his rate of wages. Making the hourly premium less than the hourly wages is the foundation stone upon which rest all the merits of the system."

Dr. Taylor comments upon this plan as follows: "The Towne-Halsey plan consists in recording the quickest time in which a job has been done, and fixing this as a standard. If the workman succeeds in doing the job in a shorter time, he is still paid his same wages per hour for the time he works on the job, and, in addition, is given a premium for having worked faster, consisting of from one-quarter to one-half the difference between the wages earned and the wages originally paid when the job was done in standard time." Dr. Taylor's discussion of this plan will be found in "Shop Management," ¶¶79-91.

Psychologically, the defect of this system undoubtedly is that it does not rest upon accurate scientific time study, therefore neither management or men can predict accurately what is going to happen. Not being able to predict, they are unable to devote their entire attention to the work in hand, and the result cannot be as satisfactory as under an assigned task based upon time study.

The discussion of this is so thorough in Dr. Taylor's work, and in Mr. Halsey's work, that it is unnecessary to introduce more here.

Profit Sharing.—Before turning to the methods of compensation which are based upon the task, it might be well to introduce here mention of "Co-operation," or "Profit Sharing," which, in its extreme form, usually means the sharing of the profits from the business as a whole, among the men who do the work. This is further discussed by Schloss, and also by Dr. Taylor in "A Piece Rate System" (¶¶32-35); also in "Shop Management" (¶¶73-77), quoting from "A Piece Rate System."

The objections to co-operation, says Dr. Taylor, lie (1) in the fact that no form of co-operation has been devised in which each individual is allowed free scope for his personal ambition; (2) in the remoteness of the reward; and (3) in the unequitable division of the profits. If each individual is not allowed free scope, one sees at once that the entire advantage of individuality and of personal recognition is omitted. If the reward is remote, we recognize that its power diminishes very rapidly; and if there can not be equitable division of the profits, not only will the men ultimately not be satisfied, but they will, after a short time, not even be satisfied while they are working, because their minds will constantly be distracted by the fact that the division probably will not be equitable, and also by the fact that they will be trying to plan ways in which they can get their proper share. Thus, not only in the ultimate outcome, but also during the entire process, the work will slow down necessarily, because the men can have no assurance either that the work itself, or the output, have been scientifically determined.

Scientific Management Embodies Valuable Elements of Profit-Sharing.—Scientific Management embodies the valuable elements of profit sharing, namely, the idea of co-operation, and the idea that the workers should share in the profit.

That the latter of these two is properly emphasized by Scientific Management, is not always understood by the workers. When a worker is enabled to make three or four times as much output in a day as he has been accustomed to, be may think that he is not getting his full share of the "spoils" of increased efficiency unless he gets a proportionately increased rate of pay. It should, therefore, be early made clear to him that the saving has been caused by the actions of the management, quite as much as by the increased efforts for productivity of the men. Furthermore, a part of the savings must go to pay for the extra cost of maintaining the standard conditions that make such output possible. The necessary planners and teachers usually are sufficient as object lessons to convince the workers of the equity of not giving all the extra savings to the workers.

It is realized that approximately one-third of the extra profits from the savings must go to the employer, about one-third to the employees, and the remainder to maintaining the system and carrying out further investigations.

This once understood, the satisfaction that results from a co-operative, profit-sharing type of management will be enjoyed.

The five methods of compensation which are about to be discussed are all based upon the task, as laid down by Dr. Taylor; that is, upon time study and an exact knowledge by the men and the employers of how much work can be done.

Differential Rate Piece Work the Ultimate Form of Compensation.—Dr. Taylor's method of compensation, which is acknowledged by all thoroughly grounded in Scientific Management to be the ultimate form of compensation where it can be used, is called Differential Rate Piece Work. It is described in "A Piece Rate System," ¶¶50-52, as follows:

"This consists, briefly, in paying a higher price per piece, or per unit, or per job, if the work is done in the shortest possible time and without imperfection, than is paid if the work takes a longer time or is imperfectly done. To illustrate: Suppose 20 units, or pieces, to be the largest amount of work of a certain kind that can be done in a day. Under the differential rate system, if a workman finishes 20 pieces per day, and all of these pieces are perfect, he receives, say, 15 cents per piece, making his pay for the day $15\times20=\$3.00$. If, however, he works too slowly and turns out only, say, 19 pieces, then instead of receiving 15 cents per piece he gets only 12 cents per piece, making his pay for the day $12\times19=\$2.28$, instead of \$3.00 per day. If he succeeds in finishing 20 pieces—some of which are imperfect—then he should receive a still lower rate of pay, say 10 cents or 5 cents per piece, according to circumstances, making his pay for the day \$2.00 or only \$1.00, instead of \$3.00."

This system is founded upon knowledge that for a large reward men will do a large amount of work. The small compensation for a small amount of work—and under this system the minimum compensation is a little below the regular day's work—may lead men to exert themselves to accomplish more work. This system appeals to the justice of the men, in that it is more nearly an exact ratio of pay to endeavor.

Task Work with a Bonus.—The Task Work with Bonus system of compensation, which is the invention of Mr. H. L. Gantt, is explained in "A Bonus System of Rewarding Labor," Paper No. 923, read before the American Society of Mechanical Engineers, December, 1901, by Mr. Gantt. This system is there described as follows:

"If the man follows his instructions and accomplishes all the work laid out for him as constituting his proper task for the day, he is paid a definite bonus in addition to the day rate which he always gets. If, however, at the end of the day he has failed to accomplish all of the work laid out, he does not get his bonus, but simply his day rate." This system of compensation is explained more fully in Chapter VI of Mr. Gantt's book, "Work, Wages and Profits," where he explains the modification now used by him in the bonus.

The psychological advantage of the

task with a bonus is the fact that the worker has the assurance of a living wage while learning, no matter whether he succeeds in winning his bonus or not. In the last analysis, it is "day rate" for the unskilled, and "piece rate" for the skilled, and it naturally leads to a feeling of security in the worker. Mr. Gantt has so admirably explained the advantages, psychological as well as industrial, of his system, that it is unnecessary to go farther, except to emphasize the fine feeling of brotherhood which underlies the idea, and its expression.

The Differential Bonus System.—The Differential Bonus System of Compensation is the invention of Mr. Frederic A. Parkhurst, and is described by him in the November, 1911, number of INDUSTRIAL ENGINEERING, (p. 342). He describes it as follows:

"The time the job should be done in is first determined by analysis and time study. The bonus is then added above the day work line. No bonus is paid until a definitely determined time is realized. As the time is reduced, the bonus is increased."

Three Rate System.—The Three Rate System of Compensation is the invention of Mr. Frank B. Gilbreth, and consists of day work, i. e., a day rate, or a flat minimum rate, which all who are willing to work receive until they can try themselves out; of a middle rate, which is given to the man when he accomplishes the work with exactness of compliance to prescribed motions, according to the requirements of his instruction card; and of a high rate, which is paid to the man when he not only accomplishes the task in accordance with the instruction card, but also within the set time and of the prescribed quality of finished work.

The advantage of this is, first of all, that the man does not have to look forward so far for some of his reward, as it comes to him just as soon as he has shown himself able to follow the prescribed methods required accurately. The first extra reward is naturally a stimulus toward winning the second extra reward. The middle rate is a stimulus to endeavor to perform that method which will enable him easiest to achieve the accomplishment of the task that pays the highest wage. The day rate assures the man of a living wage. The middle rate pays him a bonus for trying to learn. The high rate gives him a piece rate when he is skilled.

Three Rate with Increased Rate System.—Lastly, the Three Rate with Increased Rate System, consists exactly of the foregoing, with the addition that, as the man can increase his output, with continued experience, above that of the task, he receives a differential piece rate on the excess quantity, this simply making an increasing stimulus to exceed his previous best record.

All Task Systems Investigate Loss of Bonus.—Under all these bonus forms of wages, if the bonus is not gained the fact is at once investigated, in order that the blame may rest where it belongs. The blame may rest upon the workers, or it may be due to the material, which may be defective, or different from standard; it may be upon the supervision; or upon some fault of the management in not supplying the material in the proper quality, or sequence; or upon a bad condition of tools or machinery, or upon the instruction card. The fact that the missing of the bonus is investigated is an added assurance to the workman that he is getting the "square deal," and enlists his sympathy with these forms of bonus system, and his desire to work under them. The fact that the management will investigate also allows him to concentrate upon output, with no worry as to the necessity of his investigating places where he has fallen short. also.

Necessity for Workers Bearing This Loss.—In any case, whether the blame for losing the bonus is the worker's fault directly or not, he loses his bonus. This for two reasons: In the first place, if he did not lose his bonus he would have no incentive to try to discover flaws before delays occurred. He would, otherwise, have an incentive to allow the material to pass through his hands defective or imperfect, as the case might be. This is very closely associated with the second reason, and that is, that the bonus comes from the savings caused by the plan of management, and that it is necessary that the workers as well as the management shall see that everything possible tends to increase the savings. It is only as the worker feels that his bonus is a part of the saving, that he recognizes the justice of his receiving it, that it is in no wise a gift to him, but simply his proper share, accorded not by any system of philanthropy, or so-called welfare work, but simply because his own personal work has made it possible for the management to hand back his share to him.

Users of any Task System Appreciate Other Task Systems.—It is of great importance to the workers that the users of any of these five methods of compensation of Scientific Management are all ready and glad to acknowledge the worth of all these systems. In many works more than one, in some all, of these systems of payment may be in use. Far from this resulting in confusion, it simply leads to the understanding that whatever is best in the particular situation should be used. It also leads to a feeling of stability everywhere, as a man who has worked under any of these systems founded on time study can easily pass to another. There is also a great gain here in the doing away with industrial warfare.

Shorter Hours and Holidays Effective Rewards.—Probably the greatest incentives, next to promotion and more pay, are shorter hours and holidays. In some cases, the shorter hours, or holidays, have proven even more attractive to the worker than the increase of pay. In "Shop Management," ¶165, Dr. Taylor describes a case where children working were obliged to turn their pay envelopes over to their parents intact. To them, there was no particular incentive in getting more money; but, when the task was assigned, if they were allowed to go as soon as their task was completed, the output was accomplished in a great deal shorter time. Another case where shorter hours were successfully tried, was in an office where the girls were allowed the entire Saturday every two weeks, if the work was accomplished within a set amount of time. This extra time for shopping and matinées proved more attractive than any reasonable amount of extra pay that could be offered.

Desire for Approbation an Incentive.—Under Individuality were discussed various devices for developing the individuality of the man, such as his picture over a good output or record. These all act as rewards or incentives. How successful they would be, would depend largely upon the temperament of the man and the sort of work that is to be done. In all classes of society, among all sorts of people, there is the type that loves approbation. This type will be appealed to more by a device which allows others to see what has been done than by almost anything else. As to what this device must be, depends on the intelligence of the man.

Necessity for Co-operation a Strong Incentive.—Under Scientific Management many workers are forced by their co-workers to try to earn their bonuses, as "falling down on" tasks, and therefore schedules, may force them to lose their bonuses

The fact that, in many kinds of work, a man falling below his task will prevent his fellows from working, is often a strong incentive to that man to make better speed. For example, on a certain construction job in Canada, the teamsters were shown that, by their work, they were cutting down working opportunities for cart loaders, who could only be hired as the teamsters hauled sufficient loads to keep them busy.

Value of Knowledge Gained an Incentive to a Few Only.—Extra knowledge, and the better method of attack learned under Scientific Management, are rewards that will be appreciated by those of superior intelligence only. They will, in a way, be appreciated by all, because it will be realized, through what is learned, that more pay or promotion is received; but the fact that this extra knowledge and better method of attack will enable one to do better in all lines, not simply in the line at which one is working, and will render one's life more full and rich, will be appreciated only by those of a wide experience.

Acquired Professional Standing a Powerful Incentive.—Just as the success of the worker under Scientific Management assures of such admiration by his fellow workers as will serve as an incentive toward further success, so the professional standing attained by success in Scientific Management acts as an incentive to those in more responsible positions.

As soon as it is recognized that Scientific Management furnishes the only real measure of efficiency, its close relationship to professional standing will be recognized, and the reward which it can offer in this line will be more fully appreciated.

Punishments Negative and Positive.—Punishments may be first negative, that is, simply a loss of promised rewards. Such punishments, especially in cases of men who have once had the reward, usually will act as the necessary stimulus to further activity. Punishments may also be positive: such things as fines, assignment to less pleasant work, or as a last resort, discharge.

Fines have been a most successful mode of punishment under Scientific Management. Under many of the old forms of management the fines were turned back to the management itself, thus raising a spirit of animosity in the men, who felt that everything that they suffered was a gain to those over them. Under Scientific Management all fines are used in some way for the benefit of the men themselves. All fines should be used for some benefit fund, or turned into the insurance fund. The fines, as has been said, are determined solely by the disciplinarian, who is disinterested in the disposition of the funds thus collected. As the fines do not in any way benefit the management, and in fact rather hurt the management in that the men who pay them, no matter where they are applied, must feel more or less discouraged, it is, naturally, for the benefit of the management that there shall be as few fines as possible. Both management and men realize this, which leads to industrial peace, and also leads the managers, the functional foremen, and in fact every one, to eliminate the necessity and cause for fines to as great an extent as is possible.

Assignment to Less Pleasant Work Effective Punishment. Assignment to less pleasant work is a very effective form of discipline. It has many advantages which do not show on the surface. The man may not really get a cut in pay, though his work be changed, and thus the damage he receives is in no wise to his purse, but simply to his feeling of pride. In the meantime, he is gaining a wider experience of the business, so that even the worst disadvantage has its bright side.

Discharge to be Avoided Wherever Possible.—Discharge is, of course, available under Scientific Management, as under all other forms, but it is really less used under Scientific Management than under any other sort, because if a man is possibly available, and in any way trained, it is better to do almost anything to teach him, to assign him to different work, to try to find his possibilities, than to let him go, and have all that teaching wasted as far as the organization which has taught it is concerned.

Moreover, Scientific Management realizes that discharge may be a grave injury to a worker. (For seriousness of discharging an apprentice, see C. B. Going, "Methods of the Santa Fe," p. 114.) As Mr. James M. Dodge, who has been most successful in Scientific Management and is noted for his good work for his fellowmen, eloquently pleads, in a paper on "The Spirit in Which Scientific Management Should Be Approached," given before the Conference on Scientific Management at Dartmouth College, October, 1911. "It is a serious thing for a worker who has located his home within reasonable proximity to his place of employment and with proper regard for the schooling of his children, to have to seek other employment and readjust his home affairs, with a loss of time and wages. Proper management takes account not only of this fact, but also of the fact that there is a distinct loss to the employer when an old and experienced employee is replaced by a new man, who must be educated in the methods of the establishment. An old employee has, in his experience, a potential value that should not be lightly disregarded, and there should be, in case of dismissal the soundest of reasons, in which personal prejudice or temporary mental condition of the foreman should play no part. Constant changing of employees is not wholesome for any establishment, and the sudden discovery by a foreman that a man who has been employed for a year or more is "No Good," is often a reflection on the foreman, and more often still, is wholly untrue. All workingmen, unless they develop intemperate or dishonest habits, have desirable value in them, and the conserving and increasing of their value is a duty which should be assumed by their superiors."

Punishment Can Never Be Entirely Abolished.—It might be asked why punishments are needed at all under this system; that is, why positive punishments are needed. Why not merely a lack of reward for the slight offenses, and a discharge if it gets too bad? It must be remembered, however, that the punishments are needed to insure a proper appreciation of the reward. If there is no negative side, the beauty of the reward will never be realized; the man who has once suffered by having his pay cut for something which he has done wrong, will be more than ready to keep up to the standard. In the second place, unless individuals are punished, the rights of other individuals will, necessarily, be encroached upon. When it is considered that under Scientific Management the man who gives the punishment is the disinterested disciplinarian, that the punishment is made exactly appropriate to the offense, and that no advantage from it comes to any one except the men themselves, it can be understood that the psychological basis is such as to make a punishment rather an incentive than a detriment.

(To be continued.)

Efficiency Engineering Applied to Mining[1]

BY GLENVILLE A. COLLINS

If a man who is prepared to look closely and observe broadly starts in Canada and zig-zags from camp to camp to southern Mexico, taking time casually to inspect mines, mills and smelters, he will be pitifully impressed by the great difference in customs, and the general waste of labor, time and money throughout the country He will so seldom observe a dollar's worth of results given in exchange for a dollar spent that he will form a poor opinion of operating-efficiency and management. This highly scientific department, requiring an amount of skill and executive ability equaled in few, if any, of the professions, certainly falls short of the standard established in our greater manufacturing industries.

It is easily said that this is due to the diversity of conditions in mining, milling and smelting. But on second view it must be admitted that there is room for tremendous improvements in nearly every mining-organization. The proposal of such improvements is often met by the argument that any mine is but a temporary affair, yielding such profits as to make efficiency-work of no consequence; but any business which is profitable and worth doing at all is worth doing on a basis which gives the greatest return on the investment.

It is the purpose of this paper to advocate throughout the industry, high wages for workmen and low labor-costs to the employer, or what is generally known to manufacturers as the "Taylor System." This system is entirely feasible to the mining industry, through careful study and record of the time required to perform certain work.

The exact percentage to be gained under this system by such terms of payment that a workman will do his best, can be determined only from carefully kept records, taken by a trained man, over long periods of time. It is not a matter to be decided off-hand, either by labor-unions or by directors.

The usual first-class workman will prefer to remain at his old system of work and wages rather than work at maximum speed unless the increase of pay is sufficient and permanent. For this reason it is not wise to make sudden or ill-advised changes, as the workmen then lose confidence in the system. It should never be referred to as a trial system, intimating the probability that it might not be a complete success. The thing to do is to be absolutely sure, then do it, regardless of the opinions of workmen. As soon as they begin to see the practicability of increasing their earnings and comforts, their opposition will cease, and they will become highly enthusiastic and thrifty.

As soon as the workman begins to realize that he is dealt with as an individual, with growing opportunity consistent with his energy and intellect, he leaves the ranks of organized shiftlessness and becomes an ambitious worker. This is also of great advantage to the employer, as a process of elimination which often develops extraordinary talents, otherwise locked up within a sullen breast.

The majority of manual laborers naturally make their task as easy as possible, eventually doing only that which they are forced to do. If an energetic workman is put with the rest on gang-work at day-wages, he gradually realizes that he is doing more work for the same pay, and in time slows down to the normal pace of the gang.

This may be exemplified by workmen tramming ore-cars. I have often seen them, on leaving the muck-pile at the face, mount the truck and take advantage of the usual down-grade and quick time to the dump, and then, after dumping the car, sit down on the pile from

[1]Extract from a paper presented at a meeting of the Spokane Local Section of the American Institute of Mining Engineers, and published in the *Bulletin* of the Institute, Sept., 1912.

The Psychology of Management[1]--Concluded

Welfare

BY L. M. GILBRETH

"Welfare" means "a state or condition of doing well; prosperous or satisfactory course or relation; exemption from evil"; in other words, well-being. Today it is also often used as an adjective, to describe work which is being attempted for the good of industrial workers. In the present discussion of welfare, both meanings of the word will be included.

A discussion of welfare as the results of work divides itself naturally into three parts, or three questions:

What is the effect upon the physical life?

What is the effect upon the mental life?

What is the effect upon the moral life?

Under Traditional Management No Physical Improvement.—In general, under Traditional Management, there is not a definite physical improvement in the average worker. In the first place, there is no provision for regularity in the work. The planning not being done ahead, the man has absolutely no way of knowing exactly what he will be called upon to do. There being no measure of fatigue, he has no means of knowing whether he can go to work the second part of the day, say, with anything like the efficiency with which he could go to work in the first part of the day. There being no standard, the amount of work which he can turn out must vary according as the tools, machinery and equipment are in proper condition, and the material supplies his needs.

In the second place, there are no excellent habits necessarily formed. The man is left to do fairly as he pleases, if only the general outcome be considered sufficient by those over him. There may be a physical development on his part, if the work be of a kind which can develop him, or which he likes to such an extent that he is willing to do enough of it to develop him physically. Therefore under Traditional Management, there is no way of knowing that good health and increased strength will result from the work, and we know that in many cases poor health and depleted strength have been the outcome of the work. So far as physical improvement is concerned, it came rather in spite of than because of Traditional Management, in the sense at least that the management had nothing to do with it, and had absolutely no way of providing for it.

No Directed Mental Development.—As regards mental development under Traditional Management, there being no fixed habits, no specially trained habit of attention, no standard, there was no way of knowing that the man's mind was improving. Naturally, all minds improve merely with experience. Experience must be gathered in, and must be embodied into a judgment. There is absolutely no way of estimating what the average need in this line would be, it varies so much with the temperament of the man. Again, it would usually be a thing that the man himself was responsible for, and not the management; certainly not the management in any impersonal sense. Some one man over an individual worker might be largely responsible for improving him intellectually. If this were so, it would be because of the temperament of the over-man, or because of his friendly desire to impart a mental stimulus; seldom, if ever, because the management provided for its being imparted. Thus, there was absolutely no way of predicting that wider or deeper interest, or that increased mental capacity, would develop.

Moral Development Doubtful.—As for moral development under the average Traditional Management, it was not only not provided for, but was rather doubtful. A man had very little chance to develop real personal responsibilities, in that there was always some one over him who was watching him, who disciplined him and corrected him, who handed in the reports for him, with the result that he was only in a very slight sense a free agent. Only men higher up—the foremen and the superintendents—could obtain real development from personal responsibilities. Neither was there much development of responsibility for others, in the sense of being responsible for personal development of others. Having no accurate standards by which to judge, there was little or no possibility of appreciation of the relative standing of the men, either by an individual of himself, or by others of his ability. The management taught self-control in the most rudimentary way, or not at all. There was no distinct goal for the average man, neither was there any distinct way to arrive at such a goal; it was simply a case, with the man lower down, of "making good" for any one day and getting that day's pay.

"Square Deal" Lacking.—Perhaps the worst lack under Traditional Management was the lack of the "square deal." In the first place, even the most efficient worker under this form of management was not sure of his place. This not only meant worry on his part, which distracted his attention from what he did, but meant a wrong attitude all along the line. He had absolutely no way of knowing that, even though he did his best, the man over him, in anger, or because of some entirely ulterior thing, might not discharge him, degrade him or fine him. So also the custom of spying, the only sort of inspection recognized under Traditional Management of the most

[1] Copyright, 1913, by L. M. Gilbreth.

elementary form, led to a feeling on the men's part that they were being constantly watched on the sly, and to an inability to concentrate. This brought about an inability to feel really honest, for being constantly under suspicion is enough to poison even one's own opinion of one's integrity. Again, being at the beck and call of a prejudiced foreman who was all-powerful, and having no assured protection from the whims of such a man, the worker was obliged, practically for self-protection, to try to conciliate the foreman by methods of assuming merits that are obvious, on the surface. He ingratiated himself in the favor of the foreman in that way best adapted to the peculiarities of the character of the foreman, sometimes joining societies, or the church of the foreman, sometimes helping him elect some political candidate or relative; at other times, by the more direct method of buying drinks, or taking up a subscription for presenting the foreman with a gold watch, "in appreciation of his fairness to all"; sometimes by consistently losing at cards or other games of chance. When it is considered that this same foreman was probably, at the time, enjoying a brutal feeling of power, it is no wonder that no sense of confidence of the "square deal" could develop. There are countless ways that the brutal enjoyment of power could be exercised by the man in a foreman's position. As has already been said, some men prefer promotion to a position of power more than anything else. Nearly all desire promotion to power for the extra money that it brings, and occasionally a man will be found who loves the power, although unconsciously, for the pleasure he obtains in lording over other human beings. Under Military Management, there is practically no limit to this power, the management being satisfied if the foreman gets the work out of the men. The men, having practically no one to appeal to, are obliged to receive their punishment always from the hands of a prejudiced party.

Being under such an influence as this, there is little or no possibility of the development of an intelligent will. The "will to do" becomes stunted, unless the pay is large enough to lead the man to be willing to undergo abuses in order to get the money. There is nothing, moreover, in the aspect of the management itself to lead the man to have a feeling of confidence either in himself or in the management, and to have that moral poise which will make him wish to advance.

With the likelihood of suspicion, hate and jealousy arising, and with constant preparations for conflict, of which the average union and employers' association are the embodiment, real capacity is naturally not increased, but is rather decreased, under this form of management, and we may ascribe this to three faults:

(1) To lack of recognition of individuality—men are handled mostly as gangs, and personality is sunk.

(2) To lack of standardization, and to lack of time study, that fundamental of all standardization, resulting in absolute inability to make a measured, and therefore scientific, judgment; and

(3) To the lack of teaching; to the lack of all constructiveness.

These three lacks, then, constitute a strong reason why Traditional Management does not add to the welfare of the men.

Little Systematized Welfare Work Under Traditional Management—As for welfare work, that is, work which the employers themselves plan to benefit the men, if under such work be included timely impulses of the management for the men, and the carrying of these out in a more or less systematic way, it will be true to say that such welfare work has existed in all times, and under all forms of management. The kind-hearted man will show his kind heart wherever he is, but it is likewise true to say that little systematic beneficial work is done under what we have defined as Traditional Management.

Definite Statements as to Welfare Under Transitory Management Difficult to Make.—It is almost impossible to give any statement as to the general welfare of workers under Transitory Management, because, from the very nature of the case, definite Transitory Management is constantly changing. In the discussion of the various chapters, and in showing how individuality, functionalization, measurements, and so on, were introduced, and the psychological effect upon the men of their being introduced, welfare was more or less unsystematically considered.

Welfare Work Under Transitory Management Is Usually Commendable.—As to welfare work under Transitory Management, much could be said, and much has been said and written. Typical welfare work under Transitory Management deserves nothing but praise. It consists of such work as building rest rooms for the employees, of providing for amusements, of providing for better working conditions, of helping to better home conditions, in providing some sort of a welfare worker who can talk with the employees and benefit them in every way, and act as their representative in conferring with the management.

There can be no doubt that an immense amount of good has been done by this welfare work, both positively, to the employees themselves, and indirectly, to the management, through fostering a kinder feeling. There is, however, a flaw to be found in the underlying principles of this welfare work as introduced in Transitory Management, and that is that it takes on more or less the aspect of a charity, and is so regarded both by the employees and by the employer. The employer naturally prides himself more or less upon doing something which is good, and the employee naturally resents more or less having something given to him as a sort of charity which he feels is his by right.

The psychological significance of this is great. The employer, feeling that he has bestowed a gift, is naturally rather chagrined to find it is received either as a right, or with a feeling of resentment. Therefore he is often led to decrease what he might otherwise do, for it is only an unusual and a very high type of mind that can be satisfied simply with the doing of the good act without the return of gratitude. On the other hand, the employee, if he be a man of pride, may resent charity even in such a general form as this, and may, with an element of rightness, prefer that the money expended be put into his pay envelope instead. If it is simply a case of better working conditions, something that improves him as an efficient worker for the management, he will feel that this welfare work is in no sense something which he receives as a gift, but rather something which is his right, and which benefits the employer exactly as much as it benefits him, if not more.

Another fault which can be found with the actual administration of welfare work, is the fact that it often disregards one of the fundamental principles of Scientific Management, in that the welfare workers themselves do not train enough persons to follow in their footsteps, and thus make welfare self-perpetuating.

Scientific Provision for Welfare Under Scientific Management.—Under Scientific Management general welfare is provided for by the effect that the work has on physical improvement, viz: (1) the regularity of the work; (2) habits; and (3) physical development.

1.—As for the regularity of the work, we have:

(*a*) The apportionment of the work and the rest. Under Scientific Management, work time and rest time are scientifically apportioned. This means that the man is able to come to each new task with the same amount of strength, and that from his work he gains habits of regularity.

(*b*) The laying out of the work. The standards upon which the instruction cars are based, and the method of preparing them assure regularity.

(*c*) The manner of performing the work. Every time that identical work is done, it is done in an identical manner.

The resulting regularity has an excellent effect upon the physical welfare of the worker.

2.—Habits under Scientific Management:

(*a*) Are prescribed by standards. The various physical habits of the man, the motions that are used, having all been timed and then standardized, the worker acquires physical habits that are fixed;

(*b*) Are taught[120], therefore they are not remote, but come actually and promptly into the consciousness and into the action of the worker.

(*c*) Are retained, because they are standard habits, and because the rewards which are given for using them make it an object to the worker to retain them.

(*d*) Are reinforced by individuality and functionalization; that is to say, the worker is considered as an individual, and the possibilities are studied before he is put into the work; therefore, his own individuality and his own particular function naturally reinforce those habits which he is taught to form. These habits, being scientifically derived, add to physical improvement.

3.—Physical development:

(*a*) Is fostered through the play element, has been scientifically studied, and is utilized as far as possible; the same is true of the love of work, which is reinforced by the fact that the man has been placed where he will have the most love for his work.

(*b*) Is insured by the love of contest, which is provided for not only by contest with others, but by the constant contest of the worker with his own previous records. When he does exceed these records he utilizes powers which it is for his good physically, as well as otherwise, to utilize.

This regularity, combined with good habits and physical development, results in good health, increased strength and a better appearance. To these three results all scientific managers testify.

Mental Development. — Welfare under Scientific Management is also provided for by Mental Development. This we may discuss under habits, and under general mental development.

1.—As for habits we must consider:

(*a*) Habits of attention. Under Scientific Management, as we have shown, attention must become a habit. Only when it does become a habit, can the work required be properly performed and the reward received. As only those who show themselves capable of really receiving the reward are considered to be properly placed, ultimately all who remain at work under Scientific Management must attain this habit of attention.

(*b*) Habit of method of attack. This not only enables the worker to do satisfactorily the things that are assigned to him, but also has the broadening effect of teaching him how to do other things, i. e., showing him the "how" of doing things and giving him standards which are the outcome of mental habits, and by which he learns to measure.

2.—General mental development is provided for by the experience which the worker gets not only in the general way in which all who work must gain experience, but in the set way provided by Scientific Management. This is so presented to the worker that it becomes actually usable at once. It not only allows him to judge others, but provides for self-knowledge, which is one of the most valuable of all of the outcomes of Scientific Management. He becomes mentally capable of estimating his own powers and predicting what he himself is capable of doing. The outcome of this mental development is (*a*) wider interest; (*b*) deeper interest; and (*c*) increased mental capabilities.

The better method of attack would necessarily provide for wider interest. The fact that any subject taken up is in its ultimate final unit form, would certainly lead to deeper interest; and the exercise of these two faculties leads to increased mental capabilities.

Moral Development.—Moral development under Scientific Management results from the provisions made for cultivating (1) personal responsibility; (2) responsibility for others; (3) appreciation of standing; (4) self-control; and (5) "squareness."

1.—Personal responsibility is developed by:

(*a*) Individual recognition. When the worker was considered merely as one of a gang, it was easy for him to shift responsibilities upon others.

[120] H. L. Gantt, "Work, Wages and Profits," pp. 115 and 121.

When he knows that he is regarded by the management and by his mates as an individual, that what he does will show up in an individual record, and will receive individual reward or punishment, personal responsibility necessarily is developed.

(*b*) The appreciation which comes under Scientific Management. This appreciation takes the form of reward and promotion, and of the regard of his fellow workers; therefore, being a growing thing, as it is under Scientific Management, it insures that his personal responsibility shall also be a growing thing, and become greater the longer he works under Scientific Management.

2.—Responsibility for others is provided by the inter-relation of all functions. It is not necessary that all workers under Scientific Management should understand all about it. However, many do understand, and the more that they do understand, the more they realize that every one working under Scientific Management is more or less dependent upon everyone else. Every worker must feel this, more or less, when he realizes that there are eight functional bosses over him, who are closely related to him, on whom he is dependent, and who are more or less dependent upon him. The very fact that the planning is separated from the performing, means that more men are directly interested in any one piece of work; in fact, that every individual piece of work that is done is in some way a bond between a great number of men, some of whom are planning and some of whom are performing it. This responsibility for others is made even more close in the dependent bonuses which are a part of Scientific Management, a man's pay being dependent upon the work of those who are working under him. Certainly nothing could bring the fact more closely to the attention of each and every worker under this system, than associating it with the pay envelope.

3.—Appreciation of standing is fostered by:

(*a*) Individual records. Through these the individual himself knows what he has done, his fellows know, and the management knows.

(*b*) Comparative records, which show even those who might not make the comparison exactly how each worker stands, with relation to his mates, or with relation to his past records.

This appreciation of standing is well exemplified in the happy phrasing of Mr. Gantt: "There is in every workroom a fashion, or habit of work, and the new worker follows that fashion, for it isn't respectable not to. The man or woman who ignores fashion does not get much pleasure from associating with those that follow it, and the new member consequently tries to fall in with the sentiment of the community[121]."

4.—Self-control is developed by:

(*a*) The habits of inhibition fostered by Scientific Management; that is to say, when the right habits are formed, necessarily many wrong habits are eliminated. It becomes a part of Scientific Management to inhibit all inattention and wrong habits, and to concentrate upon the things desired.

(*b*) The distinct goal and the distinct task which Scientific Management sets, which allows the man to hold himself well in control, to keep his poise and to advance steadily.

5.—"Squareness." This squareness is exemplified first of all by the attitude of the management. It provides, in every way, that the men are given a "square deal," in that the tasks assigned are of the proper size, and that the reward that is given is of the proper dimensions and is assured.

Moral Development Results in Contentment, Brotherhood and the "Will to Do."—The three results of this moral development are (1) contentment; (2) brotherhood; and a "will to do."

(1) Contentment is the outgrowth of the personal responsibility, the appreciation of standing, and the general "squareness" of the entire plan of Scientific Management.

(2) The idea of brotherhood is fostered particularly through the responsibility for others, through the feeling that grows up that each man is dependent upon all others, and that it is necessary for every man to train up another man to take his place before he can be advanced. It comes about that the old-caste life, which so often grew up under Traditional Management, becomes abolished, and there ensues a feeling that it is possible for any man to grow up into any other man's place. The tug-of-war attitude of the management and men is transformed into the attitude of a band of soldiers scaling a wall. Not only is the worker pulled up, but he is also forced up from the bottom[122].

(3) The "will to do" is so fostered by Scientific Management that not only is the worker given every incentive, but he personally becomes inspired with this great desire for activity, which is after all the best and finest thing that any system of work can give to him.

Inter-relation of Physical, Mental and Moral Development.—As to the inter-relation of physical, mental and moral development, it must never be forgotten that the mind and the body must be studied together[123], and that this is particularly true in considering the mind in management[124]. For the best results of the mind, the body must be cared for and provided for fully as much as must the mind, or the best results from the mind will not and cannot be obtained.

Successful management must consider the results of all mental states upon the health, happiness and prosperity of the worker, and the quality, quantity and cost of the output. That is to say, unless the mind is kept in the right state, with the elimination of worry, the body cannot do its best work, and, in the same way, unless the body is kept up to the proper standard, the mind cannot develop. Therefore, a really good system of management must consider not only these things separately, but in their inter-relations, and this Scientific Management does. The ultimate re-

121 "Work, Wages and Profits," pp. 154-155.

122 F. W. Taylor, "Shop Management" (Harper ed.), p. 76.

123 William James, "Psychology" (Advanced Course), vol. II, p. 372.

124 See remarkable work of Dr. A. Imbert, "Evaluation de la Capacité de Travail d'un Ouvrier avant et après un Accident"; Les Méthodes du Laboratoire appliquées à l'Etude directe et pratique des questions ouvrières," etc.

sult of all this physical improvement, mental development and moral development is increased capacity, increased capacity not only for work, but for health, and for life in general.

Welfare Work an Integral Part of Scientific Management.—Strictly speaking, under Scientific Management, there should be no necessity for a special department of welfare work. It should be so incorporated in Scientific Management that it is not to be distinguished. Here the men are looked out for in such a way under the operation of Scientific Management itself that there is no necessity for a special welfare worker. This is not to say that the value of personality will disappear under Scientific Management, and that it may not be necessary in some cases to provide for nurses, for physical directors, and for advisors. It will, however, be understood that the entire footing of these persons is changed under Scientific Management. It is realized under Scientific Management that these persons and their work benefit the employers as much as the employees. They must go on the regular payroll as a part of the efficiency equipment. The workers must understand that there is absolutely no feeling of charity, or of gift, in having them; but that they add to the perfectiveness of the entire establishment.

Conclusion

The results thus far attained by Scientific Management justify a prediction as to its future. It will accomplish two great works:

1. It will educate the worker to the point where all workers will be fitted to work, and to live.

2. It will aid the cause of industrial peace.

It will put the great power of knowledge into every man's hands. This it must do, as it is founded on co-operation, and this co-operation demands that all shall know and shall be taught. With this knowledge will come ability to understand the rights of others, as well as one's own. "To know all is to pardon all."

Necessity for co-operation, and trained minds: these two can but lead to elimination of that most wasteful of all warfare, industrial warfare. Such will be the future of Scientific Management, whether it win universal approval, universal disapproval, or half-hearted advocacy today.

When the day shall come that the ultimate benefits of Scientific Management are realized and enjoyed, depends on both the managers and the workers of the country; but, in the last analysis, the greatest power towards hastening the day lies in the hands of the workers.

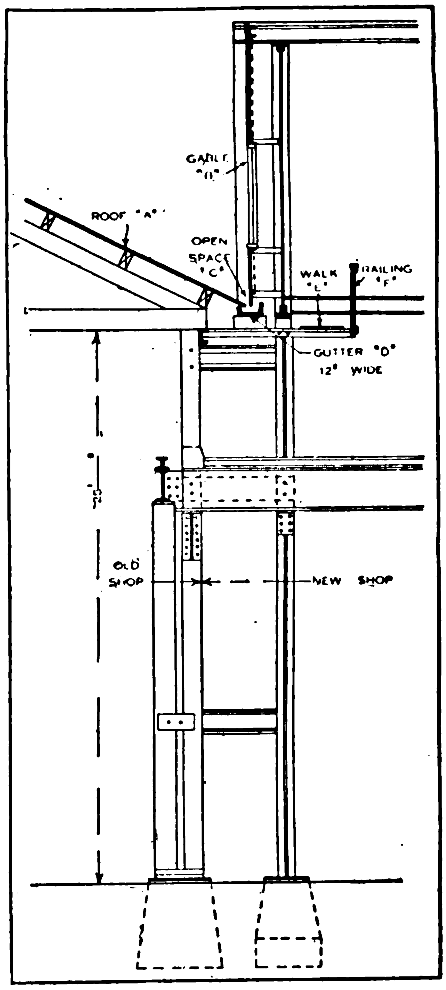
To them Scientific Management would desire to appeal as a road up and out from industrial monotony and industrial turmoil. There are many roads that lead to progress. This road leads straightest and surest, and we can but hope that the workers of all lands, and of our land in particular, will not wait till necessity drives, but will lead the way in that true "Brotherhood" which may some day come to be.

THE END

A LEAK-PROOF GUTTER

Trouble with leaky skylights and gables led the author to devise the gutter shown in the accompanying illustration. This construction was used in connecting a wing to the main shop of the West Steel Casting Co., Cleveland, and has now successfully withstood the test of snow storms, sleet, and heavy rains, without a drop of leakage having escaped from the opening, C. The main shop and the new wing are each about 52 ft. wide and about 25 ft. high in the clear under the trusses. As shown in the illustration, the iron sheeting of the roof at A is not carried down to a connection with the siding of the gable at B, and, therefore, an open space is left at C. Under the open space C is placed the gutter D. The opening C is about 3 in. wide, and the gutter, which is constructed of No. 18 gage sheet metal, is 12 in. in width. The gutter has a fall of 6 in. in the width of the building, and at the lower end is connected with a 6-in. downtake which runs the water into the city sewer.

For convenience in cleaning the gutter or repairing it if necessary, the footwalk shown at E was provided. The railing F was added as a guard. With this gutter design, either the gable sheeting or the roofing may be repaired independently



CROSS-SECTION OF BUILDING, SHOWING NOVEL GUTTER CONSTRUCTION

of each other. Of course this construction leaves an opening in the roof of the shop, but in foundries such ventilation is not objectionable at any time of the year.—Thos. D. West, in *The Iron Trade Review.*

To drill chilled cast iron, a contemporary states that the piece should be laid on a forge, the spot to be chilled covered with sulphur and the blast applied slowly until the sulphur is burned off. The chill will then be drawn and the piece can be drilled.

The total production of all kinds of pig iron in 1912 was 29,727,137 gross tons, an increase of about 26 per cent over that of 1911.

LinkedIn

Professor Bob Emiliani
Please visit bobemiliani.com

When people have a new management model to monetize, such efforts are required to be at odds with the facts. You can find F.W. Taylor's seminal paper, "Shop Management," here https://archive.org/details/transactionsof24amer/page/1336/mode/2up

What Problem Was Frederick Winslow Taylor Trying to Solve?
How to Increase Productivity

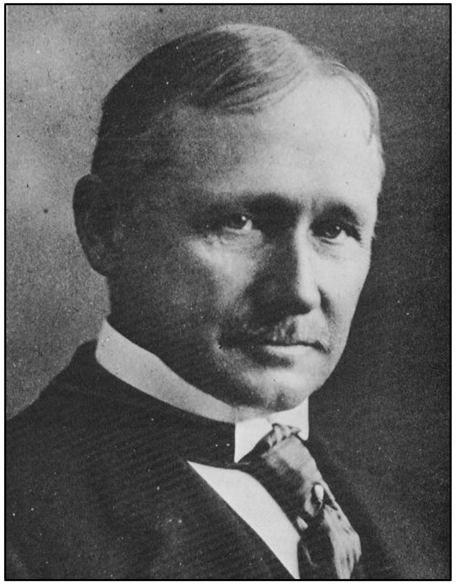
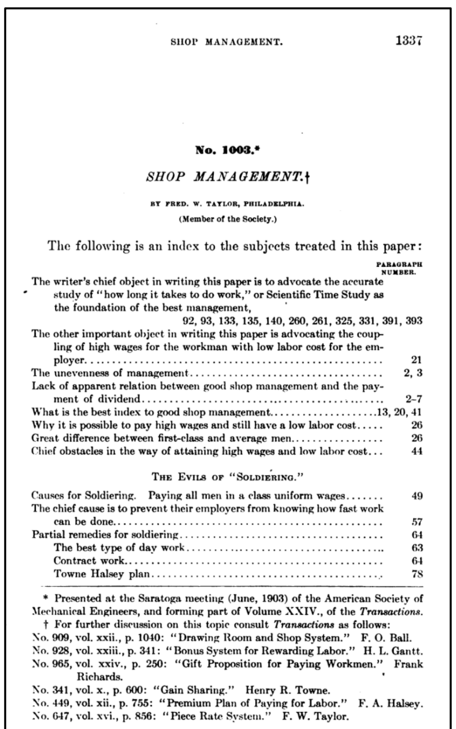


Image source: Wikipedia



SHOP MANAGEMENT. 1337

No. 1003.*

SHOP MANAGEMENT.†

BY FRED. W. TAYLOR, PHILADELPHIA.

(Member of the Society.)

The following is an index to the subjects treated in this paper:

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The writer's chief object in writing this paper is to advocate the accurate study of "how long it takes to do work," or Scientific Time Study as the foundation of the best management,	92, 93, 133, 135, 140, 260, 261, 325, 331, 391, 393
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THE EVILS OF "SOLDIERING."

Causes for Soldiering. Paying all men in a class uniform wages	49
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* Presented at the Saratoga meeting (June, 1903) of the American Society of Mechanical Engineers, and forming part of Volume XXIV., of the *Transactions*.

† For further discussion on this topic consult *Transactions* as follows:
No. 909, vol. xxii., p. 1040: "Drawing Room and Shop System." F. O. Ball.
No. 928, vol. xxiii., p. 341: "Bonus System for Rewarding Labor." H. L. Gantt.
No. 965, vol. xxiv., p. 250: "Gift Proposition for Paying Workmen." Frank Richards.
No. 341, vol. x., p. 600: "Gain Sharing." Henry R. Towne.
No. 449, vol. xii., p. 755: "Premium Plan of Paying for Labor." F. A. Halsey.
No. 647, vol. xvi., p. 856: "Piece Rate System." F. W. Taylor.

Transactions of the American Society of Mechanical Engineers, Vol. 24, 1903 1337-1480.

Many people think Scientific Management had no science at all. That is because it was not created in a highly formalized scientific way with respect to discrete hypothesis statements and testing (same is true for the early decades of TPS). That does not mean there were no hypotheses and no testing. In fact, there was plenty of that. For example, time study and improved work methods (the foundation of Scientific Management) proved the hypothesis that work could be made much more efficient (meaning, productive – higher output per unit input). **Another hypothesis** what that work could be made easier for workers and flow more smoothly. **Another hypothesis** was that workers would do work the new way if they could make more money. **Another hypothesis** was that costs could be made lower by hiring non-productive workers -- a staff of engineers to analyze work. **Another hypothesis** was that study and experimentation (science) was superior to "rule of thumb." **Another hypothesis** was that harmony would produce better business results than discord. **Another hypothesis** was that cooperation (teamwork between management and workers) would yield better business results. **Another hypothesis** was that workers and managers restrict output when it suited their interests. **Another hypothesis** was that workers should be trained to develop their skills and capabilities to produce better work. **Another hypothesis** was that standards would result in more economical production. **Another hypothesis** was that a company could have both high wages and low costs. In the 1880s, it was revolutionary to formulate and test these hypotheses -- all of which were found to be true (and which we take for granted today). To understand the wide range of hypotheses that Frederick Winslow Taylor tested in real businesses, read his seminal work, "Shop Management," published 1903.

What Problem Way Frederick Winslow Taylor Trying to Solve?
How to Increase Productivity

Most people think Taylor was a driver of workers. **The fact is he advocated for "abandoning the military type of organization," long in existence, that did drive workers.** Taylor was more concerned about managers than workers because productivity could not be improved if managers did not change their way of thinking. Taylor said:

> "...nine-tenths of the trouble with those of us who have been engaged in helping people to change from the older type of management to the new management — that is, to scientific management — that nine-tenths of our trouble has been to 'bring' those on the management's side to do their fair share of the work and only one-tenth of our trouble has come on the workman's side. Invariably we find very great opposition on the part of those on the management's side to do their new duties and comparatively little opposition on the part of the workmen to cooperate in doing their new duties."

Source: "The Taylor and Other Systems of Shop Management: Testimony of Mr. Frederick Winslow Taylor," Hearings Before Special Committee of the House of Representatives to Investigate the Taylor and Other Systems of Shop Management Under Authority of H. Res. 90, Volume 3, 25 January 1912, pp. 1395

Isn't that the same problem that we have today?

Under such circumstances, is it credible to think that Taylor et al. alienated workers from their work? Given most managers' satisfaction with the status quo (military type of organization), work in hierarchical systems, coupled with division of labor, is intrinsically alienating to greater or lesser extents, and thus has everything to do with managers and nothing to do with Taylor who, after all, was trying to connect workers to their work and improve the service of business in society. *Remember, when people have a new management model to monetize, such efforts are required to be at odds with the facts*.

Professor Bob Emiliani
Please visit bobemiliani.com

What did workers think of Scientific Management? Did they feel they were dehumanized and turned into machines? Here are two short articles, one from 1910 and the other from 1915. For more on workers' perspective, see https://www.linkedin.com/posts/professor-bob-emiliani-660a72170_clarence-bertrand-thompson-audits-107-companies-activity-6786455361579700225-j624/

SCIENTIFIC MANAGEMENT AS VIEWED FROM THE WORKMAN'S STANDPOINT

What the Men Thought of the Methods Used in a Shop That Increased Its Production by Modern Methods of Handling Men

In the past few months there has appeared in the columns of INDUSTRIAL ENGINEERING considerable material on the scientific management of labor, its effect on the efficiency of the shop, and the benefits that will accrue to all hands by the adoption of its principles, rather than by adherence to the older type of "military" management. Much that has been written dealt with the question from the employer's side. Stress was laid on the fact that he could increase the quality and quantity of his product without the addition of new machinery. It was also stated that scientific management would totally eliminate labor troubles; of this last statement many owners and managers are probably skeptical, and perhaps with reason. It does, at first sight, appear improbable that a workman could be required to turn out from two to three times as much work as formerly, and have him remain contented at the same time. A skeptic of such a statement is fairly entitled to proof. We are now prepared to offer it.

In proving the statements as to the contentment of the worker, the employer's word need not be accepted. We can safely take his statements in regard to increase of product, and of quality of work, but for proof that the methods used to obtain this increase are not burdensome we must go to the men themselves. This the writer has done.

The Link-Belt Company, having shops at Philadelphia, Chicago and Indianapolis, operates these shops wholly under the principles of scientific management. In the main, the so-called "Taylor System" is in use. Modifications of the original system have been found advisable. One of the fundamental principles of scientific management is that all planning of the method of doing a job shall be done by a man, or men, especially trained for the work, and not by the man at the machine. Another is that the minimum time required to do a certain piece of work be accurately determined. The man is then given an instruction card telling him exactly how to do the work, and the time required for each piece if the instructions are followed. If the man does each piece in the time specified or less, he is given a certain price per piece. If he takes longer than the time specified, he is given another, and much lower, price per piece. This is what Mr. Taylor calls the "differential rate piece" plan of payment, and is the principal method used in the Link-Belt shops.

It was the writer's privilege, recently, to spend considerable time in the Philadelphia plant investigating the workings of the system of management there used, and its effects. As he was at one time, several years ago, and before the present scheme of management was installed, employed in this same plant, he was able to compare with some accuracy the results obtained under the old and new systems.

The officials of the company were most emphatic in their statements as to the value of the new order of management, which has now been tried for over five years. From his knowledge of previous conditions in the shop, which even in the earlier days was one of the best managed in the country, the writer could see that from the employer's standpoint scientific management was an unqualified success. He, however, was most curious as to its effect on the men. It was immediately suggested by the superintendent that he get the information at first hand from the men themselves. He was allowed to wander around the shop and question the men at will.

It is interesting to note that the men do not know of any particular system of management in the shop. They know that if they do what is expected of them the earning rate is high, and if they do not, the earning rate is much lower. They refer to differential rate system as "two-rate piece work."

Invariably all conversations with the men led back to the subject of the pay envelope, and in every case the man volunteered the information that it was the amount of money he received on pay day that interested him. He did not object to working in any particular way desired by the boss, provided that he was able thereby to receive a fatter pay envelope. He soon learned that he could turn out the greatest amount of work by following the instructions given him, rather that by trying methods of his own. Therefore, as one workman put it, "I'm doing the work so as to get the most money, and the boss's way is the best way I know."

The writer talked with many of the men. The burden of the talk of all was the same; they had to work steadily; they had to pay strict attention to business; they had to follow the instructions given to them; but, they made more money than they could in any other shop; the bosses helped them; the company treated them square, and you could not drive them out of the shop with a club.

A typical interview was that with one of the lathe hands. This man, at day work, was rated at 28 cents per hour. He stated that on the "two-rate piece work" his earnings were as high as 43 to 45 cents per hour. Questioned as to how much more he turned out at piece work than if he was on day work he said, "I don't know. You see it's been a long time since I was on day work, and on piece work we don't slow down any, for then we might get into the low rate, and we would make but little more than we do on day work." Asked then if he was not afraid that if he made high wages the rate would be cut, he replied, "No, the company's square. They never cut the rate. If they make a mistake and we made a little more than they wanted us to, they take their medicine and there's no kick coming." And be it known that when you have got a workman to say that the company is square, you have obtained the *last word on the subject.* There is *no higher praise possible.* And the *squareness* of the company is one of the most important factors in scientific management. We shall have more to say on this later.

"But," continued the workman, "if they make a mistake the other way, they fix it. If they give us a job and figure on taking two cuts over it, and we find the casting is made large, so that we have to take three cuts, or is hard so that we can't run as fast or take as heavy a cut as they want us to, or if anything happens that they didn't think of, so that it takes longer than they thought it would, all we have to do is to tell the gang boss. He puts it up to the office, and they make a new rate on the job. The mistakes are always on the company and not on us, if we do as they want us to." It will be well to keep in mind the above paragraph. It will explain to a great extent the duties of the "demonstrator" to appear later.

The workman was then asked if he had to work much harder at piece work than he would if the whole shop was on day work, to which he replied in the affirmative. "But," he added, "it's this way: it is rather steadier than harder. I'm after the coin; I'm going to work where I can get the most. If I could get more over at Midvale[1] than I can here, I'd quit and go over to Midvale, even if I had to work harder than I do here. I don't mind the work. I get more money for doing it than I would if I was on day work some place else, so I'm staying right here as long as I can make good." This statement led to the question as to how soon a new man was expected to "make good" at the necessarily high pace that was the standard in the shop. It transpired that plenty of opportunity was given to become accustomed to the existing conditions. New men are put on day work for from four to six weeks, until they catch the spirit of the place. They are then put on piece rate, and the incompetent automatically weed themselves out. If they cannot maintain the standard set, they make a very low rate per piece, and possibly earn less than they would at day work in a shop where the average speed of working is lower. They therefore leave of their own accord, and it is seldom necessary to discharge a man for inefficiency. Consequently, all the men average up to a high standard, probably much above that found in most shops in Philadelphia.

The man was then bluntly asked if he would rather be on piece work than on day work—they are sometimes put on day work if the job has not been standardized, or if no time-study of its conditions has been made—and he replied, "If you saw the long face on a fellow on day work for a week you wouldn't ask that. Why, his pay envelope looks so thin that you'd think there was nothing in it." From which it may be inferred that the piece work system, if conducted right, is not the unmixed evil it is often claimed to be by some misguided persons.

[1]Midvale Steel Works, an adjoining plant.

The man was next questioned as to spoiled work. It developed that if he spoiled a piece, he was expected to replace it on his own time— *i. e.,* he was not paid for the time required to make the new piece. He was also asked if there was much work spoiled. This subject was deemed important, as it has been claimed by opponents of advanced systems of management that the high speed required of the men is subversive to accuracy. The workman pointed out, clearly and forcibly, that he spoiled very little work. In the first place, he couldn't afford to. In the second place, in order to make the high rate he had to attend very strictly to his machine, and he did not allow his attention to be distracted while he was working. His instruction card told him plainly what to do, and if he followed instructions he could not go wrong. This testimony was later confirmed by the superintendent, who stated that the quality of work was much higher than it formerly was. In answer to a question as to whether he was any more fatigued at the end of the day than formerly, when he did not have to maintain such high speed, the man said he did not think he was. He said that he was kept so busy all day that he did not have time to think of being tired. Quitting time came before he thought it was near due. Finally, the man expressed himself as being thoroughly satisfied with his job, and convinced that he was much better off than before the company began to pay him the way it was now doing.

Conversations with other men brought out practically the same facts. They are all contented. They took pride in their work, and seemed to be especially proud of the fact that they were employed in the Link-Belt shops.

Mention has been made in one of the previous paragraphs of the duties of the "demonstrator." It is necessary under the system used in the Link-Belt shops that when the time in which a piece of work is to be performed is fixed and the instruction card bearing this time is issued to the workman, the company be prepared to demonstrate to any workman that the work can be done in this time. The writer had related to him by the demonstrator an incident which showed the value of this provision. The demonstrator in this case also happened to be the man who sets the rates on all the work in the shop.

The incident related by the demonstrator was as follows: A new turret lathe had been installed and it was decided that a certain piece to be made in quantity should be manufactured on this machine. The rate setter had had no opportunity to run the machine in question or to make any time-studies on it. However, from his knowledge of how the job had been done in other machines and from his general knowledge of machine work, he put a time of 23 minutes on the job. The card was issued to the workman early the next morning giving instructions for this job and showing him the time in which it should be performed. The demonstrator was prevented by illness showing up at the shop the next morning. The next day, when he appeared, he found considerable trouble in the shop. The man to whom the job had been assigned declared that it was impossible to do it in 23 minutes. He had appealed to the gang boss and to the superintendent who were powerless to change the time set in the absence of the rate-setter. The workman was naturally very much disturbed. The superintendent and the gang boss were somewhat stirred up, as the man was one of the best workmen in the shop and they desired to aid him. They suggested that the rate-setter either revise the rate or convince the workman that the job could be done in the time allowed. The rate-setter, who now became the demonstrator, after a short conversation with the workman, said that although he had never run the machine, he was sure that he (the demonstrator) could do the work in the time allowed. The workman offered to bet him that he could not do it in three trials. The demonstrator took him up and started in. On the first trial he made the piece in 23½ minutes; on the second trial he made in 22 minutes; and on the third trial in 19 minutes. The man who had been closely watching the motions of the demonstrator, then told him to get away from the machine, that if he could do it in 23 minutes, he was sure that he (the workman) could. On his first trial he made the piece in 21 minutes and subsequently, reduced the time to 17 minutes, which is now about what he usually requires on this job.

The rate-setter declared that 23 minutes was a very bad estimate on his part, and that if he had known the machine better, it would probably have been lower.

In many shops the temptation in this case would have been to cut the rate so that the man would have been regularly required to do the work in 17 minutes. The fact that this has not been done shows that the company thoroughly appreciates the necessity of acting fairly by its men and maintaining a rate when it has once been made. The fact that the company maintained this rate and others of like class, convinces the men that they have nothing to fear by working at their maximum pace and turning out the greatest possible quantity of work. They know that in no case will they be compelled to call the maximum rate, attained under probably exceptional conditions, the ordinary rate to be attained under any and all conditions. Because they thoroughly understand the necessity of keeping faith with the men is one of the reasons why the Link-Belt Company is able to retain in its employ such a large body of exceptionally fine mechanics, while working them at a much swifter pace than is the case in most every other shop in the country.

SCHEDULING LOCOMOTIVE REPAIR WORK ON THE CANADIAN PACIFIC RAILWAY

A Method of Handling Engines in the Shop Which Made For Economy and Produced Results

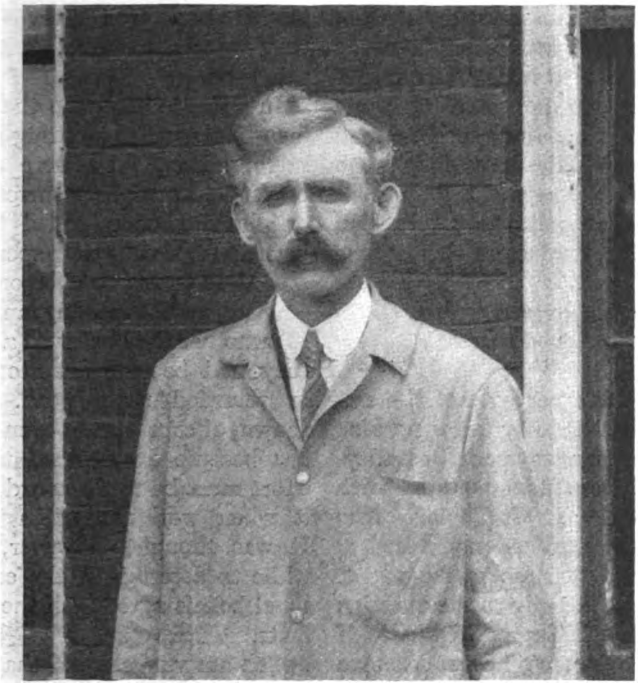
The Canadian Pacific Railway has adopted at its Angus shops in Montreal, a system of scheduling locomotive repairs, so that it can be definitely determined in advance just when an engine sent into the shop for repairs can be placed back in service. It has done more than this, for incidentally in scheduling the engine through the shop, it has eliminated friction between departments by squarely placing the responsibility for delays; it has definitely assigned to each department a task, to be done on a certain day, and has issued instructions as to how this task can best be performed in the shortest possible time; it has thereby reduced the cost of repairs; it has shortened the time that an engine is out of commission, thereby saving to the road the loss it would otherwise sustain due to the loss of the engine's services; in short, it has raised the efficiency of the entire plant a measurable degree.

Locomotive repairs are a perplexing problem on all railroads. The time that an engine is in the shop represents a dead loss to the road. While it is desirable to cut this time down to the lowest possible limit, it is yet necessary to make the repairs in such a manner that the intervals between trips to the shop shall be as long as possible. Consequently, any means which will enable the most complete overhauling to be done in the shortest time, is the most efficient. Due to the fact that many separate departments are involved in locomotive repairs, delays in putting the engine back on the road are liable to occur, and the responsibility cannot always be clearly placed. Inasmuch as the erecting shop must receive from the various departments, such as the boiler shop, foundry, machine shop, and stores, the various parts of the engine in a certain sequence, a delay in one department, which is required to have its part placed on the engine at an early date, will nullify all the good work of every other department, and may delay the completion of the engine for a considerable period. The Canadian Pacific suffered from these repair troubles like every other railroad, and a couple of years ago engaged the services of Mr. H. L. Gantt to supervise the reorganization of the Angus shops. This reorganization, while as yet uncompleted, has already progressed to a point where there is a marked improvement in the conduct of the locomotive department.

The system in use ties together absolutely the various departments concerned. When an engine comes into the shop, it is known in advance what must be done on it, and the date on which it must be delivered back to the operating department. Before a stroke of work is done, every operation that must be gone through is determined, and not only that, but who shall have charge of that operation, and when it shall be completed. The work is laid out so that the man responsible for the scheduling of an engine through the shop can tell, literally, at a glance just where each piece is, when it went there, and when it will be delivered to the erecting shop. He can also tell when each portion of the engine will be assembled, when it will be tested

System, The Magazine of Business, September 1915, Vol. XXVIII, No. 2

CASEY'S answers to the questions on which the accompanying article is based are typical of hundreds of others sent by thoughtful employees. He reads two Boston newspapers. He also takes two trade publications and one magazine devoted to fiction. He has read some histories during the last two years



THE two men in which Casey is most interested are Louis D. Brandeis and Samuel Gompers. He is among the minority group of the employees who knew of good will in the commercial sense – he defines it as: "A guarantee of honest value for money received and strictly square, honest dealings with confidence"

THIS is Thomas Casey, foreman of the cutting room of the Regal Shoe Company's plant in Whitman, Massachusetts. Before he was selected to be a foreman, he worked as a cutter. Casey is forty-seven years old and has been married twenty-five years. During the past twenty years he has saved nearly seven thousand dollars. Casey takes a keen interest in labor activities and as a result is well known among the men in the factory

"I think that a few more dollars spent on common labor would bring my employers more returns on their high-priced labor. I mean it would pay to give one man $1.75 or $2 to help three or four men that get $3. This would increase the output of the three-dollar men to a greater extent than the cost of one two-dollar man."

In an effort to bring out definitely just what contact the men have had with scientific management, as well as their attitude toward it, they were asked to tell: Whether they knew anything about Frederick W. Taylor and his method of shop management, what they thought about scientific management, and whether they would object to time studies of their work. The men were almost unanimously in favor of scientific management. Ninety-five per cent of them spoke well of it. Most of them qualified their approval, however, with an admonition that scientific management be directed by practical men and fitted to practical conditions when applied.

When it came to the question of time studies, the men were not as unanimous as they were in regard to scientific management. Over sixteen per cent of them flatly objected to time studies. One man stated that "time studies have done much to queer scientific management." A number, however, mentioned that they had been making time studies on themselves.

WHAT THE MEN THINK ABOUT SCIENTIFIC MANAGEMENT

Although but five per cent of the employees reported that they knew nothing about scientific management, seventy-seven per cent were unacquainted with the name of Frederick W. Taylor. And seventy-eight per cent had not heard of the Taylor system of shop management.

One of the men, in reply to the question about Frederick W. Taylor, replied: "I know but one Taylor, and he was foreman at our plant. He was under bigger heads, and it was under their system that he worked. He thought more of his men than he did of his job." But the percentage who did know about Frederick W. Taylor and his management methods gave fairly comprehensive replies, as this typical answer illustrates:

"Taylor developed the system of analyzing motions of operators with the object of establishing one standard method of performing a given task with the least number of motions, and, hence, in the shortest possible time."

A number of questions were asked that would reveal the attitude of the men toward various equipment problems. It has been shown that a machine which operates in a rhythmic manner in a good many instances reduces wasted motions to a minimum. In order to discover the reaction of this problem on employees themselves, the men were asked to express their opinion. Over eighty-nine per cent of them agreed that machines with which they work in a rhythmical manner are the best. Sixty per cent stated that there would be a tendency to speed up or slow down until they worked in unison with machines of this type.

In order to ascertain the opinion of the men in regard to working conditions and surroundings, they were asked: (1) If bright, clean, sightly surroundings, music or pleasant odors aided them to work better; (2) if they were spending considerable time trying to overcome distractions – noises, audible talking, and the like; and (3) whether they believed a noise to which they had become accustomed disturbed or retarded their work. It has been shown, of course, that even after a worker has become accustomed to a noise, an effort must be made in order to overcome it when working within earshot of it. It was thought, however, to be worth while to ascertain if the employees' personal beliefs agree with the demonstrated facts.

The answers showed that they do not, in a great many instances. Nearly seventy per cent of the employees asserted that a noise to which they had become accustomed did not retard their work. A few of the men, however, correctly held that even noises with which they were familiar disputed with their work for their attention.

Even more interesting results were obtained in regard to distracting noises. The replies indicate that no less than thirty-eight per cent of the employees believe that they are spending considerable time overcoming the annoying effect of audible talking and similar noises.

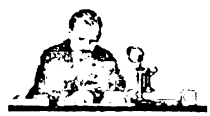
THE OPINION OF THE MEN IN REGARD TO THE SURROUNDINGS IN WHICH THEY WORK

An overwhelming majority of the employees agree that attractive surroundings help them to do better work. But thirteen per cent specified that music did not aid them, and sixteen per cent reported that pleasant odors were of no assistance.

The employees were asked several questions drawn up with a view to dis-

WHAT *the* MEN ARE THINKING ABOUT

THIS is an analysis of the employees' replies to a number of SYSTEM's questions. In several instances there were scattering answers which could not be computed under definite headings. These replies were included in the totals from which the average percentages given below were computed, but they are not listed. The last two sets of percentages represent the replies to a request to the employees to select from among nine widely known names those in which they are most interested and to answer this question: "What is good will?"



	YES	NO	FAVOR	DO NOT FAVOR	KNOW NOTHING ABOUT	IN DOUBT CONCERNING
MANAGEMENT						
Scientific			95%	None	5%	
Time studies			83.7%	16.3%		
Taylor system					78.3%	
Frederick W. Taylor					77%	
PROFIT SHARING						
Ford Plan			60.2%	4.8%	3.6%	27.7%
EQUIPMENT						
Does modern machinery favor the employment of women?	50.6%	46.7%	(2.7% felt that modern machinery favors women in offices and men in factories)			
Do you think machines with which you work in a rhythmical way are the best and reduce waste motions to a minimum?	89.1%	10.9%				
Do bright, clean, sightly surroundings, music or agreeable odors help you to do your work better?	94.1%	5.9%	(13% excepted music; 16.1% excepted music and agreeable odors)			
WORKING CONDITIONS						
Do you find that you are spending considerable time trying to overcome distractions – noises, audible talking and the like?	38.9%	61.1%				
Do noises to which you have become accustomed disturb you?	31.4%	68.6%				
Should executives be on the time clock?	62%	34%				4%
Do you think that a rhythmic sound would lead you to speed up or slow down until you worked in unison with it?	60%	36.6%				3.4%
EXTERNAL RELATIONS						
Are you studying to improve your earning power?	49.3%	38.9%	(11.8% did not supply information on this topic)			
MAN MOST INTERESTED IN						
Edison, Thomas A.	46.3%					
Ford, Henry	35.9%					
Brandeis, Louis D.	6.5%					
Gompers, Samuel	5.7%					
Smith, Adam	3.2%					
Redfield, W. C.	2.4%					
Showed knowledge of what "good will" means (in a commercial sense)	58.4%	41.6%				

covering their knowledge on definite business activities and their attitude toward problems more or less external to business. One of these questions requested them to describe any studies to which they were giving attention in an effort to improve their earning power. It developed that forty-nine per cent of the employees were studying, although the studies were not, in a number of instances,

WHAT *the* MEN READ

THE following analysis shows the type of reading matter preferred by the employees. SYSTEM asked them to specify what books they had read during the last two years and to list the newspapers and magazines which they read regularly. It is interesting to notice that while a considerable percentage of the employers are reading books concerned with the war, history and economics, the employees do not mention books dealing with these subjects. Since many of the men read literature in several of the fields listed, these percentages refer to proportions of the entire group interested in each field

NEWSPAPERS	
Daily papers	**97.4 per cent**
MAGAZINES	
Fiction	**94.0 per cent**
Business, technical and trade	**63.4 per cent**
Reviews and current events	**19.4 per cent**
Travel, geographical and outdoor	**10.0 per cent**
Socialistic	**6.1 per cent**
Rural	**1.2 per cent**
None	**3.8 per cent**
BOOKS	
Novels	**38.9 per cent**
"Classics"	**19.4 per cent**
Scientific	**9.0 per cent**
Very few	**7.7 per cent**
Business subjects	**6.2 per cent**
Bible	**3.0 per cent**
None	**22.2 per cent**

connected with their daily work – one man reported that he is preparing to be a "state embalmer." Another said: "After returning home from work, for three nights a week, and for three hours each night, I go to school in hopes of bettering myself."

HOW ONE MAN INCREASED HIS WAGES OVER FIFTY PER CENT WITHIN SIX WEEKS

A third mentioned the handsome returns he had obtained from his efforts to improve his earning power.

He said:

"For the last six weeks I have been attending a night class in tool design, three nights a week, and at the present writing am starting on a job of that kind, having increased my wages by sixty-six and two-thirds per cent."

Frederic W. Upham, president of the Consumers Company, pointed out in last month's SYSTEM the importance of every employee dealing with customers in such a manner that good will towards their employers' concerns would result. In order to ascertain if the average employee knows what the expression "good will" means when used in a commercial sense, a question on the point was asked. It was found that only forty-one per cent of the employees knew what good will signified commercially. From among this minority, however, some very interesting definitions of good will were obtained. Here are two examples:

"An imaginary value of much elasticity."

"In my case good will is that unknown quantity that makes me pass from other equally good stores, that I may buy from one particular establishment. It is a sense of value or service received, or perhaps personal reasons for desiring to spend my money where I feel I am known."

The employees were asked what magazines and newspapers they are interested in, and what books they had read during the last two years, in an effort to find out what general topics claim most of their attention. The answers establish that almost sixty-four per cent of the employees are reading business, technical and trade publications. Practically all of them read daily newspapers – some as many as four – and only 3.8 per cent are not reading magazines.

Novels are the most popular type of book among the employees, although nearly twenty per cent read standard works or classics. Three per cent read the Bible. Twenty-two per cent have not read any books during the last two years. The complete details of the reading done by employees are tabulated in the table on page 236.

The books read by some of the men are of interest. For example, one man has read during the last two years works by Thomas Paine, Rousseau, Voltaire, Spencer, Huxley, Haeckel, Serviss and Larkin. Another lists Milton's Lycidas, L'Allegro, Il Penseroso, Tennyson's Idylls of the King, and Shakespeare's Macbeth. A third has confined himself to Dickens and Homer; a fourth has read: Darwin's "Origin of Species" and Spencer's "Spontaneous Generation" and Cesare Lombroso's works on criminology.

The names of nine widely known men and women were listed in one of the questions, and the employees asked to designate those in whom they are most interested. The answers to this question indicate the type of achievement in which the employees are interested. They are tabulated in the table on page 235.

Another question asked whether or not department heads should "punch the clock," if their subordinates were on a time-clock registration system. Thirty-four per cent of the employees think that department heads should not punch the clock, and give reasons to support their belief. Five of these reasons follow:

WHAT THE MEN THINK ABOUT "PUNCHING THE CLOCK"

"A department head or an executive should prove the inefficiency of the clock system by being always ahead of time."

"Department heads should not punch the clock because it submerges individuality."

"If a man is big enough to hold the position of department head he should be considered big enough to be away from the clock."

"The executive's value is not measurable by the time he spends in the shop, office or at his desk."

"Department heads should not punch the clock because it is presumed they are efficient and reliable, and it would be inconsistent with the dignity of their positions to put them on the clock."

Finally, in order to discover the scope of the executives' grasp of typical business subjects, they were asked:

"Assuming that your company needs an addition to its factory, costing $150,000, and that it has a surplus of $100,000 on deposit drawing three and one-half per cent interest, that it can make money earn nine and three-fourths per cent and borrow on its notes at four per cent, what method of capitalizing the addition would you recommend?" Thirty-eight per cent of the executives said they would borrow on four-per-cent notes; and thirty per cent decided that they would use the surplus first and then borrow.

So much for the cross section of the attitude of over ten thousand employees toward practical management problems. How it compares with a similar indication of the opinion of two hundred and fifty employers can be ascertained from SYSTEM for October, which will contain pages assembling the results obtained from the poll of the employers.

Linkedin

Professor Bob Emiliani

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A familiar dilemma -- work, wages, and profits -- solved by Scientific Management. James Mapes Dodge was the Art Byrne of his day. He was president of the Link-Belt Company. "Dodge's personal involvement and personality made this happen. He had offered the workers special arrangements and incentives to accept Taylor's changes, which won him much respect and trust from the workers." Learn more about Mr. Dodge here https://en.wikipedia.org/wiki/James_Mapes_Dodge

Industrial Management[1]

Scientific Management as Related to the Plant or Industry in Its Entirety

BY JAMES MAPES DODGE[2]

My experience in Scientific Management dates from before the time when Mr. Frederick W. Taylor published his epoch-making paper on "The Art of Management," some ten years ago. Having enjoyed the intimate friendship of this gentleman, and being in close touch with his work, I watched with great interest the introduction of the Taylor System in our Philadelphia plant, which was done at the same time that the system was introduced in the works of the Tabor Manufacturing Company, Philadelphia. These two plants were the first ones to adopt the Taylor System in its entirety, and in both it was successfully introduced, and has now been working for a number of years.

I quote from the sworn testimony before a special committee of the House of Representatives of the United States, investigating the "Taylor" and other systems of shop management in 1912. Two members of the special committee of three are now members of the Cabinet of the President of the United States.

"I had full opportunity to see," in speaking of a manufacturing plant operating under the Taylor System, one of the witnesses before that committee testified, "all of the books and figures, and nothing was more impressive to me than the fact that this company with approximately the same number of men and machines as was used under the old system, was turning out three times the production; that it was giving 73 per cent higher wages to workmen; that it had made a 25 per cent reduction in the selling price of the machines; thereby producing so much saving to the consumer. Moreover, this company, which had lost money before the introduction of Scientific Management, was now and had been making a good profit; that from a condition of strife and inharmonious relations before the introduction of Scientific Management there had come about the friendliest of feelings between the management, workmen and outsiders."

I might add that this statement at the present date would apply in substance to a number of establishments in the United States. I had the pleasure of going over this paper with Mr. Taylor, and would state that it met with his hearty approval.

Scientific Management, in its presentation to the world, of necessity was exploited as a codification of the best-known details having to do with the industrial worker in the shop primarily, and his correlated workers in the office secondarily, and accomplishing what has been admirably designated as "the transference of skill." As time moved on, these two groups of individuals have received the greater share of attention separately, and of necessity, in order to establish a working basis, this course was the only one open to Mr. Frederick W. Taylor and his followers.

During this period of about ten years' duration a most important phase of the subject, while well known and prophetically recognized by Mr. Taylor, has not been prominently exploited in the literature of the movement.

No more fitting opportunity than the present one could possibly be afforded to present this view of the subject, which is that Scientific Management in its highest development has to do with the plant or industry in its entirety, increasing the earning power without disturbing the percentage of the gross profit which goes to the wage earner as compensation and to the proprietor as net profit, and increasing the monetary return to each without any change in these percentages, or without either party benefiting to the detriment of the other.

No business has a fixed percentage or amount of profit connected with it. The net gain of any establishment fluctuates from many causes. Of course, every line of business is affected by general trade conditions. Thus, national depression causes individual curtailments of profit, whereas national prosperity augments individual gains, but, quite independent of either of these general or national conditions, Scientific Management manifests itself by increasing the profits of a business at *all times*—in good times by increasing them beyond what we may call the normal or average, and in bad times by preventing the curtailment of profit as much as might otherwise be the case.

If an establishment is conducted both in its manufacturing and executive departments in an unscientific manner, it is obvious that its net profits are not so great as they would be if the management were under the highest type of scientific direction and control. In other words, there is an augmentation of profit through proper management of the establishment as a whole, and it goes without saying that this condition calls for co-operation in the highest degree between all those connected with the plant. This co-operation will result in increasing the profits, and therefore the concern will have to its credit more money than it otherwise would, and it is from the division of this extra profit that the owners and operatives can rightfully obtain reward for their joint effort and general betterment.

To illustrate, I might say that a certain concern is making a net profit of $100,000 a year. The wage earners feel that they should have an

[1] An address to the joint meeting of the Verein Deutscher Ingenieure and the American Society of Mechanical Engineers, at Leipsig, Germany, June 24, 1913.

[2] Past-President, The American Society of Mechanical Engineers, Chairman of Board, Link-Belt Company, Philadelphia.

orders were from four days to three weeks behind, the box shop is now delivering boxes to the factory, from one hour to five days in advance of the time they are needed.

increase in wages. The management is well satisfied, considering the investment and the effort they make, that $100,000 net profit is none too much, and if anything, is too little. Each side feels that the other should give way, the wage earners that part of this $100,000 should be handed over to them in the shape of wage increase, while the proprietor believes that the workingmen are already receiving too much and that their wages should be curtailed and the profit to the management increased above the $100,000 mark.

It is beyond the scope of human knowledge to decide whether the balance between the employer and the employee is exactly right or not. All that we can judge by is the average. If we could tell what the average earnings are in a given line of industry, and what the average profits are, we might assume that these figures, having been arrived at through a long period of time and experience, are nearly, if not, in fact, exactly right. How is it possible for either side to secure greater compensation without working hardship to the other? It would seem that there is only one possible solution, and that is to increase the net gain by increasing the output, thus enabling the employers to increase their earnings and also the wages of their employees. It is obvious that if this is done the percentages, representing wages on the one hand, and net earnings on the other, need not be radically changed for either side in order that there may be an increased return to both, because the amount to be apportioned has been increased. This is what Scientific Management can accomplish and is accomplishing today.

The very foundation of Scientific Management is increasing prosperity by intelligent co-operation. It is known to all that industrial unrest comes from the lack of agreement as to what shall be the division of the earnings of an establishment.

Bad management and exploitation of an industry hold down the profit, and if at the same time the workers feel that they are doing their best and should receive more wages, we have a condition leading to mutual mistrust and consequently industrial disagreement, the result of which we all know only too well. If, on the other hand, the management of an establishment is all that can be desired in the matter of its accounting, selling and advertising, and other departments, and the shop is behind either because of obsolete machinery or inefficient, untrained and dissatisfied operatives, the same results may be looked for, that is, discontent, mutual distrust and strife. If, however, the fact is recognized that neither employer nor employee is alone to be benefited by the introduction of Scientific Management, but that it is essentially and necessarily a matter of mutual good, enlightenment and co-operation, it puts a new phase on the matter.

In its essence, Scientific Management involves a complete mental revolution on the part of the workingmen engaged in any particular establishment or industry—a complete mental revolution on the part of these men as to their duties toward their work, toward their fellowmen, and toward their employers. And it involves an equally complete mental revolution on the part of those on the management's side—the foreman, the superintendent, the owner of the business, the board of directors—a complete mental revolution on their part as to their duties toward their fellow-workers in the management, toward their workmen, and toward all of their daily problems. And without this complete mental revolution on both sides Scientific Management cannot exist.

If the employer feels that Scientific Management is merely a method by which he makes his workmen exert themselves very much harder, and entirely to his own gain, he had better abandon all consideration of the subject and stick to his present methods, or else go out of business. If, on the other hand, the workingman feels that Scientific Management is simply an ingenious scheme to exhaust him physically, and permit all his other conditions to remain as they are, he too is in an unfortunate intellectual state. It is necessary for both of these interested groups to realize that they must change their view and earnestly desire to assist each other.

Obviously, if the workingman desires more wages under existing conditions, whatever he obtains in excess of his present compensation must be deducted directly from the profits of the concern, and if the proprietor feels that he must for his own comfort increase his profits, and his vision reveals to him only the total of his pay-roll, from which he proposes to extract enough to make him happy, then both are grievously at fault, and are working hopelessly in the wrong direction.

If, however, the employer will recognize that each of the names on his pay-roll represents a human manufacturing unit, entitled to a fair and living return on its physical and mental investment, and in addition thereto a reasonable profit to cover other things besides food, clothing and shelter, a proper frame of mind will be established mutually to give that which is most desired, the highest reasonable and proper recompense for effort and investment.

If this mental attitude can be made permanent in both the employer and employee, and each recognizes the necessity of increasing the output in order to increase the net gains, then Scientific Management comes to its own and the greatest good that it is possible for it to bestow can be given to all, and the artificial barrier between the employer and employee removed for all time.

The practical method of obtaining this most desirable end is for Scientific Management to act as a medium between the class of employers and the class of employees and to train and educate them both at the same time. The first lesson is that mutual confidence can take the place of mutual distrust, and this effort carries with it the first change of mental attitude. The employer must understand that the fact of his outranking the employee does not necessarily mean that he possesses all of the necessary knowledge and experience needed in directing him properly. In other words, he must not think that because he is in a commanding position there is nothing for him to learn. On the other hand, the employee must change his mental attitude and realize that the title of workingman, machinist, patternmaker, or whatever it may be, does not give him a universal knowledge of his trade, but that the employer may have useful knowledge to impart to him. In turn the employer may acquire useful and desirable information from the workingman. Scientific Management is the clearing house standing between them, the principal work of which is to make this demonstration so clear that both sides will appreciate it and understand it. After this is accomplished, nothing is left but the arranging of the mechanical and clerical details, which can be readily and satisfactorily done.

The next result is that the employer and employee mutually understand and aid each other, and Scientific Management, although present and ever pervading, ceases to be apparent because it has been absorbed by both sides and continues to do its beneficial work without exciting comment. This condition actually does prevail in all the shops and establishments in which Scientific Management in its entirety has been introduced and has become an organic part of the establishment. In other words, were a stranger to visit a shop in which Scientific Management has been in full operation for a few years, and ask any one in the establishment, with the possible exception of a few having the upkeep of the system directly in charge, what system, if any, they were working under, he might be surprised to find that none of the clerical or productive force knew that there was any special system in vogue, since they had become so accustomed to the conditions, and so well satisfied with them, that the name of the system under which they were working would be of no importance, and if ever known, had been forgotten.

It is well to bear in mind that this question of mental attitude is a matter of much more importance than is commonly supposed, since Scientific Management stands in direct contrast with the older or what has been aptly called the Military System of Management. Writers on this general subject have pointed out very properly that the military idea does not represent the best form of industrial or civil management. Its idea is based on military methods, in which under the best conditions a man is carefully trained from the position of private, step by step, until he attains the highest rank, having mastered the details of each step in the ladder of advancement. The science of war is a very highly developed one, so that a mentally diligent officer can add to his personally acquired knowledge by means of literature on the subject, and consequently be eminently fitted to command and lead.

Such an educational possibility, except in very rare instances, does not exist in industrial and commercial development. While a few of those in commanding positions in industrial life have risen from the ranks, a large percentage attack the problem from the top, and consequently have but a theoretical knowledge of the conditions surrounding the employee and of his mental attitude. Placed in the position of command, they are apt to assume that the position carries with it all necessary knowledge, and therefore that blind obedience is to be demanded and accorded. The workingman feels that he is in possession of knowledge which his employer possibly has not, and that the employer makes mistakes not only in the instruction which he may impart but also in failing to surround the workmen with proper facilities wherewith to meet the demands of his work. In this case the employee loses respect for the man ostensibly over him and is stung with the injustice of the situation. In the absence of the harmonizing influence of Scientific Management, the two parties never understand each other sufficiently to realize that their interests are identical, and not opposed to each other.

What then should be the attitude of both sides? The employer should pay as high wages as is properly possible and should make the employee physically comfortable, giving him sanitary surroundings, which are the first requisite to physical and therefore mental comfort. He should next provide him with every proper facility for performing his work, as the soldier is provided with proper clothing, equipment and firearms, and without which it would be ridiculous and unjust, and if avoidable, really criminal for the commanding officer to make demands upon him. For instance in a shop, bad water and light, insufficient ventilation, lack of proper heat, bad tools, etc., all conspire to render it impossible for the workman to do himself or his employer justice. Nevertheless, in many cases everything is demanded and facilities are woefully lacking, making it therefore impossible for the employee to respond satisfactorily.

Now, if scientifically attempted, and with the proper sympathetic regard, it soon becomes apparent to the workingman that the information that is given him, with a view to aiding him in the performance of hiw work, is correct and in advance possibly of what he has known before. This is an important step inspiring confidence. Then, if the tools are properly selected, and supplied him, his environment made comfortable, and his whole endeavor surrounded by rational aid, this feeling of confidence and regard for his employer becomes a fixture in his mind and being. If, while this is going on, honest effort is made by the employee to perform his work, the employer is impressed with respect for the workman, and this respect and a growing confidence in him gives the employer and the employee a better understanding and a high appreciation of their mutual values in the success of the establishment.

After these conditions are brought about, all else is easy, and simply calls for an expenditure of time, patience and a desire to aid and assist. The details of Scientific Management so far as methods of time-keeping, pay, time-study, and all that goes with it, have been ably presented, and I do not deem this the proper time to say more in regard to these details of the problem. It is sufficient to say that no one of these details is absolutely essential. All may be modified, provided that in making the modifications positive conflict with other details is not developed.

Professor Bob Emiliani

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Page 1 was written by Henry Kendall. He was a manager at Plimpton Press, the site of a successful "installation" of Scientific Management. Page 2 was written by Henry Gantt, a close associate of Frederick Winslow Taylor. Page 1 is very good, but Page 2 is even better!

Prerequisites to Scientific Management

A Symposium which Considers the Attitude of Management and Men, and the Misleading Effect of Wrong Standards

THE ATTITUDE OF MANAGEMENT AND MEN[1]

By Henry P. Kendall[2]

Attitude and Support of Management.—One of the most important things which the devotee of Scientific Management has to do in endeavoring to have it installed in his particular plant, is to get the management, as far down as the foremen, if possible, to really believe that it is something which is going to help the business, and help their own individual work; that it is fundamentally right, and that it is possible to develop it in the business, even though they cannot see the direct application of it. Weeks or months spent in doing this will help tremendously when the work is once under way, but it is always a handicap to the men doing it when there are those higher up that they feel are not in sympathy. Also the opportunity is given to foremen and superintendents to get the ear, and more or less sympathy, of those higher up, who are in the other camp, so to speak.

The Proper Mental Attitude of Foremen and Office Men.—The mental attitude of those who are among the earliest to feel the effect of any change is important. A lot of work goes slowly because the men's minds develop slowly or not at all. Some foremen have taken the attitude that the thing must be right if the management believe it is so, and that it is up to them to so thoroughly post themselves that they will believe it also; and some men have had a real struggle to develop the right mental attitude in themselves, when the spirit that prompted it was the spirit of loyalty to and faith in the concern. Oftentimes this spirit of loyalty and faith in the concern becomes a vanishing point when the actual changes and inconveniences of developing Scientific Management begin to affect them. Too much importance cannot be given to this feature.

General Survey and Outline of the Work.—Insufficient time, as a rule, is taken to make a general survey of the manufacturing problems, and then to plan out a theoretical outline or chart of just the way the Scientific Management is going to be developed, and the form in which its possible phases will shape up. Too often we feel that such a system must apply, and it is only necessary to construct the paraphernalia and then to make it work. We have recently been working on a little different plan in connection with one plant which is having Scientific Management installed and in which even the workmen themselves are hardly aware that it is going in. We have taken plenty of time to study, formulate and develop the theoretical application of the system, and then are applying this in spots, each time building with an idea of the whole. In every business where there are many departments, and much complexity in the manufacturing, this plan is not absolutely feasible, but it seems to me that more and more attention should be paid to doing this thorough, careful, preliminary constructive work.

Difficulties of Installing.—Scientific Management creates in its advocates a spirit of intolerance of a thing which is not exactly right. This reacts on the mind of the person installing it, in making him over-cautious or hesitating in starting practical work, or in starting task and bonus, for instance, until he has everything else done. And in looking for everything else to do, he can find so many little things that the main thing, the task and bonus, is likely to wait an undue length of time.

In the "Vicar of Wakefield," the vicar says that at seventy-two prudence is likely to be our only virtue left. Prudence, another word for caution, is likely to occupy a disproportionate place in the minds of many installing the work. Mr. Taylor has, in a number of conversations, impressed upon the writer the fact that task and bonus must be started early, because when that is once done, it adds the extra stimuli to getting the other things working right.

There is another thing which is absolutely essential, and the lack of which is likely to decrease the enthusiasm and energy which have already been worked up to a certain pitch. That is, the ability to bring things to pass when the preparatory work has been done. It is quite possible for a man to have the paraphernalia of routing several months after the time when the routing should become a fact. The ability to take the men in hand, set them to work down to a point where it becomes a fact and an actual power and force in the establishment, is a quality which should be developed, and the development of which is absolutely necessary to the success of Scientific Management.

In the training of salesmen, by the so-called salesmanship schools, they bring out the fact, when possible, that a salesman should work the customer up by thoroughly well-recognized and legitimate methods to a point where he is ready to make a decision. Then, if the salesman cannot discover that time, and bend himself quickly to making the customer decide, he can easily, by a continuation of his tactics, work the customer right down on the other side of the hill in full retreat, and lose his whole opportunity of securing the decision to purchase.

That is true also in installing Scientific Management. There is a time when the preparatory work, the interest and enthusiasm of the help-

1 A paper read before the Society to Promote the Science of Management, March 21, 1913.
2 Manager, Plimpton Press, Norwood, Mass.

ers, should be at once turned into effective operation, and if the preparatory work is carried too far, the interest wanes, and it is just so much harder to get it going again.

THE MISLEADING EFFECT OF WRONG STANDARDS[1]

By H. L. Gantt.[2]

In considering what action it is necessary to take to pave the way for the introduction of Scientific Management, the first idea that strikes us is to catalog the obstacles which we are likely to meet in the work. These obstacles are different in different plants, but there is one which is common to almost all manufacturing establishments. It is particularly evident in such plants as are controlled by owners or financiers at a distance, who take their information and advice from their expert cost accountant. Not long ago I said to an assembly of business men, that we had had during the past fifteen years an epidemic of cost accountancy in this country, and if we had had an epidemic of Asiatic cholera instead during that space of time the detrimental effect on our industries could hardly have been greater. This is stating the case mildly.

For purposes of accounting, many accountants arbitrarily divide people in a factory into producers and non-producers; they assume, for instance, that the clerk who collects the information by which the workman is governed, and the draftsman who makes the design, are non-producers, while the man who operates a machine tool is a producer. They assume also that the factory in which the ratio of non-producers to producers is the smallest is the one which is being operated most efficiently. In other words, that factory which has a small office force, and which sends incomplete information to the shop, to be bungled by a large number of workmen, is more efficiently operated than the factory in which a large and intelligent office force sends into the shop exact information of what is wanted, and how it is to be done, in such a manner that a small and intelligent shop force can do the work quickly and economically. In the former case this ratio is smaller, and according to the standard, indicates efficiency, while in the second case it is much larger, indicating by the same standard, a shop which is run inefficiently. By the same standard the superintendent who has replaced ten workmen by an automatic machine has made his shop less efficient.

Also, the superintendent who uses a skilled workman, a man who can perhaps do three times as much as the ordinary worker, to teach the untrained men so that they may at least do twice as much work, is making a mistake. Such action increases his non-productive expense, for an instructor is usually put in the non-productive class, and diminishes his productive expense, sending up the ratio, which is used by the financier as an indication of inefficiency. Too often this ratio is considered of more importance than the actual cost. Examples of this kind of criticism might be multiplied almost indefinitely, and they are most common where expert accountants have had the fullest sway. Many of our large corporations having come under the domination of the financier and his right-hand man—an expert accountant—are forcing themselves into a condition of inefficiency by the strict application of this standard. Fortunately, however, many of the smaller establishments have not fallen under this hypnotic influence and are still trying to make advances by introducing automatic machinery and by training their workmen, ignorant of the fact that they are breaking all the rules which some accountants hold so sacred.

If, therefore, we wish to promote efficient operation, we must first counteract any such influence which may have been established in the works, and change the viewpoint of those in authority so that they may see clearly that this ratio bears no relation whatever to the efficiency with which the work is done, and that the only available test by which we can measure the progress in a factory is the one of total cost and total production.

The other idea which we must combat is that high wages necessarily produce high costs. Inasmuch as the total labor cost on a manufactured article is seldom more than twenty per cent of the whole cost, including fixed charges and selling expense, an increase in wage cost of ten per cent adds only two per cent to the cost of the article. Inasmuch as an increase in wages of ten per cent, if given in the proper manner, will invariably increase the output in a much greater ratio, thereby bringing down the fixed charges in the same ratio, it is seldom that an increase in wages, if made to depend upon services rendered, does not actually reduce the total cost of the article produced.

To summarize: As a preparation for the introduction of Scientific Management we must first counteract the misleading influence of wrong standards, and next take the proper steps to get those in authority to see that we can afford to pay the workman well for a large production, for the additional wages we pay will almost invariably be more than offset by the reduction in fixed charges per unit of product.

[1] An address to the Society to Promote the Science of Management, Mar. 21, 1913.
[2] Consulting Engineer, 149 Broadway, New York.

Aluminum of high purity is less readily acted upon than that of lower purity. The presence of sodium and copper in the metal increase the rapidity of corrosion. Well-annealed metal is more resistant to corrosion than unannealed metal. In general the corrosion of aluminum is a process of oxidation, and, as a matter of fact, metal exposed for several months to water or salt solutions from which the dissolved air has been expelled undergoes no corrosion whatever. The normal course of corrosion excluding the action of acids and alkalies, is thus a transformation of aluminum into alumina, which separates as a flocculent precipitate without any of the aluminum passing into solution.—G. H. Bailey.

Brass wood-screws are made without any lead in the brass mixture, in order that the heads may be formed by upsetting.

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A great article highlighting the struggle to "install" Scientific Management" and the benefits that resulted from success. Wilfred Lewis was the president of Tabor Manufacturing Co. Note that back in 1911, "efficiency" was synonymous with "productivity." Learn more about Mr. Lewis here https://en.wikipedia.org/wiki/Wilfred_Lewis special arrangement of boiler, economizer pipes, superheaters in exhaust, etc., 50 per cent of the waste heat should be recoverable. Taking the efficiency of conversion at 80 per cent, four pounds of steam should be generated per B.H.P. of capacity ($12,000 \times 0.50 \times 0.80 \div 1,185 = 4$). The steam cylinder used would be similar in type to that of the two-cycle gas engine—*i. e.*, with no exhaust valves, and similar to that of the Stumpf unidirectional engine [see p. 32, INDUSTRIAL ENGINEERING, July, 1910], the jacketing of the ends being done by exhaust gas. Such a cylinder will give 1 B.H.P. from 12 lb. steam. This gives a power from the steam cylinder of one-third that of the gas cylinder, and consequently reduces the consumption for total effective power to 9,000 B.T.U. per B.H.P.-hour, or less than for the economical gas engine alone, which requires 9,500 B.T.U. per B.H.P.-hour.

The total cost should be less, for we have, taking approximate prices]English.—Ed.] of gas engines at $25 per I.H.P. and steam engines at $15, three-quarter gas engine at a reduced cost (lower pressures), say, $20 per I.H.P., one-fourth steam cylinder (less special crank and valve drive, but including exhaust boiler) at $15. The approximate comparison then per I.H.P. is: Gas engine, $25; steam engine, $15; compound engine, $18.75. A gas engine with an auxiliary steam cylinder has other advantages outside economy. It is an excellent method of starting the engine, or for marine work for reversing, and it provides a means for the gas engine taking a considerable overload, so that considerable progress may be looked for in this direction in the near future, as well as in other and more novel forms, as the Humphrey, turbine, Brayton engines, etc.

AN OBJECT LESSON IN EFFICIENCY[1]

The History of a Plant for Which Scientific Management Spelled the Difference Between Success and Failure

BY WILFRED LEWIS[2]

Public attention has recently been drawn very pointedly to the subject of Scientific Management, and the Tabor Mfg. Co., of which the writer is president, has frequently been cited as an illustration of what has already been accomplished along the lines laid down by Frederick W. Taylor.

Prior to my connection with the Tabor Mfg. Co. in 1900, the whole of my active business life had been devoted to the cause of efficiency in machines, and I believe with some measure of success, but I had yet to learn the value of good management in the development of men, and the greater importance in business life of efficiency in men as against efficiency in machines.

As then organized and conducted in 1900, the business was rather commercial in character. The machines were built on contract to our designs and the activity of the company was directed chiefly toward their sale and demonstration. I soon found a number of details in which the designs could be improved, but as a promoter of sales, I was entirely out of my element. I proposed, therefore, that we should have a shop of our own and begin to realize whatever profit there might be in manufacturing.

CONDITIONS UNDER MILITARY MANAGEMENT

At this time I was advised by my well-wishers to keep an open shop and keep down the number of clerks or non-producers. Success, I was told, depended upon the ratio of producers to non-producers in any well-managed concern. Draftsmen were recognized as a necessary evil, the fewer of whom the better, and one good superintendent to

[1] A paper read at the Congress of Technology, Boston, April 10, 1911.
[2] President, Tabor Mfg. Co., Philadelphia.

lay out the work and keep it moving through the shop was considered quite enough. In fact, to the casual observer, we had hardly enough work to keep a good man busy and we did not appreciate the need of better shop management until our growing business began to show increasing losses. Before we were aware of any dissatisfaction, also, and within a year of the opening of our shop, we were surprised by a general strike for higher wages and shorter hours. Our unguardedness or lack of management had encouraged our men to combine against us and make unreasonable demands. We were then paying them more than they earned and they insisted upon having still more, which simply meant ruin to the company in a shorter time. Our strike was compromised by the concession of shorter hours at the same pay, the men agreeing to turn out the same amount of work per day. There was no difficulty about their doing this, and for a time, I believe they kept their promise, but a day's work was then with us, as it is now with nearly the whole world of industry, a very variable and indefinite result for a given expenditure of time or money. We had no standard by which a proper day's work could be fixed except the very shaky and misleading one of the best that had been done before, and having, as we were now well aware, an organized resistance against any increase in output or efficiency to meet, the outlook for the company was not encouraging.

Financial Difficulties

At the same time we knew that machines had been built by others for less than they were costing us, and we felt confident that a way could be found out of our difficulties. But we were obliged to sell stock and borrow money for several years, until it seemed unreasonable to expect any further financial aid. Fortunately my good friend, Taylor, who was then writing his remarkable essay on "Shop Management," came again to our assistance and offered to loan us more money if we would agree to put in his system of management. We were only too glad to do this, without having any conception of what it really was or would finally mean to us. Accordingly the money was advanced and in due time the installation of the Taylor system was begun.

Advance sheets from "Shop Management," which was read before the American Society of Mechanical Engineers in 1903, were sent to me as they were written and Mr. Taylor himself gave some personal attention to the introduction of his system. The enormous amount of detail involved required, however, the constant attention of a trained expert and we were fortunate at the outset in securing the services of Mr. Barth, one of Mr. Taylor's assistants in his reorganization of the Bethlehem Steel Co. We had nothing in the nature of system that fitted in or was worth preserving, and Mr. Barth was obliged in the first place to lay the foundation for the structure he proposed to rear. This meant a lot of preparatory work for which there was no immediate use and from which no return could be expected until other features were introduced.

The Beginning of Scientific Management

In the meantime the business had to go on, while those engaged in running it were subjected to more or less inconvenience by the changes proposed, and these led to a good deal of irritation and dissatisfaction in certain quarters. In fact, it was not long before a revolt began to be felt which was not confined entirely to the shop. At this crisis Mr. Taylor recognized the futility of attempting to reorganize a house divided against itself and insisted upon his right to direct the introduction of his system according to agreement without obstruction or interference in the shape of adverse criticism, and for a time the good work went on without active opposition perhaps, but certainly without the hearty good will most needed from within. Mr. Barth was obliged, as he proceeded in his work, to call for more and more assistance, and as new men were added to our planning department, the cost of the new system began to draw so heavily upon our resources that for a year or two we seemed to be actually losing ground, and we certainly would have been obliged to suspend but for the grit and determination of Mr. Taylor, who had the courage of his convictions and carried us through the storm which culminated in the resignation and withdrawal of the opposing forces.

From this time forward conditions began to improve, and the work began to bear fruit. It was not long before we ceased to lose money, broke even and began to gain. A better spirit prevailed, better wages were earned, and production increased so rapidly that I was lost in astonishment at the potency of the engine gratuitously placed in our hands. We had in effect been installing at great expense a new and wonderful means for increasing the efficiency of labor, in the benefits of which the workman himself shared, and we have to-day an organization second I believe to none in its loyalty, efficiency and steadfastness of purpose. Its loyalty was tested a year ago at the time of the general strike when the streets of Philadelphia were filled with thousands of idle men bent upon inducing others to join them. Out of the 150 then employed, but one man failed to resist the pressure, and he was paid off without regret as one of our least efficient workers.

I have given the above brief history of my experience to emphasize the adverse conditions under which the Taylor system was installed and carried on to a successful conclusion. I do not believe so much opposition will ever be encountered by others, because carping criticism has been subdued, if not yet silenced, and successful methods are sure to be emulated; but more or less resistance is always to be anticipated, because any change, however slight in management, may be taken as a reflection upon previous methods of reaching the desired end, and therefore as personal to the advocate of discarded ways and means.

The suppression of personal pride and prejudice, with the disposition to seize and adopt the best ideas to be found anywhere, has been a great help to the scientific habit of thought under which the Taylor system of scientific management has been built up and will continue to grow. Differences of opinion may arise and different conclusions may be drawn from the same evidence, but a body of fundamental principles has already been established by Mr. Taylor which may safely be taken as the nucleus for a new science of management. As in any other science these fundamental principles must be subjected to rigid analysis and demonstrated in a practical way by successful performances, seeking always "truth for authority and not authority for truth."

The advice given me eleven years ago about keeping an open shop and weeding out the non-producers was good orthodox business gospel at that time, and it would no doubt still be endorsed to-day by 95 per cent. of the manufacturers in this country, who would also subscribe to the principle of one supreme authority delegated and subdivided among subordinates on the military plan, as the only practical type of management for any business.

But who knows, when he has an open shop, to what extent it may be filled by conspirators ready to take advantage of the first opportunity to make unreasonable demands, and how can loyalty be fostered and encouraged throughout all departments of a diversified business? How comes it also that a large increase in the force of non-producers can be made to effect such an enormous increase in output?

The Results of Scientific Management

In 1910 the Tabor Mfg. Co. turned out two and one-half times as much value in finished product as it ever did under the old *régime* with the same force. Formerly for every ten men engaged as producers, or "chip-makers," as Mr. J. M. Dodge defines them, we had not more than one man connected with the shop as a non-producer. Now we have fewer men at the machine with three times as many non-producers turning out practically three times as much work, because as prices are lower to-day than they were five or six years ago and two and one-half times the value means about three times the product.

To explain in detail these anomalous results would carry me far beyond the limits of this paper and call for the elucidation of a system which had better be studied at first hand in the admirable series of articles by Mr. Taylor now appearing in the *American Magazine* and the "Principles of Scientific Management" just published by Harper & Brothers. At the same time the type of management under which we are working should be seen in operation to be fully appreciated, and I must confess that in the beginning, eight years ago, I gathered very little about it from my perusal of the advance sheets on "Shop Management." The fact is that the system is so engrossing and calls for so much undivided attention that it is almost futile for any one actively engaged in meeting customers, providing for their wants and collecting accounts, to undertake its installation single-handed. The reorganization should therefore be left to an expert who is not hampered by the necessity of running the business.

Difficulties With the Men

It is not an easy matter to start any innovation in an open shop full of union men, and, as might be anticipated, the appearance of a man with a stop watch and tally sheet was at first very irritating and strenuously opposed by the workmen. So also was the suggestion of a bonus for the successful performance of an allotted task. But the kickers were gradually converted or discouraged, better discipline was established and a few of the men were soon earning 30 per cent. more wages than they could command elsewhere.

In the beginning the men were suspicious and disinclined to believe that a good performance was not to be the signal for a cut in price, but they have since learned by experience that prices are fixed by the management upon definite knowledge of all the time elements involved in any piece of work and that the time allowed will not be changed so long as the method employed remains the same. In this way the management demonstrates its loyalty to the workmen and they in turn are glad of an opportunity to demonstrate their loyalty to the management, as they did last year.

We pay better wages for fuller and better results performed in a definite way, and yet there is no driving in the ordinary sense of the word. The tasks assigned to the workmen are easily within their ability to perform and when new work is given out, as occasionally happens, at day rates, before the time on the job has been set, nobody wants to take it because there is no bonus attached for its quick and accurate performance.

Functional Foremanship

But our wonderful increase in production is not due entirely to rapidity of performance, for in some instances very little gain in that direction has been made. A great deal is due to the functional foremen whose duty it is to prepare and guide the way of every piece of work going through the shop. The old notion that a man cannot serve two masters or take orders from more than one superior is denied by the new philosophy which makes it possible for a workman to have as many bosses as there are functions to be performed. There is no conflict of authority unless the functions overlap and even there, such conflict as may arise is salutary and to the interest of the company. A gang boss, for instance, covers one class of machines or work, and it is his business to see that every man is provided with at least one new job with all the tools and fixtures ready for its immediate performance as soon as the job upon which he is engaged has been completed. He also gives the necessary instructions about setting the work, explains the drawings and teaches the workman how to set his work when necessary. This man has nothing to do with the running of machines and does not interfere at all with the speed boss who also has supervision in his function over the same men as the gang boss and sees that each machine is run at its proper speed with feed and cut as per written instructions. He also teaches the workman and gives him such practical assistance as may be needed. An inspector also helps the same set of men and sees that the work done is of the right quality and that the first piece made is up to the standard in all dimensions, fit and finish. He also makes further inspection from time to time to see that the standard is maintained. An over-zealous speed boss in his desire for a large output may impair the quality of the work done by exceeding the speed limit, and there is therefore the possibility of a conflict between the speed boss and the inspector, but the inspector's requirements must be fulfilled and such a conflict cannot fail to be salutary. because rapidity of production when accompanied by inferior results is never to be desired, and in almost all cases some method is found by which high speed can be maintained and the best quality preserved. It rarely happens that the superintendent or manager is called upon to adjust a difficulty between the two functional foremen.

In assembling the various parts required to make a complete machine the stock keeper sees that all the parts for a group of machines are in hand ready to go together before work is begun upon any one of them and the whole group is finished at the same time.

The Improved Stores System

To avoid delays incident to materials which should be ordered in advance, the store room must carry a sufficient amount of stock to cover the time required for replacements, and this is cared for by a store keeper and his clerical assistants in an automatic way. Formerly it was necessary for the superintendent to bear in mind or to look ahead to see what was wanted in advance, but with many thousand parts going through the shop at once, important details, sometimes few and sometimes many, were invariably overlooked, which meant delay and disappointment to the customer and very often the cancellation of orders. Now a balance of stores is kept in the planning department by which new orders are placed as soon as the stock on hand falls below a certain established minimum kept plainly in view against every detail. This minimum may vary as conditions change and it is fixed by the discretion of the manager of the planning department in consultation with the sales department.

The Planning Room

In the planning department, which is to the shop what the drawing room has been for many years to the superintendent, every new machine is charted to show the progress of the work through the shop and every piece is provided with an instruction card for its proper manipulation, showing the machine upon which it is to be made, the tools and fixtures required, the feeds and speeds to be used, the sequence of operations and the time allowed in detail for each and every elementary movement. As these operations are performed they are checked off in a route file from which can be seen at any time the exact condition of the work and the time remaining for its completion.

An order-of-work clerk directs the progress of the orders to be filled in accordance with a schedule prepared by the manager in consultation with the sales department and he has before him in miniature a view of the whole shop, showing every machine or vise, the work being done on each, the work ready to be done and the work ahead in the shop, but which has not yet arrived at the machine. This is a large board or wall plate, which shows also what machines are manned and where a man can be conveniently shifted when there is no work ahead at his particular machine. By this means all of the work in the shop is kept moving in proper balance at a normal rate of speed, men are taken on or laid off as the exigencies of business may require, and no loss is sustained by the usual tendency of workmen to relax when orders are falling off and work ahead is hard to find. At such times we are, of course, obliged to curtail production, and the situation being apparent to all, no complaint is made against a reduction in time, which we always prefer to a loss of well-trained men.

A well-equipped tool room in charge of a competent man is a *sine qua non* in any machine shop and here also one of our greatest improvements has been made. Formerly each workman was inclined to accumulate his own assortment of tools and fixtures which were stowed away in dark corners and kept in disorder and confusion. Now everything comes in perfect order (and the best of its kind) from the tool room as required and goes back again when the job for which it was taken out is finished. Tools are ground to standard forms and not to suit the whims of individual workmen and the tool room is responsible for the condition of all tools sent out.

The Drafting Room

The drawing room is perhaps of all departments less affected by the new order of things than any other, and yet there is an indirect effect due to the atmosphere of activity which pervades the whole plant. Here the work is by its very nature more or less original and, of course, no time can be set for the completion of that which is not definitely known, and which grows into shape by a process of trial and error, until something satisfactory is attained. Designing is not therefore amenable to time study, and, depending largely as it does upon inspiration, there is no superior intelligence to direct its progress. It is in the nature of original research which flourishes and bears its best fruit under adverse criticism. A good designer is like a good composer, his work is creative and full of harmonies, and being an artist in his line he cannot be held to a time schedule. In original work, the incentive, therefore, must come from within rather than from without, and this is generally inborn with the ability to create. Copyists on the other hand, who always need direction, might be brought under the domination of time study and in many clerical operations this has been done, but we have not yet attempted to fix tasks in tracing or bookkeeping, and we do not pretend to say that our development is by any means complete. We have progressed, however, to a point which makes further progress comparatively easy, and in the face of stubborn opposition we have firmly established a successful business upon the principles of Scientific Management as laid down by Mr. Taylor. This means increased production and higher wages at a lower cost, and contains the key to the solution of the labor problem. Labor is made to share in the increased production realized, and the reward of labor is made to depend upon the individual effort put forth in production. The Taylor system makes more room on top and gives a better chance to rise. Men thus schooled in efficiency are qualified for better service and learn to measure more accurately the value of time.

The scientific habit of thought as applied by Mr. Taylor to the production of high-speed steel, has resulted in speeding up machine shops about three to one, and I think it is not unreasonable to expect that the same habit of thought as applied by him to the every-day hand work of men will eventually result in doubling the average output of labor with comparatively little increase in the physical effort required. The margin for improvement varies, however, so greatly in different trades and countries that an accurate estimate cannot well be made.

THE STRENGTH OF OXY-ACETYLENE WELDS IN STEEL[1]

BY HERBERT L. WHITTEMORE

Oxy-acetylene welding, or as it is also known, autogenous welding, has been used successfully for the following purposes:

(1) Welding tanks and sheet metal work of all descriptions. (2) Welding frame joints for automobiles, making a rigid structure all in one piece. (3) Adding metal where needed, usually in small quantities. (4) Repairing boilers by either welding cracks, patches, etc., or by adding metal where grooving or pitting has occurred. (5) Bonding of electric traction rails by fusing the copper bond to the rails. (6) Repairs of all kinds made necessary by breakage.

The experiments described below were undertaken to secure information in regard to the strength and other physical properties of oxy-acetylene welds in steel. Although the work was limited to a small range in the thickness of the steel plates, an attempt was made to determine the effect of other variables, such as thoroughness of fusion, forging and heat treatment, and flame regulation, which might have an effect on the welds. The apparatus used was part of the equipment of the Laboratory of Applied Mechanics of the University of Illinois. All the work of welding and testing was done by the writer. A Fouché blowpipe was used, and the entire apparatus was arranged as in Fig. 1.

There are two methods of making autogenous welds. The first, suitable for thin plates, requires that the edges be brought into perfect contact, when they are fused together without the addition of any material. The second, used for thick plates, consists in fusing into a groove formed by the beveled plate edges, material similar to that in the plates. The thickness generally given as the dividing line between the two methods is ¼ in.

The method of preparing and testing speci-

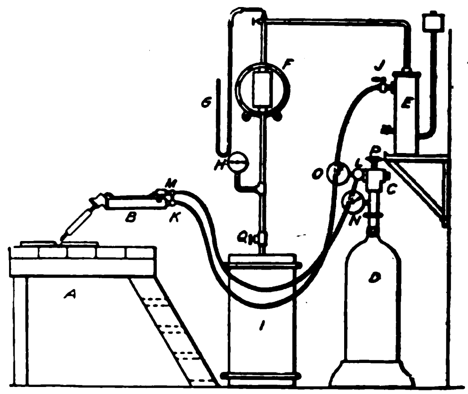

FIG. 1.—ARRANGEMENT OF APPARATUS.

mens to show the strength of welds is shown in Fig. 2. A plate of steel was cut into strips A, B, C, etc., and from the ends of each strip test pieces were cut which were tested in tension to give the strength of the plate material. The cuts are shown in Fig. 2 (a), by broken lines lengthwise of the strip. The two parts were then welded together and the welded strip cut across the

[1]Condensed from Bulletin No. 45 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

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Professor Bob Emiliani
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"Fakirs" (or "fakers") was a term used 100+ years ago to describe incompetence -- people who lacked the knowledge and qualifications to do a job properly. These two short articles report on a common problem in the early 1900s: managers, incompetent for running down the business, hire efficiency engineers who are likewise incompetent, usually because they would not pay for someone who was competent. Sound familiar? Leaders of The Efficiency Society, as well as The Taylor Society, were very concerned about the competency of improvement consultants (both members and non-members). Today there is no similar concern expressed by any Lean organization that I know of.

Fakir Managers • Fakir Consultants

A LITTLE FAKING ON BOTH SIDES

A recent article about the Efficiency Society which appeared in various papers throughout the country made much of the fact that the Society was expected to eliminate fakers who were trying to sell their services as efficiency experts.

This is undoubtedly one of the first duties of the Society, but it is also somewhat the duty of the Society to point out the faking that sometimes takes place on the side of those who employ efficiency experts. Generally officials of mismanaged and, therefore, failing concerns wait until the last moment before employing an efficiency expert. When he is employed he is simply turned loose in the plant and then they expect the business, which has taken possibly many years to run down, to be resuscitated in a few weeks as if by a magic wand. They do not want to pay much for the service, and they hardly get started when they become dissatisfied and discharge the engineer as a failure.

The other day the Society received an inquiry from a manufacturing firm in regard to employing an efficiency engineer, in the course of which the writer said—

> "We are very much like a burnt child; we dread the fire. We have been tricked and spent considerable money and time with efficiency workers in both factory and office. Also systematizing companies and auditing companies, and if we ever take up a new proposition, such as efficiency engineering, we are going to know without a shadow of a doubt that the people can produce on the money we pay them. We are going to have some sort of an opening to get out, in the event they do not. We have never had any concern, so far, perform any services for us that have been of any value."

In the course of our answer we said—

> "When a man is in charge of a factory and that factory fails, the failure is due entirely to him, and, if he hires experts and they fail, their failure is due entirely to him."

The statement has been made to us concerning the manufacturing firm with which this writer is connected that it has never given an efficiency expert a free hand with which to work and that it employed experts only for diplomatic reasons and was quite indifferent to the results they might achieve. There is no need of securing positive verification of this statement, because the Society is not recommending any list of efficiency engineers to this firm. The matter is cited here only that those responsible for the employment of experts may be made to understand that they are responsible for what is introduced in their plants, and the efficiency engineer is only an adviser, and if his advice is accepted the employer must not blame the efficiency engineer for the result.

Sometimes a very successful old time manufacturer makes up his mind to modernize conditions in one of the departments of his factory. He employs an efficiency engineer and turns him loose in the shop. After a while he finds that the efficiency engineer has introduced methods which he does not understand—they do not comport with those established in the rest of his plant. He begins to feel queer about the situation, not knowing where he is coming out, and after a talk with the efficiency engineer he dismisses him and the conditions revert to where they started. A greater opportunity for faking, however, is on the other side, and apparently the desire to fake sometimes outruns the opportunity.

A decent-appearing chap comes into the office of the Efficiency Society and asks qualifications for membership. He says he would like to join and that he would like to have a list of efficiency engineers and a list of business firms wishing to employ efficiency engineers. He says that he hopes to secure commissions to install efficiency methods in factories and business houses. A little questioning reveals the fact that he knows nothing about the management of factories or business houses, nor about mechanical details of shop work; that he is simply a man out of a job. Of course, it is difficult to have patience with one who asks the Efficiency Society to make him by fiat an efficiency expert. It is as presumptuous as if he should ask Congress to make him by fiat an ex-president of the United States.

The following correspondence will serve to indicate the sort of questions which the Efficiency Society is receiving continually.

Here is a portion of a letter to Mr. James G. Cannon from a man connected with a western firm.

> "Sunday's paper gave a brief account of 'The

Efficiency Society' of which you are President. The article was too short to enable me to form a clear opinion of the purposes and possibilities of this society. I am very much interested in 'Efficiency Engineering.' I never go into any factory but that I find myself looking for defects in the method of operation. I believe this is work I would enjoy very much, and since I have an inclination for such work, I believe that if I can get into the right field I can make good.

I am a photographer in a tourist resort and I have work only three months in the year. During the season we are busy, but this work does not offer me anything of real interest as an opportunity for advancement, so I am on the lookout for something better and with a field for development.

He received this reply:

"I am a little surprised to see how many people feel that they can qualify immediately and almost magically as experts in branches of industry in which they have had no experience. Your letter is by no means unique in expressing such a desire. Our answer to all who wish to become efficiency experts is to advise them to choose that line of work in which they wish to be recognized as expert, and then proceed to become so.

There is a certain degree of justification, however, in your wish to instruct others in time-saving methods. There is a good deal of difference, of course, between doing work efficiently and in observing how it can be done most efficiently. Many a person lacking the manual dexterity for a given task has the faculty for pointing out how a person doing that work can reduce effort.

My advice, however, would be for you to become expert in the routine work of photography. There is a great field for time-saving in this art, simply because most photographers insist upon considering their business merely an art and neglecting the business side. If you can simplify the processes of your work and the business dealings with the public, you are bound to be recognized and to secure material reward. Consider how much time is wasted, for instance, in posing, and consider further how every added moment in posing a subject simply adds to the artificiality of his expression. A more scientific study of the conditions that obtained when you secured the best results would enable you to reproduce those conditions an indefinite number of times. Consider further the opportunities there are for shortening the length of time between posing and handing the finished pictures to the subject. If your work is such as to give you much leisure time, as you pointed out, you are in a singularly fortunate situation for making such studies."

A young man in Connecticut writes that he is not satisfied with his present work and would like to become an efficiency expert. He says:

"Would like to know about how much salary a person of my experience entering this line of work would get. The form of contract with a concern for this kind of work is another point about which I would like to know, as I realize that in some instances this work is very delicate and must be handled with a great deal of care, especially in union factories. Would like to know if in these instances the concerns are made to understand beforehand that the progress would depend largely on the conditions in the factory."

To such a request we could only reply with whatever patience we could summon, as follows:

"No man can become an efficiency engineer at a bound. It implies a general recognition of a man's expertness for him to be called Efficiency Engineer. Merely to have done expert work is not sufficient.

The best way is to become master of a special field of industrial work and to know your job in that connection so much more thoroughly than any one else in it that people can't escape asking your professional advice."

If men with no claim to expertness in any field of industry wish to adopt the whole world of knowledge as their province, we can easily imagine how strong the temptation is with men genuinely expert in certain lines to extend the field of their operations; and when, in a slack time, an opportunity comes for them to install methods in a line of work for which they are not really fitted, we can realize how few of them are likely to profess a lack of fitness.

The Efficiency Society cannot judge the professional qualifications of business experts. We should require a board of judges as omniscient as some of the efficiency experts claim to be. All it can do is to point out that many of the experts who have joined the Society are annoyed by the pretensions of a few of their fellows. The first-class consultant in every case is co-operating with the Society in its recommendation that business firms look carefully into the qualifications and experience of efficiency engineers; that they give more credence to those who define their field and that, having employed efficiency engineers, they continue to regard them merely as consultants, at no time surrendering authority.

The Society is asking several efficiency engineers to prepare papers on the subject of the relationship between the efficiency engineer and the general manager, so that in the course of the next few months the Society can present to its members the views of men actually engaged in efficiency work on the subject we have just been discussing.

Fakir Managers • Fakir Consultants

Inefficient Efficiency Experts

In a recent issue of the Railway Age Gazette appeared an article concerning the conference on Scientific Management held by the Western Economic Society in Chicago, March 14 to 15 last, from which we quote:

"One thing is going to delay the general introduction of the new principles for many years, and that is that so few men are actually fitted to introduce them, and that so many fakers have rushed into the field. * * * To develop a trained leader in this field should require at least as much time as to train a first class physician, and yet look at the so-called 'Efficiency Experts' who have sprung up like mushrooms in a night! Near the close of the session one factory manager who had introduced scientific management with good results, asked if there was no way in which these fakers could be driven from the field, and no one could suggest a solution of the problem."

In the December, 1912 number of our Bulletin there appeared an article entitled "A Little Faking on Both Sides," which touched on this very subject, and in which the view was brought forward that in some cases there was also faking on the part of those who employ efficiency experts; that as a rule many firms employing the latter do not wish to pay much for the services rendered, yet often delay calling in such men until after their plant has been running down for years, and when they do call in such experts, if conditions do not improve rapidly they are dissatisfied with them. In fact, the course pursued is much as if a family should call in a physician to attend a man, ill with typhoid fever, only after his entire system was thoroughly worn out by many days' or weeks' suffering from the disease, during which no treatment had been afforded him, and then expect the physician's treatment and skill to make a well man of him at once.

That there are fakers in the efficiency field, as in every other field, is, alas, only too true! Yet with proper care on the part of firms employing efficiency engineers, and a rigid examination into their fitness for the work desired done, the chances of being "stung," as one firm put it, are slight indeed.

When, for example, one requires the services of a dentist, care is taken to consult one with an established reputation, and not visit the "Painless Dental Parlor," the claims of its advertising having struck their attention, because charges are low and promises large; on the other hand, when one has selected a dentist in whom he has reason to place confidence, if there is serious trouble with his teeth, due to their having been allowed to run down and become inefficient in the performance of the work it is their function to accomplish, it is not expected that the immediate application of the skill and the experience of the dentist will at once place one's teeth back in proper condition. It takes time, skill and expense to do that.

To the firms employing efficiency engineers we can only say, inquire well into the qualifications of the man you think of employing, not only as an efficiency engineer, but his qualifications for and experience in doing the class of work you desire done, and once having selected the right man, give him the proper

Source: *Bulletin of the Efficiency Society*, Vol. 2, No. 4, April 1913

chance to show what he can do, and do not expect the work of a short interval to correct at once troubles which have crept in during a period of years.

While it would be utterly impossible for the Efficiency Society to possess knowledge concerning all men practicing as Efficiency Engineers, yet we are endeavoring as rapidly as possible to obtain, for the benefit of our members and all who desire to have work of an organizing or systematizing nature done in their plants, information regarding business experts in different lines which will enable them to judge, to some extent at least, as to the man best qualified by his experience to undertake the work they desire done, or at least to get some idea of the field in which such experts, by their training and investigations, are best able to give advice as to methods for efficient and successful operation.

In conclusion we can only repeat that the first class consultant, in every case, is co-operating with the Society in its recommendation that business firms look carefully into the qualifications and experience of efficiency engineers, and that they give more credence to those who define their field; while those who employ the services of an efficiency engineer should remember that the conditions which have made the employment of the latter desirable, if not absolutely necessary, as is often the case, are the out-growth of years, and the result of the inefficiency of the management itself, and that it takes time to cure unhealthy conditions in a business organization the same as it does unhealthy conditions in the human organism.

 Source: *Bulletin of the Efficiency Society*, Vol. 2, No. 4, April 1913

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Professor Bob Emiliani
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The great Henry Gantt, in few words, tells it like it is. He is sharply focused on workers' wages, health, and well-being. Managers talking about efficiency does not improve efficiency, changing habits does. Learn more about Mr. Gantt https://en.wikipedia.org/wiki/Henry_Gantt

Conditions Necessary for Efficiency

A Few Words on the Subject of Getting Things Done

By H. L. Gantt, Member

A great many people imagine that they have discovered something when they have begun to talk about efficiency. They imagine that when they get a new system of management they are going to get greater efficiency. To my mind the term has been overworked. Talking about efficiency will not produce efficiency. Efficiency and inefficiency are habits of action, and unless habits of action are changed, talking will do but little good.

I find that many people think that when they have changed the forms or blanks that they are using in their business, they are going to get efficiency instead of inefficiency, and are disappointed when they do not accomplish this result. To change people's habits is a big job and takes a long time. It cannot be accomplished by so-called "get together" methods. Such methods produce temporary enthusiasm and serve to waken up the public to possibilities, but the only methods which get results are those which involve continuous and persistent training.

I find that few people over thirty years of age will submit to the amount of training necessary to change them from inefficient to efficient workers, and those under thirty years of age will not submit to it unless they receive a very substantial share of the products of their increased efficiency.

Many people regard the problem of increasing the efficiency of a human being much in the same way as they regard that of increasing the efficiency of a machine, and expect themselves to get the benefit of the full increase. In the case of a machine or animal which requires no share in the profits, their expectations may be realized; but in the case of human beings, we can get efficiency only by having their entire co-operation, and if we are to have their entire co-operation we must give them a fair share of the profits accruing from that co-operation. But this is not all. The amount of work that a man can do depends largely upon his physical condition, and the sanitary conditions of his surroundings. If, then, we would promote efficiency in our employees, we must see—

First, that a scheme of compensation is devised by which they can get a fair share of the products of their efficiency.

Source: *Bulletin of the Efficiency Society*, Vol. 2, No. 6, June 1913

Conditions Necessary for Efficiency

Second, that they must be taught methods by which efficient work can be accomplished, and trained to operate according to these methods. This training oftentimes covers a great deal of time.

Third, the work must be so planned and the surroundings so arranged that the worker is able at all times to preserve the best of health and to put forth his energies without detriment to his physical condition.

It is impossible for me to overemphasize the importance of these three points, for no matter how fully I explain them to employers, they never take them seriously enough, and it is very exceptional when I find employers who do not so neglect one or more of these points as to bring dissatisfaction among their employees. When this point is reached, and we point out to them that the workman has a legitimate cause to be dissatisfied, they seem to realize fully for the first time that we really mean what we say when we specify the conditions necessary for the promotion of efficiency.

In conclusion, I wish to say that a few more examples of efficient co-operation between employer and employee will do more to advance the cause of efficiency than any amount of academic discussion on the subject.

Source: *Bulletin of the Efficiency Society*, Vol. 2, No. 6, June 1913

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It is well-documented that Frederick Winslow Taylor was a modest man and also a very generous man. Here are two examples of his modesty, which reflect the reality that innovations in management are actually the result of evolutionary change and the contribution of ideas made by many people.

Community vs. Individual Knowledge

MR. TAYLOR'S MODESTY

"One of the first suggestions that I had for an experiment was from Mr. John Bancroft, now one of the ablest engineers in the country. He suggested that I try the effect of using a round-nose tool, with a round cutting-edge. Hardly a single piece of original work was done by us in Scientific Management. Everything that we have has come from the suggestion of some one else. There is no originality about Scientific Management. And, gentlemen, I am proud of it; I am not ashamed of it, because the man who thinks he can place his originality against the world's evolution, against the combined knowledge of the world is pretty poor stuff."

* * * * *

"I have said, and I repeat, that no one claims any originality for Scientific Management; it was all done before. I do not know of a person who claims any originality for it whatever. It has simply taken what other people were doing before. Long before we had any development of Scientific Management, there was in existence a far finer case of Scientific Management than we have ever succeeded in developing. The finest mechanic in the world had developed Scientific Management long before we touched it or ever dreamed of it. You all know him, every one of you; he is the modern surgeon. In his operations five or six men cooperate, each doing in turn just what he should do. How does that finest mechanic teach his apprentices? Do you suppose that when the young surgeons come to their teachers, the skilled surgeons, they are told first of all: "Now, boys, what we want first is your initiative; we want you to use your brains and originality to develop the best methods of doing surgical work. Of course you know we do have our own ways of performing these operations, but don't let that hamper you for one instant in your work. What we want is your originality and your initiative. Of course you know, for example, when we are amputating a leg and come to the bone, we take a saw and cut the bone off. Don't let that disturb you for a minute; if you like it better, take an axe, take a hatchet, anything you please; what we want is originality. What we want of all things is originality on your part."—*Frederick W. Taylor at Tuck School Conference on Scientific Management.*

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Source: *Greater Efficiency*, Journal of Efficiency Society , Inc., Vol. 3, No. 5 February 1914

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Frederick Winslow Taylor's insistence on abandoning the management of organizations in the style of the military -- what I refer to as "classical management." You can find F.W. Taylor's seminal paper, "Shop Management," here https://archive.org/details/transactionsof24amer/page/1336/mode/2up More on classical management here https://bobemiliani.com/book/triumph-classical-management/

Some Excerpts from F.W. Taylor's Shop Management Paper (1903)

Abandon the Military Type of Organization in Industry in Favor of Specialization and Teamwork

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time enough is allowed for these to produce their effect. It is rarely the case, however, that superintendents and foremen can find any reasons for changing their methods, which, as far as they can see, have been successful. And having, as a rule, obtained their positions owing to their unusual force of character, and being accustomed daily to rule other men, their opposition is generally effective.

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217. The first of the four leading principles in management calls for a "clearly defined and circumscribed task." Evidently the foreman's duties are in no way clearly circumscribed. It is left each day entirely to his judgment what small part of the mass of duties before him it is most important for him to attend to, and he staggers along under this fraction of the work for which he is responsible, leaving the balance to be done in many cases as the gang bosses and workmen see fit.

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edly lies in planning the work in this way. This can, in the judgment of the writer, be best accomplished by ABANDONING THE MILITARY TYPE OF ORGANIZATION and introducing two broad and sweeping changes in the art of management:

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mouthpiece. So deep rooted, however, is the conviction that the very foundation of management rests in the military type as represented by the principle that no workman can work under two bosses at the same time, that all of the managers who are making lim-

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252. The prepossession in favor of the military type was so strong with the managers and owners of Midvale that it was not until years after functional foremanship was in continual use in this shop that he dared to advocate it to his superior officers as the correct principle.

Source: *Transactions of the American Society of Mechanical Engineers,* Vol. 24, 1903. 1337-1480

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Editorial from 1911 about the "new science" of Scientific Management. An excellent summation! Learn more about the famous Eastern Rail Road Company Freight Rate Case before the United States Interstate Commerce Commission in 1910 which propelled Scientific Management to global prominence https://www.google.com/books/edition/Evidence_Taken_by_the_Interstate_Commerc/U5DVAAAAMAAJ and future Supreme Court Justice who was the attorney representing the plaintiffs (and who coined the name "Scientific Management").

INDUSTRIAL ENGINEERING
and
THE ENGINEERING DIGEST

Vol. IX JANUARY, 1911 No. 1

WHAT IS SCIENTIFIC MANAGEMENT, AND WHAT DOES IT DO?

The Freight Rate Hearings at Washington Showed What Scientific Management Has Done for Many Industries—A Definition and an Explanation

When in June last we announced our opinion that INDUSTRIAL ENGINEERING could do no more important work than devote its energies to the furtherance of scientific management, we had no idea of the importance the subject would obtain in a short six months. When Mr. Brandeis startled the country with his announcement that the railroads could save at least a million dollars a day by the adoption of scientific management, and by the expression of his intention to present this as the reason why freight rates should not be advanced, we realized that INDUSTRIAL ENGINEERING had taken a stand on a subject of the utmost importance to the manufacturers of this country. The attention that has been attracted to scientific management by the hearing at Washington in regard to freight rates has justified our position in the matter, and we are naturally gratified that this journal was the first and only one to have the courage to take its stand on the advancement of a practically new science.

During the past six months we have printed a great deal of material in regard to the various phases of scientific management. On reviewing the work we have done, however, we find that we have never at any one time stated just what scientific management involves in its entirety. We had not deemed that the time was ripe for this. The prominence which the subject has attained within the past three weeks, however, makes it essential that a rather full definition of scientific management be given, together with a statement of how it will apply not only to machine shops but to other industries, such as contracting and even to the railroads themselves. The reports in the daily papers of the hearings at Washington were more or less unsatisfactory to one who was earnestly seeking to learn what this new science is and how it works. This was but natural. The reports were transmitted by men totally unfamiliar with the subject, working under the stress necessary to get their copy in for the afternoon editions, and these reports were edited by men who knew as little as the reporters and were under the necessity of pruning the reports to fit the exigencies of space in the edition just going to press.

The editor of INDUSTRIAL ENGINEERING in a letter to the New York *Times* on December 2 wrote in part as follows regarding scientific management:

> In every operation of doing work there are two functions—planning and performance. The planning consists in, say, machine shop work, of selecting the machine in which the work is to be done, choosing the tool to use in the machine, determining the sequence of operations, the speed of the machine, the depth and thick-

ness of cut, and a number of other considerations. Under the usual form of management, planning as well as performing is usually left to the workman or to a badly overworked foreman. The work is laid out and done largely according to precedent or tradition—in the way the work or some job nearly like it was done by someone else.

Scientific management separates sharply the planning and performance. Few workmen know the full capability of their machine, and are therefore unable to plan their work to the best advantage. Under scientific management men specially trained for the purpose plan all work and issue definite written instructions to the men for its performance. These instructions are not based on guesswork, on traditions, or on precedent. They are the results of careful studies made on the fundamental operations necessary to the performance of a given piece of work, which determined the most economical way to do it, the best tools to use, the speed at which the best results could be obtained, the proper sequence of operations, and the minimum time required for each fundamental operation, including that necessary to place the work in the machine, to remove it, and adjust it. All these things are made matters of record, and from these records the man who does the planning draws up his instructions to the workman, giving him at the same time a statement of the time required.

The skilled workman thus has but to follow the instructions in order to duplicate the results required by the planning department. In its highest form, scientific management provides the stimulus for the workman to duplicate these results by giving him a rate of pay greater than the usual rate of his class when he does the work in accordance with the time allowed, and giving him a much lower rate when he does not accomplish the task as laid down. It is noteworthy that few men fail to obtain the higher pay when they have been properly instructed.

It should be noted that, although the workman receives more money in a given period of time, the employer benefits to a much greater degree. The cost per unit of product is less, and the work being done quicker, the capacity of the factory is increased without the expenditure of a dollar for new machinery. These are not idle dreams. They are hard facts, based on experience. Witness the testimony of James M. Dodge, of H. K. Hathaway, of Henry M. Towne, of H. V. Scheel, of Frank B. Gilbreth, and other men before the Interstate Commerce Commission, and the articles and editorials in INDUSTRIAL ENGINEERING the past summer. Scientific management involves more than planning of the work, however, in its last analysis. It involves a study of men, of materials, and of tools; a standardizing of tools and equipment, and an investigation of their qualities and capacity. It involves motion study, to discover what motions made by the men are unnecessary and therefore wasteful, and a rectification of the conditions which make for useless motions. I refer you to the work of Gilbreth, who reduced the motions of a bricklayer in laying one brick from eighteen to six, as one of the great examples of what motion study will do; and bricklaying is an art so old that the bricklayers of 4000 years ago worked almost the same as the men of today. I personally know of a case where the output of a man in a machine shop was quadrupled by motion study, and the man was considered a good machinist who used the best methods of his trade.

Summed up in a few lines, scientific management might be termed "applied common sense." It requires a man to do only that work for which he is best suited, but requires him to do that work at his greatest efficiency. It requires that he shall not do that work for which by training or environment he is unfitted and which someone else can do better than he. It requires that the conditions be made right for the greatest efficiency of the worker, this including not only the tools he works with, but his surroundings, his pay, and everything else which affects his work.

The world owes a debt of gratitude to Fred W. Taylor, the man who reduced the principles of management to a science, and who almost single-handed for a quarter of a century worked on in the face of opposition and discouragements that would have appalled an ordinary man. It is a cause for gratification that Mr. Taylor's reward has come while he is yet among us.

Regarding this letter, Mr. Fred W. Taylor stated that it was an excellent short résumé of the subject of scientific management. We can, therefore, accept it as a fairly accurate definition of the science. The New York *Times*, commenting editorially on this letter on December 4, said in part:

By rule o' thumb a man could unload two tons of pig iron an hour, for which his employer paid him 16 cents an hour. An observer, who had never handled a pound of pig iron, saw that the tracks in the foundry might be laid so that each bar need be carried not more than ten feet. By trial he saw that the average man unloading could move at a greater average speed. He saw that several of the physical movements used to transfer a bar from car to pile were unnecessary, consuming time and energy. In these three respects he established "units of efficiency," taking care, also, to provide a system of rest intervals to prevent fatigue. He then declared a standard of unloading pig iron at the rate of seven tons an hour to be easily practicable, and recommended a wage scale of 2.7 cents a ton, or 19 cents an hour, for the men who conformed to this standard. Under a sliding upward scale of wages, men were found willing and able to handle continuously ten tons an hour, for which service each received 27 cents. The increase in output was fivefold that under the rule o' thumb; the wages paid were seven-tenths greater, and the laborers were physically and financially better off.

Gangs shoveled with the same shovel such different materials as coal, coke, iron ore, sand, and lime. A man who had not seen much shoveling done, but with trained powers of observation, determined that for each material a shovel which would hold 22½ pounds—a fair weight for the average laborer—should be of special size and shape. Then a set of necessary movements was devised with reference to physical leverages and speed. It was found, too, that a pile of lime or sand should be attacked at the top, and of coal at the bottom. Having fashioned the standard shovels, and devised the units of speed, movement, and weight, he found that the new method and a system of bonuses increased the efficiency of the shoveling gangs 150 per cent.

For forty centuries the bricklayer stooped to pick up his bricks. The "efficiency engineer" devised platforms on jacks raised by boys to the level of the growing wall. Under the rule o' thumb the bricklayer for ages turned his brick any or all of three ways to find the face, tested the good bricks, picked up and threw down the defective ones, which had to be lowered from the height to which they had been raised, and turned his trowel to tap each good brick into the mortar. Boys now sort the bricks on the ground, piling the good ones face forward upon the platforms, and the brick sinks of its own weight into a new consistency of mortar. Bricklayers got $5 a day. Gilbreth enabled them to earn $6.80 a day, at the same time trebling their efficiency.

Such methods kill rule o' thumb wherever introduced. They are not respecters of persons or of professions or of trades. They are usually introduced by outsiders — men who "know nothing about the business."

The last paragraph of the *Times* editorial hits the nail squarely on the head, so far as the railroads and other skeptics are concerned. It has been the invariable experience of men familiar with the workings of the science of management when talking with managers in different industries that these managers would agree that scientific management was a beautiful thing, that it would work wonders when applied to some other industry, but that it would be a total failure in their particular case. They took the ground that having been in business for many years they knew more about it than any outsider could possibly know. It has invariably happened that when these men, sometimes against their will, permitted the scientific manager to apply his principles to their business that they learned that the outsider could teach them more than they ever thought it was possible to know about any business.

As an indication of the wide application of the principle of scientific management, it is only necessary to refer to the testimony introduced at Washington before the Interstate Commerce Commission to show why railroad rates should not be raised. There were introduced representatives of industries as widely different as could well be imagined and their testimony was universally to the effect that scientific management has reduced the cost of finished product notwithstanding the fact that raw material cost more, that output was increased, that quality of work was improved, that higher wages were paid, that the men were more contented and that scientific management had been a benefit in every direction. Among the witnesses were representatives of companies building hoisting and conveying machinery, molding machines, metal saws, locks, and other products involving machine work; representatives of the printing and bookbinding industries, representatives of cotton mills using labor that could not speak English, contractors handling unskilled labor, and men who had actually installed scientific management in certain departments of the railroads. The editor of the *Engineering Magazine* testified as to what had been done on the Santa Fé Railroad by scientific management; and the editor of INDUSTRIAL ENGINEERING told what had been done for the Canadian Pacific Railway by scientific management, substantially as related in the article "Scheduling Locomotive Repairs on the Canadian Pacific Railway," and the attitude of labor toward scientific management, as shown in the article "Scientific Management as Viewed from the Workman's Standpoint," both published in these columns last month.

In view of what has been done in these diverse industries including railroads, he is a bold man indeed who will say that scientific management is inapplicable to any industry. It is with a great deal of amusement, therefore, that we read the hysterical protests of the various railroad organs against the doctrine advanced at Washington. It is an old, old story to those who know scientific management, and we venture to say that within a few short years these journals will wish that they could expunge from the records the remarks they are printing today.

Let us examine some of the testimony presented at Washington to see wherein scientific management applies to varied industries. The first witness was H. K. Hathaway, of the Tabor Manufacturing Co., maker of molding machines. The product of the company is about fifty per cent standard material, put through the factory as a manufacturing proposition. The remaining fifty per cent comprises special machines built to specification, Manifestly, the work done in this plant is a sufficient answer to those men who will grant that the principles of scientific management might apply to a concern where every job is similar to every other one, but not to a shop where every job is different. Here is a shop where work of both kinds is going on at the same time. What were the results in the Tabor Company's plant? Mr. Hathaway testified that the number of machine operators in the shop had decreased from 105 to 70, that the output of the shop was doubled at least. He furthermore testified that whereas formerly there was more or less trouble all the time with union labor, in the general strike which affected Philadelphia last spring, but one or two men failed to come to work, while in a shop employing several thousand men, directly across the street, nearly fifty per cent of the men engaged in the strike. He further testified that since the installation of scientific management the company's business had become sharply competitive, and that they were enabled to meet competition with reduced prices and yet maintain a wider margin of profit than before.

Mr. James M. Dodge, chairman of the Link-Belt Co., Philadelphia, followed Mr. Hathaway and described the installation of scientific management in the shops of his company at Philadelphia, Chicago and Indianapolis. The Link-Belt Co. manufactures hoisting and conveying machinery of every description. This is all built to specification and practically every job going through the shop is different from every other one. Mr. Dodge testified as to the attitude of his men toward the system of management, for which we refer the reader to the article noted above, "Scientific Management as Viewed from the Workman's Standpoint," and as to the reduced cost of production. He stated that although raw material cost more, the price of the product to the ultimate consumer had decreased steadily since scientific management was instituted in his shops. The methods adopted in putting the work through were described by Mr. Dodge, but as the article "Methods of Management that Made Money," published elsewhere in this issue, outlines these methods, we will not refer further to them here. These two witnesses showed what scientific management has done in establishments making heavy machinery. Let us see how it will apply to lighter work.

Henry R. Towne, president of the Yale & Towne Manufacturing Co., Stamford, Conn., maker of the well-known Yale lock, said in part:

> The effect of the introduction of the system [of scientific management.—Ed.] into the two departments where we have it, representing, perhaps, about 40 per cent of our total product, has been to increase the efficiency of men and of machines, so that, at the present time, we are getting an output from the same amount of floor space and the same machine tool equipment at least 25 per cent greater than we had before the introduction of the system. We have reduced our labor costs. We have reduced what are commonly known as the overhead or indirect elements of cost, which are greater than labor, in many cases. We have effected a total reduction, varying with different articles, of from 10 to 40 per cent in final cost. We have improved the quality of the product, and we are making better profits.
>
> In all we have accomplished what we regard as the greatest advance in our manufacturing operations that we have made in the forty years of our history, by getting better products, higher efficiency from the workmen, and higher earning power of the workmen, increased the output of the machine and per square foot of factory floor space occupied, and a substantial reduction in cost, which we think has only begun—we see an indefinite future of progress in this direction—and an improvement in the quality of our product.
>
> The panic of 1893 affected our industry, in common with all others, and more severely, perhaps, than the average. We found ourselves confronted with a largely reduced production, with resulting increase in the ratio of our fixed charges to our sales, with a falling market, and no opportunity for advancing prices to recoup ourselves; and with the only hope for salvation, in that sense, lying in the direction of a reduction of costs of product. That we sought by studying our methods of production and aiming to increase the efficiency of our plants, our machines, and our workmen. We accomplished more, under the stress of that competitive condition, in the next three or four years than we had in the preceding ten years, I think; and accomplished results which have been lasting and from which we are still deriving great benefit. Indeed, they form the foundation of what followed in later years.

It is a long cry from the making of locks or hoisting machinery to the weaving of cotton goods. Yet scientific management was shown to apply equally well to this industry. Mr. H. V. Scheel, of the Brighton Mills, Passaic, N. J., has been engaged for about two years in the installation of scientific management at that plant. Mr. Scheel has to handle operators who usually are unable to speak English. He told how an investigation was conducted to ascertain the causes of delays in the weaving of a certain grade of cotton duck used in automobile tires. Although the Brighton Mills had previously operated under a system of management considered just as good as that in any works of a similar character, the investigation revealed many places where improvements could be made, notably in the scheduling of work from the time the raw cotton arrived in the factory up to the time when it was delivered to the looms as filling material for the fabric. After perfecting a schedule for the cotton through the various departments, and removing all the obstacles to the adherence to this schedule, Mr. Scheel was ready to lay a definite task for a single workman on one of the looms. This man was to receive a bonus for the fulfillment of the task. The first trial demonstrated that there were still other conditions to be made right before the man could earn his bonus. When these were rectified the man easily earned the bonus on a task which called for nearly double the amount of cloth from the looms that had formerly been obtained. This man was then made an instructor to teach the other non-English speaking workmen how to perform their tasks so as to earn bonuses. Mr. Scheel introduced charts showing how the men earned a bonus, irregularly at first, but gradually improving until at the end of a few months every man in the department was turning a greatly increased amount of cloth every day, and earning considerably higher wages than formerly. The total cost of the cloth per yard, despite higher wages, was less. The same methods were followed here and the same principles applied as in the other industries. Individual outputs of the men were recorded, time studies and investigations of methods were made and the work planned out in advance exactly as had been done in the Tabor, Link-Belt and Yale & Towne shops. The methods were the same but the product was different.

It has often been objected that union labor would offer an insuperable obstacle to the installation of scientific management in any institution which it dominated. Nothing could be farther from the truth. Probably one of the strongest unions in the United States is the typographical union, particularly that branch in New York City. Mr. John R. Williams, a printer of New York, told how he had partially installed scientific management in his printing establishment. The men were suspicious at first and declined to take the bonus which they earned over and above their regular wages. They had no particular objection to doing the work in accordance with the methods devised, after a scientific study of the problems had been made, although this tended to increase their output. They, however, looked on the bonus as somewhat in the nature of a bribe, and for some little time would have nothing to do with it. The bonus was kept in an envelope separate from the regular pay envelope and was not forced on the men, but they were told it was waiting for them in the office and that they could have it whenever they wanted it. After two or three weeks the men began to ask for their bonus, and before long they were all accepting it. A rather amusing fact was brought out in that the regular pay day was on Saturday, while the bonus was given to the men on Wednesday. It was stated that they thought more of the bonus than they did of their regular pay envelope, coming as it did in the middle of the week when funds were low. Information of much the same character was offered by Mr. Kendall, of the Plimpton Press, Boston, a book printing and binding institution.

Up to this point all the testimony offered concerned what might be termed establishments under one roof. The railroads were contending, as was evident from the line of cross-examination adopted by their counsel, that while scientific management might apply to such establishments it was a very different proposition on outdoor work such as the railroads had. Frank B. Gilbreth, contractor, New York, was put on the stand to tell what scientific management had done in his work. Mr. Gilbreth had done work for railroads and employed the same type of labor as did the railroads and had them in widely scattered groups, a condition similar to railroad work. He showed that it was a comparatively simple matter to increase the output, raise the wages and at the same time reduce the cost of unskilled labor by such a simple expedient as placing the men so that their output could be measured individually and recorded separately, thus introducing the element of competition. He described the wonderful results obtained by motion study, summing up in a short talk the substance of his serial article "Economic Value of Motion Study in Standardizing the Trades," published in INDUSTRIAL ENGINEERING April to September, 1910. He related how the quality and quantity of work of all kinds, brick work, concrete work, carpentering, excavating, pile driving, etc., had been benefited by the application of the principles of scientific management. He explained concisely that whereas in a manufacturing plant permanently established and located, scientific management might require two or three years for its complete installation, on contracting work, comprising a series of comparatively short jobs in one location after another and often with entirely new sets of men, no such amount of time could be allowed. There are, however, certain fundamental principles which can be applied immediately and which have the effect of doubling output within a very short space of time. It is the refinements and not the fundamentals of scientific management that require the expenditure of a great amount of time and money.

Henry L. Gantt described how he had applied some of the principles of scientific management to the repair and building of locomotives on the Canadian Pacific Railway, substantially as described in these columns last month, and Harrington Emerson, following, told what he had accomplished on the Santa Fé road by the application of the principles of scientific management there and how the road had effected a saving of approximately $5,000,000 in three years. Mr. Emerson's work was described very completely in the *Engineering Magazine*, March-July, 1909, and we refer readers to that publication for a complete account of it.

It is not our intention here to argue that the railroads should or should not adopt scientific management or should or should not raise their freight rates. We have summed up the testimony presented at Washington because it shows, as no other evidence ever presented at one time has shown, that scientific management is applicable to all trades and every industry. Management is a science, whose laws are as immutable as those of gravitation. A man who says that the principles of this science will not apply to his particular calling is merely exposing his own ignorance of the subject. The trained observer from outside can often see faults to which the insider has become so accustomed that he thinks that they are correct and possibly the only way of accomplishing his object. As an example we may refer once more to the railways. Mr. Towne was asked if in his opinion there were any phases of railway work in which scientific management would prove beneficial. We quote from his testimony as follows:

Although I profess to no experience in that field, I have had the same opportunity that any citizen has to come in contact with it, as a business man and otherwise. In addition to that, I have a pretty large acquaintance among railroad men and have frequently discussed with them the problems that they are working out in this direction, so that I have some general knowledge. It seems to me that there are almost as great possibilities for self help on the part of the railroads as there are and have been proved to be on the part of manufacturing industries.

They have a great many problems that are similar, and some that are identical. Take the case of their machine shops and repair shops, which are quite a large element in their organization and in their total outlay. They have precisely the same conditions as exist in any machine shop, or carbuilding shop, which is devoted to a similar work of a general kind.

I have no doubt whatever that the systems which are being so successfully developed now, in many private establishments, for increasing the efficiency of machines and of men, in machine shops and foundries, and woodworking establishments, can be utilized and availed of in the corresponding shops of the railroad companies, especially the large ones.

But I see other directions in which, it seems to me, the railroads are far behind the times in these matters, and in several directions. One of them is in the effort to utilize modern mechanical skill and ingenuity and experience in every productive industry that I am familiar with, and I know something about quite a number of them. Inventive ability and experience have developed wonderful changes in the last twenty-five years, in the last ten years, in the substitution of better machines, machines that are largely automatic, in many cases, and in the more intelligent application of human labor, even to machines which are unavoidably not automatic.

In every mechanical industry there is a constant effort to study this problem, and to achieve further success in it. In fact, I think most people who have been in touch with it feel that, with all the wonderful things that have been accomplished, we have only made a beginning, and that greater results are surely before us in the future.

On the part of the railroads, I fail to see any corresponding effort. I do not see that the railroads have awakened to the existence of these conditions, so far as relates to their employment of manual labor in the performance of the work of the railroads is concerned. And manual labor constitutes a very large part of the expenditures of every railway, in the handling of freight, of baggage, of the manipulation of traffic, and so on—it is all manual labor.

Whatever may be possible in the way of handling baggage mechanically, a vastly greater field exists in the possibilities of handling freight mechanically. It is done already by some of the great coal carriers, and to some extent in the handling of coal, and, in a few cases that I have seen, in the handling of sand, materials that will flow, like sand and coal. But no effort has been made that I know of to apply mechanical methods to the handling of the vast volume of merchandise which the railroads handle at every terminal onto their platforms, from the platforms to their cars, back again from the car to the platform, and from the platform to the truck, or whatever else it is carried away in. Millions of tons of material, taking the country as a whole, are moved every day, and moved by the crudest kind of labor. I am absolutely sure, as to some cases—I believe in a great many cases—probably in all of the great terminals, that mechanical appliances could be successfully availed of, at least for some part of that work; probably for a great part. But so far as the public knows, no effort has been made in that direction whatever.

I see another field, drawing an inference from my own experience as a manufacturer, in which I believe that the railroad companies have not gone far, and some have not ventured at all; and that is in what has come to be known under the nomenclature of this modern scientific industrial system as functional management. I can illustrate, or explain that in a few words, best by reference to a factory or workshop of the average kind and size.

Under old conditions, what was sometimes referred to as the military system prevailed, in which the foreman or superintendent of each department or room was responsible for everything done in that room—the discipline, the adjustment of wages, the allotment of work, the instructions to the workmen as to what they were to do, and how they were to do it, the inspection of the product of the workmen, and, in fact, everything pertaining to the management of the work in that room was concentrated in the hands of one person, possibly having some assistants.

Under the functional system, on the contrary, the management of one room will be covered by four, five, six, and in some cases even ten, different persons, the responsibility of each of whom runs on functional lines. One man will have to do with the employment of help. Another with the adjustment of wages and piece rates; another with the allotment of work, its distribution to the different men and machines, and another with the ascertainment of labor costs, and so on. The functional system, where it has been availed of intelligently, is proving itself over and over again to be the sounder system of the two. That higher or intensified skill results in the ascertainment of better methods, in the successful application of those improved methods, to the operation in the plant where the functional system is in use.

We can see that if the railroads are not already fully availing themselves of the functional system there must be a very great opportunity for them to do so. They could do that in their office work, in their great central administrative offices, which each one of the large systems has to maintain, and in the subordinate offices, which many or most of them maintain at other points, and throughout the operative system, wherever a large number of men are gathered together under one control and for a combined result.

If an outsider can see these possibilities for the railroads in the adoption of scientific management, is it not fair to assume that an outsider, albeit a trained expert observer, could see equal possibilities for any industry?

THE ART AND PRACTICE OF GRINDING[1]

A Symposium Showing the Field and Methods of the Most Recent of Machine Shop Processes

THE FIELD FOR GRINDING

BY C. H. NORTON

Grinding in various forms has been known to man from the very beginning of history, yet it is doubtful if many engineers have a clear conception of the field for metal grinding. Experience (as a specialist) covering twenty-five years has taught the writer that the usual thought of grinding is that it is a slow, tedious, expensive, but sure method of obtaining accuracy, and that where great accuracy is not required grinding should not be done.

The intelligent use of grinding, however, yields such large returns that it warrants careful study by the very best engineering and scientific minds and a place in the courses of our technical schools.

The results thus far attained warrant a change of the world's idea of grinding, and instead of using it as a synonym for slowness, tediousness and drudgery, it should be

[1]Compiled from two papers presented at the December (1910) meeting of the American Society of Mechanical Engineers.

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Professor Bob Emiliani
Please visit bobemiliani.com

This should sound familiar to Lean practitioners. Note that the understanding of waste was not exactly the same then, in 1915, as now. Nevertheless, the basic idea remains to make work easier by eliminating waste -- and it applies to managers as well as workers.

Efficiency Society Journal, Volume 4, No. 7, October 1915, p. 55

The greatest misunderstandings occur as to the aims of scientific management. Its fundamental aim is the elimination of waste, the attainment of worth-while desired results with the least necessary amount of time and effort. Scientific management may, and often does, result in expansion, but its primary aim is conservation and saving, making an adequate use of every ounce of energy of any type that is expended.

F. B. & L. M. GILBRETH, *Annals*.

Professor Bob Emiliani
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Between 1912 and 1916, there was a wide range of understandings of what Scientific Management was resulting in varied definitions -- much as has been the case with Lean management. Defining Scientific Management became important as it came under severe criticism from labor unions and politicians. This 1916 article by Professor Horace Drury parses a definition of Scientific Management that allows for its future evolution -- and it sounds a lot like Toyota management.

Efficiency Society Journal, Volume 5, No. 1, January 1916, p. 54

A Definition of Scientific Management.

I.

DURING work extended over the past three years the writer has been confronted by the question: What is scientific management? The best that he could do was to go back to the fact that "scientific management" was a slogan chosen by a certain group about October, 1910, and by them impressed upon the public as the name of their industrial system. The term, in its historical origin, was little more than a proper name descriptive of those ideals and practices sometimes called the Taylor System. The other day, however, while the writer was attending the Philadelphia meeting of the Society to Promote the Science of Management, a bit of conversation convinced him that a vast gain might now be made by recognizing in these words a new and more general meaning. To pass on to others this new definition and the reasons for its significance is the object of the present writing.

The danger in prescribing for the entire scientific-management movement the precise vision of its founder is that it might mean stagnation or death. Great as was Mr. Taylor's service, he could not know all that the future would bring. Progress and its accompanying change of opinion are bound to eliminate, gradually, his technique, and impair the worth of his concrete achievements. Even his followers—not to mention the world at large—will eventually find themselves in a new position, from which anything finished today will seem obsolete. If scientific management is to be identified with the finished system of today, a few years hence it will be nothing more than a historical incident—an incident that had an interesting and important part to play—but yet only an incident.

It sometimes happens, however, that out of a man's concrete achievements the public wills to select a central principle for perpetuation. Such an eventuality is the one consideration that might lead us to anticipate for scientific management a lasting life. If Taylor's formula can be reduced to one that will admit of growth, if scientific management can be defined as some basic principle, from which successive generations may draw their own fresh applications,—then possibly it will prove to be the nucleus of a real science. Should we seek in scientific management a thought that merits such a singling out?

The situation would seem to warrant it. Scarcely five years have passed since the name "scientific management" was first daringly launched. Yet today it has already won a respectable standing and is pronounced by practioner and outsider alike without quaver and without apology. Almost all suspicion of bluff has been removed by the continued seriousness and frankness of the system's leading votaries. A widespread sense of its importance is attested to by works in economics, by periodical literature, popular and scientific, and by debates before Congress. The public, or a large section of it, is already eager to avail itself of the essential spirit in scientific management.

But has the scientific-management movement an essence or aim capable of being dissociated from the old moorings and linked up with new and wider ideas? Can the old bottle hold new wine? Recent events suggest that this may be the case. For quite a time there has been a partial splitting off of factions more or less antagonistic to the strictly Taylor group. If, however, conflicting ideas can be tolerated, and their exponents not completely banished, this very condition will prove an ideal one for growth. In the end, the movement will be the richer for freedom to wander, for a genuine struggle between divergent tendencies, for the survival of the fittest. Now the present indication is that a unity can be found in scientific management great enough to include all these groups. Men as widely divergent in their views as Emerson and Gilbreth honored the memory of Taylor by their presence at the Philadelphia memorial meeting. Gantt could see merit in the same achievements that were praised by the Philadelphia group. While these leaders of industrial reorganization may not always have thought highly of one another's ability or genuineness, they feel at least the fellowship of men struggling for the same goal.

There are other hopeful and rather convincing signs of growth, for instance, as a certain subtle shifting of emphasis within the original group towards a more humane and socialized interpretation of Taylor's maxims. But the most crucial question now is as to whether this promise for a great future can be put upon a solid basis. Can scientific management, indeed, be so defined as to permit of universal adoption and development? In this crisis, Mr. G. D. Babcock has brought forth a definition of scientific management which seems to us to clear away the mists. The reader is accordingly invited to consider as a solution of the problem outlined above Mr. Babcock's formula:

Scientific management is that kind of management which conducts a business or affairs by STANDARDS *established by facts or truths gained through systematic observation, experiment, or reasoning.*

Here is a definition concise and yet smoothly worded. It lifts scientific management out of the realms of personality and accident to an enduring position. See how the movement surrenders all its peculiarities and becomes in reality science applied to management!

The opening words carry us to the field. *Scientific Management is that kind of management which conducts a business or affairs.* The field, evidently, is the unbounded field of action. Not alone with factory operation or gang direction, but with the entire world of affairs are we concerned. The science of army management, of political management, of the management of religion—all these are possible branches. Mr. Babcock thus yields to the general demand for a scientific management in all sorts of places.

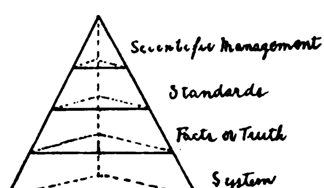
But management in any field to be scientific must pass a test. It must be conducted *by standards.* We have emphasized the word "standards" in the definition above because this is the one point in the whole of it upon which attention should be focused. A definition of a pure science would put the emphasis upon the facts or truths. But in the case of the science of action, the emphasis must be put upon the means by which fact is to be translated into result. It is only by finding out the best way in which work can be done and by erecting this as a standard, that management can be acted upon by science. How else could method, or excellence, or science be made effective? The discovery of the best method, its use by all, this is the essence of scientific management.

That the standards must be *established by facts or truths* hardly needs to be urged. It was standards established *by fact* that was the kernel of Mr. Taylor's practice and teaching. Fact is the very atmosphere of science.

The closing limitation, however, deserves attention. The facts or truths must be *gained through systematic observation, experiment, or reasoning.* Mr. Babcock has been exceptionally thoughtful in including observation, experiment, and reasoning among his ways of acquiring knowledge. This specification is so rich and flexible as to include and suggest any legitimate method.

It should be noted that the word "systematic" clinches matters and guarantees that only such setting of standards as is based on adequate effort will bear the name of scientific. "System" is a word that may mean many things. Perhaps, however, it marks the distinction between the scientific and the unscientific better than any other test.

The nature of scientific management as here defined may be brought out more clearly by reference to a pyramid construction devised by Mr. Fred W. Jones.



As in the definition, so in the diagram, scientific management is represented as resting upon standards. The standards are based on facts or truths. The facts or truths are gained through systematic observation, experiment, or reasoning. The pyramid representation is a fortunate one in that it permits the basic elements to bulk large—as, indeed, they should. Scientific management, though the crown and aim of the whole system, is a simple idea as compared to the many standards set under it. Each standard, again, can be set only after many facts have been gathered. Each fact ascertained is the product of a great system, a system whose human representatives and material implements constitute the real body of the whole arrangement. As in the diagram, system is the starting point and the support of the whole.

II.

Here two questions arise to demand further consideration: First, does the above definition, in fact, account for the principles brought forward by Taylor? and second, if so, does this analysis also correctly picture the great science of management of the future?

In regard to the first question, it can be shown that out of some such general idea as that outlined above arose, and necessarily arose, all the larger elements of method identified with the Taylor name—and, indeed, with the scientific-management movement everywhere. One cannot set tasks or impose standards unless the conditions of work—machines, materials, etc.—have first been *standardized*. Accuracy in this work is impossible without some form of *time study*. The standards are not all that they might be if they are not based on *Motion Study*. The *Instruction Card*, or something analogous, is necessary as the only rope that can bind together the discovery of the standard and its application on the job. *Routing and scheduling* and systems for the handling of *supplies* are simply the results of standards applied to the movement of materials. *Selection of workmen,* when it is fully developed, will be the application of standards to employment. *"High pay for success, loss in case of failure"* had for its object the enforcement of standards; and this, too, if generalized so as to run "personal interest in the attainment of standard," was inevitable. The system of *functional management* was the Taylor answer, and a very good answer, to the "how" of systematic action.

These are the earmarks, in a general way, of Taylor's work; and they are common to all the schools of efficiency. Every one of them has and always will necessarily follow where an active manager is imbued with the spirit set forth in the definition.

In regard to the future, and the extent to which the ultimate science of management will develop along the lines here outlined—this will probably depend chiefly on the extent of the field for setting standards. Of willingness to introduce standards, there will doubtless be no lack. To the extent that there is profit, men are going to be set aside for standard determination, or will be encouraged to devote a part of their time to this task. But as to the readiness with which the methods of business and affairs, including human agents, can be brought under such a system, it may be predicted that much will depend on the business or the circumstances. Where machinery is largely automatic, or work is routine, standards of some kind appear almost of their own accord, and they might as well be scientific as unscientific. There are, however, still many situations in life which demand a different response from any other situation. It is in proportion to man's ability to respond quickly and efficiently to a strange situation that he is a real man and a valuable member of society and industry. This higher sort of activity can never be standardized; it is better than standardization, as genius—we are tempted to say—is better than science. The greater the part of the population that can act with this freedom, the more efficient all will be.

Nevertheless, even in the case of the most self-directed person, there runs along beside the conscious and thought-out activity much that is automatic and routine—in fact, it is the greater part of all activity. Here scientific management has a proper field. Even where individual preference might dictate an independent course, standardization is often desirable for the sake of co-operation with others. We may conclude, therefore, that in a broad way standards of a greater or less degree of refinement are possible and desirable throughout a very large part of life.

Turning to Taylor's ideal of a definite task assigned for every workman, with high pay for success, which was the first kind of a standard in which he was interested and which was always very fundamental to his mind, the emphasis which the science of management will lay upon this will depend very largely on the industrial organization of the future. Could industry be so democratically organized and control so localized that every individual would be in business for himself as it were, then this side of the scientific management of the past would in the future have no pertinence. Should labor copartnership or labor interest in the success of business be extensively developed, it would lose much of its importance. On the other hand, should there be periods of greater centralization, should industry tend to be organized on a larger and more inflexible scale, the determination and enforcement of this type of standard would become of the utmost importance. It would constitute the gearing that would hold the wheels of industry together.

As to the development of functional management, something of this sort follows from our definition and from the general idea of science in management. Could there be a science without the scientist? Some provision must be made almost necessarily for the specialization of certain individuals to look after certain ends of the work or of the investigation. But the details of the arrangement are rather optional.

Details, we may now generalize, are in all the phases of scientific management a fit subject for controversy. But the general aim and larger methods of the system apparently constitute the essential basis of all scientific method in the future.

III.

That it should have been Mr. Taylor, a man of our own day, who should have first brought forth these fundamental principles, may seem to some incredible. In *the great society*, however, Mr. Graham Wallas points out that scientific management would have been impossible except under conditions which have come into existence only during the last generation, namely, the standardization of iron, cotton, tools, machines, etc., so that the conditions of work are exactly equivalent at different times and places. Those familiar with the story of Mr. Taylor's work know that he, himself, had to take the last step in bringing this state of affairs into existence, by bringing standardization down to that final stage of perfection where it was possible to set fair tasks and impose exact methods.

Now, without doubt, earlier men grasped something of Taylor's idea. But the time was not ripe for the full development of the principle; and a careful tracing of the lines of causation shows that it was actually through Taylor that the modern movement was started. You can take almost any efficiency engineer and trace the lineage straight back.

Thus it indeed fell to Taylor to bring forth the ideas listed above. He it was who first won distinction by the perseverance and ingenuity with which he attacked the problem of the management of factories. He it was whose achievements aroused the world to the idea of high standards for workmen both as to the amount of the performance and as to the method employed. The very idea of determining such a standard was to most persons a revelation and a surprise. He it was who emphasized fact as over against theory, truth as over against rule of thumb. Taylor it was who carried all these things through with the thoroughness of science, winning for his greatest work the degree of Doctor of Science and the Presidency of the American Society of Mechanical Engineers.

Yet, in spite of the past, the principles which Mr. Babcock has so splendidly stated did not *belong* to Mr. Taylor. They *belonged* to him no more than does graviation belong to Sir Isaac Newton. Research as to graviation is in order at any time. And so have the industrial and social leaders of today and tomorrow the right and the duty to strike out afresh to apply the principles of science to life. Mr. Taylor and his followers could not monopolize the principles; they are desirous of giving away the name. Whoever can is welcome to take up the fight for scientific management.

The chief opportunities for the enrichment of scientific management are in the progressive setting of more accurate and improved standards, in the enlargement of vision so as to take into account more fully the well-being of the worker, and in the perfection of organization. Here is a task ambitious enough for a world of effort. May we look forward to a scientific management, efficient in its results, democratic in its administration, and considerate of every human interest in its aims.

HORACE B. DRURY.
The Ohio State University.

Professor Bob Emiliani
Please visit bobemiliani.com

Scientific Management was not solely focused on manufacturing. It was applied to office work such as purchasing, personnel administration, etc. William Leffingwell, of Ontario, Canada, was the Ken Eakin of his day! He worked in industry and then became a consultant. Mr. Leffingwell wrote a book "Scientific Office Management" in 1917. Learn more about Mr. Leffingwell https://en.wikipedia.org/wiki/William_Henry_Leffingwell And don't forget to check out Ken's wonderful book, Office Lean https://www.amazon.com/Office-Lean-Understanding-Implementing-Administrative/dp/0367196646/

Efficiency Society Journal, Vol. 6, No. 12, December 1917, pp. 618-633

Motion Study In Office Work

A Lecture by W. H. Leffingwell, of L. V. Estes, Inc., Chicago.

MOTION STUDY, as I use the term, has a pretty broad application in office work.

It refers, not alone to the motions of the hand and body, but, if I may use the phrase, the motions or efforts of the brain.

Taylor's Four Principles.

Frederick Winslow Taylor, the father of Scientific Management, in his work, continually emphasized the fact that Scientific Management does not consist solely of the various mechanical features that he used, but summed up his whole philosophy of management into four principles:

First—Making a science of business.

Second—Scientific selection of the workman.

Third—The task idea with a large bonus.

Fourth—Intimate cooperation between the management and the men.

It is these four principles that I have always tried to keep in mind in my work, not any particular cut and dried plan.

The first principle, "Making a Science of Business," is quite a large enough order for one lecture and I shall confine myself to it. I shall not get very far into the subject, at that and I only hope to give you a few ideas on the office side of management to think about.

The Two Parts of Motion Study.

Motion Study consists of two parts:

First—A study of those motions that precede the particular operation about to be studied, of which there are two kinds:

(a) Mental Motions.

(b) Physical Motions.

Second—A study of those motions that are contained in the operation, of which there are also two kinds:

(a) Mental Motions.

(b) Physical Motions.

That is to say, it is often necessary to go back and analyze the operation of the opening of the mail to find out why the goods were not shipped on time.

Motion study, in other words, is analysis. No chemist would undertake to make an analysis from the facts on the surface. He must dig deeper, he must get down to elemental things to get the truth.

Bad Surroundings.

Let me illustrate. I was recently called in consultation by the proprietor of a large mail order company in Chicago. I had heard of this company for years but had never been inside of the door. I was asked to tell why it was difficult to retain employes for any length of time, tho wages paid were standard. I was also asked why the efficiency of those retained was so low.

Five minutes' inspection of the office gave me the answer. It was an overcrowded, badly ventilated, poorly lighted office. Employes were asked to work on a balcony which had a temperature of about 90 degrees. When I talked with the manager about these things, he said they were not important, he called me in to show him how to get increased efficiency. He also added that as soon as he could afford it, he was going to get a new building.

I said to him: "When you get your new building, call on me. Then I can, perhaps, help you. Now, I cannot. You ask employes to work under conditions which are repellant to them, while other houses give them fair wages with good light and ventilation thrown in. A hardy geranium plant would die in an environment like this, why should you expect human beings to work in it?"

Not all offices, of course, are as bad as this one, but since good air, good light and space are necessary for good work, it has always been a mystery to me why office managers do not insist on the very best there is. It certainly pays.

The Office Lay-Out.

Then, there is the lay-out to be considered.

It is one of the most common things to find an office laid out without regard to the work to be done. Just the other day, I was called in to inspect the plans of a new office for a company employing seventy-five clerks. There were windows on two sides, eighteen of them. The plans showed five private offices to contain one person each. These five had thirteen of the windows. This left five windows for seventy clerks. These clerks were bookkeepers, stenographers, bill clerks and others, whose work would compel them to use their eyes the entire day. In the five private offices, five gentlemen would sit at their desks, talking with visitors more than half of the time! Is that common sense?

Another common thing is to find an office so laid out that the work in its progress travels back and forth many times, crossing and recrossing the room. Because a letter or an order weighs a fraction of an ounce, little attention is paid to this waste. It must be remembered, however, that it takes nearly as long to carry an ounce 100 feet as it does ten pounds. The ideal office is laid out like the ideal factory, raw material in one end and finished product out of the other. It not only can be done, but is done. In fact, some offices are laid out on a plan where the paper travels down this route on a conveyor belt. How near does your office approach this ideal?

Getting Orders Out on Time.

Another instance of studying the motions that precede the operation is the analysis of office routine.

In one large company I was called in to tell them how to ship the orders the same day they were received. They were rushed to death, apparently, working overtime every night, yet the orders for each day could not be handled in that day. I made a great many changes in this office, but perhaps the most important change was in the manner of opening the mail. It was opened by one of the officers of the company. He had done that when the company was small and he continued in the same rut. He was down there early in the morning and started work sooner than any of the others. A big batch of orders would come in in the first mail.

First a clerk would put all of the letters through a cutting machine and then deliver them to this officer. The officer would go through this batch, taking the letters out of the envelope, and slowly, deliberately reading each one from start to finish. Now, he would come across a doubtful account and call to the bookkeeper to look it up in the ledger. Then, he would get a nice bunch of orders from the star salesman and tell the good news to one of the other officers. The clerks meanwhile would be busy on the orders left over from yesterday. About nine or nine-thirty, they would finish yesterday's orders and by that time the officer would have a nice lot ready for them. About eleven or twelve o'clock the superintendent would come tearing down stairs to see whether or not he could have just a few orders. Yes, here are some that had just been finished. In the afternoon another mail arrived and the same procedure was gone through. About five o'clock the boss would go around to see how many clerks could arrange to stay down and work awhile.

What we did there was simple. First we put a couple of girls on the mail opening job and had them come down a half hour earlier than the rest of the clerks. They made it their particular business to open the mail—not to read it. They were supposed to do this at the rate of 300 an hour. They did it. One hour cleaned it all up. When the clerks arrived there was a batch of orders ready to begin on—today's not yesterday's. From then on, they flowed in a steady stream right through the credit department, order department and into the factory. Letters went to the various correspondents or to the officers, according to their importance. There is no more overtime work there now and orders are shipped the same day they are received.

A Thorough Analysis Necessary.

You may gather from what I have said so far, that we go into an office, glance about for a few minutes and give the answers right off the reel. There are many people who believe that this is the procedure. They credit us with some sort of magic powers of observation or intuition. But the real facts of the matter are that every bit of this investigation and analysis is hard work. Of course the fact that we are doing this work all the time, that we are constantly learning new ideas from the large and small companies that we visit, gives us an advantage over the ordinary observer—at least we know what to look for. Beyond a few surface indications, however, we have to dig for all we get and dig pretty hard.

If this were not so it would mean that either efficiency men were monumental fakirs or office managers short-sighted fools. And, while some of you may be inclined to believe the first, I am decidedly not inclined to credit the office managers with foolishness—as a rule. Of course, there are some very important exceptions to both rules:

No, we have to dig, and to dig deep.

Let me tell you how we do it.

Getting a Working Hypothesis.

First we make a general analysis of the whole office and its systems. This analysis is made in writing and often accompanied by charts. The purpose of this written analysis is to give us a working hypothesis, and to prevent us from going off on a tangent. It is just possible that the work in one department may be entirely revolutionized and done with a minimum of labor, but after this is done it would not work in with the general scheme at all.

All businesses are not alike. In fact, the old argument: "My business is different" is strictly true. Very seldom are two businesses in the same line alike as to methods.

On the other hand, just because your business is different, is no reason why the methods you use are the very best.

Assume nothing. Investigate. What you find to be the facts are the facts.

As I said before, this analysis gives us a working hypothesis.

Four Hours of Labor for Each Order.

Some of the things we find in these general analyses are really remarkable. Let me give you an example.

In one office recently examined there were seventy-seven clerks. First examination of surface indication showed that everyone was apparently working as well as in the average office. The first thing we examined was the quantity of work to be done. We found that all of the clerks were working either on orders, on work that the orders created, or work that created orders. In other words, if only half as many orders were received one month as in another, there would be about one-half as much work. We found that the average number of orders received daily, over a period of one year, was 154. The average items per order, three. This figured out just four hours of clerical work for an order, or eighty minutes an item!

Now, one of the outstanding reasons for the division of labor in modern industry is to shorten the over-all time required. Can you imagine any system so complicated that it would take one clerk four hours to do all of the clerical labor on one order? Just picture yourself in an office, receiving the mail, opening up the letter, registering the order, making out the order forms, making out the invoices, making out the bill of lading, entering the order on the books, sending a statement at the end of the month, receiving the remittance, crediting the payment, and balancing the account. Do you believe that that would take you four hours? You do not. Neither did the manager of this office. On this basis, a large mail order house receiving say 20,000 orders a day would require 10,000 clerks. As a matter of fact, one large company in Chicago who gets 20,000 orders a day, with an average of six items each (twice as many items as the other company mentioned) handles them with 1,500 clerks. This is about 36 minutes an order or 6 minutes an item as compared with 240 minutes an order or 80 minutes an item.

Now, do not tell me that this company was a back number. As a matter of fact, it was a rapidly growing firm with a wonderful sales department.

I will not weary you with an explanation of where we found that waste, but you can depend upon it that we not only found it but corrected it and today that company is handling its orders with an average of one hour clerical labor. They have not as yet reached the mail order company's standard but feel pretty good about what they have accomplished.

The point I wish to convey in this example is that you can tell nothing at all from surface indications. Anyone looking at these clerks, no matter how expert, could not have detected more than ten or fifteen per cent waste. Yet analysis showed that the office was not twenty-five per cent efficient.

How Long Does it Take You?

When you go back to your office today, find out how many clerks work directly or indirectly on orders. Count all of those in the sales department, the accounting department as well as the order department. Get your average daily orders. Find out how many minutes per order you are paying for. If it is more than one hour, you will find it extremely profitable to find out the reason, for undoubtedly there is a big waste there. In one company that I know of, orders are handled with a total expenditure of fifteen minutes of clerical labor each!

After we have our working hypothesis, it is next necessary to make the detailed analysis. We analyze each operation, in writing as before. What does this show us? First it shows us whether or not the best method is being used.

Finding the Right Method.

It is a remarkable fact that there are dozens of methods in use for every operation in the office. All of them cannot be right. It is our business to find the right one. This finding of the best method is an important part of our work and here our broad experience helps a lot.

In a certain large mail order company there is in operation a very clever order system. Instead of copying the order, the items for each department are clipped and pasted on a sheet, one sheet for each department covered by the order. It is a wonderful scheme but very limited in its application. However, I have studied it carefully and know every detail. The other day we found a large wholesale drug company in a northwestern city using this same system. Someone had told them about it and they tried it out. There was great confusion. It was not working at all. It did not take me long to find that they had copied only the mere outlines of the system and knew nothing of its details. Nor did it take me long to make it work satisfactorily.

We have no cut-and-dried plan for the simple reason that such plans would not work in all places. We find the best method by careful analysis.

It is not at all uncommon to find possibilities of cutting the labor in two by merely changing the general method.

Duplication of Effort.

Duplication of labor is another thing we look for. In one case we found a certain record being kept in one department of a large woolen mill, that cost $7,000 a year to keep. Practically this same information was being kept in a slightly different manner in another department. The elimination of this duplication saved the company $7,000 a year.

ELIMINATING DUPLICATION SAVED $13,000.

In another case we found certain information being written five times for every order. In the primitive way this information would have been written twelve times but this company had advanced to a multiple billing system and by carbon process made seven writings in one. We studied the operation carefully and finally did the five remaining operations by a duplicator system in one writing. This alone saved this company $13,000 a year. Look in the advertisements of the manufacturer of this device and you will find the figures stated authoritatively. It was the duplicator that did the work all right, but it was the analysis that showed that there was a job for it.

MIXING MECHANICAL WORK WITH JUDGMENT WORK.

A common error we find in offices is mixing work which requires judgment with merely mechanical work. In the example mentioned in the beginning of my talk, the officer of the company did much mechanical work in order that he might do a little work requiring his judgment and experience. It is pretty hard to get some people out of a rut that they have been in for years and it sometimes takes a lot of tact and diplomacy.

In one example we recently discovered a clerk was paid $52 a week because he was the only one in the office who knew all of the various prices the company was quoting its customers for its product. He also knew how to make the computations necessary in order to make out an invoice. We put all that he knew on paper and found that it was indeed very little, so we added a great deal more to it. We made a card system of prices quoted on the visible index system. We made tables of computations. Now the work is done by a $12-a-week girl even better than it was done before, with an annual saving of $2,000. The $52-man is now the office manager and doing work that is really worth the salary he is getting.

Few Operations Are Properly Divided.

Very few operations are properly divided, so as to entirely separate judgment from the mechanical features. Take bookkeeping for example. In some of the large companies the accounting is so subdivided that an ordinary clerk with only sufficient intelligence or knowledge to copy or to add on an adding machine, can do the work. In other places a bookkeeper must be an accountant and know the ways and wherefores for every step that is taken.

Dividing the Bookkeeper's Work.

For example. In one place there were three bookkeepers and one assistant bookkeeper besides a chief accountant who directed the work. Each of the bookkeepers did his own entering, posting, balancing and statement work. The combined weekly salaries of the four was $108. There was not enough work for four but the way the work was done it was necessary to have four good all-around bookkeepers. In this firm we divided the work. First, we made a copy of the invoice for the sales record which made all of the charges without extra expense. Next, we made a copy of the daily deposits on a typewriter, balanced these with the cash and thereby got a record of the credits. Next we had these charges and credits posted on the ledger by a carbon copy system, in which the original was the statement and the duplicate the ledger sheet. A daily net balance of each account was taken, a proof sheet of postings was made and balanced with controlling accounts, so the books were always in balance. This work, thus simplified, was finally done by two $15 a week clerks, the books in daily balance and a net saving of $78 a week to the company or over $4000 a year.

"Do it Now"—a Bad Motto.

A number of years ago, some bright genius invented the motto "Do it Now" and for a while every office had a half dozen of these mottos hanging about. Like all generalizations, it was only half true. Many managers and many clerks, however, followed the advice literally. That motto perhaps is the cause of more waste in this country than any other one phrase or sentiment. It was probably intended to prevent procrastination, but it violated one of the fundamental principles of efficiency—that of grouping like things together and doing them at one time.

When you make that examination of the length of time taken in your office to handle an order you will undoubtedly be surprised. Make another test. Take an average order, follow it thru from one operation to another with a stop watch and find the net amount of time taken on an average order and you will probably find it very much less than the total time paid for. Why?

The answer is that all orders are not the average kind. You will find dozens of irregularities creeping in. It is these irregularities that cause the waste of time. If you make further examination you will probably find that these irregularities are handled on the "Do it Now" plan. If they were grouped and handled at one time you would make a great saving.

For example, I found one clerk go into the vault to consult old records six times in one hour. How much time would he have saved if he went in but once for the entire six? How many times do you interrupt yourself and your stenographer in handling the morning's mail to dictate a letter? I know one manager that takes an entire morning to handle twenty letters and another that handles them all at once and does his twenty in one hour.

Making Tables Do the Work of Figuring.

How many years ago is it that you bought your first interest table at the stationery store? I bought mine over twenty years ago. Is there any saving in such a table of computations? If there is have you made tables of all the similar computations that you have in your offices? Computing machines are all right—fine things in their place. But in many cases, a table, requiring about an hour to make, will do the work much more quickly and with greater accuracy. A simple thing isn't it? Not a new idea either. Yet we hardly ever go into an office without finding occasion to suggest several such tables to handle much of the work that is at present being handled on computing machines or in many cases by the mental manual process.

The Specialist.

The specialist is another great cause of waste. This is a man who has learned what he knows about the business thru years of training. To replace him would mean to train another person a similar period. The knowledge he holds is important to the welfare of the company, yet it is all in his head. If he dies tomorrow, that knowledge goes with him. Our constant aim is to eliminate the necessity for specialized knowledge. We find it in every company we go in. It can be eliminated in 99 per cent. of the cases. When it is once eliminated the management breathes a great deal easier.

Study the Motions.

Let us now turn to the motion study as applied in the operation itself.

There are three important things to be studied and considered in every operation:

First, the Posture.

Second, Fatigue involved.

Third, the problem of concentration.

The Posture.

The first question, the posture, is one of the most important, yet is one that can only be solved by continual teaching. Very few people either sit or stand correctly and especially is this very pronounced in office work. An erect posture permits free and uninterrupted circulation of the blood. A person who sits or stands erectly, will not tire easily. If he does not tire easily he will produce much more than one who does. A person who sits all humped up, with sunken abdomen will tire much more easily and naturally will not produce as much. Erect postures, however, are only possible when the body is developed properly. Exercise of the muscles of the back and abdomen are needed and naturally this can not be done in the office. Only by constant teaching can high ideals of posture be obtained.

Much depends, however, upon the kind of equipment the clerks work with. You buy desks and chairs of a standard height but you cannot hire clerks of a standard size. There are many things that can be done to remedy these faults, such as raising or lowering the height of the chair or desk. Standing desks are also responsible for bad postures. The bookkeeper is commonly supposed to stand at a standing desk, but more than half of his time he is perched on a high stool that is neither comfortable nor adjusted at a comfortable height.

The Elimination of Fatigue.

The question of the elimination of fatigue is also important. Much of this is tied up with the question of posture but in addition there are many things that can be done after the posture is corrected.

For example. The elbows of a typist should be on a level with the keyboard. If they are not, it is necessary for the muscles of the operator's arm to be unduly strained in holding the hands up; more force is required and in general much fatigue is developed. A person operating a numbering machine or a rubber stamp will do more work with less fatigue if the top of the numbering machine is at or below the level of the elbow than if it is above that level. In one case the output of an operator was increased 15 per cent. by the simple expedient of lowering the table six inches.

In one case that came to my attention there were ten girls working on index files. Each box of cards weighed nine pounds. These boxes were placed in a large cabinet. It was necessary for the girls to get up from the desk, go to the cabinet, take a box out, put it on the desk, look up the card, put back the box in the cabinet. This was done about 150 times a day by each girl. In the course of a day's work she lifted 2,700 pounds, yet she only handled 150 cards. By substituting a tub desk for the cabinets, all necessity for handling the card trays was eliminated and three girls handled 500 cards each a day without lifting anything but the single cards. By eliminating fatigue, three girls did what was formerly done by ten.

Concentration Necessary.

The problem of concentration is more difficult. It is very important. Lack of concentration is the cause of most errors in office work.

Few people realize that it is the effort to concentrate which causes most of the fatigue in mental work. In manual labor there is always some outside object; the machine, the work in the machine, the tool, or the object worked upon, that rivets the attention. It is thus comparatively simple to hold the mind on the work. In fact, in some operations it is very difficult to get the mind off the work. In office work, however, we are dealing with pieces of paper and abstract ideas. It requires a distinct effort to hold the mind on these abstract lines and any outside attraction quickly draws the attention away. Loud talking, shouting from one end of the room to another, loud sneezing, or any other spasmodic noise immediately draws the minds of all clerks in the room from their work. Many minutes in the aggregate are wasted in this manner when a little common sense would avoid them.

The greatest factor in obtaining concentration, however, is getting an interest in the work. Getting clerks interested is a problem of management that we have continually to solve. It is obtained by getting a good esprit de corps. One of the best ways to cultivate this interest is by the measuring of the work, and matching the records of one clerk with another.

The Factor of Decision.

The importance of decision in office work is also much underestimated. It is commonly supposed that the only person who has to make decisions is the executive. Far be it from me to depreciate the value of quick decisions on the part of an executive, but I really believe that if the power of decision were doubled on the part of the clerks, the aggregate value would be much greater.

Let me explain what I mean by decision in office work by a common example in sport. In a game of baseball, three men are on base and the batter bunts the ball. What would happen if every man on the team was not alert and capable of deciding in a tenth of a second just what he should do. Suppose each man were to go thru a long mental process in coming to his decision, would you call that good ball playing? You would not. Well, when you go back to your office watch a few clerks. Watch them pick up a letter, study it thru carefully, make several false starts and finally, with a great show of deliberation, finish the task. Then, figure out with a stop watch if you have one, or guess at it if you have not, just what proportion of time was devoted to doing the work and what proportion to deciding. In one case I doubled the output of some mail readers in a mail order company by merely teaching them to decide instantly to do things they knew very well how to do. Whenever you see a clerk pondering for a long time over a problem that he has performed hundreds of times before, you can pretty well make up your mind that he is "wool-gathering". Get him to take an interest in the work, get his mind on his job, teach him to decide just as quickly as the pitcher on a baseball nine has to decide and you will double or triple his output without requiring any more effort on his part.

It is the Little Things That Count.

In all motion study, the importance of little things is to be considered. It is the proportion that counts, not the length of time taken for the motion. If I were to carry a piece of paper across this room and back it might take as much as a minute. Yet, if I only did that once or twice a day in the course of my work, it would only mean that I used up one or two minutes in that kind of work which might be eliminated. I would call that an unimportant thing. If, however, the false motion I performed required only a hundreth of a minute and I made ten thousand of those motions a day, the waste would be one hundred minutes, a very large proportion of the day.

In one operation, that of stamping letters, there are thousands of clerks who do the work with from four to six motions, when only two are necessary. What is more important, the separate motions of the two-motion operation can be performed much more rapidly than those of the four motions. The problem is to find the necessary motions and teach every one to use exactly these and no others.

Teaching.

After we have made our analysis, our motion studies and have standardized operations, the next thing is to teach the clerks to perform these operations at the rate of speed required. This does not, as is commonly supposed, result in making the work of the clerks harder, but it always results in getting more work done.

It is not at all an uncommon thing to see two clerks working side by side, doing the same work, getting the same pay, while the output of one is double that of the other. Now, in such cases, it is evident that there is an injustice being done to someone.

Measuring the Work Uncommon.

The most common thing, however, is to find an office manager who has no idea whatever how much time it takes to perform any operation in his office. If this same office manager bought merchandise he would insist upon counting and weighing it but so long as a clerk agrees to be in on time and not leave the office before quitting time he is satisfied. What that clerk does, does not seem to count, so long as it is not too much below the general average.

What is Your Output?

Do you know how many letters your stenographers can write in a day?

Do you know how many they do write?

How many entries can a bookkeeper post in a day?

How much can a bill clerk do?

Do you know any of these things?

If not, you had better find out right away, if you are at all concerned with the amount of your pay roll.

After we standardize the methods we set a task and expect the clerk to perform that task. But, we do not leave him by himself to learn how to do it. We teach him. This teaching is itself standardized. We get not only a highly trained crew of clerks working but we perpetuate these methods in written standards, so that the management can continue the training process after we are gone.

In getting high standards of work done, emulation is one of the strongest factors. We suggest that the records of those who have made high marks be published. If this is done, it isn't long before all the other clerks are striving for similar marks. This injects a new interest in the work.

An incentive is necessary for good work and though the incentive of emulation is very powerful, in all fairness it is important to pay a money incentive also. You cannot expect clerks to do from 50 to 100 per cent. more work for the same money as they formerly received.

Bonus Plans Used.

We use a bonus plan. We set a task and whether or not the clerk reaches it, he gets his regular salary. If, however, he makes an extra effort and reaches the high standard he is rewarded by additional money.

Of course, it is much more difficult to arrange office work on a bonus plan that manual labor for the reason that it is so much harder to measure. Because it has been difficult, few houses have made any attempt to do it. Those who conquer the difficulty realize a large reward to which they are justly entitled.

It can be done, it is being done and some day it will be only the slow, easy-going, contented manager who hates to get out of a rut, that will attempt to run an office without measuring the work his clerks do.

Motion study in office work is an accomplished fact. Its possibilities have never been wholly learned. Yet rarely do we find an office in which it is impossible to save at least 10 per cent. of the payroll. In some instances savings of 50 per cent. are possible. In one department of one of the largest companies in the United States, work formerly done by 25 people was, under efficiency methods, done by 5.

A Difficult Labor Market.

In these days of a difficult labor market, it is becoming more and more difficult to secure sufficient people to accomplish the work to be done. Especially is this true in office work. Conservation of energy will save the day. We are now wasting entirely too much effort in industry.

Hoover asks us to save the food we ordinarily waste in order that we may feed the boys who are fighting for us. Let us save the energy that is being wasted today and we can not only feed what we have but supply more if they are needed.

How much energy are you wasting in your office?

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Industrial Engineering curricula at nine universities circa 1920. Notice the wide range of topics covered, from engineering to production to business -- "Management Engineering."

Existing Courses in Management Engineering

By COLLINS P. BLISS

Head of the Department of Mechanical Engineering, New York University

Analysis of the positions held by the graduates of engineering colleges shows that only fifteen to eighteen per cent stay in technical work. The major portion enter widely different pursuits, although many seek positions of executive or managerial responsibility. This situation, and the need of industry for trained intelligence to direct and operate its complex activities, has caused a number of the engineering schools to establish new courses to educate executives. The Society of Industrial Engineers has also planned such a course. At the convention of that society held in Pittsburgh in October, 1920, Professor Bliss presented a brief address comparing some of these courses. He has now expanded that address into a comprehensive paper showing the make-up of eight courses and giving the time allotted to each general group of subjects and to each study.

CALVIN COOLIDGE, when Governor of Massachusetts, once said: "Our prosperity comes from our industry and our industry cannot flourish unless it is directed with the highest intelligence. Far more in the future than in the past will this intelligence call for sound training in science and in its innumerable applications to industry." And yet, despite this need, many large manufacturers admit their inability to secure properly trained men to carry out the details of executive planning and of production.

Those studies which most of our technical schools are able to cover in four years are purely the essential fundamentals of the usual courses in civil, mechanical, electrical, and chemical engineering. In fact the basic engineering training today in all types of technical courses is either civil or mechanical. In the early days of engineering, however, the first courses instituted were designated as "civilian" engineering in contradistinction to "military" engineering. But now the cry is heard on every side for that type of training which will furnish men skilled in the art of using that which the civil or mechanical engineer has built, and in a manner to produce the greatest results at the least cost. For the lack of a better name we are calling this training "Management Engineering," and to meet the industrial awakening not far distant in this country and but a little further remote all over the world, it is within the province of the educators of this country to rise to the emergency and prepare for the market that which the market demands.

The Demand for Trained Men

There is probably at the present time no technical school that has not revised its curriculum in the last few years, and this has come about as a result of the lessons learned from the intensive training called for by the government during the war.

The invasion of an army of men from the industrial walks of life, the everlasting production of those four years of supremacy of essential industries and above all the indisputable fact that "trained" men were the only ones wanted have all worked together to show the schools and colleges of engineering that by the use of trained men more can be accomplished in less time. Moreover, greater co-operation with those that produce is at least one of the signs of the times likely to be displayed for the next decade.

The Industrial Engineer

"Industrial Engineering" seems to be the title most generally adopted to designate those courses which endeavor to train men for constructing, operating, and managing that which the professional engineer has designed. Other designations such as: Administrative Engineering, Business and Engineering, Engineering Administration, and Executive Engineering, all seem to point towards the substitution of subjects that might be generally termed "economic" for the more highly specialized technical ones. The kind of graduate such courses are planned to produce is one who shall possess the qualifications of an executive trained for engineering rather than for business. In other words, in terms of a definition promulgated by the Educational Committee of The Society of Industrial Engineers, "the training of the industrial engineer should fit him to direct and control as an executive all of the agencies and forces of productivity." For the purpose of this paper and its place of publication the term "Management Engineering" has been adopted.

In a paper by Prof. W. H. Timbie of the Massachusetts Institute of Technology, read before a recent meeting of The Society for the Promotion of Engineering Education, we find the following:

> It is these men who in the last analysis must direct the operation of the nation's industries. For our industries cannot compete with those of other countries unless they are conducted by men who have large vision, intimate knowledge of manufacturing details, and a thorough training in science and scientific methods. Manufacturing must be conducted on a sound financial basis, which means that processes of production must be so managed that the total cost of the finished article will be low enough to compete with the products of foreign factories. For this task the service of an engineer who has a thorough knowledge of manufacturing processes are invaluable and his duties multifarious. He must not only be familiar with the best methods of production, but he must thoroughly understand scientific research, in order that he may take advantage of new discoveries and continually better his methods of production.

A feature introduced by nearly all of the institutions offering these new courses is a plan of co-operative work involving direct contact with industrial plants, and even those which have not adopted a definite co-operative plan require their students to spend four or eight weeks during each summer acquiring experience in those lines which either cannot be taught in college, through lack of time and facilities, or which are peculiar to manufacturing and industrial enterprises.

While most of the co-operative courses in this country, from the inaugural one at the University of Cincinnati to the most recent ones at Massachusettes Institute of Technology, the Harvard Engineering School, and New York University, are not confined to courses in Industrial Engineering alone, they show a tendency of the time in making a part of their requirements some form of practical instruction to be obtained only in direct contact with industry itself. But whether the two weeks' period of alternate work at the college and at the industry as introduced by Dean Schneider, or the three months' interval of work in each between the end of sophomore year and beginning of senior year, as tested for ten years at the University of Pennsylvania, is the best for final adoption by all may still be open to argument.

Co-operative Work a Feature of the Course

Still another plan is in operation between the Massachusetts Institute of Technology and the Lynn Works of the General Electric Company, where thirteen weeks are spent in the industry and eleven weeks at the institute alternately for the last three years of a five-year course in electrical engineering.

New York University has a plan confined solely to its course in Industrial Engineering where at the end of the sophomore year the student spends half his time for the remaining twenty-four months of his course at the industry and half at the university in alternate periods of four months each, the longest term yet attempted under the co-operative plan. A fifth year is spent in elementary research or in the investigation of industrial problems either at the university or at the industry or partly at both. The usual B. S. degree is given at the completion of the four-year term and the degree of I. E. at the end of the fifth year under the above arrangement.

Under each of these methods of introducing the student to the great field outside of the college walls, whether this contact be worth more by reason of a short interval or a long one, the fact remains that his education is broadened and his ability to think and act for himself increased.

Typical Courses in Management Engineering

As to the content of those courses now being given under the general title of Industrial Engineering by a half-dozen or more of our leading universities, while the general aim is the same it is variously emphasized. From an analysis of the actual class hours devoted to each subject there seems to be a trend in three directions:

1. Studies looking towards training of a broad executive character.
2. Those taking up the details and methods of production.
3. Courses along business and commercial lines.

What weight has been given to each of these three aspects of the economic substitutions can only be arrived at by a tabulation of the time allotted to courses classed under these heads. This has been done and the results are given in the following schedules in the preparation of which an effort was made to so group the various courses given at the seven technical schools selected that the dominating subjects may be apparent in each curriculum.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Engineering Administration

GENERAL SUBJECTS

Mathematics
- Analytical Geometry
- Calculus
- Differential Equations

Language
- English and History
- Written and Oral Reports
- Engineering Addresses

Science
- Chemistry
- Physics
- Military Science

GENERAL ENGINEERING SUBJECTS

Mechanical Engineering
- Drawing and Descriptive Geometry
- Machine Tool Work
- Mechanism (Kinematics)
- Machine Design
- Engineering Laboratory
- Heat Engineering Electives

Civil Engineering
- Analytical and Applied Mechanics
- Materials of Engineering
- Hydraulics

Electrical Engineering
- Elements of Electrical Engineering
- Central Stations
- Electrical Laboratory

SPECIFIC SUBJECTS

Human Relations
- Industrial Relations
- Labor Problems and Sociology
- History of Industry

Production
- Accounting
- Industrial Organization
- Statistics
- Business Management
- Cost Analysis

Marketing
- Sales, Advertising and Trade under "Business Management"

Finance and Law
- Political Economy
- Business Law
- Banking
- Securities and Investments

PENNSYLVANIA STATE COLLEGE

Industrial Engineering

GENERAL SUBJECTS
- *Mathematics*
  - Trigonometry
  - Analytical Geometry
  - Calculus
- *Language*
  - English Composition
  - Argumentation
  - Public Speaking
  - Modern Language
- *Science*
  - Physics
  - Chemistry
  - Military Science
- *Modern Economic History*

GENERAL ENGINEERING SUBJECTS
- *Mechanical Engineering*
  - Shopwork (Forge, Foundry, Machine, Woodworking)
  - Kinematics of Machinery
  - Drawing and Descriptive Geometry
  - Heat Engineering and Power Plants
  - Machine Design
  - Mechanical Laboratory
- *Civil Engineering*
  - Elementary and Applied Mechanics
  - Engineering Materials
  - Mill Building Design
  - Metallurgy of Iron and Steel
- *Electrical Engineering*
  - Dynamo Machinery
  - Industrial Electrical Applications
  - Electrical Engineering Laboratory

SPECIFIC SUBJECTS
- *Human Relations*
  - Principles of Industrial Engineering
  - Psychology
  - Social Service
  - Political Parties
- *Production*
  - Accountancy and Industrial Accounts
  - Scientific and Shop Management
  - Factory Planning and Inspection Trips
  - Industrial Management and Organization
  - Time and Motion Studies
- *Marketing*
  - Briefly treated under "Industrial Management"
- *Finance and Law*
  - Engineering Law and Contracts
  - Principles of Economics
  - Money and Banking or Commerce Subjects

YALE UNIVERSITY—SHEFFIELD SCIENTIFIC SCHOOL

Administrative Engineering

GENERAL SUBJECTS
- *Mathematics*
  - Algebra
  - Trigonometry
  - Analytical Geometry
  - Calculus
- *Language*
  - English Literature
  - Report Writing and Composition
  - Public Speaking
  - Modern Language[1]
- *Science*
  - Physics
  - Chemistry
- *History and Government*

GENERAL ENGINEERING SUBJECTS
- *Mechanical Engineering*
  - Engineering Practice
  - Drawing and Descriptive Geometry
  - Water and Heat Power Engineering
  - Mechanical Laboratory
- *Civil Engineering*
  - Mechanics and Structural Design
  - Strength of Materials and Metallurgy
  - General Contracting[2]
- *Electrical Engineering*
  - Fundamentals of Electricity
  - Generation
  - Transmission
  - Industrial Applications[2]

SPECIFIC SUBJECTS
- *Human Relations*
  - Psychology or History of Industry[1]
  - Labor Management
  - Social Science
  - Administrative Engineering Problems[1]
- *Production*
  - Engineering Economics
  - Industrial Management
  - Cost Accounting
  - Shop Equipment and Management[2]
  - Machinery and Processes
- *Marketing*
  - Sales and Advertising Statistics
  - Transportation[2]
- *Finance and Law*
  - Business Administration
  - Business Finance
  - Business Law
  - Specifications and Contracts

[1] Junior Electives.
[2] Senior Electives.

COLUMBIA UNIVERSITY

Industrial Engineering

GENERAL SUBJECTS
- *Mathematics*[3]
- *Language*
- *Science*
  - Physical Laboratory
  - Engineering and Industrial Chemistry

GENERAL ENGINEERING SUBJECTS
- *Mechanical Engineering*
  - Power Generation
  - Machine Elements
  - Engineering Thermodynamics
  - Mechanical Laboratory
  - Machine Design and Analysis
- *Civil Engineering*
  - Metallography
  - Mechanics
  - Strength of Materials
- *Electrical Engineering*
  - Direct and Alternating Current
  - Electrical Laboratory

SPECIFIC SUBJECTS
- *Human Relations*
  - Public Assets of Business
  - Labor Problems
- *Production*
  - Principles of Accounting
  - Factory Cost Analysis
  - Business Statistics
  - Factory Management and Equipment
  - Manufacturing Processes
  - Analysis of Productivity
  - Selected Industries

[3] All general subjects covered in 3-year college course.

Marketing
No separate course given
Finance and Law
Principles of Money and Banking
Business Law
Corporation Finance

NEW YORK UNIVERSITY
Industrial Engineering

GENERAL SUBJECTS
Mathematics
Algebra
Trigonometry
Analytical Geometry
Calculus
Language
Rhetoric and Composition
Technical Writing
Survey of Scientific Literature
Public Speaking
Modern Language or American Government
Science
Physics
Chemistry
Military Science and Hygiene

GENERAL ENGINEERING SUBJECTS
Mechanical Engineering
General Engineering Practice
Drawing and Descriptive Geometry
Applied Kinematics
Heat Power Engineering
Mechanical Laboratory
Civil Engineering
Analytical and Applied Mechanics
Properties of Materials
Hydaulics and Hydraulic Motors
Electrical Engineering
Direct Current
Alternating Current
Industrial Applications of Electricity

INDUSTRIAL SUBJECTS
Human Relations
Psychology or Modern Language
Industrial Relations and Employment
Economic or Administrative Problems (Thesis)
Production
Bookkeeping and Accounting
General and Cost Accounting
Factory Organization
Industrial Engineering
Shopwork and Methods
Marketing
Advertising and Selling
Trade and Transportation
Economic Geography
Finance and Law
Business Organization
Principles of Economics
Engineering and Commercial Law

UNIVERSITY OF PITTSBURGH
Industrial Engineering

GENERAL SUBJECTS
Mathematics
Algebra
Trigonometry
Analytical Geometry
Calculus
Language
English
Report Writing
Science
Physics
Chemistry

GENERAL ENGINEERING SUBJECTS
Mechanical Engineering
Shopwork (Forge, Foundry, Machine)
Machine Design
Heat Power Engineering
Civil Engineering
Surveying
Mechanics
Mechanics of Material
Hydraulics
Electrical Engineering
Direct Current
Alternating Current

SPECIFIC SUBJECTS
Human Relations
Psychology
Industrial Employment
Personnel Administration
Production
Industrial Statistics
Cost Accounting
Shop Methods
Time and Motion Studies
Marketing
Advertising (To be treated under Sales Management)
Sales Engineering
Sales Management
Transportation and Foreign Trade
Finance and Law
Credit and Banking
Corporation Finance
Business Law
Contracts and Specifications

PURDUE UNIVERSITY
Industrial Engineering

GENERAL SUBJECTS
Mathematics
Algebra
Trigonometry
Analytical Geometry
Calculus
Language
English or Modern Language
Science
General Chemistry
General Physics
Military Science
Personal Efficiency (Hygiene)

GENERAL ENGINEERING SUBJECTS
Mechanical Engineering
Mechanical and Machine Drawing
Shopwork (Woodworking, Forge, Foundry, Machine)
Kinematics and Machine Design
Engines and Boilers
Power Plants and Transmission
Heating and Ventilating
Mechanical Laboratory and Seminar
Civil Engineering
Analytical Mechanics
Electrical Engineering
Elements of Electrical Engineering
Industrial Lighting

SPECIFIC SUBJECTS
Human Relations
Measuring Mental Ability and Achievement
Psychology (General and Educational)
Safety Engineering and First Aid
Labor Problems and Sociology
Human Nature and Industry
Fundamental Laws and Principles of Human Relations

Production
- Employment Management
- Time and Motion Studies
- Shop Course in Manufacturing
- Industrial Equipment
- Factory Layout and Management Systems
- Cost Accounting
- Industrial Engineering

Marketing
- Salesmanship

Finance and Law
- Elementary Economics
- Business Statistics

COURSE PROPOSED BY THE SOCIETY OF INDUSTRIAL ENGINEERS

Industrial Engineering

GENERAL SUBJECTS

Mathematics
- Algebra
- Trigonometry
- Analytical and Descriptive Geometry
- Calculus (Optional)

Language
- English
- Composition and Literature
- Public Speaking
- Modern Language (Optional)

Science
- Physics
- Chemistry (Industrial Applications)
- Hygiene and Physical Culture

GENERAL ENGINEERING SUBJECTS

Mechanical Engineering
- Drawing
- Machine Design
- Mechanical Laboratory
- Elementary Power Engineering

Civil Engineering
- Properties of Materials
- Strength of Materials

Electrical Engineering
- Covered in Physics

SPECIFIC SUBJECTS

Human Relations
- Psychology (Optional or P. G.)
- History of Industry
- Philosophy of Industry

Production
- Statistics and Statistical Control
- Factory Organization and Management
- Cost Analysis
- Shop Practice (Principles)

Marketing
- Industrial Relations
- Finance and Marketing (Optional or P. G.)

Finance and Law
- Principles of Economics
- Business Law (Optional or P. G.)
- Economic Problems of Industry

The class hours given in the schedules represent as nearly as possible the actual time spent in lecture room and laboratory excluding all preparation hours. Moreover, no summer work has been included in the figures, as comparative values between institutions under the co-operative plan and those not under the plan would have no significance. Under the heading "General Engineering Subjects," where shopwork or surveying, for example, are given entirely during the summer in one institution and in term time in another, there is naturally a slightly unfair weighting of total hours. This, however, is not serious enough to nullify general comparisons, which is all that is attempted in this presentation

A PROPOSED MANAGEMENT ENGINEERING COURSE

The last course tabulated is a rearrangement of that proposed by a special committee at the Philadelphia convention of The Society of Industrial Engineers in March, 1920. The publication of this course has accomplished a good deal in that it has brought forth comment from various educators as to what really ought to be taught in the training of an industrial engineer.

One says, "I have no quarrel with any one who wishes to give a course under the head of 'Business Management' or a similar title, but I do hold that if any engineering course is given it should contain the fundamentals of engineering, such as calculus, applied mechanics, heat engineering, machine design, etc. I realize also that some men who have not this engineering training may make excellent managers and I shall be very glad to pass such men over to such schools as will give them training in management, but I will object to having their training called engineering and to their receipt of degrees in engineering."

Another writes, "I believe that the foundations of a course in Industrial Engineering should include psychology—principles of human behavior—as well as engineering and economics. Since the detailed course outlined is not heavier than our course in mechanical, electrical, and chemical engineering, I believe the committee's suggestion does not fully utilize the possibilities of a four-year undergraduate course in Industrial Engineering of grade to correspond with the engineering courses now given in technical schools of the first class."

Still another comments as follows: "First, I do not agree at all that calculus should be optional. As a matter of fact, it is not possible for the student to study intelligently a number of the courses listed in your scheme unless he has a knowledge of calculus, unless indeed he is prepared to study these subjects 'parrot fashion,' which, as you are well aware, is not the proper method. My second objection is that I find no mention of analytic mechanics. Analytic mechanics is the keystone of the arch of an engineering course, and furthermore, again, without mechanics many of the subjects that you have listed further along in the course would have to be given in an exceedingly crude and elementary fashion. In other words, I think the course lacks the two subjects which are most important in the training of an engineer."

The quotations given represent opinions at three typical institutions, viz.: Pennsylvania State College, Purdue University, and Cornell University. So far as the course criticized is concerned, it would seem that if the word "optional" be stricken out and the subject of analytical and applied mechanics be added, the proposed curriculum would not differ in essentials from those with which it is compared.

Referring to Table 1, in the four subdivisions under the heading "Specific Subjects," there seems to be the widest variation in percentages under "Production," with the one exception of Purdue University, under the heading of "Human Relations." The decisions of The Society of Industrial Engineers' Committee on curriculum would indicate that those institutions having the highest percentages under "Human Relations" and "Production develop more nearly the ideal course."

In Table 1 the percentages under the three main headings indicate that the University of Pittsburgh is the most representative in the column of "General Subjects," Yale University under the "General Engineering Subjects," and New York University under the "Specific Subjects."

It is the opinion of the writer that in the usual engineering courses at most of our technical schools, the curricula are too much alike, and the colleges of engineering ought to be more distinctive in the courses they offer and not all do practically the same thing. It would seem that The Society of Industrial Engineers through its special committee has performed a creditable piece of work in calling attention to the fact that industrial engineering education has at least started right.

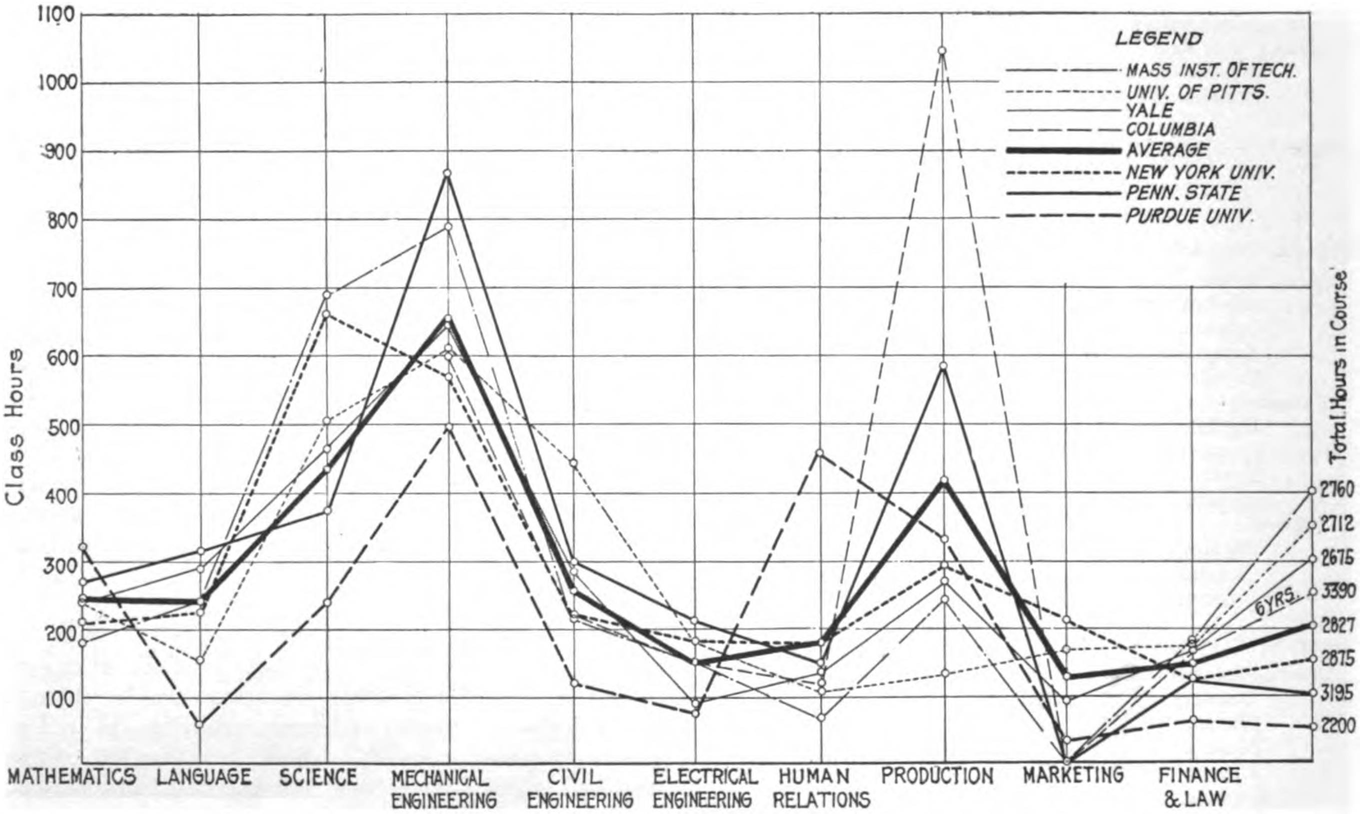

FIG. 1 CHART SHOWING THE NUMBER OF CLASS HOURS DEVOTED TO INDIVIDUAL SUBJECTS AT THE SEVEN INSTITUTIONS LISTED IN TABLE 1

The author is indebted to Professor Gano of the University of Cincinnati for assistance in plotting this chart

TABLE 1 SUMMARY OF THE NUMBER OF HOURS DEVOTED TO INDIVIDUAL SUBJECTS

INSTITUTION	GENERAL SUBJECTS						GENERAL ENGINEERING SUBJECTS						SPECIFIC SUBJECTS								Total Class Hours
	Mathematics		Language		Science		Mechanical		Civil		Electrical		Human Relations		Production		Marketing		Finance and Law		
	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	Class Hours	Per Cent	
Mass. Inst. of Technology.	180	6.6	240	8.7	690	25.0	790	28.6	220	8.0	150	5.4	70	2.5	240	8.7	......	......	180	6.5	2760
Penn. State College.......	270	8.4	270 45[1]	10.0	375	11.7	870	27.2	300	9.4	210	6.6	150	4.7	585	18.3	......	......	120	3.8	3195
Sheffield Scientific School..	240	9.0	200 90[2]	10.8	465	17.4	645	24.2	285	10.6	90	3.5	135	5.0	270	10.0	90	3.2	165	6.2	2675
Columbia University[3].....	......	......	......	......	135[4]	......	600	17.7	225	6.6	150	4.3	120	3.5	1050	31.0	......	......	165	4.8	3390
New York University.....	210	7.3	225	7.9	660	22.9	570	20.0	225	7.8	180	6.2	180	6.3	295	10.0	210	.4	120	4.2	2875
University of Pittsburgh...	240	8.8	156	5.8	504	18.6	612	22.6	444	16.4	180	6.6	108	4.0	132	4.8	168	6.2	168	6.2	2712
Purdue University[6].......	330	15.0	60	3.0	240	10.8	495	22.5	120	5.5	75	3.4	460	20.8	330	15.0	30	1.3	60	2.7	2200
AVERAGE...........	245	8.7	214	7.6	438	15.5[1]	655	23.2	260	9.2	148	5.1	175	6.7	415	14.6	124	4.4	142	5.0	2829

[1]Modern Economic History. [2]History and Government. [3]Six-Year Course—3 years' Industria lEngineering.
[4]This figure represents hours given in the three-year course in addition to those in the preliminary college course.
[5]This figure is made up of the hours indicated plus the average of the hours in the "General Subjects" for the sake of comparing all four-year courses.
[6]Class H ours based on credit hours multiplied by 15.

discussions, and excursions combined with classroom instruction and parallel with shop and drafting office experience

Finally, a working knowledge of the systems used in the clerical, purchasing, storekeeping, accounting, sales, patent, and shipping departments, since they are so closely interwoven with the engineering department systems, will assist the draftsman very materially in determining "why," "when," "where," and "what," and arriving at the "how" in numberless cases that frequently come up for disposition.

Management engineering. Education *658(07)*

A New Course in Management Engineering in England

By R. POLIAKOFF

Assistant Professor of Mechanical Technology, Technical Institute, Moscow, Russia

IN the July number of MANAGEMENT ENGINEERING, Prof. Collins P. Bliss gave the detail of seven courses in management engineering in use in American universities and technical schools. Similar courses are being introduced abroad. As an example, the Municipal College of Technology in Manchester, which is considered one of the best schools for higher technical education in England, has opened recently a new Department of Industrial Administration which in the words of the college authorities has the following objects:

1. To investigate all problems relating to industrial management and to collect and co-ordinate the information obtained with a view to assisting in the building up of a science of industrial administration.
2. To put all knowledge so gained at the disposal of the business community and in particular to organize classes and lectures for managers, workers, and students.

The subjects to be studied in the department will be as follows:

A. INDUSTRIAL HISTORY
- 1. Medieval Guilds
  - Statute of Apprentices
  - Domestic System
  - Colonial Expansion
- 2. Industrial Revolution
  - Mechanical Inventions and Improvements in Transportation
- 3. Factory Legislation
  - Trade Unions and Employers' Associations
  - Co-Operative Movement
  - Health Insurance
  - Unemployment Insurance

B. LABOR ASPIRATIONS
- 4. Trade Unions
  - Conciliation and Arbitration
  - National Industrial Councils
  - Trade Boards
- 5. State Socialism
  - Guild Socialism
  - Syndicalism
  - Communism and Bolshevism

C. ECONOMICS
- 6. General Principles
  - Production
  - Labor and Machinery
  - Unemployment
  - Exchange
  - Credit and Interest
  - Distribution
- 7. Organization of Industry and Commerce
  - Competition
  - Localization
  - Combinations
  - Company Formation
  - Foreign Trade
- 8. Industrial Finance
  - Gold and Paper Money
  - Inflation
  - Index Numbers
  - Banking
  - Company Funds
  - Foreign Exchange

D. TECHNIQUE OF MANAGEMENT
- 9. Type of Management
  - Departmental
  - Functional
  - Committee
- 10. Employment
  - Selection
  - Education
  - Training
  - Discipline
  - Works Regulations
- 11. Routine
  - Planning
  - Progressing
  - Graphical and Statistical Control
  - Cost Accounting
  - Time and General Offices
- 12. Experimental
  - Processing
  - Rate Fixing
  - Time and Motion Study
  - Fatigue

E. PERSONAL
- 13. Incentives
  - Time, Piece, Premium Plans
  - Sliding Scale
  - Profit-Sharing
  - Co-Partnership
  - Promotion
- 14. Working Conditions
  - Security of Tenure
  - Sick Benefits
  - Pensions
  - Holidays
  - Safety and First Aid
  - Hygiene and Sanitation
  - Welfare, Canteens, etc.
- 15. Interrelations
  - Internal Publicity
  - Personal Contact
  - Community Interests
  - Works' Committees
  - Spheres of Activity
  - Relation to Management
- 16. Education
  - Continuation Education
  - Apprenticeship Schemes
  - General Adult and Vocational Training
- 17. Recreation
  - Cultural
  - Sports
  - Handicrafts

From the above it can be seen that the program is complete, and taking into account the general interest in management engineering which is felt now both in this country and in Europe, one cannot fail to notice that the new Department of the Manchester College has developed a very complete program.

Professor Bob Emiliani
Please visit bobemiliani.com

Lean practitioners can relate to this article. Like Taiichi Ohno, Henry Gantt grew tired of "men of accounts" (accountants) who made "production conform to the ideals of an accounting system," thus diminishing the work of those who possess the capability of making goods efficiently. At on top of that, some "men of accounts" claimed to be "efficiency engineers" yet still possessed "the minds of bookkeepers." Sound familiar? Learn more about Mr. Gantt here https://en.wikipedia.org/wiki/Henry_Gantt

Efficiency Society Journal, Vol. 6, No. 9, September 1917, pp. 460-461

Making Goods Versus Making Records

By H. L. Gantt.

MORE than twenty years ago our industries reached a point where much better methods of accounting and record keeping were needed than those which the people then directing them had been able to devise. They naturally called to their assistance men who had experience in accounts—bookkeepers, certified public accountants and various other kinds of accounting experts. Unfortunately, few of these men who were trained in figures had had any experience in production. Their activities had been almost entirely confined to merchandising. The result was that they devised schemes of accounting and record keeping that did not meet the needs of the manufacturer, and at length thinking men began to realize that they could not greatly improve their industries by figures that were not related to the productive process.

About this time the word "efficiency" came into prominent notice, and the new idea was heralded as a sovereign cure for all the evils that existed. Naturally, many accountants simply changed their title to efficiency engineer, bought stop watches and started on a new campaign. The result in many cases was a further complication of the problems of production, for they were still accountants, and had the minds of bookkeepers whose prime object is to balance accounts. Systems of manufacturing devised by such people were made to conform to systems of accounting, often leading to dissatisfaction as well as to the detriment of the productive process.

This was so true in many cases that in the attempt to produce a fine system of accounting, one that would balance all expenditures to a cent, the feature of production was entirely lost sight of, and the productive forces were hampered to an almost inconceivable degree by a method that led nowhere.

This attempt to make production conform to the ideals of an accounting system perhaps reached its highest perfection in the departments of the Federal Government, where the manufacture of records (paper work), which nobody uses goes on with an activity and continuity which cause the productive forces to seem insignificant by comparison. Congress is blamed for much of this, but members of Congress would never have legislated such schemes on to the departments if those schemes had not been devised and advocated by *men of accounts* who were supposed to know but, as experience proves, did not. We cannot get true efficiency until the whole scheme is changed and manufacturing records are devised with the primary object of promoting productive effectiveness.

Some civilian engineers are today feeling the irksomeness of the Army and Navy accounting methods. They are complaining that too much stress is put on figures and documents. The written records loom large when actually the thing itself is what the nation needs. Battles are not fought with figures in a book but are lost or won by guns and shells.

The biggest national task of recent years was the building of the Panama Canal. It required organizing and engineering ability of the highest order. Two eminent civilian engineers successively undertook the responsibility of its direction, and both resigned after a few months because of the hampering restraints of red tape. General Goethals followed them, met the same difficulty, obtained executive permission to violate governmental regulations where necessary and built the canal.

The great war into which we have so recently entered also teaches us most emphatically that power no longer belongs to those whose principal ability is making figures, but to those who can produce the goods. If we would do our part in the struggle which is before us, we must organize on a basis entirely different from the one which now prevails, and devote our efforts to supporting the man *who knows what to do* and *how to do it*, rather than dissipate our energies in making records which serve no useful purpose.—(*Reprinted from Industrial Management.*)

LinkedIn

Professor Bob Emiliani
Please visit bobemiliani.com

Scientific Management was seen by Frederick Winslow Taylor and some progressive business leaders as a substitute for unionism. By around 1912 Scientific Management began to run into severe criticism from union labor leaders and politicians, as illustrated by this group of seven articles. Their interest, of course, was to maintain the status quo; to assure that traditions prevail over advancement and preserve vested economic and political interests (local optimization). To this day, labor unions largely remain opposed to progressive (Lean) management, though some politicians at the state and national levels in the U.S. have been in favor of it in recent decades. Could Lean management be a substitute for the emerging unionism we see today among tech and gig workers? Not if traditions prevail. If you want to know why traditions prevail, please see https://bobemiliani.com/wonder-no-more/

Greater Efficiency, Journal of Efficiency Society, Inc., Vol. 3, No. 6, March 1914

Organized Labor's Opposition to Scientific Management*

By HORACE B. DRURY

Member

INTRODUCTORY

The following is the first of a series of four articles to appear in GREATER EFFICIENCY upon the above subject. They constitute a summary of facts gathered and of opinions formed by the writer during the course of an investigation which was conducted according to the following plans: First, a general impression with regard to what scientific management claims to be, was obtained by looking into books dealing with the merits of the system. Second, a measure of the hostility of organized labor to it was attempted through the seeking out and interviewing of various representative labor men, in and about New York City. Third, visits were undertaken to the strongholds of scientific management in the city of Philadelphia, on the occasion of which the authors and operators of the system were given an opportunity to reply to the attacks on scientific management, and the writer was able to make some personal observations. And fourth, the inspections and interviews having been completed, the investigator's own ideas, together with those of various impartial and competent critics, were rearranged as a system of conclusions regarding the relationship between organized labor and scientific management. It has seemed best to make this same four-fold division of the subject the plan of arrangement in presenting this series of articles.

PART I. AN OUTLINE OF THE THEORY OF SCIENTIFIC MANAGEMENT

Whenever the term "scientific management" is used in this paper, it must be understood that the thing in mind is simply that form of industrial organization which has been sometimes styled the "Taylor System." To mention a pertinent fact or two in the history of scientific management, it was about thirty years ago that Mr. Fred W.

* This series is being published in *Industrial Engineering*, to whom we are indebted for this article.

Taylor began to form plans designed to make more efficient the organization and management of men engaged in manual work. Mr. Taylor, in the course of time, devised many methods which, it is claimed, were put into successful operation in various shops, and which were fully described by him to the public in an article called "Shop Management," which was read before the American Society of Mechanical Engineers at their 1903 meeting. Having risen by his efforts along these lines from a position as mechanic to a position for a time as president of the American Society of Mechanical Engineers, Mr. Taylor now purposes to devote the rest of his life to the spreading of scientific management. There are also several other men, mainly Mr. Taylor's followers, who have distinguished themselves in the same field. Among these might be mentioned Harrington Emerson, H. L. Gantt, Carl Barth, Frederick A. Parkhurst, Sanford E. Thompson, Frank B. Gilbreth, Morris L. Cooke, H. K. Hathaway, and many others.

Having thus limited the meaning of the term scientific management, and having made this mention of the origin of the system, let us now take up one by one the various theories underlying its application.

(*a*) ELEMENTARY TIME STUDY AS A MEANS OF DETERMINING WAGES

The first and perhaps the most widely advertised feature of scientific management has to do with the problem of determining wages. As is well known, under ordinary management, wages are commonly determined according to one or the other of the two following methods. According to the day work method, a man is employed at a fixed rate per hour. This rate the workman receives whether he turns out in the course of the day a small output or a large output. The chief stimulus towards industry and efficiency is the fear of discharge or the hope of promotion. According to the piece-work method, this custom of paying in proportion to the amount of time put in, is abandoned, and each man is awarded according to his efficiency, as measured by the quantity of work which he accomplishes. It is also well known that because day work is said to rarely result in a workman's doing his best, piece-work has been introduced by many employers wherever possible.

Now scientific management, when it considers the usefulness of these two wage systems, does not hesitate a moment before pronouncing the day work system inefficient and almost unworthy of discussion. Turning next to an analysis of the merits of the piece-work system, it declares that the theory of piece-work is excellent. However, the methods to-day employed in determining the rates are so pernicious as to vitiate the usefulness of the entire system.

According to the advocates of scientific management, an employer who has made up his mind to introduce a piece-work system ordinarily manufactures it in the following way: He, on the one hand, reaches a decision as to how much per hour he wishes his workmen to receive; and he, on the other hand, makes a rough guess as to how long it should take a good man to finish the work. The piece-work rate he then fixes at such a figure that an able man by rapid work will just about earn the predetermined wage.

So far everything is fair enough. But suppose, now, that an able or enterprising workman, urged on by the lure of big wages, makes a material increase in the volume of his output. For a time he will make big profits, let us say 35% more than his fellows. But after a season the employer looks over his pay roll, and he notices that on a certain job a workman is earning 35% higher wages than was his purpose when fixing the rate. There was a mistake made here, he thinks, and so the rate is ordered cut.

Now in actual life the lowering of piece-work rates has occurred over and over again. The workmen know that if they can succeed in restricting their output they will continue to be paid at rates which will net them the average income for their trade, in return for a moderate exertion on their part. But piece-workers are in general convinced that if in hope of greater gain they work harder and do more, the time will eventually come when their rates will be so cut that in spite of the increased output, their earnings will be no greater than before. It is for this reason that labor unions sometimes fix a minimum wage for their members, and he who insists on earning more is heavily fined. And it is because of this same aspect of the situation that a workman will sometimes go to considerable trouble to study out how he may work slowly and yet maintain the appearance of industry. So it is that the charge is made that the piece-work system has fallen short of accomplishing its principal aim, which is to persuade the workmen that it is to their interests as well as those of their employers that the output be at a maximum.

Now, say the advocates of scientific management, the root of the above trouble is this: That under ordinary management the piece-work rate is not based upon exact knowledge, but instead, that which it ought to be is simply guessed at by the boss. The men, in order to be given rates that are fair and favorable to themselves, are practically compelled to deceive the boss regarding the difficulty of the work. But if the difficulty of each job could be determined by methods whose accuracy was unimpeachable, then the possibility and the necessity of these ruinous tactics would be eliminated. Such a solution, scientific management announces that it has discovered through the working out of the science and are of elementary time and motion study.

The fundamental point to be grasped in making an examination into elementary time study is this: That its conclusions are based upon a painstaking analysis of work into the elementary movements of hand and body, which when followed one by the other, accomplish the desired end. On the following page has been inserted a list of the elements into which a certain kind of excavation work has been divided. It should be said that in many cases the analysis is carried much more into details, this particular example having been selected mainly because of its simplicity. Nevertheless the record illustrates very well the all-important fact that in elementary time-study the results are based not upon the timing of the work as a whole, but rather upon the timing of little work elements, little individual motions, which enter into the job.

To clear up this idea further, an analogy will be here introduced from the field of chemistry. Imagine a chemist with 1,000 compounds before him, whose molecular weights must be determined. If the chemist is good at analysis, the simplest way for him to perform his task will be to analyse each compound into its elements, and then by consulting his tables of atomic weights he can calculate the weights of the molecules. Let the chemist in this illustration become by analogy a time-study man. The 1,000 chemical compounds whose molecular weights are to be determined are transformed by analogy into 1,000 factory jobs whose times of performance are to be calculated. Now note that just as the chemist can analyse his 1,000 different compounds into some 70 like elements, so an expert time-study man can analyse the 1,000 jobs which enter into any trade, into a surprisingly small number of like elementary movements. One element might consist in the throwing of a shovel full of earth, another in the grasping of the handles of a wheelbarrow, another in the striking of a blow with a hammer, and another in the picking up of a file. And so it clearly follows that just as the chemist, by working backwards from his table of atomic weights, can determine the molecular weight of a compound, so the time study man, by working backwards from the time which it takes to do various elementary movements, can calculate how long it should take to finish an entire job.

TIME STUDY ANALYSIS OF WHEELBARROW EXCAVATIONS

Detailed Operations	Time Per Barrow (in Minutes)
a. Filling barrow with sand	1.24
b. Starting	.182
c. Wheeling full, 50 feet	.225
d. Dumping and turning	.172
e. Returning empty, 50 feet	.260
f. Dropping barrow and starting to shovel	.162
	2.241
a. Filling barrow with clay	1.948

Time A. M.	*Complete Operations*	Total Time (in Minutes)
7:00	Commenced loading sand	
9:02	43 loads wheeled 50 feet	122
9:50	Picking hard clay	48
11:39	29 loads wheeled 50 feet	109
11:46	Picking clay again	7
12:01	4 loads wheeled 50 feet	15
		301

NOTE.—Comparison of "Detail" with "Complete" operations shows that about 27% of the total time was taken in rest and other necessary delays. About the same quantity loose as at the start. (Data taken from F. W. Taylor's "Shop Management," page 15*.)

This elementary time study seems correct in principle. But perhaps the question arises, why go to all this trouble? Why not time the jobs as a whole? To this query there might be given two answers In the first place, a job as a whole is too complicated to make of it a single measurement. The accuracy of a record obtained in this unanylitical manner would depend very largely upon the honesty of the workman studied. It is in fact precisely because of the uncertainty creeping into such lump observations, that in fixing ordinary piece-work rates a premium has been placed on deception, with all the disastrous results which deception brings. But it is the beauty of thoroughgoing analysis into details, that it is thus possible for the time-study man to keep an effective check upon the man studied. Integrity of results may always be easily obtained, because the time-study expert can make use of his previous experience to determine just about how long any elementary motion should take. Thus by elementary time-study, and by this means alone, can unimpeachable data be obtained such as may be used as a basis for fixing uniform piece-work rates.

A second very important reason for the introduction of detailed analysis into time-study is said to be the fact that in many shops there are entirely too many different jobs to time each one separately. Especially in a machine shop where the product is made to order and according to no one standard plan, the jobs are always varying one from another in some particular, so that two jobs are not ordinarily alike in all respects. Yet if a new operation be analyzed beforehand, it is found to consist of old elements which have occurred over and over again in slightly different combinations in connection with other jobs. So in such shops the expert who has spent several years in making a time-study of the ordinary work elements is able by simply going to the proper tables to calculate beforehand the total time which it should take to do a new job.

Now the sum obtained by the addition of the times allowed for the various work elements is increased by a fairly liberal margin, which is supposed to allow sufficient time for rest and other necessary delays, and then the resulting product is regarded as the standard time granted for the performance of the job. The promise is then made that whoever gets done with his work within the time set will be paid the ordinary rate of wages for the trade, plus a bonus, which varies from 30% in some cases to 100% in other cases, over and above the regular wages.* To this standard every workman is expected eventually to rise. If he does not, then he is like the lawyer who does not make good, or the business man who fails in his business. Such a workman is asked to quit and give place to some other man better suited by nature for the work.

The shops which have introduced scientific management claim that a piece-work rate once established by this standard method has never been cut. Even should a mistake be made, and a workman find himself able to make much more than had been expected—even then the rate would be maintained. Thus the workman has no fear of rate-cutting, and it is to his interests to get out as much work as industry and ingenuity will permit.

(*b*) THE STANDARDIZATION OF WORKING CONDITIONS

When wages are obtained in this manner there is one other step which it is extremely essential to take, namely, the conditions of work must be standardized. For, if a certain amount of time is allowed to do a certain piece of work on the supposition that the workman will use a sharp tool, whereas he really has a very dull tool, or perhaps no fit tool at all, then he will lose out in the race against time, and the entire system will be branded as unfair. So it is that scientific management assumes the responsibility of seeing that the conditions that are met in performing the work are equivalent to those under which the time-studies were made. Tools, factory conditions, materials and all other things must be of strictly uniform character. While the primary purpose of this standardization of conditions is to render the bonus system just, it will be readily seen that in addition it has an important direct effect in the way of increasing efficiency.

(*c*) SCIENTIFIC MANAGEMENT AS A MEANS OF DISCOVERING EFFICIENT METHODS OF PRODUCTION

It has been pointed out that the first principles of scientific manage-

* The bonus system is only one of several piece-work wage systems from among which the scientific management expert is free to choose that one which is the best adapted to the situation at hand. Mr. Taylor himself favors a somewhat different arrangement.

ment deals with the wages question, and aims to promote efficiency through instilling into the workmen a desire to do their best to increase the output. We have now come to the second and opposite side of scientific management, which aims to secure results through more effective activity on the part of the management. Let us now consider how the trained minds of the office enter the shop and place a fund of scientific knowledge at the disposal of the workmen.

An idea of how this is accomplished can best be obtained by examining an instruction card, such as that shown on the opposite page. It will be noticed that this illustration is a blank card, so ruled as to be ready to be filled out with detailed instructions for the use of a workman who is to turn a tire. On the left-hand column notice the list of operations, and on the extreme right the time which may be properly taken for each one. This much of the card would be entirely sufficient to give the necessary information regarding the piece-work rate. But there are several other columns. Column 2 tells a workman what pattern he should use, column 3 to what size he should cut the tire, column 4 how deep the cut should be made, column 5 how the belt should be fixed, and so on. Now what are these various columns for? It is evident that columns 2, 3 and 4 give instructions connected with the design which the draftsman has planned for the tire. But columns 1, 5 and 6 go much further than this. Column 1 informs the workman in just what order it is most economical of time to arrange the operations, while columns 5 and 6 indicate just how this machine should be adjusted so as to proceed at maximum efficiency.

Now what is the reason and justification of all these instructions? Does not the workman know his business? Is he not competent to decide in what order things should be done, and how fast his machine should be operated? Scientific management answers, no. It says that the individual workman is a man of limited experience, of limited training, not to mention limited ability, and that there are many things which he can not efficiently manage. For instance in a machine shop it takes more than mere good judgment to decide how a machine should be operated. There are certain technicalities which only a trained engineer can properly decide, and even he must have made a long series of experiments. Into what shapes the tools should be ground, how fast the machines should run, how deep the tools should be set, these are details that can not be learned once and for all, but which must be changed again and again according to the nature of the work, or to the hardness or softness of the metal to be tooled. Only by the use of complicated mathematical rules, and only by methods that are entirely beyond the understanding of the untrained workman, can the work be efficiently planned.

TIRE-TURNING INSTRUCTION CARD

Machine shop..

Order for..................................Tires............

Do work on tire No.......................................

As follows and per blue print.................................

	(1) Templet	(2) Size to be cut to	(3) Depth of cut	(4) Driving Belt	(5) Feed	(6) Rate	(7) Time this operation should take
Surface to be machined...	......	......	......	......	......	......	......
Set tire on machine ready to turn	......	......	......	......	......	......	......
Rough face front edge....	......	......	......	......	......	......	......
Finish face front edge.....	......	......	......	......	......	......	......
Rough bore front.........	......	......	......	......	......	......	......
Finish bore front.........	......	......	......	......	......	......	......
Rough face front I. S. C...	......	......	......	......	......	......	......
Cut out filled............	......	......	......	......	......	......	......
Rough bore front I. S. C...	......	......	......	......	......	......	......
Rough face back edge.....	......	......	......	......	......	......	......
Finish face back edge.....	......	......	......	......	......	......	......
Finish bore back..........	......	......	......	......	......	......	......
Rough bore back.........	......	......	......	......	......	......	......
Rough face back I. S. F...	......	......	......	......	......	......	......
Cut out filled............	......	......	......	......	......	......	......
Cut recess	......	......	......	......	......	......	......
Rough turn thread........	......	......	......	......	......	......	......
Finish turn thread........	......	......	......	......	......	......	......
Rough turn flange........	......	......	......	......	......	......	......
Finish turn edge..........	......	......	......	......	......	......	......
Clean fillet of flange.......	......	......	......	......	......	......	......
Remove tire from machine and clean face-plate.....	......	......	......	......	......	......	......

(Taken from F. W. Taylor's "Shop Management," page 86.)

It is claimed, moreover, that many valuable discoveries with regard to the most expeditious ways in which to handle work are revealed by the time-study. The man with the stop-watch makes a record of every minute motion made and puts down the amount of time consumed. Then an expert looks over the records and says to himself: "What is this motion for? It does not seem to do any good." Or he makes a comparison, and asks: "Why is it that this workman performs only a few motions and gets done quickly with the work, while that workman makes so many more motions and takes such a long time? Somebody is using a clumsy method in his work." Thus it is said that the searching analysis of time-study detects innumerable little wastes and many big wastes in the manner of doing work. In short, work is a science, and only men who have unusually keen powers of observation and analysis are capable of planning it in an efficient way.

Hence it is that under scientific management, before an operation is entrusted to a workman, the job is carefully studied in the office. On an instruction-blank directions are then written out, which state just how the work may be done most conveniently for the worker, and most economically from the technical standpoint. These cards are put into the hands of the workman, who is expected to carry them out to the letter.

(*d*) SCIENTIFIC MANAGEMENT AND THE DIVISION OF LABOR

Another theory of scientific management which has really been implied in what has just been stated, but which is of such great importance that it merits separate mention, is this, that under scientific management there is supposed to be a great extension of the principle of the division of labor. Under the ordinary system of management each man is given work to do. If he succeeds, alright; if he fails, he is discharged. No great amount of help is given to him, but he is left to such devices as he may pick up for himself. But under scientific management, we have seen that the office makes itself responsible for every side of the work. It is largely to meet this responsibility that a division of labor is extended into the supervising function. The different sides of a man's work are separated in thought the one from the other, and for every phase of work thus distinguished there is employed a professional supervisor who spends all his time looking after this one line of activity, wherever it may be found in existence about the shop. One specialist looks after the belts on all the machines. Another oversees the routing of work from man to man, so that no operation is neglected. One man has charge of all the stock bins. Another makes a long study of the art of cutting metals. One man makes a time-study analysis of motions. Another polices the shop, and another is a teacher of the workmen. Thus a workman may be working under half a dozen different bosses at one and the same time. The boss need not have greater general ability than those whose work he supervises, but along the line in which he has specialized he is fitted to direct.

(*e*) SCIENTIFIC MANAGEMENT AND THE HARMONIZING OF THE INTERESTS OF THE EMPLOYER AND THE EMPLOYE

The final place will be given to that one basic theory of scientific management, from which as a starting point the entire system claims to have been developed. Scientific management sets up as its deepest principle the ideal that employers and men are copartners in one work. It is to the interest of the man that the management suceed. It is to the interest of the management that the men succeed. Therefore by mutual helpfulness, rather than by pulling in opposite directions, will the interests of all be best served. Under ordinary management the thoughts of the men are centered very largely in the contest between the employer and the employee. But under scientific management there is set up this one all-embracing ideal—settle the rate of wages scientifically, then forget about the wage question once and for all, and let all cooperate in devoting every effort to the one really important task, that of increasing the output.

Greater Efficiency, Journal of Efficiency Society, Inc., Vol. 3, No. 7, April 1914

Organized Labor's Opposition to Scientific Management*

By HORACE B. DRURY

Member

PART II

We now enter upon the second stage of our investigation, that is, a study of the attitude of the leaders of organized labor with regard to the system whose theory has just been set forth.

JOHN MITCHELL

Probably the most favorably known of American labor leaders is Mr. John Mitchell—he, who was President of the United Mine Workers during their heroic and successful strike of 1902, and who has since served as a Vice-President of the American Federation of Labor. Mr. Mitchell kindly consented to talk over the questions connected with scientific management, and we present in the following paragraphs a summary of his views.

In beginning to speak about scientific management, Mr. Mitchell starts out in a manner so calm and impartial, that we are almost uncertain for a time as to what is his position. But, after a while, his words begin to take on color, and it becomes evident that he is to be placed on the side of the opposition. More and more forceful grows the form of his speech, as he brings out fact after fact which seems to tell against the new system. By the end of the interview one has come to feel that there is absolutely no possible solution of the problem of relationship, that the interests of labor are utterly irreconcilable with the interests of scientific management.

By way of analysis, it might be first said that Mr. Mitchell touched upon a point very vital to the controversy, when he laid down the principle that organized labor is opposed to piece-work. We have piece-work in coal mining, Mr. Mitchell explained, because it is inevitable. The conditions of mining are such that men work in isolation and adequate supervision is impossible. Hence, payment accord-

* This series is being published in *Industrial Engineering*, to whom we are indebted for this article.

ing to the amount of coal mined is the only practicable stimulus towards industry. But outside of such special cases, piece-work is, in general, not to be desired, and the great reason for this is that the present wage system is good enough. The average workman is an honest man, and wants for two dollars worth of pay to do two dollars worth of work. The exceptional cases, which are sometimes to be found, are not numerous enough to justify a resort to piece-work. The whole matter would be different, Mr. Mitchell says, if the American workman were unduly slow. But, instead, he is, in fact, the speediest laborer on the face of the earth. Piece-work, whose sole aim is to make men work harder, is, therefore, for the American workman undesirable in its very principle, for our laborers already work as hard as they should.

Again, taking up another side of scientific management, that of increasing efficiency through the establishing of a planning department, and the employment of a force of motion-study experts, Mr. Mitchell doubts very much whether real gains can be made in this way. To prove that scientific management does not, considering everything, results in ultimate economy of energy, he criticizes, by way of illustration, the motion-study and subsequent reorganization of the trade of brick-laying. By this often-quoted experiment, the number of movements incidental to brick-laying was apparently reduced from 18 to 5. For instance, instead of a workman stooping every moment to pick up a brick, the materials were all placed in the handiest possible position by an assistant, who, moreover, looked over the bricks and placed each brick with its best side up, a little apart from the rest, so that it could be easily seized. Thus the bricklayer's work was made easy. But, asserts Mr. Mitchell, all the original movements still had to be performed. What has happened is simply this: that under the new system, the greater part of the same old movements are performed by low-priced, unskilled helpers. Thus, even should a financial saving be made, it is purchased at the cost of lowering the tone of the trade, and forcing many skilled mechanics out of employment. In much the same way, Mr. Mitchell declares, that, generally speaking, there is no saving in distributing about a shop a lot of foremen, whose function it is to constantly oversee workmen and enforce instructions regarding their minutest movements. The creation of a science of working is too costly, and, considering everything, work can be done no cheaper than according to the older method. After noting the effects of the introduction of scientific management in various places, Mr. Mitchell has reached the conclusion that as a system of production it is of doubtful efficiency.

A third objection of Mr. Mitchell's, and one that bears down upon the listener with more weight than either of the others, is this: That in laying a heavy hand on the shoulder of the workman, and requiring of him absolute conformity to laws of motion established by others, scientific management is taking the soul out of work and making man's life in the shop, not the life of a human being, but that of a machine. Mr. Mitchell explains that a normal act is but the outward expression of a more vital inward thought. In transferring the thinking to the office, and from that point directing the act in the shop, two things, which ought to go together, are unnaturally separated. The worker should not be deprived of his right to think. At this point, the suggestion is offered that there are times when it is agreeable to perform simple mechanical work, typewriting, for instance. Mr. Mitchell replies that when he was President of the United Mine Workers he had a large amount of clerical work done, but that he noticed that what interested the clerical force was not the act of typewriting, but rather the subject matter of the letters, that is, the work was endurable and pleasant, not because of the mechanical side, but because of the thinking.

Among the other criticisms which Mr. Mitchell makes are these: Scientific Management sets a pace so fast that many of the workers are not able to keep up. Especially are the native-born driven out of the shops and their places taken by the foreigners. Is such a result to be commended? Again, Scientific Management deprives many men of an opportunity to become skilled in a trade, and reduces workmen to a lower rank in the industrial world. Again, while wages may be for a time slightly higher than under the old system, this raise is only temporary, and in the end the laborer, for all his trials, will receive no greater income than before. Finally, Mr. Mitchell remarks, "I suppose you know that Mr. Taylor is opposed to trade unions. He won't say so in public, but it is well known that he is."

As Mr. Mitchell talks, his actual words, reinforced by the personality of the man, seem to work their way into the listener's mind, and there give rise to certain feelings and to certain fancies. As the great labor leader speaks, the listener already sees before his mind's eye an industrial world towards which Scientific Management is leading. In this repulsive industrial world genuine freedom does not exist, for up above the heads of all there towers a grim giant called Scientific Management, a power which confines the vital activities of men within very narrow channels. Indeed, the workman's movements are not his own, nor is he a free agent, but all his acts are merely the acts of the great inhuman system, of which he forms an inconsiderable part. We notice, too, that all pleasant and normal ways of life have been cast ruthlessly aside, and on all sides there is only rush.

Then, as Mr. Mitchell continues, there appears a contrasted vision, a picture of the ideal industrial world. This ideal organization consists of a group of men who have joined themselves together for the purpose of accomplishing some common end. There is within each a feeling of responsibility for doing his proper share, and a feeling of trustfulness towards others pervades the entire force. The individual worker, left largely to his own initiative, is finding real pleasure in surmounting the various little obstacles which rise in the course of the day's work. In short, in this ideal industrial world men engage in serious work much as children prepare for giving a party. Genuine industry must indeed be present if anything is to be accomplished. But yet the pace is never so hot, or the striving after efficiency so intense as to prevent the general diffusion of a spirit of joyousness. When fatigued, the workers stop to rest and talk, and all the time life is enjoyed as it passes.

Now, of course, these pictures do not correspond exactly to anything which Mr. Mitchell actually said. However, they do express, as nearly as can be expressed, the listener's impressions of the labor leader's ideals. We go away feeling that Mr. Mitchell is an apostle of the worth of life as opposed to the worth of mere wealth, a defender of mankind against those who would introduce into life the sordid and the mechanical at the expense of the beautiful and the human.

H. T. KEATING

Let us take another trip to a fountain head of labor opinion, this time having for our destination the Labor Temple, New York City. It is a Friday night, when the Central Federal Union is holding its regular meeting. This union is a kind of congress of the New York branches of the American Federation of Labor, every New York local being entitled to representation. The main subject under discussion to-night is whether or not the union should endorse the employers' liability bill before the State legislature, and arguments are presented for and against. After adjournment, the assembled body of men is treated to a stereopticon lecture, in the course of which are thrown upon the screen the various union labels that the members should look for in buying clothing, tobacco, printing, etc. The lecturer is a union organizer, and seems to be an unusually active and capable exponent of the creed of trade unionism. So as he comes down from the platform and into the crowd, we stop him, express our interest in scientific management, and ask him what he thinks of it.

The answer is instantaneous and vehement. Scientific management is a bad thing. Trade unionism is altogether opposed to it. Scientific management injures the worker who is not a fast man. It judges men according to their ability to fit in with certain mechanical conditions of work, and discriminates against the unfortunates who cannot adapt themselves to these conditions. Then, too, scientific management throws a lot of men out of employment.

Mr. Keating, for that is his name, is a man from the firing line. He is one of those labor leaders who go out and organize unions and on occasions take charge of strikes. Many a time has he worked for many hours at a stretch, and at least once he was so badly injured that he had to be taken to the hospital. Mr. Keating's opinion may, therefore, be taken as that of a man who is well acquainted with the rank and file of the labor army. His main point seems to be that scientific management is wrong, in that it measures the worth of a man by considering how well he fits into a place as a cog in a great industrial machine, rather than because of his personal worth as a human being. For this reason, between organized labor and scientific management, there can be no compromise.

F. S. TOMLIN

Our next interview is with a labor man of the very opposite type. Mr. F. S. Tomlin was formerly President of the Glass Blowers' Union, and is still a man active in the labor circles of his borough and city, being at the time of the interview the Secretary-Treasurer of the Joint Labor Legislative Conference of Brooklyn. When interviewed at his Brooklyn home, Mr. Tomlin declares that he is in sympathy with scientific management. He believes that whatever system is most efficient must, in the end, succeed. If scientific management is more efficient than the older forms of management, then if America does not adopt it, France, Germany, and Japan will, and we shall be left behind in the race with those nations. Therefore, the American Federation men are short-sighted in opposing it. President Gompers, John Mitchell, and the others are moving in the wrong direction. For, just as machinery has succeeded, so must scientific management succeed. Improvement in methods helps the worker. Then Mr. Tomlin cites numerous examples from his own trade of glass-blowing which illustrate the effect of the introduction of machinery. Improvements in methods have brought increases in wages, so that the glass-blower of to-day is making big money. It is true that machinery and scientific management make it unnecessary to employ so many men to produce a given output. But Mr. Tomlin says that he tells the other labor men that as the cost of making glass bottles is lessened, there is a corresponding increase in the demand, so that the result has been that all the old men have been needed in order to take care of the growing business.

In judging of how far Mr. Tomlin's opinion may be regarded as typical of labor thought in general, it is necessary to take two things into consideration. First, this man is an independent thinker. He speakes for himself principally, and not as the mouthpiece of any definite party among the union men, unless in so far as he may have built up a personal following, or as his thinking may have chanced to develop along the same lines as that of his colleagues. In the second place, as regards the relationship between labor and the rest of the world, Mr. Tomlin is not a man of strict partisan type. Though his younger days were given over to glass-blowing, and though as a union man of long standing and high rank, he declares that industrial relations should be determined through the instrumentality of the trade union, yet Mr. Tomlin is first of all a public man and only secondarily a union man. He has an interest in the welfare of the community at large, and even sees good in the employing class. We are all very much alike, he believes, laborers and employers as well. The employers are doing just what we would do if we were in their place. Mr. Tomlin is one of the few labor men who are actively identified with the National Civic Federation, and he was the first labor man who saw fit to join the Efficiency Society. And so it is that when Mr. Tomlin declares that scientific management is both necessary and desirable, he is expressing simply a personal opinion. It is possible that some day his point of view will be adopted by other important labor men. But he himself does not deny that at the present time the majority of labor leaders are arrayed on the opposite side of the scientific management contest.

HUGH FRAYNE

Our next trip will be to the New York headquarters of the American Federation of Labor on Twenty-third Street, opposite Madison Square. We enter this office on about the second day of the great clothing strike, when the New York representative of the Federation, Mr. Hugh Frayne, is so busy that one would not think of asking for an interview. But when someone chances to mention the magic words, scientific management, he at once forgets all about the strike, and begins a spirited harangue. System is alright, he declares. He himself tries to run things efficiently about his own office. But for the side of scientific management, which has to do with the handling of men, Mr. Frayne has no use whatever. Piece-work is wrong, and he is opposed to it. It is suggested that in some instances piece-work might not be entirely bad, for example, in picking strawberries by the quart. But no, Mr. Frayne stands firmly by his trade union traditions. He will not admit that piece-work is ever right. Mr. Taylor, he says, is a very nice man socially. He himself has been invited to Mr. Taylor's home, but not happening to be in Philadelphia, he did not take advantage of the invitation.

MR. DUFFY

Mr. Frayne hurries out, but we stay a while and talk with other men, of whom we will mention Mr. Duffy. Mr. Duffy is a mechanic who has become a union organizer, and he states that he led a strike which was successful in keeping scientific management out of a certain shop. He recounts the arguments which he has presented when addressing crowds of men on the subject. He declares that by scientific management, the employers are trying to squeeze the last drop of blood out of the bodies of the workers. They are trying to carry the policy of getting much work for little money to the bitter limit. However, there is one employer whom Mr. Duffy heartily commends, and that is Secretary of Commerce Redfield. Mr. Redfield has a plant over in Brooklyn which it is claimed is very efficient. But he is fair to labor, and has no trouble with his men. Secretary Redfield, we know, attends efficiency conferences, but is not committed to the Taylor methods of increasing output.

In concluding this part of the paper, it should be mentioned that the opposition to scientific management has in some quarters taken a very aggressive form. It is said that in a Western state, a law has been proposed which aims to make its introduction illegal; while by the National House of Representatives, a special committee was appointed to investigate the Taylor and other systems of scientific management. This committee, under the leadership of Congressman W. B. Wilson (now Secretary of Labor), a labor man, wrote out a report favoring efficiency in a general way, but disapproving of the more distinctive methods of scientific management, decrying especially the use of the stop-watch. The principal conclusion of the committee was that there is nothing distinct enough about scientific management to entitle it to be called a "system."

PART III

AN ACCOUNT OF SEVERAL INTERVIEWS WITH THE AUTHORS AND OPERATORS OF SCIENTIFIC MANAGEMENT, AND OF VISITS TO THEIR SHOPS

There being no instance of the introduction of scientific management in New York City, it will be necessary for the third stage of our investigation that we go to the city of Philadelphia, where are situated several shops which have introduced this system. At Philadelphia also lives Mr. Fred. W. Taylor, often called the originator of scientific management, and to-day the leading figure in the field. It is to Mr. Taylor that we will go first.

(a) FRED. W. TAYLOR

We had asked Mr. Taylor in a letter whether he still held the same views as he held at the time "Shop Management" was written. So this matter comes up first, and Mr. Taylor replies that he has made no change of mind—far from it. "Shop Management," he says, is not a theory, but it is a history of a system which has been in use now for thirty years. This book is not composed of opinions. It is a record of facts. And the shops are running to-day. You can go out this afternoon and see them for yourself.

Mr. Taylor then proceeds with a spirited defense of scientific management. He attacks the idea that men are overworked, or that their health is injured. "I will give you fifty dollars," he says, "if you can find a single man in these shops who is overworked." Then Mr. Taylor mentions the names of several great magazines whose representatives called and investigated the scientific management shops. They came expecting to find men imposed upon, and they were looking for signs of overwork. But they, one and all, went back saying that there was no injury to workmen. Mr. Taylor criticises the labor attack, which he characterizes as founded upon misunderstandings and upon deliberate falsehoods. There has never been any trouble between employers and workmen under scientific management. In thirty years there has been but one strike and that was while a system was being introduced, and when the men did not yet understand it. It lasted but a few days and ended in a peace that has been unbroken. It is with a tone of indignation, springing out of a sense of deep injustice, if not ingratitude, that Mr. Taylor recounts how, after these thirty years of pleasant relationship, suddenly the New York group of labor officials came along and began to try to create hostile public sentiment, to make the public believe that he has been guilty of injuring his men. And this, he says, after he has given his whole life over to helping workmen. This is the first time in history that the workmen's interests have been regarded in the improvement of industrial methods. Always before, when machinery or other improvements have come in, the innovators have cared nothing for the good of the men. Mr. Taylor says that he has invited the labor men to come down and go through the shops, but that they will not come. They would learn things that they do not want to know.

When Mr. Taylor is asked whether he believes in trade unions, he replies that he does. When asked whether it would be possible to permit the trade unions to have something to say in establishing the condition of scientific management, he asks in turn: "What could they do?" Scientific management is a science, and the workmen do not understand the principles upon which it is based. But, we again inquire, could not the unions agree with the employers as to the rate of pay which a first-class man should receive? No, he answers; the rate of wages, too, can only be determined scientifically. Experience has shown that if men receive more than 60% higher wages than their fellows, it does them injury rather than good. They dissipate and do not benefit by receiving the greater pay. Wages are to be determined by the management scientifically. What, then, we inquire, is the proper function of the trade union? The trade union, Mr. Taylor replies, should look out for the welfare of the workmen, help make them better men, and cooperate with the management in educating them industriously. Under the old system unions were very necessary, but under the new system the men do not need protection, scientific management looks out for their welfare.

(b) THE TABOR MANUFACTURING CO.

The first shop to be visited is that of the Tabor Manufacturing Co. This company is engaged in the making of molding machinery, belt benches, lifting and carrying trucks, the Taylor-Newbold saw, the Taylor grinder, and other more than ordinarily complicated products. The shop is a small one, employing about 100 men, a fact which makes it in some ways not quite a fair place to use as an example. For in a small shop relations between employer and employes are naturally simpler than in a large shop. The great advantage in making a study of the Tabor Manufacturing Company is this; that here, as nowhere else in the United States, scientific management has been introduced thoroughly. It has been installed in all the departments, whereas most shops have introduced the system only partially. But, on the other hand, the Tabor plant is a very unfair place to see scientific management, according to the labor men. For they claim that it is not typical. Mr. Keating says that it is the one place in the country where scientific management has the appearance of working. Mr. Mitchell says that it may be compared to an exhibit of big apples, such as the exploiters of a new country are wont to put on display at a fair. The apples are two or three times as big as ordinary lands will produce, even in the wonderful new country. Nevertheless, let us go inside and note the conditions.

In looking through the Tabor manufacturing plant, it is evident that the complicated nature of the product requires the employment of a large drafting and planning force. About 20 out of the 100 employes are in the planning department. The drafting force, as soon as an order comes in for a special machine, makes a detailed set of drawings showing all the parts which must be assembled together in order to fill the order. Next a man skilled in the technicalities of the business fills out for each part an instruction card indicating just what operations must be performed on that part, what is to be the order of the performance of the operations, what is to be the general method of going about the work, and what is to be the piece-work price. Then, under the supervision of the production and route clerks, the time when work on each of these parts shall be done is fixed, it being the special duty of these clerks to see that every part is finished at the proper time. By means of files, called bulletin boards, work is regulated in its journey about the shop with much the same precision as are the movements of trains on a railway. It is almost as unlikely in this shop that a job will be neglected, or that a man or machine will be idle, as it is that there will be a collision on the New York subway.

Now, when one looks about to see in what particular manner the economies of scientific management are realized, he notices dozens of ways in which wastes are eliminated. At one point, it is by ingeniously arranging the bins in the stock room. Another detail is the care taken to see that nuts attached to tools are so lubricated that they may be worked by the fingers. Again, regular inspections of belts are made to see that their drawing power is within certain limits of efficiency.

These and many other ideas might seem to be rather due to the ingenuity of the management, than to the merits of the system. Yet this would not be entirely true. For many of these improvements are directly due to methods which are peculiar to scientific management. For instance, here is a great lathe, which stops rotating at the proper time very quickly, because of the attachment of a brake. Formerly there was no brake, but when the job was timed with a stop watch, and the different elements entering into the work analyzed, it was discovered that in the aggregate a great deal of time was lost in waiting for the lathe to stop revolving. Hence, the attachment of the brake. Again, we see great machines which seem to be cutting metal at an unusually rapid rate, so that the machine reminds us of a man sweating at his work. Then as one looks at the toiling machine, he remembers that the exact depth of the cut, the shape of the tool, and the number of revolutions per minute, all these details are fixed at that maximum of efficiency which only the scientific planning of work is able to correctly determine. Again, there seems to be no useless running around the shop after tools, as it is a principle of scientific management that all these shall be supplied to the men before the work on which they are to be used is begun.

The savings which have been thus far mentioned are mainly due to the perfection of technical details, and the influence of a high standard of efficiency on the part of the management. But the chief objections of organized labor were not to such savings, but rather to the introduction of the piece-work system, and to the control of the movements of a man by other men higher up.

Now, what were the actual conditions with regard to this side of scientific management, the human side? As regards speeding up, the guide explained that the increased output per man does not depend at all on movements being made faster than before. Under scientific management, a man is not expected to grab a monkey-wrench any quicker than under any other system. It is due to the elimination of certain movements altogether, coupled with the elimination of loafing, that the gains are made. These statements of the guide were, as far as could be observed, borne out by the general atmosphere of the shop.

As regards the control of motions, our guide pointed out that in this particular shop, no effort is made to go into minutia in instructing the men as to how they shall work. A man is allowed to hold a hammer at the end or close to the head as it suits him best, and he strikes as he sees fit. Of course, if an ignorant workman should handle himself clumsily, someone is ready to advise him. That these claims were true, every appearance indicated. In this shop, at least, there did not seem to exist that undue interference with the freedom of workmen which our interviews with the labor men had lead us to expect. If there was one general impression left by the shop it was this: that here was a rather small body of men working together rather steadily towards the accomplishing of some end in which they were all interested. Relations between the men and the management seemed to be very healthy.

According to our guide, the Tabor Manufacturing Company is now turning out three times as large an output as it manufactured before scientific management was introduced, and this without increasing the number of employes. The men, we are informed, make about 35% higher wages than similar workers employed in other shops.

(c) THE LINK BELT CO.

The other factory which is to be inspected is that of the Link Belt Co. This shop has about 400 employes, and its system is said to be essentially the same as that of the Tabor Manufacturing Co., though scientific management has not yet been extended to all kinds of work. We enter this shop at a time when the men are cleaning up their machines preparatory to quitting for the night. As in the case of the shop just described, one notices here no evidence of hurry.

We are shown a man who has worked under scientific management for about thirty years, and apparently he is now none the worse for his exertions. The superintendent takes us down into the basement where the men are now washing. Each man is using a separate wash basin, provided by the company, and as the men move about, they joke and talk among themselves, seemingly not over-fatigued by their day's work.

The most striking feature of this shop is the cordial feeling existing between the management and the men. The Superintendent and the

President of the Company, as well, known all the men by name. And as the Superintendent walks about, there is evidently the friendliest sort of feeling towards him on the part of the workmen. Mr. Adams has taken a personal interest in the welfare of the individual men, trying to help them to good positions, and sometimes apparently taking more interest in the men's welfare than do they themselves.

Mr. Adams is of a philosophical bent. He wonders why it is that some men receive so much pay, and others so little. He has asked this question of some very prominent economists without getting it answered. When asked whether the men might have some control over scientific management, he says that he thinks that they are not capable. He says that scientific management would be as abstruse to them as a lecture on celestial mechanics, which he had recently attended, was to himself.

Thus, at the Link Belt works, one finds most excellent conditions, under a type of management which might be called paternalistic. The management probably takes better care of the workmen than they would take of themselves. At a cost of many thousands of dollars and several years of hard work, scientific management was introduced. The company now pays its men about one-third higher wages than they would receive elsewhere for the same kind of work. The company does not need to be compelled to make liberal payments to workmen who have received injuries. It does so voluntarily. The factory building is modern and the conditions of work are pleasant. The company is making money, and the troubles of the outside world are hardly felt. Everybody is better off than they would be elsewhere, and the whole force seems to constitute a kind of happy family.

It is realized that the inspection of these two shops is too narrow a foundation upon which to base safe conclusions with regard to the character of all scientific management. Possibly these two shops might be models of excellence, and yet the labor men might be correct in their judgment that scientific management is objectionable. For the labor men might be speaking, not of these factories, but of others where a lower order of scientific management has been introduced. It is, in fact, not open to dispute, that in going through the works of the Tabor Manufacturing Co., scientific management was seen at its best. Mr. Emerson and Mr. Taylor would themselves admit it.

However, in judging scientific management, is it not proper to judge it at its best? Should one not note the tendencies where the system conforms most closely to the ideals of the founder? It is very likely, moreover, that many of the same conditions which have been noted in these two shops, prevail also in numerous other shops where scientific management has been installed, especially when Mr. Taylor or one of his direct followers was the systematizer. As for systems inaugurated by outside parties, who adopt the methods but reject the spirit of scientific management, Mr. Taylor himself has declared that they have done much harm, but he would not classify such systems as scientific management, but rather as its perversion.

This important point, however, should be noted. If scientific management should indeed tend to degenerate when it gets out of the sight of Mr. Taylor, then perhaps even the beautiful manifestations of it which have just been described, have lurking, beneath the surface, potential evils. If the labor men are right in scenting such danger, then the whole outcome of the matter might be that Mr. Taylor's methods of organization are at present working well, but that if the stability of his high ideals is to be guaranteed under any and all circumstances, certain safeguards should be added.

However, this is not a side of the question, which is being brought out at this point. The important thing to note at this stage in our investigation is this: that the evils which the labor men declare to exist under scientific management are not present in those shops where the system has been fully worked out according to the ideals of the founder.

It is desired to quote just two more statements on the employers' side of the question, and then that will close this part of the investigation. The first statement is that of Mr. Harrington Emerson. When questioned with regard to whether scientific management is as suitable for large shops as for small shops where the employers are acquainted with the individual workmen, Mr. Emerson replied that the same principles can be carried out in large shops, but that the results must be obtained by means of the cooperation of foremen, who come in between the men and the management.

The second statement is that of Mr. Frank B. Gilbreth, one of

Mr. Taylor's most devoted followers. Mr. Gilbreth says that he has never been in any trouble with workmen or with unions. Only once was there a misunderstanding and a strike of a few days' duration. At present, Mr. Gilbreth is working in harmony with union officials.

"The ideal industrial community would be one in which every member should have his proper daily task and receive a corresponding reward. Such a community would represent the condition of which Kipling says:

'We shall work for an age at a sitting
And never be tired at all.'

"This is what Scientific Management in its best development aims to accomplish, for it aims to assign to each, from the highest to the lowest, a definite task each day, and to secure to every individual such a reward as will make his task not only acceptable, but agreeable and pleasant. Whatever we do must be in accord with human nature. We cannot drive people; we must go with the current."—*H. L. Gantt.*

"I find in many factories that the amount of work in process, moving in a desultory way through the factory, is two or three times as great as there is any necessity for, if its course were properly planned. It not only takes up factory space, but it ties up a large amount of capital where work is not properly planned. The ordinary stock-keeper or foreman always wants to give himself about two or three times as much time as is needed to get the work done."—*H. L. Gantt.*

Greater Efficiency, Journal of Efficiency Society, Inc., Vol.3, No. 6, March 1914

Scientific Management Between Two Fires

By BRIGADIER-GENERAL WILLIAM CROZIER*

There is a difference between government industrial work and private industrial work, with regard to the difficulties that we both have to meet. As President Eliot called to your minds, we differ from private establishments in that we have no profits to make and no profits to share, but we differ in other ways also. I take it that a private employer, if he satisfies the men in his establishment and produces a contented shop, so that the men are not only stimulated but are pleased at being stimulated, are satisfied with their compensation and are trying to earn it intelligently, considers that his relations are satisfactory. He does not have to care what outside people may think. He is secure in his relations with his own employes. That is not always the case with the government, as illustrated somewhat by our experience in the introduction of the system of scientific management which Mr. Taylor has given us, in the arsenals. These arsenals, as Col. Wheeler has told you, are six in number. They employ altogether between 5,000 and 6,000 workmen at the present time. Of course they are not running at full capacity, they very rarely do in time of peace, but the number is sufficient to be of some importance and to give rise to industrial questions.

You may form an idea as to whether or not we are conducting these establishments in the interest of our workmen as well as in the government interest, when I say that at the Watertown arsenal, where we have carried this system farther than at any other arsenal, although we are gradually introducing it at others, in the seventeen months which expired a few months ago, up to which our records ran at the time that our figures were made up, we had paid out in the kind of premiums that Mr. Taylor and Col. Wheeler have spoken to you about some $22,000, which was over and above the regular pay of these workmen, which is regulated by the wages in the vicinity. The government does not engage in the system which might possibly be

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* Delivered before Boston Efficiency Club branch, February 11, 1914.

described as a pull and haul system between labor organizations and employers, but it takes the result of the efforts that are made by such a system as exemplified in the wage scale of the vicinity and it pays that to its workmen; and all these premiums are over and above the regular wages that result from that scale. I have made to me every month from the Watertown arsenal a report of all the workmen who have done any work under the premium system. We are trying to increase the number all the time, but owing to the fact that time studies are sometimes difficult to get on certain jobs, because some jobs are not to be repeated and therefore it is useless to make a time study of them, and because previous records may not suffice to set a rate for those particular jobs, and for other reasons, all of the shop cannot be working on the premium system; but we are increasing the percentage all the time of this kind of work that is done. These reports show that the men working under this system make an average of from 25 to 30 per cent., and have been doing so for something over two years in which we have had the system in operation, over and above their regular wages.

I have tried oftentimes to ascertain whether these men are satisfied. It is not easy to find out. I have talked with some of them, and I have been told by some that they are very well satisfied; I have been told by others that they are not. The labor organizations do not like the system. There are some reasons why we can see that they might not like it. Labor organizations have always fought anything that increased the productivity of the individual. They commenced years ago by fighting labor-saving machinery. They do not now oppose the introduction of that kind of machinery as such, but they oppose these labor-saving methods. One reason, I fancy, is that there is a belief that there is only a certain amount of work to go round, and that if it is done by a smaller number of men, some men will lose their jobs. That that condition is not likely to obtain in a government factory results from the fact that the work is not usually appropriated for specifically, but by sums of money. We have a certain amount of money for rifles, we have a certain amount of money for ammunition, and if we can produce the rifles or the ammunition more cheaply, we do not at the time we have manufactured as much as we had expected to manufacture at the beginning of the year turn the balance of the funds back into the treasury. We are in the habit of saying we don't get enough money anyway for these purposes, and we simply use the additional money to do more work and employ more labor. That reason, therefore, does not obtain. At the Watertown arsenal, since the introduction of the present methods, there has been no diminution in the number of workmen employed, and of course as we have followed always the wages of the vicinity there has been no diminution in the rate of wages of the employes.

Another reason for which we might suspect that the labor leaders would not like this method may be that by these percentages of increase of pay you will see that we do far more for the men than their leaders lead them to hope they can do by their methods. We are familiar with the violent agitation in favor of a 10 per cent. increase, whereas we think nothing of a 20 or a 25 per cent. increase. It may possibly be that a labor leader will see that a workman would be led to suppose that these methods would do more for him than he could do, and might possibly find his own job threatened, and not enjoy it. The workmen are of course strongly under the influence of the unions. We have no objection to labor unions. Personally I have no objection to labor unions. I recognize that they have done a great deal for workmen in the past. If I were a workman in the present state of industry, I should certainly belong to a labor union. But while we promise, and while we are fulfilling our promises, having a record as long as our record has become, to do so much better than the labor unions promise for the men, it is reasonable that we should ask that they should hold their efforts in abeyance.

I am satisfied that, owing to the advantages under which our workmen pursue their employment, some of which have been stated to you by Col. Wheeler, the labor unions cannot follow the usual method of opposition to us with success; they cannot conduct a successful strike, which is the ultima ratio of the labor union—its final weapon. I have no belief that they could hold their men against the advantages which the government offers to them for any length of time, in a strike. We could fill the places without difficulty. The men themselves would not leave. They are, therefore, driven to employ another method. There is another method open to them. They can bring political pressure upon the administration, and they can bring political pressure upon Congress.

Congress must necessarily pay attention to organizations of the constituencies of the members. They are subject to influence by all kinds of organizations. They are influenced by the National Guard very properly; they are said to be influenced by the Women's Christian Temperance Union, very properly, and they are undoubtedly influenced by the labor organizations, in many instances I have no doubt, very properly; I don't wish to be understood as criticising Congress. It would be unbecoming in me to do so. It is forbidden, and I have no disposition to do so. I have had a good deal of experience with Congress, having been for a number of years the head of a bureau and having to appear before committees of Congress a number of times every year, and my observation of them is that they are generally, if anything, a little more advanced than the average constituency; a little better inclined to give intelligent ear to reports of methods by which their responsibility can be better discharged. But they are human beings, and they have to give ear to what seems to be the sentiment of the communities which send them there, or they cease to exist as Congressmen.

We have recently had from the Watertown arsenal a petition for the discontinuance of the time study and premium features of the Taylor system of management, signed by something over half of the employes. It is very much of a question whether these signatures represent the real sentiments of the employes. I doubt it very much. It is highly desirable to find out what they do feel. Some men who have signed these petitions are making regularly, and have been making regularly for two years and more, $15, $20, $25 and $30 a month over and above their regular pay. They are not working overtime; they are working only eight hours. None of them have complained of being overworked; none of them have stated that they know of any other individuals who have been overworked. But they signed those petitions. It is something of a question as to whether they may believe that the system is not going out anyway, and that they will have the opportunity to continue to earn the premiums, and they can keep themselves in good with their labor organizations by signing petitions against the system, so that no harm is done.

I recognize the difficulty upon the part of Congress of acting on such petitions; and that action is possible, and has to be reckoned with, is evidenced by the fact that before the last Congress there were two resolutions introduced, one in each house, for abolishing these features of this system. Both were reported back favorably to the respective houses by the committee on labor of the House of Representatives and the committee on education and labor of the Senate, to which they were respectively referred, with the recommendation that they should pass; and I have been informed by a number of members of both houses that if either of those resolutions should come to a vote it would pass like a shot. Now, I am very much inclined to believe that many of the members would not like to see them pass, and I believe that many of the members who might vote for them might consider that they were compelled to vote for them, would not like to see them pass; but they are urged to vote for them by certain elements in their constituencies, and they receive no counter impulse from any other element. The resolutions are before this Congress. They are before committees to which they have been referred, but they have not yet been reported out.

In commenting upon this petition which was submitted to the Secretary of War, of which I have just told you, I recognize the necessity of having before Congress the result of some kind of an impartial investigation of the system as it is in operation at the place which I have chosen for the principal experiment station, namely, the Watertown arsenal, and where we are carrying on what one of your citizens has described, I think rather aptly, as a laboratory experiment; in that it is carried on under very good conditions and is entirely open, as all government work must be. The power of the administration can be had by any properly accredited body to require that all the operations as they are carried on shall be laid bare for investigation. In order that such an investigation might be had there that would satisfy the administration, would satisfy Congress, I recommended that the subject be referred to the Commission on Industrial Relations, which was created by an act of Congress of August 23, 1912, to which the personnel was appointed by Mr. Taft, but were not confirmed, and were afterwards appointed by President Wilson and have been confirmed, so that they are now in office. This commission consists of three members representing the employer class, three representing the employes' class, and three representing the general public; and it has taken up this subject. Of course we know that it will make a thorough investigation. It has the evidence that was taken by the committee of the House of Representatives that was appointed two years ago and carried on an investigation, and received the testimony which has been printed in the rather formidable volumes which Mr. Taylor has mentioned, which evidence of course this committee will master, and it will take such other evidence as it sees fit.

This committee being a judicial body, its report, its conclusions, should not be anticipated. It will of course have every opportunity to inform itself completely as to what we are doing. If the report shall be in favor of what we are doing, it will be something which Congress can be guided by; but I fancy that individual members of Congress, being persons still subject to pressure from their constituencies, ought to have the encouragement to follow the report of the commission, in case it should be favorable to the system, which would come from an evidence of appreciation of the justice of that report from some element in the districts which they represent. I cannot think that the industrial community will remain indifferent to the fate of as conscientious an effort as has been made to improve the conditions of employment in an establishment which is in its midst. The Watertown arsenal is very near to you all here. If the government is not permitted to carry on the work there efficiently, if it is prevented from diminishing the cost of manufacturing while at the same time increasing the wages of labor and preserving the agreeable conditions now existing under which that labor is carried on, it cannot be otherwise than prejudicial to every other industry which is carried on in the neighborhood. While watching us, as we recognize that the public has a right to watch us, I trust that you gentlemen who are interested in this subject will remember that we need some encouragement; that those who have the fate of this kind of an effort in their hands, namely, the political forces of this government, are entitled to receive expressions of opinion from those who are interested on one side of this question as well as from those who are interested on the other side of the question, particularly when the active element of those interested on the other side is not the element which is directly working under the system, but an aggregation of organizations outside of our own employment, who consider that the methods which we are using carry some remote threat in regard to the conditions of organized labor as it is carried on outside of government employ, and which therefore produce the kind of pressure which it is very difficult for Congress to stand out against.

I have had now some four or five years' opportunity to observe in our own establishments the operation of this system. I am, perhaps naturally, personally convinced that it is good. I hope that you will pay enough attention to it to reach a conclusion yourselves, and having reached such a conclusion I would be glad if you would allow those who are in authority to know it.

The Labor Union, Scientific Management and the Government

The efforts of the labor unions to prohibit the use of Scientific Management upon Government work have at last borne fruit. Although the efforts of the labor union leaders to accomplish this prohibition by means of direct legislation have proved unsuccessful for the past four or five years, they have finally succeeded in having a rider attached to the Army Appropriation Bill, which prohibits the use of the stop watch, time study and the payment of all premiums or bonuses for work performed in Government Arsenals. The Army Appropriation Bill, with this rider attached, has passed the House of Representatives and if it succeeds in the Senate, there will be an end, for the present at least, to modern and economical methods on Government service.

Two things stand out prominently in this connection. One is that the labor unions have succeeded by trickery where they have failed by direct methods. The rider as a means of securing undesirable legislation has been severely condemned and a series of propositions have been made from time to time to prohibit riders to appropriation bills as a means of securing legislation upon different subjects. The rider method of securing legislation is despicable, as Congress, as a rule, will hesitate to jeopardize the fate of an appropriation bill for the sake of a more or less minor question. It is interesting to note also, that the efforts of the labor unions in the past few years to secure this legislation have heretofore failed to succeed in having the bill reported out of committee.

Another thing that stands out is that the employes of the Watertown Arsenal, the principal station affected by this legislation, are opposed to the action. In the earlier days of Scientific Management at that Arsenal, they were lined up against it. It has now been in operation at Watertown about four years, and during that time the employes have learned that under Scientific Management their burdens have been lightened and their pay increased from 30 to 50 per cent over their former wages. Nevertheless, to satisfy the ambition of a few labor union leaders the higher wages and extra earnings of these employes are to be sacrificed. This sacrifice has already taken place, for premiums and bonus payments were suspended at Watertown Arsenal immediately upon the passage of the rider by the House. Employes of the Arsenal have already learned that they are the ones who will be the ultimate sufferers through the political activity of labor union leaders who have been promoting their own interests at the expense of the working men.

It is doubly unfortunate that Congress should allow itself to be deceived in this manner at the present time. It has a Commission on Industrial Relations which is studying the whole question of Scientific Management in Government work, for the purpose of making a report on the subject to Congress. Good business would require that Congress should wait until this new Commission has reported on the subject. Furthermore, it is notorious that Government work, as a rule, is a splendid example of inefficient methods and high costs, and the Watertown Arsenal by its high efficiency and low production costs has made the common inefficiency in Government establishments all the more conspicuous. The reports of the Chief of the Bureau of Ordnance, under whose jurisdiction is the Watertown Arsenal, have constantly shown that the product of the Watertown Arsenal has cost the Government much less than it did before Scientific Management was used, while at the same time the workmen benefited to the extent of greatly increased pay. It is lamentable that at a time when the country is suffering from heavy burden of increased taxes, that Congress should take a step which will still further increase the cost of operation of one of its most important departments.

It is to be expected that the passage of this legislation will be the first step in a campaign by the labor unions against the use of any methods requiring efficient performance by men in Government work. Doubtless some such procedure will be followed as was the case with the eight-hour law, which first prohibited Government workshops from operating more than eight hours a day, and which prohibition was later extended to establishments supplying material to the Government. Manufacturers doing Government work were prohibited from working their men more than eight hours per day, the result being that many manufacturers withdrew from competition for making supplies for the Government. It is to be expected that having achieved their initial success, the unions will now attempt to prohibit the Government from purchasing any material which has been made under any efficient system of management whatever. Tax-payers and manufacturers generally should take immediate steps to have this pernicious legislation killed in the Senate before any further mischief is done.

One of the largest traveling cranes in the country is being built by the Shaw Electric Crane Co., for the Smith's Cove pier at Seattle, Wash., at a cost of $50,000. The crane will be installed on a municipal pier and will be used for handling lumber and structural steel. The crane is of the double cantilever gantry type, having an over-all length of more than 200 ft., and a travel of 800 ft. along the pier. The ends of the crane bridge will project over the water, one end being hinged to permit the placing of vessels for unloading. Special gripping devices have been arranged to handle the lumber. The opening between the gantry legs will be wide enough to permit the passage of material 32 ft. long without turning. The crane will travel at the rate of 400 ft. per min.

PROCEEDINGS

OF THE

SEVENTH
ANNUAL CONVENTION

— OF —

The Metal Trades Department

OF THE

AMERICAN FEDERATION OF LABOR

HELD AT

SAN FRANCISCO, CAL., NOVEMBER 4-5-6

1915

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WASHINGTON, D. C.
JOHN P. DUNN & BRO., PRINTERS
1915

PROCEEDINGS

OF THE

SEVENTH ANNUAL CONVENTION

OF THE

Metal Trades Department

OF THE

American Federation of Labor

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FIRST DAY—Thursday Morning Session

CIVIC CENTER AUDITORIUM,
SAN FRANCISCO, CAL.,
November 4, 1915.

Pursuant to law, the regular meeting of the Seventh Annual Convention of the Metal Trades Department of the American Federation of Labor was called to order at 10 o'clock a. m., by President O'Connell.

President O'Connell introduced Mr. F. P. Miller, President of the Metal Trades Council of San Francisco, Cal.

PRESIDENT MILLER. (In part.) In the name of the Metal Trades Council of San Francisco, Cal., I extend to you a hearty welcome to our city. I know you will have plenty of work to do, but I hope you will be able to arrange to visit the Fair. I regret that our Council is not in a position to do much entertaining, but the general committee will look after you. Again I welcome you and hope your stay will be pleasant, and your work beneficial to the Metal Trades.

Chairman Miller introduced Congressman John I. Nolan.

CONGRESSMAN NOLAN. (In part.) I can assure you that it is a great pleasure to be with you. We of San Francisco feel particularly proud of the name the Iron Trades Council of this City has made for itself. We have here the first solid Metal Trades Council that was ever organized. It is the outcome of the Machinists' strike some years ago. We realized after this strike the necessity for a closer affiliation. You know the result of this closer affiliation in this city, a general eight-hour day, I say again that we are particularly proud of the accomplishments of our Metal Trades Council. I want to call your attention to the fact that this building you are meeting in is the gift of California to the exposition and was built entirely by union labor. On behalf of the Metal Trades Council of San Francisco, Cal., I welcome you to our city.

Chairman Miller introduced President Murphy of the San Francisco Labor Council, and Secretary O'Connell of the same organization who delivered appropriate addresses of welcome.

CHAIRMAN MILLER. Before I hand over the gavel to President O'Connell I want to say that I believe this is going to be the most important meeting the Metal Trades Department has ever held. We have been watching the press of the country and we believe that the next two years is going to offer many opportunities to the Metal Trades. I trust the East will get an eight-hour day, so that we will find it less difficult to hold our own.

PRESIDENT O'CONNELL. I am sure I voice the sentiments of the delegates mitted their members to do the erecting. We endeavored to prevent this, but failed in our purpose.

The Machinists finally decided, after representatives of the organization had conferred with officials of the York Manufacturing Company, to declare this company fair and entered into an understanding with the company whereby it would discontinue refusing to handle or erect the machinery, in return for which the company agreed to give them a free hand to organize the machinists at the factory, but did not agree to unionize its plant or to use its influence in that direction.

We are, therefore, in the position of having the one organization that could really be of invaluable service in aiding our Department to bring about the unionizing of this plant, withdraw its co-operation and declare the firm fair, while it is held to be unfair by our Department. It is, therefore, useless to continue this contest with the York Manufacturing Company unless we have the united support of all our affiliated organizations.

President Johnson and I interviewed Mr. Shipley, general manager of the company, at York, Pa., October 13, 1915, and went over the whole situation with him. He declared that he was not opposed to the organization of his employees, would not in any manner indicate to the men that he did not want them to organize, and that he would instruct those in charge of the various Departments that they must not indicate in any way their likes or dislikes, friendliness or opposition to the men organizing, but that he would not compel the men to join the various unions. He expected the organizing work would be done on the men's own time so that their relations with the company as workmen during working hours would not be interfered with.

Scientific Management.

Scientific management is understood to mean the various systems devised by Taylor, Gantt, Harrington, Emerson, and others.

During the last session of Congress we had introduced a bill having for its purpose the regulation and method under which Government employees were to work. The intention of this law is to prevent the introduction of the so-called Taylor or similar systems. The bill never came to a vote, but instead we had a resolution adopted by the Naval and Army Appropriations Committees, which was added to the appropriation bills covering these two Departments, which reads as follows:

"*Provided*, That no part of the appropriations made in this Act shall be available for the salary or pay of any officer, manager, superintendent, foreman, or other person having charge of the work of any employee of the United States Government while making or caused to be made with a stop watch or other time-measuring device a time study of any job of any such employee between the starting and completion thereof, or of the movements of any such employee while engaged upon such work; nor shall any part of the appropriations made in this Act be available to pay any premium or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operation of any Government plant."

We learned after Congress had adjourned that a large sum of money had been appropriated in the Fortifications Appropiation Bill for the manufacture of various materials for the use of the War Department at the Watertown and other arsenals. We endeavored to have the Secretary of War make the same restrictions apply at Watertown and other arsenals, in connection with the operation of these plants when work under the Fortifications Bill was being done. We failed, however, in having the restrictions observed. It will therefore be necessary for us, during the coming session of Congress, to have the same restrictions added to the Fortifications Bill as were applied in the Navy and War Appropriations Bill.

We endeavored to have the exception to the Naval and War Appropriation Bills construed to mean that piecework was not to be introduced or continued where it was in operation. The Attorney General, however, ruled against us on this point, holding that the amendment to the Naval and War Appropriation Bills meant only the so-called Taylor systems.

A very large amount of the money appropriated by the Appropriation Committee for the War Department is expended at several of the arsenals under a piece-work and bonus system. If it is the wish of the convention, the officers of the Department should be instructed to have the appropriation bills amended so as not only to prevent the so-called Taylor system, but also the discontinuing of all the systems now in operation except that of the straight day's pay.

The United States Commission on Industrial Relations made a most exhaustive investigation in connection with Scientific Management. Three men were selected to make the investigation—Mr. Robert T. Valentine, representing the employers; Mr. John P. Frey, representing labor, and Professor Robert F. Hoxie, of the University of Illinois. The investigation covered a period of more than one year. A large number of shops were visited. Scientific managers, leaders, experts, employers, and employees were examined. This committee submitted a unanimous report to the D. S. Commission on Industrial Relations.

The report has not been printed in full by the Commission, but has been submitted to Congress with other papers and documents, with the hope that all of the material not printed by the Commission will be put in print by Congress.

I herewith quote from the report of the committee, which will give you some idea as to the result of their investigation and the conclusions reached by them. The report of the committee was unanimously adopted by the Commission itself and ordered sent to Congress for its disposition.

"Scientific management in its direct relation to labor is not devoid of beneficial aspects, inasmuch as it is to a large extent an attempt at immediate standardization of labor conditions and relations. It may also serve labor by calling the attention of the employer to the fact that there are other and more effective ways to meet severe competition than by 'taking it out of labor.'

"Conditions in actual shops do not conform to the ideals of the system, and show no general uniformity. Actual field investigations demonstrated beyond reasonable doubt that scientific management in practice is characterized by striking incompleteness and manifold diversity as compared with the theoretical exposition of its advocates. This incompleteness and diversity in practice apply not only to matters of detail, but cover many of the essential features of scientific management even among those shops designated by Taylor, Gantt and Emerson as representative of their work and influence. The following particular defects were observed:

"*a.* Failure to carry into effect with any degree of thoroughness the general elements involved in the system. This may take the form of ignoring either the mechanical equipment and managerial organization, adopting simply a few routine features, such as time study and bonus payment, or the adoption of all mechanical features with a complete disregard of the spirit in which they are supposed to be applied.

"*b.* Failure to substantiate claims of scientific management with reference to the adaption, instruction and training of workers. Scientific management shops in general depend upon nothing in the way of occupational adaption of the workers except the ordinary trial and error method. Investigation reveals little to substantiate the sweeping claims of scientific managers made in this connection, except that in the better scientific management shops many workmen are receiving more careful instruction and a higher degree of training than is at present possible for them elsewhere. The most that can be said is that scientific management as such furthers a tendency to narrow the scope of the workers' industrial activity, and that it falls far short of a compensatory equivalent in its ideals and actual methods of instruction and training.

"*c.* Lack of scientific accuracy, uniformity and justice in time study and task setting. Far from being the invariable and purely objective matters that they are pictured, the methods and results of time study and task setting are in practice the special sport of individual judgment and opinion, subject to all the possibilities of diversity, in accuracy and injustice that arise from human ignorance and prejudice.

"*d.* Failure to substantiate the claim that scientific management offers exceptional opportunities for advancement and promotion on a basis of individual merit. While scientific management undoubtedly separates the efficient from the inefficient more surely and speedily than ordinary methods, it was shown by the investigation that scientific management often fails in the development of functional foremanship and in the elimination of favoritism. It tends to create a multitude of new tasks on which less skill is required and lower rates can be paid. It has developed no efficient system for the placing or adaption of the workers. It is inclined in practice to regard a worker as adapted to his work and rightly placed when he succeeds in making the task. It tends to confine the mass of workmen to one or two tasks, and offers little opportunity, therefore, for the discovery and development of special aptitudes among the masses. It tends to divide the workers into two unequal classes—the few who rise to managerial positions and the many who seem bound to remain task workers within a narrow field.

"*e.* Lack of democracy under scientific management. As a result of the investigation, there can be little doubt that scientific management tends in practice to weaken the power of the individual worker as against the employer, setting aside all questions of personal attitude and the particular opportunities and methods for voicing complaints and enforcing demands. It gathers up and transfers to the management the traditional craft knowledge and transmits this again to the workers only piecemeal as it is needed in the performance of the particular job or task. It tends in practice to confine each worker to a particular task or small cycle of tasks. It thus narrows his outlook and skill to the experience and training which are necessary to do the work. He is therefore easier of displacement. Moreover, the changing of methods and conditions of work and the setting of tasks by time study with its assumption always of scientific accuracy puts the individual worker at a disadvantage in any attempt to question the justice of the demands made upon him. The onus of proof is upon him and the standards of judgment are set up by the employer, covered by the mantle of scientific accuracy.

"It would seem also that scientific management tends, on the whole, to prevent the formation of groups of workers within the shop with recognized common interests, and to weaken the solidarity of those which exist. Almost everything points to the strengthening of the individualistic motive and the weakening of group solidarity. Each worker is bent on the attainment of his individual task. He can not combine with his fellows to determine how much that task shall be. If the individual slows down he merely lessens his wages and prejudices his standing without helping his neighbor.

"Scientific management as a movement is cursed with fakirs. The great rewards which a few leaders in the movement have secured for their services have brought into the field a crowd of industrial 'patent medicine men.' The way is open to all. No standards or requirements, private or public, have been developed by the application of which the goats can be separated from the sheep. Employers have thus far proved credulous. Almost anyone can show the average manufacturing concern where it can make some improvements in its methods. So the scientific management shingles have gone up all over the country, the fakirs have gone into the shops, and in the name of scientific management have reaped temporary gains to the detriment of both the employers and the workers.

"Fake scientific management experts, however, are not alone responsible for the lack of training and intelligence which contributes to the diversity and immaturity of scientific management in practice and its failure to make good the labor claims of its most distinguished leaders. The fact is that on the whole, and barring some notable exceptions, the sponsors and adherents of scientific management—experts and employers alike—are profoundly ignorant of very much that concerns the broader humanitarian and social problems which it creates and involves, especially as these touch the character and welfare of labor.

"To sum up, scientific management in practice generally tends to weaken the competitive power of the individual worker, and thwarts the formation of shop groups and weakens group solidarity; moreover, generally scientific management is lacking in the arrangements and machinery necessary for the actual voicing of the workers' ideas and complaints, and for the democratic consideration and adjustment of grievance. Collective bargaining has ordinarily no place in the determination of matters vital to the workers, and the attitude toward it is usually tolerant only when it is not understood. Finally unionism, where it means a vigorous attempt to enforce the viewpoint and claims of the workers, is in general looked upon with abhorrence, and unions which are looked upon with complacency are not the kind which organized labor, in general, wants, while the union co-operation which is invited is altogether different from that which they stand ready to give. In practice, scientific management must, therefore, be declared autocratic in tendency—a reversion to industrial autocracy, which forces the workers to depend on the employers' conception of fairness, and limits the democratic safeguards of the workers."

New Federation of Government Employees.

During the year the employees at the Norfolk Navy Yard, located at Portsmouth, Virginia, organized what they called the Navy Yard and Arsenal Employees Federation, which for the time being was to admit to membership all employees at Government navy yards, naval stations and arsenals.

A local branch of the Federation was organized at Portsmouth, Va. A constitution and by-laws were adopted and submitted to the international organizations for approval.

When we heard of the organization, I immediately corresponded with our organizations and called attention to the fact that the organization was a rival one to our Department and that we were perfectly capable of looking after the interest of the Government employees which were to be covered by the new organization. As an evidence of this, it is only necessary for us to point to what we have already accomplished in the interest of the mechanics and others employed at the navy yards, arsenals, etc.

So far as I know, none of the international organizations gave their approval to the new organization. Later we learned that it was the intention of this Federation to establish a national organization and to apply to the A. F. of L. for a charter as a department having jurisdiction over Government employees.

We had several conferences with representatives of the organization. Secretary Berres visited Portsmouth on two occasions to explain to the men that it would be impossible for them to secure a charter for a new department in the A. F. of L.; that our Department and its affiliated organizations held complete jurisdiction. At the meeting of the Executive Council of our Department, held at Washington in August, we invited the President and Secretary of the Portsmouth organization to come to Washington and meet with us, which they did, when the subject was fully discussed.

Later I addressed a letter to the organization, setting forth the work that had been accomplished by our Department in the interest of Government employees, pointing out to them that they could co-operate with each other in the same manner in a council under our Department with much greater prospect of success and secure for

Efficiency Society Journal, Volume 5, No. 6, June 1916, p. 286-291

Current Legislation and Scientific Management

By R. A. Feiss.

THERE is before Congress legislation which proposes to make it a criminal offense to make time study or to use any other means to measure the time of workers in government shops. It is further proposed to make it a crimnial offense to pay premiums or bonuses to workers. To the average layman this legislation may seem to be rather limited in its effect and of very little importance. As a matter of fact, it is of most vital interest not only to industry as a whole but also to the future of the American workman in particular and the American nation in general.

While this legislation purports only to affect government work, it must be taken for granted, that what applies to the management and efficiency of government workers, not only is of vital interest to management and efficiency elsewhere, but is also of great importance to the American citizen who is the real employer and owner of government shops. If the use of certain methods or principles in government work is criminal and should be prohibited, then it is criminal and should be prohibited in private industry.

The economic question is of importance second only to the moral question involved. As to the economic question, it is not only admitted but well proven that scientific management, as first propounded by the late Frederick Winslow Taylor and as applied in the government shops in question and elsewhere, has meant an increase per capita of output averaging 100 per cent or more. It has also been proven and admitted that under scientific management not only is the output increased, but costs are lowered and wages are raised. This means efficiency. And efficiency in both government shops and industry at large is a matter not only of vital necessity in the question of preparedness for war, but also in the ever present question of preparedness for peace.

There is no part of the community to whom efficiency is more vital than the worker. He can never hope to better his status without that proportionate increase of production which results only from increased efficiency. The most radical theorist, as well as the general run of practical economists, will assert that the worker's prosperity and ultimate salvation depend upon his opportunity to receive a fairer, and, generally speaking, a larger share of that which is produced. It therefore follows that he is not only interested in large production, but in the largest possible production in order that his fair share is forthcoming.

If it is admitted and proven that scientific management increases the production and is a valuable asset to the worker and to the community, neither it nor any of its methods must be discarded unless their ultimate effect is shown to be permanently injurious. It is claimed that time study and bonus payments are injurious, as they constitute a "speeding up" process, which results in injury to the workers. It is therefore necessary to consider what time study and bonuses or premium payments consist of.

Management, in order to be scientific, must act only upon accurate knowledge based upon scientific investigation. The stopwatch and other time measuring devices are absolutely essential for scientific investigation and the establishment of facts regarding all the conditions under which an operation is or should be performed, as well as of the performance itself. Some kind of time study is performed in a crude way at all times by every worker for himself. So called time and motion study aims to bring in the best possible scientific methods in order more accurately to determine facts for both the worker and the management. Neither can make any accurate deductions without some scientific assistance. Their deductions will be accurate in proportion to that extent to which scientific methods are applied.

There is a great deal of misunderstanding about scientific time study; first, because it is a new science; and most men are suspicious of anything new—especially of anything that is not readily comprehended by them; and secondly, because time study has been in some instances applied for unworthy ends. It would be absolutely preposterous, however, to do away with time study for this latter reason, altho this is the one that is constantly quoted in opposition to it. There is hardly a known science which is not used as a means of abuse in the hands of some men. For example, chemistry, which has been responsible for such wonderful contributions to human knowledge and comfort, in the hands of some men enables them to produce poisons for the purpose of destroying others. Can it therefore be said the practice of chemistry shall be prohibited as a crime? If a science is capable of abuse, it seems preposterous to legislate for the purpose of abolishing it entirely. Legislation, should there be any, should aim to remedy the specific abuse.

As a matter of fact, no greater contribution to industry has ever been made than that of scientific management in its application of scientific methods to the problems of production. Scientific time study, in the first place, is used to analyze and standardize the conditions of operation. The most efficient tools, the most efficient speeds, the least tiresome and most efficient motions, as well as other conditions are established by time study and can only be established by time study methods. After the conditions of operation have been standardized, time and motion study are the scientific means for establishing a fair performance. In establishing a fair performance, at no time is it possible to accept the best performance of an exceptionally skilled worker. This is safeguarded by the fact that if such performance were taken, time study would immediately defeat its own ends.

Time study itself is the greatest known safeguard against overspeeding and the setting of injuriously high or impossible tasks. In making a scientific investigation, it is not only possible to divide each operation into its component parts and to determine the proper time allowance for each motion, but, as a part of this science, it becomes a practical necessity. It is essential to study the causes of delay, safe and proper allowances for unavoidable interruptions and the proper allowances for fatigue. In other words, time study would amount to nothing and no sane man would waste his time on it unless his object were to study all the conditions relating to efficient operation in detail.

Thru time study speed has not only been increased, but has been regularized. Very little, if any, increase in speed is obtained thru faster movements of the operator, but is obtained thru improvement and standardization of conditions and the elimination of waste motion and effort of the operator, made possible only by time study. In many cases the output has been doubled when thru the assistance of time study the necessity for standardization of materials has been realized. When time study has shown the necessity and means for standardizing conditions, steadying the flow of work and otherwise improving the service to the operator, output has often been doubled and tripled without the slightest addition of effort on the part of the worker.

Time study has another function of equally vital importance to both the worker and industry at large. It lifts practically every field of human endeavor, no matter how lowly, from the plane of unskilled to skilled. This is not only because scientific management recognizes every field of human endeavor as a science, but also when thru time study, the skill required to perform any task in the most efficient way has been studied and established, it recognizes the necessity and the responsibility, thru time and motion study, to analyze the shortcomings of the individual worker in order properly to train him and make him efficient. Time study, therefore, is a scientific means to accomplish that mutual end in industry, viz., the producing of trained men.

Scientific management itself recognizes that while the means for studying the work of the worker is essential, management, in order to be scientific, cannot end when it has merely established the means to produce skilled men. It is true that scientific management, thru time study and other scientific methods, has, where applied, increased the welfare of the worker by making him more skilled, by giving him a steady supply of work, by regularizing employment, by shortening hours, by standardizing and improving other conditions, but scientific management has not stopped there. It has secured for the worker, as a part of that science, a larger and fairer share of the fruits of production than has ever been obtained for him before. Scientific management not only recognizes as an economic problem that the worker is entitled to a fair share, but it has laid down as a principle that not only a fair but a very large return must be permanently guaranteed to him, not only as a reward, but as a necessary incentive toward efficiency. Whether this additional reward is paid to him by means of a premium or bonus, piece rate or any other method makes no difference. The form that is used depends upon the specific conditions. In some cases one and in some cases another form is more applicable. The result is the same. Scientific management insists that a large reward must be assured the worker for a scientifically determined standard of accomplishment. This principle is essential, altho the greater part of additional accomplishment is entirely due to expenditure of money and effort on the part of the management alone.

Altho many of the most essential and beneficial methods of scientific management have sometimes been used for abuse, nevertheless, wherever scientific management has been established in private industry, the workers have thrived not only materially, but also physically and mentally. Any impartial investigation would not only show the beneficial results, but would prove conclusively that the workers themselves almost unanimously will uphold scientific management and would object to returning to old and traditional methods.

At the Clothcraft Shops of the Joseph & Feiss Company, in addition to this having been time and again proven by investigation, some of the results can be quoted as further and irrefutable evidence. During the five years from 1910 to 1914 the average annual income of all workers has been increased 37 per cent. During the same period the cost of production has shown a slight decrease. No better proof of its effect on the worker can be had than the fact that complete medical and other records show that no one within the last seven years has ever left the employ of this company because of overwork or breakdown. Although 70 per cent of the workers are women, over one-third of the workers have been in the steady employ of the company for a period of five years or more. Not only would this be impossible if time study and scientific management methods overspeeded the workers, but, if this were true, the labor turnover would show a material increase. As a conclusive refutation of this fact, the labor turnover of this company is here given:

LABER TURNOVER 1910-1914.

Year.	Stand. Payroll.	New Hands.	Per Cent.
1910	1,044	1,570	150.3
1911	951	807	84.8
1912	887	663	74.7
1913	874	569	65.1
1914	865	291	33.5

The manufacture of ready-to-wear men's clothing is a most complicated proposition, involving a tremendous number of various kinds of operations. Since the introduction of time study and other scientific methods the usual continuous haggling over production and rates has been entirely eliminated. In its place exists only the friendliest relationship and a spirit of co-operation. Time and motion study, by substituting scientific investigation and fact for dispute and opinion, removes the greatest source of irritation and the greatest obstacle to mutual co-operation between management and men.

With the welfare of the worker primarily at heart, legislation should not be introduced to abolish time study and other scientific management methods, but should be introduced to enforce their use in government shops, if not in all shops.

A business in difficulty is like a person who is ill. Each needs a physician, a real one, who can diagnose and treat the case. Even now, with all our experience, the real reason for failures in business are so little known and acknowledged as to astonish one familiar with such matters. Few concerns would ever come to grief if the proprietors and creditors would take the trouble either to act on the knowledge they have or to secure competent advice and help when the first symptoms appear. Here is a large and inviting field for preventive work, but it requires experienced, wise, sympathetic practitioners.—Willard P. Barrows, *Journal of Accountancy.*

An accounting system is a co-ordinate set of records designed to show in detail the physical and financial transactions of a business, as they take place, and to combine or summarize such data in appropriate groups or classifications, so as to give the management reliable information as to the current operations and the resulting physical and financial condition of the business.—E. Elmer Staub, *Journal of Accountancy.*

The Factory Medical Department of the Ford Motor Company treated 206,324 cases during the year ending August 31, 1915.

Efficiency Society Journal, Volume 5, No. 7, July 1916, p. 373-380

Opposing Anti-Efficiency Legislation

THE committee of ten has been doing much active and effective work in opposition to the bills now before Congress that are aimed at the introduction and use of time studies for the promotion of efficiency in government work.

Realizing the serious effect of such legislation upon industry in this country a large delegation, composed of the following well known individuals, representing a large percentage of the country's principal business interests, met members of both houses of Congress and presented arguments in opposition to these bills:

THE DELEGATION.

George R. Alden—Pres. The Norton Co., Worcester, Mass.

L. P. Alford—Editor American Machinist, New York.

Howard E. Coffin—Chairman Committee on Industrial Preparedness of the Naval Consulting Board, New York.

Morris L. Cooke—Acting Director, The Utilities Bureau, Philadelphia, Pa.

Allen M. Cook—Norfolk, Va. former Executive Officer of the Battleship IDAHO.

F. B. Copley—President The Royalton Co., New York.

John Driscoll—Machinist, Watertown, Mass.

Boyd Fisher—Vice-President Executives Club, Detroit Board of Commerce.

Gerome R. George—Morgan Construction Company, President Worcester branch, National Metal Trades Association, Worcester, Mass.

H. A. Goddard—Export Manager Perfection Spring Co., New York.

W. Herman Greul—Otis Elevator Co., Secretary Committee of Ten, New York.

John W. Higgins—President Worcester Pressed Steel Co., Worcester, Mass.

H. P. Kendall—Treasurer The Plimpton Press, Norwood, Mass.

David Kirshbaum—President National Assn. Clothiers, Philadelphia, Pa.

O. B. Kritchfield—Goodyear Tire & Rubber Co., Akron, O.

F. C. Lawton—Cadillac Motor Car Co., Detroit, Mich.

Wilfred Lewis—President Tabor Manufacturing Co., Philadelphia, Pa.

William Lodge—President Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

Fred. J. Miller—Manager of Works, Remington Typewriter Co., New York.

H. D. Minich—United Shirt & Collar Co., Troy, N. Y.

E. A. Muller—Secretary The King Machine Tool Co., Cincinnati, O.

Albert E. Newton—Manager Reed-Prentiss Co., Worcester, Mass.

E. B. Passano—President Williams & Wilkins, Baltimore, Md.

R. A. D. Preston—Goodyear Tire & Rubber Co., Akron, O.

H. H. Rice—The Waverly Company, Indianapolis, Ind.

W. B. Richards—Vice-President Gunn Richards & Co., N. Y.

Oberlin Smith—President Ferracute Machine Co., Bridgeton, New Jersey.

J. L. Sydnor—Goodyear Tire & Rubber Co., Akron, O.

Donald Tulloch—Secretary Employers Assn. and Secretary Worcester branch, National Metal Trades Assn., Worcester, Mass.

John G. Utz—Chief Engineer Perfection Spring Co., Cleveland, O.

W. A. Viall—Secretary Brown & Sharp Mfg. Co., Providence, Rhode Island.

C. Wood Walter—Vice-President Cincinnati Milling Mach. Co., Cincinnati, O.

W. R. Whitney—Naval Consulting Board, General Electric Co., Schenectady, N. Y.

On June 21, the delegation called upon President Wilson and explained the effect the pending legislation will have upon the industrial development of the country. The argument of the delegation were presented by Mr. H. P. Kendall who spoke in part as follows:

The men composing this delegation come from New York, Virginia, Massachusetts, Michigan, Connecticut, Ohio, Rhode Island, Indiana, Pennsylvania, Illinois and New Jersey. They are men of high standing in their communities, the representatives of leading companies and associations in a wide range of industries.

They are leaders in that they represent the best that has been attained in good working conditions, short hours and high wages for the employees and low cost and high quality of output of their mills and factories.

They represent annual expenditures of hundreds of millions of dollars. They are members of no single organization but speak for many industrial organizations and chambers of commerce.

They are the type of men to whom the country is looking to advance our foreign commerce and to improve our manufactures and domestic trade. They are men of broad vision and balanced judgment and they came together on a moment's notice to protest against legislation that all are agreed is vicious, and to explain their reasons for their protest.

The legislation is opposed by this group, by manufacturers generally and by practically all employees working in plants under the form of management attacked by the legislation embodied in the so-called Tavenner bill H. R. 8665. This bill provides:

> "That it shall be unlawful for any officer, manager, superintendent, foreman, or other person having charge of any employee of the United States Government to make or cause to be made with a stop watch or other time measuring device a time study of any job of any such employee between the starting and completion thereof, or of the movements of any such employee while engaged upon such work. No premiums or bonus or cash reward shall be paid except for suggestions resulting in improvement or economy in the operation of any Government plant.
>
> Sec. 2. That any violations of the provision of this Act shall be deemed a misdemeanor and shall be punished by a fine of not more than $500 or by imprisonment of not more than six months, at the discretion of the court."

The Naval Appropriation Bill H. R. 15947 and the Fortification Bill as passed by the House have the following rider attached:

> "Provided, That no part of the appropriations made in this Act shall be available for the salary or pay of any officer, manager, superintendent, foreman, or other person having charge of the work of any employee of the United States Government while making or causing to be made with a stop watch or other time measuring device a time study of any job or any such employee between the starting and completion thereof, or of the movements of any such employee while engaged upon such work; nor shall any part of the appropriations made in this Act be available to pay any premium or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operation of any Government plant."

These rider bills are under consideration in the Senate and will shortly be followed by similar measures providing funds for the Army, Post Office and sundry deficiencies.

The clear purpose of these measures is to prevent the use of any watch, clock or other timing device in connection with Government work and to prohibit the payment of any money in excess of a flat day wage as a reward for specific accomplishment.

The greatest progress in the science and art of industrial management has been made during the last decade due to the formulation of a new and different set of principles by an American industrial engineer recognized as the leader in his field by the entire industrial world. France, Germany, England, Belgium, Switzerland are all paying their tribute of praise and have adopted these principles in their industries. These principles were formulated some 20 years ago and like all new ideas were slow in adoption. The last few years however have seen them rapidly gain headway until today hundreds of thousands of workers are benefiting by them.

There are a number of very essential features of this form of management, functional leadership, centralized planning, complete classification, definite routing of materials, job analysis and some form of pay beyond the regular flat wage, based on quality and production.

The stop-watch is an essential instrument in making an accurate job analysis and a job analysis is made of every hand or machine operation for two distinct purposes:

First, to make such a thoro study that the best way to do the job can be found.

Second, to form a basis of reward for special skill and accomplishment.

In a recent time study made to discover the best way of drying cloth, the instruments used by the consulting engineer in a purely scientific investigation of that particular operation, were hygrometers, thermometers, a steel tape, graduated balances and a stop-watch. The engineer is a man who had had no previous experience in an industry operating under the principles of scientific management. The instruments were necessary to determine how best to operate the machine and the study had reference purely to the machine and its product. Later to complete this job analysis it will be necessary to study the motions and the workman, times of changing from one kind of work to another and of stopping and starting the machine.

Such a job analysis will be incomplete without a study of such human factors as ventilation, lighting, fatigue, rest periods, etc. With the analysis complete it will be possible to operate the machine in a better way than at present and with less nervous strain and wear and tear on the operative it will be possible to produce a greater output with higher earning for the operator.

This is merely a single instance of the use of the stop-watch as one of the precision instruments in constant use in the most advanced industrial management.

It is not a theoretical case. It is typical of the search for facts continually going on in industry.

Similar studies have been conducted over a period of years in Government arsenals and navy yards and on our battleships. Admirals and commanders of battleships have repeatedly told us that the stop watch has been an absolutely essential factor in the improvement of the fighting efficiency of our fleet.

The soundness of the principles is a demonstrated fact. Scientific management, socalled, in which the stop watch is an essential precision instrument has already increased production, lowered cost and increased the workers' earnings. The increased wages are a component part of the plan that has made lower costs possible.

The popular conception of the stop watch as a speeding up device, pure and simple, with its chief and only function that of driving the worker to the limit of endurance is fast giving way as the real knowledge of its use grows. The old popular conception of the use of the stop watch, growing out of its association with the race course, is only retained by those ignorant of its proper function or those obstructionists who deny the value of real cooperation between the worker and his employer. If the old conception was correct those advocating the improved principles of management could neither square their position with their ideals nor have the moral courage to oppose publicly legislation of this kind.

A brief description has been given of a single example of job analysis. This plays but one part in the new scheme of industrial management. Eighty per cent. of the increased production made possible by the application of these principles is due not to greater effort of the worker nor even to the better direction of his individual efforts, but to the plan of the management which accomplishes; first, complete standardization of materials; second, the proper control and movement of these materials in right quantities, in the right direction, at the right time and to the right place for their use; third, the giving to the workers complete information as to the best way of doing a certain piece of work and as to the best way of operating the machine; fourth, the scheduling thru the routing system and the planning room of all orders in their proper sequence and to completely balancing production; fifth, the improvement in the care and in the design of machines as a result of the analytical time study.

To make possible the scientific routing, scheduling and balancing of product it is necessary to know in advance how long the job is likely to take, otherwise preceding or subsequent jobs will interfere. Time study is the only method of obtaining this information without which uniform rate of production cannot be obtained.

When this careful job analysis in which the operators cooperate, has been made it is the purpose and practice to pay the workers who accomplish an easily attainable task in a given time, a premium or bonus running from 10 to 50 or 75% increase over their basic earnings.

This greater earning capacity of the worker is made possible by work of the management after it has organized itself properly to perform the work which the management has to do, namely to give proper information to the workman, to bring the material and tools to him at the proper time and to give him a suitable machine with full instructions as to the best way to use it.

The task or bonus time is determined very carefully and results in an accurate knowledge of the time in which work will be accomplished with the resultant possibility of better planning and more uniform production.

It makes possible greater production from the plant as a whole and thus makes possible larger earnings for the workers. These larger wages are in fact secured with less wear and tear, less nervous strain and under better working conditions than were wont to prevail under earlier methods of management.

These are not exaggerated statements They are facts borne out by ample evidence. Such conditions can be seen in many kinds of industry and in many plants over the country, tho not in a large proportion of the plants because these principles are relatively new. These plants as a whole represent the best working conditions, the best industrial relations, the highest earnings, the smallest change in labor personnel and the best health and happiness of the employees that can be found in the country

Without exception, the introduction and development of these principles have resulted in a very marked improvement in each respect mentioned above.

An example, not the least in importance, is found in the Watertown arsenal where in the last few years has been demonstrated the improvement in wages, in lowered costs and in greater output. Two present members of the Cabinet and a member of the House formed a committee under a former administration to investigate the methods in vogue there and reported it unwise to pass legislation prohibiting the methods they found.

It has been said by the advocates of the legislation we oppose that members of labor unions are opposed to time study and premium payments. Wherever these principles have been applied in industry there was quite as much cooperation on the part of union workers as of any other and these principles are pretty thoroly developed in some companies which have virtually union shops. It is of interest to know that two labor unions in large cities in different states are now employing industrial engineers for the purpose of making time studies and job analyses as a basis for fair and equitable rates for which they collectively bargain. The labor union officials in England proposed these same methods of stop watch time study and premium payments as the best security for the workers' interests under the increased output demanded for their country's defense.

We contend:

First. That few of those who decided on legislation of this kind have a clear idea of what is meant by time study and premium methods of payment or of their place in modern industrial efficiency.

Second. That the Government of the United States should be second to none in its grasp and use of the best methods of management, that to legislate against the use of any instrument of measure or precision which may be used to determine the best ways of doing work is not only unwise but extremely dangerous; that with the necessity for preparedness for peace as well as for war, the United States should take the lead in seeking to develop and increase the efficiency of its managers and its men.

Third. That those who would lead our legislators into believing that the use of the stop watch and premium or bonus payments are pernicious "speeding up devices" are either completely misinformed as to the principles and practices of the form of management of which these methods are a part, else, for their own purposes, seek to prevent the Government from using the best and most advanced methods that have been developed in private industry in this country and abroad.

Fourth. That the only way of increasing earnings without increasing costs is by improvement in industrial efficiency, that the principles of scientific management have accomplished this and that over 100,000 workers in this country have been and are working in plants in which this method is used, gaining greater earnings under better and more healthful conditions than existed before this new form of management was developed.

We urge therefore:

First. That our legislators inform themselves as to the facts regarding the legislation we oppose and its far-reaching influence in both Government and private industry, and

Second. That if they find our statements are substantial they oppose such legislation as is proposed in the Tavenner and Van Dyke bills and such riders on the various appropriation bills as seek the same ends.

We urge that they use their influence and legislative power to secure in every department of Government activity the adoption of these best principles and practices of industrial management that has been developed, which have been found to further the greatest production, the least waste, the greatest earnings, the greatest safety, the greatest improvement in health, and the greatest loyalty and interest of the workers; and in its broadest sense the greatest efficiency.

Professor Bob Emiliani
Please visit bobemiliani.com

Many people say that Scientific Management was not scientific. How wrong they are! They never heard of Carl Barth. A key element of Scientific Management was measurement and standardization. As part of that work, Frederick Winslow Taylor's close associate, mathematician Carl Barth, created many different types of compound slide rules (mechanical analog computers) for various types of calculations -- and thus moving away from "rule of thumb" (guesses) to facts based on science. Learn more about Carl Barth and his ingenious work here https://en.wikipedia.org/wiki/Carl_Georg_Barth

Transactions of the American Society of Mechanical Engineers, Vol. XXV, 1904, pp. 48-62

No. 1010.*

SLIDE RULES FOR THE MACHINE SHOP AS A PART OF THE TAYLOR SYSTEM OF MANAGEMENT

BY CARL G. BARTH, SWARTHMORE, PA.
(Member of the Society.)

1. In his paper on "Shop Management," read at the Saratoga meeting of the Society in June last, Mr. Fred W. Taylor referred to certain slide rules that had been invented and developed under his supervision and general guidance, by means of which it becomes a comparatively simple matter to determine that feed and speed at which a lathe or kindred machine tool must be run in order to do a certain piece of work in a minimum of time.

2. These slide rules were also mentioned by Mr. H. L. Gantt in his paper "A Bonus System of Rewarding Labor" (New York Meeting, December, 1901), as being at that time in successful use in the large machine shop of the Bethlehem Steel Company, and reproductions of a number of instruction cards were therein presented, the dictated feeds and speeds of which had been determined by means of these slide rules.

3. Mr. Taylor early set about making experiments with a view to obtaining information in regard to resistances in cutting steel with edged tools, and also the relations that exist between the depth of cut and feed taken to the cutting speed and time that a tool will endure; and he advanced far enough along these lines in his early position as engineer for the Midvale Steel Company to make systematic and successful use of the information obtained; but as this, of course, was confined to tempered carbon tools only, it was not applicable to the modern high-speed steel, so that the invention and introduction of this steel called for new experiments to be made.

4. These were first undertaken under Mr. Taylor's directions at

* Presented at the New York meeting (December, 1903) of the American Society of Mechanical Engineers, and forming part of Volume XXV. of the *Transactions*.

Bethlehem, so far as the cutting of steel alone was concerned; and later on at the works of William Sellers & Co., Inc., of Philadelphia, at which place the writer spent fifteen months in going over these experiments again, on both steel and cast iron, and with tools of a variety of shapes and sizes, and for which nearly 25 tons of material were required.

5. However, it is not the writer's intention at this time, to give an account of these experiments, or of the results obtained and conclusions drawn from them, but merely to give some idea of the slide rules on which these have been incorporated, and by means of which a most complex mathematical problem may be solved in less than a minute.

6. He will also confine his attention to the most generally interesting of these slide rules; that is, the slide rules for lathes, and he will take for an example an old style belt-driven lathe, with cone pulley and back gearing.

7. Considering the number of variables that enter into the problem of determining the most economical way in which to remove a required amount of stock from a piece of lathe work, they may be enumerated as follows:

I. The size and shape of the tools to be used.
II. The use or not of a cooling agent on the tool.
III. The number of tools to be used at the same time.
IV. The length of time the tools are required to stand up to the work (LIFE OF TOOL).
V. The hardness of the material to be turned (CLASS NUMBER).
VI. The diameter of this material or work.
VII. The depth of the cut to be taken.
VIII. The feed to be used.
IX. The cutting speed.
X. The cutting pressure on the tool.
XI. The speed combination to be used to give at the same time the proper cutting speed and the pressure required to take the cut.
XII. The stiffness of the work.

8. All of these variables, except the last one, are incorporated in the slide rule, which, when the work is stiff enough to permit of any cut being taken that is within both the pulling power of the lathe and strength of the tool, may be manipulated by a person who has not the slightest practical judgment to bear on the matter;

but which as yet, whenever the work is not stiff enough to permit of this, does require to be handled by a person of a good deal of practical experience and judgment.

9. However, we expect some day to accumulate enough data in regard to the relations between the stiffness of the work and the cuts and speeds that will not produce detrimental chatter, to do without personal judgment in this matter also, and we will at present take no notice of the twelfth one of the above variables but confine ourselves to a consideration of the first eleven only.

10. Of these eleven, all except the third and tenth enter into relations with each other that depend only on the cutting properties of the tools, while all except the second, fourth and ninth also enter into another set of relations that depends on the pulling power of the lathe, and the problem primarily solved by the slide rule is the determination of that speed-combination which will at the same time most nearly utilize all the pulling power of the lathe on the one hand, and the full cutting efficiency of the tools used on the other hand, when in any particular case under consideration values have been assigned to all the other nine variables.

11. If our lathe were capable of making any number of revolutions per minute between certain limits, and the possible torque corresponding to this number of revolutions could be algebraically expressed in terms of such revolutions, then the problem might possibly be reduced to a solution, by ordinary algebraic methods, of two simultaneous equations containing two unknown quantities; but as yet no such driving mechanism has been invented, or is ever likely to be invented, so that, while the problem is always essentially the solution of two simultaneous equations, or sets of relations between a number of variables, its solution becomes necessarily a tentative one; or, in other words, one of trial and error, and involving an endless amount of labor, if attempted by ordinary mathematical methods; while it is a perfectly direct and remarkably simple one when performed on the slide rule.

12. The slide rule method of solution may, however, also be employed for the solution of numerous similar problems that are capable of a direct and perfect algebraic solution; and it will, in fact, be best first to exhibit the same in connection with the simplest imaginable problem of this kind.

13. In the first place, the solution of two simultaneous equations may be graphically effected by representing each of them by a curve whose coördinates represent possible values of the two

unknown quantities or variables, for then the coördinates of the point of intersection of these curves will represent values of the unknown quantities that satisfy both equations at the same time.

14. *Example* 1. Thus, if we have $y + x = 12$ and $y - x = 3$, these equations are respectively represented by the two straight lines AB and CD in Fig. 3; and as these intersect at a point (1)

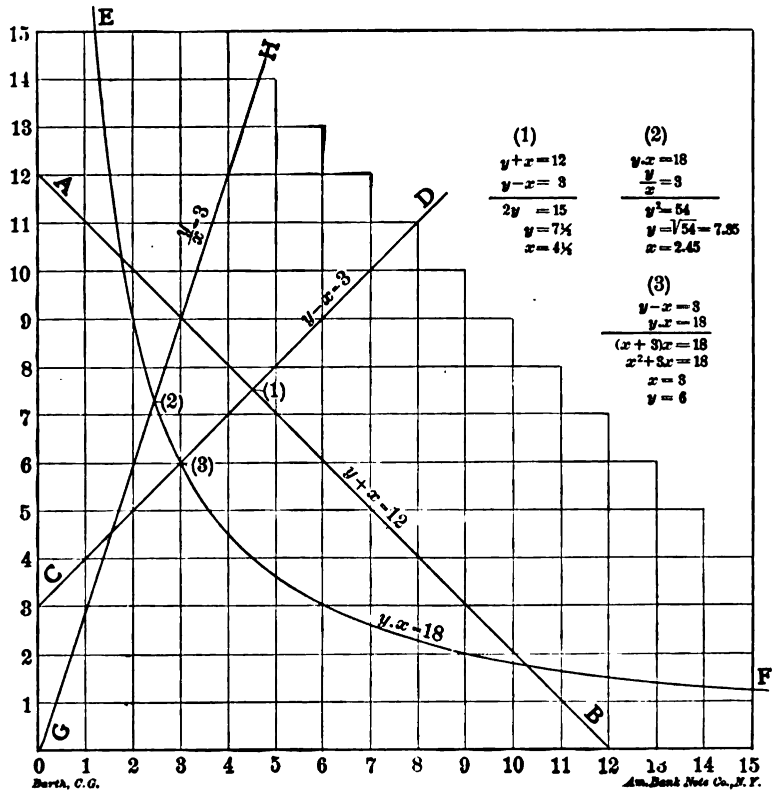


FIG. 3.

whose coördinates are $x = 4\frac{1}{2}$ and $y = 7\frac{1}{2}$, these values will satisfy both equations at the same time.

15. *Example* 2. Suppose again that we have $x . y = 18$ and $\frac{y}{x} = 3$, and these equations are respectively represented by the equilateral hyperbola EF and the straight line GH; and the coördinates to the point of intersection of these (2) being respectively $x = 2.45$ and $y = 7.35$, these values will satisfy both equations at the same time.

16. *Example* 3. Similarly, if we have $y - x = 3$ and $y.x = 18$, these equations are respectively represented by the straight lines CD and the equilateral hyperbola EF; and the coördinates to the point of intersection of these (3) being $x = 3$ and $y = 6$, these values will satisfy both equations at the same time.

17. The slide rule method of effecting these solutions—to the consideration of which we will now pass—will readily be seen to be very similar in its essential nature to this graphical method, though quite different in form.

18. In Fig. 4 is shown a slide rule by means of which may be solved any problem within the range of the rule of the general form: "*The sum and difference of two numbers being given, what are the numbers?*"

19. The rule is set for the solution of the case in which the sum of the numbers is 12 and their difference 3, so that we may write

$$y + x = 12 \text{ and } y - x = 3,$$

which are the same as the equations in Ex. 1 above.

20. In the rule, the upper fixed scale represents possible values of the sum of the two numbers to be found, for which the example under consideration gives $y + x = 12$, opposite which number is therefore placed the arrow on the upper slide.

21. The scale on this slide represents possible values of the lesser of the two numbers (designated by x) and the double scale on the middle fixed portion of the rule represents possible values of the greater of the two numbers (designated by y); and these various scales are so laid out relatively to each other, and to the arrow referred to, that any two coincident numbers on these latter scales have for their sum the number to which this arrow is set; in this case accordingly 12.

22. The bottom fixed scale on the rule represents possible values of the difference of the two numbers, in this case 3, opposite which number is therefore placed the arrow on the bottom slide of the rule, the scale on which also represents possible values of the lesser of the two numbers, x; and the double fixed scale in the middle of the rule representing, as already pointed out, possible values of y, the whole is so laid out that any two coincident numbers on these latter scales have for their difference the number to which this arrow is set; in this case accordingly 3.

23. Fixing now our attention on any number on the double y scale in the middle of the rule, we first note the values coincident

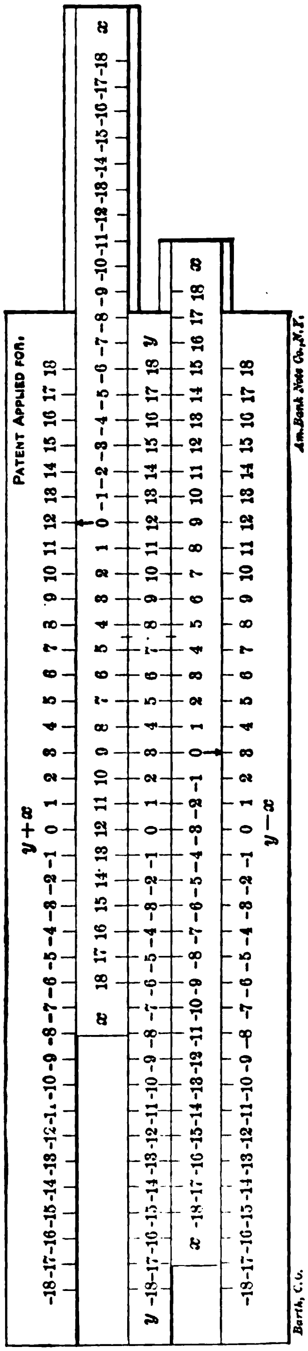
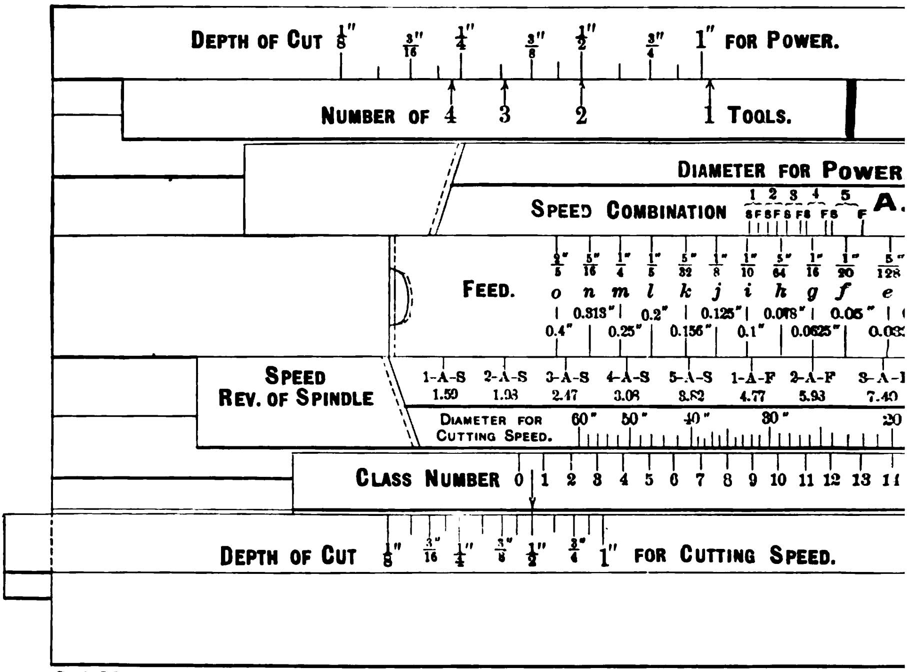
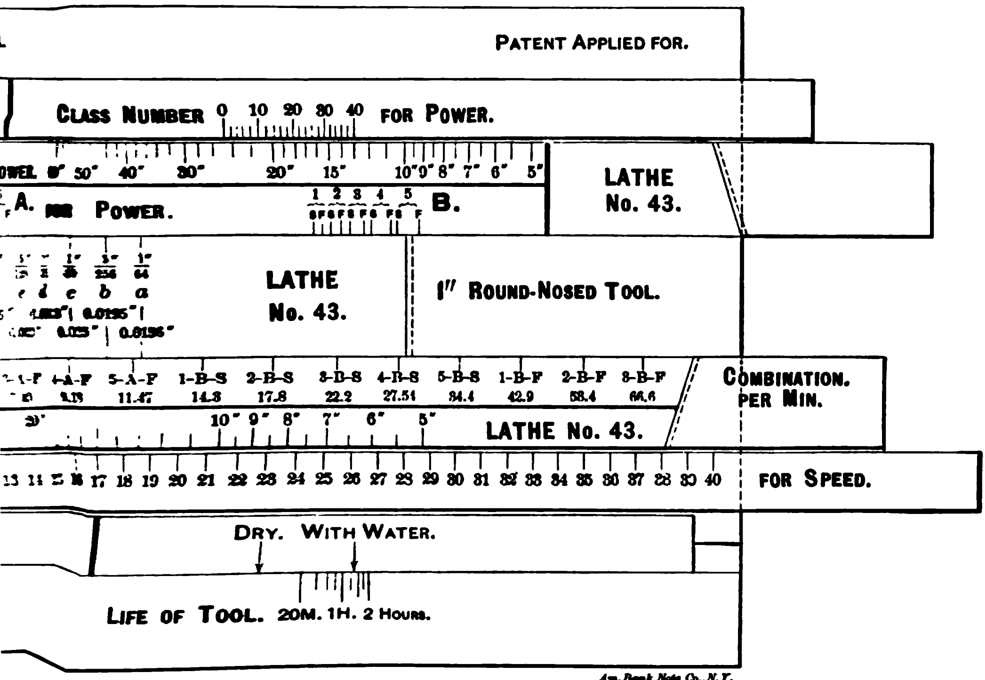


FIG. 4.


DEPTH OF CUT FOR POWER.
NUMBER OF 4 3 2 1 TOOLS.
DIAMETER FOR POWER
SPEED COMBINATION
FEED.
o n m l k j i h g f e
SPEED
REV. OF SPINDLE
1-A-S 2-A-S 3-A-S 4-A-S 5-A-S 1-A-F 2-A-F
1.59 1.93 2.47 3.08 3.82 4.77 5.93 7.40
DIAMETER FOR CUTTING SPEED.
CLASS NUMBER 0 1 2 3 4 5 6 7 8 9 10 11 12 13
DEPTH OF CUT FOR CUTTING SPEED.

Barth, C.G.

FI


PATENT APPLIED FOR.
CLASS NUMBER 0 10 20 30 40 FOR POWER.
50" 40" 30" 20" 15" 10" 9" 8" 7" 6" 5"
A. POWER. B.
LATHE No. 43.
LATHE No. 43.
1" ROUND-NOSED TOOL.
e d c b a
5-A-F 1-B-S 2-B-S 3-B-S 4-B-S 5-B-S 1-B-F 2-B-F 3-B-F
11.47 14.3 17.8 22.2 27.51 34.4 42.9 53.4 66.6
COMBINATION. PER MIN.
10" 9" 8" 7" 6" 5"
LATHE No. 43.
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
FOR SPEED.
DRY. WITH WATER.
LIFE OF TOOL. 20M. 1H. 2 HOURS.
Am. Bank Note Co., N.Y.

to it in the two x scales on the slides; and this done, we readily discover in which direction we must move along the first scale in order to pick out that value of y which has the same value of x coincident with it in both x scales. For the case under consideration this value of y is $7\frac{1}{2}$, and the coincident value in both scales is $4\frac{1}{2}$. Evidently, therefore, $y = 7\frac{1}{2}$ and $x = 4\frac{1}{2}$ are the numbers sought.

24. In the same manner we may make a slide rule for the solution of the general problem: "*The product and quotient of two numbers being given, what are the numbers?*"

Such a rule would differ from the above described rule merely in having logarithmic scales instead of plain arithmetic scales.

25. By the combined use of both arithmetical and logarithmetic scales we may even construct rules for a similar solution of the general problems: "*The sum and product, or the sum and quotient, or the difference and product, or the difference and quotient, of two numbers being given, what are the numbers?*" and a multiplicity of others; and the writer ventures to suggest that slide rules of this kind, and some even simpler ones, might be made excellent use of in teaching the first elements of algebra, as they would offer splendid opportunities for illustrating the rules for the operations with negative numbers, which are such a stumbling block to the average young student.

26. We now have sufficient idea of the mathematical principles involved, for a complete understanding of the working of the slide rule whose representation forms the main purpose of this paper.

27. This slide rule, in a somewhat ideal form in so far as it is made out for neither steel nor cast iron, but for an ideal metal of properties between these two, is illustrated in Fig. 5. It will be seen to have two slides in its *upper section* and three in its *lower section*, and it is in so far identical with the rules made for the Bethlehem Steel Company, while in the rules more recently made it has been found possible and convenient to construct it with only two slides in the lower section also.

28. It is shown arranged for a belt-driven lathe (No. 43*) with five cone steps, which are designated respectively by the numbers 1, 2, 3, 4, 5, from the largest to the smallest on the machine. This lathe has a back gear only, and the back gear in use is desig-

* The main frame of the rule is used for a number of lathes, and is arranged to receive interchangeable specific scales for any lathe wanted, as may be seen in the illustration.

nated by the letter *A*, the back gear out by the letter *B*. It also has two counter shaft speeds, designated respectively by *S* and *F*, such that *S* stands for the slower, *F* for the faster of these speeds.

29. The SPEED COMBINATION 3—*A*—*S* thus designates—to choose an example—the belt on the middle cone step, the back gear in, and the slow speed of the countershaft; and similarly, the combination 1—*B*—*F* designates the belt on the largest cone step on the machine, the back gear out, and the fast speed of the countershaft; and so on.

30. The double, fixed scale in the middle of the rule (marked FEED) is equivalent to the *y* scale of the rule in Fig. 4, and the scales nearest to this on the slides on each side of it (marked SPEED COMBINATION FOR POWER, and FOR SPEED, respectively) are equivalent to the *x* scales on the rule in Fig. 4. The rest of the scales represent the various other variables that enter into the problem of determining the proper feed and speed combination to be used, fixed values being either directly given or assigned to these other variables, in any particular case under consideration.

31. The upper section of the rule embodies all the variables that enter into the question of available *cutting pressure* at the tool, while the lower section embodies all the variables that enter into the question of *cutting speed*; or, in other words, the upper section deals with the *pulling power* of the lathe, the lower section with the *cutting properties* of the tool; and our aim is primarily to utilize, in every case, both of these to the fullest extent possible.

32. The example for which the rule has been set in the illustration is:

A ½ *inch* depth of cut to be taken with each of two tools on a material of class 14 for hardness, and of 20 *inches* diameter, and the tools to last 1 *hour and* 45 *minutes* under a good stream of water.

33. The steps taken in setting the rule were:

1. The first scale in the upper or POWER section of the rule, from above, was first set so that 2 in the scale marked NUMBER OF TOOLS became coincident with ½ *inch* in the fixed scale marked DEPTH OF CUT FOR POWER.

2. The second slide in this section of the rule was so set that 20 *inches* in the scale marked DIAMETER OF WORK FOR POWER became coincident with 14 in the scale marked CLASS NUMBER FOR POWER.

3. The first slide from below, in the lower or Speed section of the rule, was so set that the arrow marked With Water became coincident with 1 *hour* 45 *minutes* in the fixed scale marked Life of Tool.

4. The arrow on the lower side of the second slide in this section of the rule was set to coincide with $\frac{1}{2}$ *inch* in the scale marked Depth of Cut for Cutting Speed.

5. The third and last slide in this section was so set that 20 *inches* in the scale marked Diameter of Work for Cutting Speed became coincident with 14 in the scale marked Class Number for Cutting Speed.

Let us now separately direct our attention to each of the two sections of the rule.

34. In the Power section we find that all the speed combinations marked *B* (back gear out) lie entirely beyond the scale of feeds, which means that the estimated effective pull of the cone belt reduced down to the diameter of the work, does not represent enough available cutting pressure at each of the tools to enable a depth of cut of $\frac{1}{2}$ inch to be taken with even the finest feed of the lathe. Turning, however, to the speed combinations marked *A* (back gear in), we find that with the least powerful of them (5—*A*—*F*) the *e* feed, which amounts to $\frac{5}{128}$ inch = 0.039 inch, may be taken; while the *f* feed, which amounts to $\frac{1}{20}$ inch = 0.05 inch, is a little too much for it, though it is within the power of the next combination (5—*A*—*S*), and so on until we finally find that the most powerful combination (1—*A*—*S*) is nearly capable of pulling the *i* feed, which amounts to $\frac{1}{10}$ inch = 0.1 inch.

35. In the Speed section of the rule we likewise find that all the *B* combinations lie beyond the scale of feeds, while we find that the combination 5—*A*—*F* (which corresponds to a spindle speed of 11.47 revolutions per minute), can be used in connection with the finest feed (*a*) only, if we are to live up to the requirements set for the life of the tool; while the next combination (4—*A*—*F*) will allow of the *e* feed being taken, the combination 3—*A*—*F* of the *f* feed, and so on until we finally find that the combinations 3—*A*—*S* is but a little too fast for the coarsest (*o*) feed, and that both of the slowest combinations (1—*A*—*S* and 2—*A*—*S*) would permit of even coarser feeds being taken, so far as only the lasting qualities of the tools are concerned.

36. We thus see that there is a vast difference between what the

POWER section of the rule gives as possible combinations of feeds and speeds for the utilization of the full pulling power of the lathe, and what the SPEED sections of the rule gives for such combinations for the utilization of the tools up to the full limit set. However, by again running down the scale of feeds we find that, in both sections of the rule, the *i* feed ($\frac{1}{10}$ inch = 0.1 inch), is but a trifle too coarse for the combination 1—*A*—*F*, while the *h* feed ($\frac{5}{64}$ inch = 0.078 inch) is somewhat too fine in connection with this speed combination 1—*A*—*F*, both for the full utilization of the pulling power of the belt on the one hand, and for the full utilization of the cutting efficiency of the tools on the other hand.

37. In this case, accordingly, the rule does not leave a shadow of doubt as to which speed combination should be used, while it leaves us to choose between two feeds, the finer of which does not allow us to work up to the full limit of either the belt or the tools, and the coarser of which will both overload the belt a trifle and ruin the tools a trifle sooner than we first intended to have them give out.

38. The final choice becomes a question of judgment on the part of the *Slide Rule and Instruction Card Man*, and will depend upon how sure he is of having assigned the correct CLASS NUMBER to the material or not; and this latter consideration opens up a number of questions in regard to the practical utilization of the rule, which for the lack of time cannot be taken up in the body of this paper, but which will be fully answered by the writer in any discussion on the subject that may arise.

39. Having decided upon the speed and feed to use, the Instruction Card Man now turns to the TIME slide rule illustrated in Fig. 6, and by means of this determines the time it will take the tools to traverse the work to the extent wanted, and making a fair allowance for the additional time consumed in setting the tools and calipering the work, he puts this down on the instruction card as the time the operation should take.

40. For finishing work the pulling power cuts no figure, so that this resolves itself into a question of feed and speed only; and for the selection of the speed combination that on any particular lathe will give the nearest to a desired cutting speed, the SPEED slide rule * illustrated in Fig. 7 is used.

41. It will readily be realized that a great deal of preliminary

* Described in the *American Machinist* of November 20, 1902.

work has to be done before a lathe or other machine tool can be successfully put on a slide rule of the kind described above. The feeds and speeds and pulling power must be studied and tabulated for handy reference, and the driving belts must not be allowed

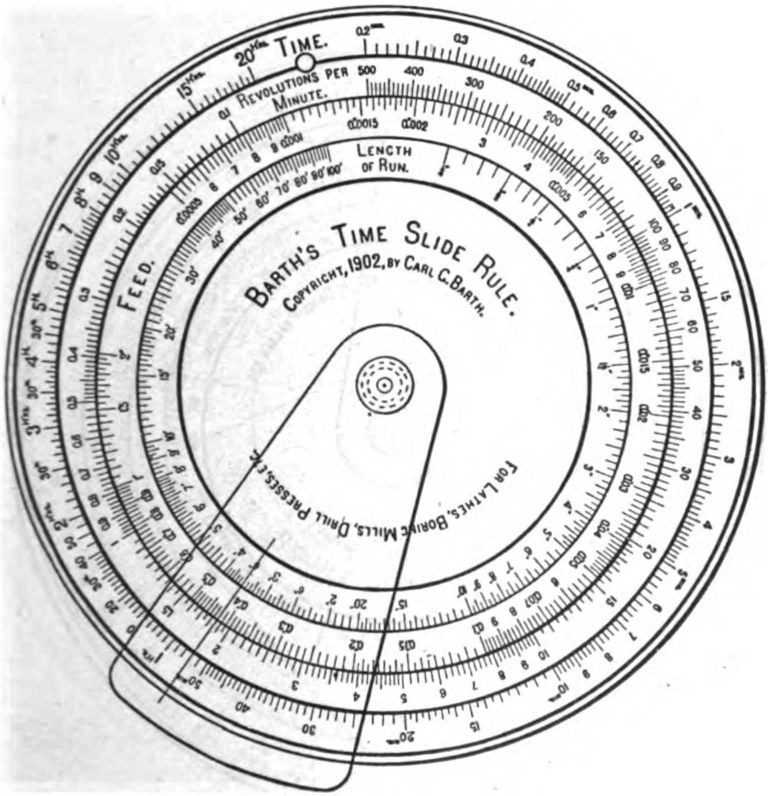


Fig. 6.

to fall below a certain tension, and must, in every way, be kept in first-class condition.

42. In some cases it also becomes necessary to limit the work to be done, not by the pull that the belt can be counted on to exert, but by the strength of the gears, and in order to quickly figure this matter over the writer also designed the Gear slide rule * illustrated in Fig. 8, which is an incorporation of the formulæ established several years ago by Mr. Wilfred Lewis.

* Described in the *American Machinist* of July 31, 1902.

43. For the pulling power of a belt at different speeds, the writer has established new formulæ, which take account of the increasing sum of the tensions in the two sides of a belt with increasing effective pull, and which at the same time are based on the tensions recommended by Mr. Taylor in his paper entitled "Notes

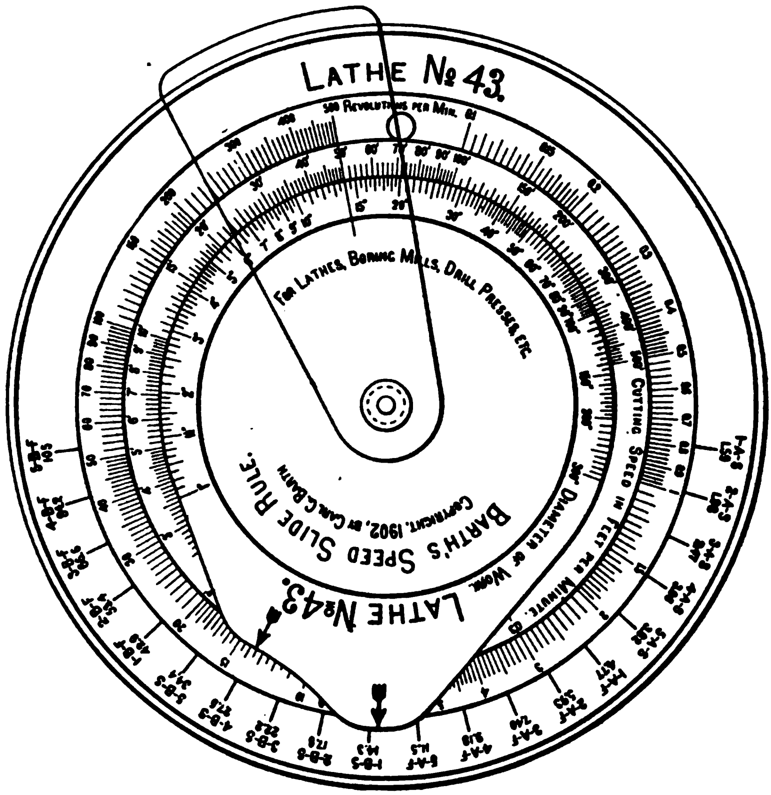


FIG. 7.

on Belting," which was presented at the Meeting of the Society in December, 1893.

44. These formulæ have also been incorporated on a slide rule, but as the writer hopes at some future time to prepare a separate paper on this subject, he will not go into this matter any further at the present time.

45. Having thus given an outline of the use of the slide rule system of predetermining the feeds and speeds, etc., at which a machine tool ought to be run to do a piece of work in the shortest

possible time, the writer, who has made this matter an almost exclusive study during the last four years, and who is at present engaged in introducing the Instruction Card and Functional Foremanship System into two well-known Philadelphia machine shops, which do a great variety of work in both steel and cast iron, will

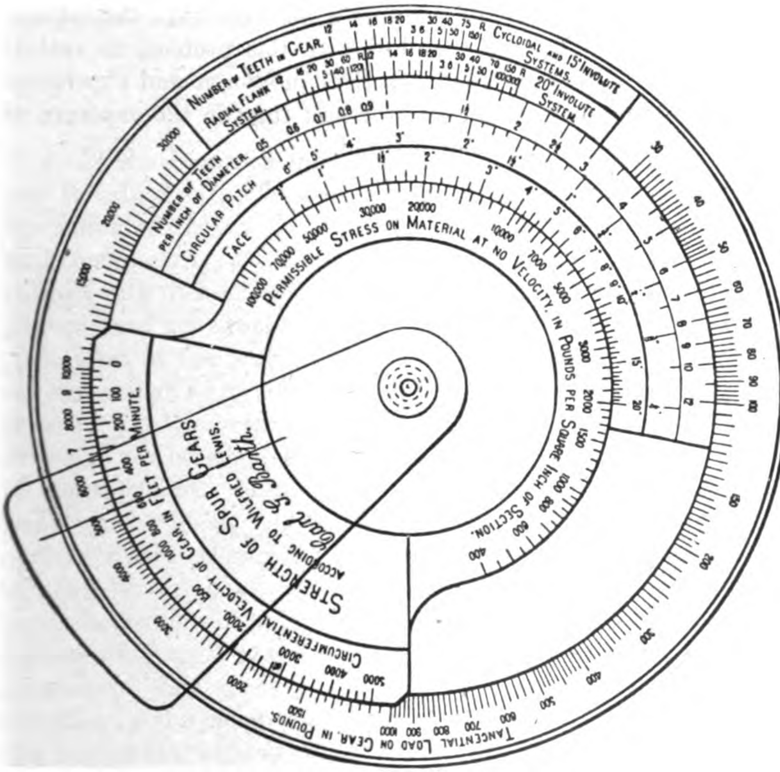


FIG. 8.

merely add that, in view of the results he has already obtained, in connection with the results obtained at Bethlehem, the usual way of running a machine shop appears little less than absurd.

46. Thus already during the first three weeks of the application of the slide rules to two lathes, the one a 27 inch, the other a 24 inch, in the larger of these shops, the output of these was increased to such an extent that they quite unexpectedly ran out of work on two different occasions, the consequence being that the superintendent, who had previously worried a good deal about how to get the great amount of work on hand for these lathes out of the way, suddenly found himself confronted with a real difficulty in keeping them supplied with work. But while the truth of this statement may appear quite incredible to a great many persons, to the writer himself, familiar and impressed as he has become with the great intricacy involved in the problem of determining the most economical way of running a machine tool, the application of a rigid mathematical solution to this problem as against the leaving it to the so-called practical judgment and experience of the operator, can not otherwise result than in the exposure of the perfect folly of the latter method.

Professor Bob Emiliani
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Carl Barth's mathematical analysis of labor turnover. Notice here, and in the other posts, that Frederick Winslow Taylor did not surround himself with dummies. It was, in fact, the opposite. Taylor and others were brilliant and did groundbreaking work in their time which many others later built upon.

Bulletin of the Taylor Society, Vol. V, No. 2, February 1920, pp. 52-58

LABOR TURNOVER[1]

A MATHEMATICAL DISCUSSION

BY

CARL G. BARTH[2]

BELIEVING that some kind of mathematical analysis might be made to throw light on the main point in the controversy about how labor turnover ought to be calculated, I recently set to work on such analysis as the mathematics within my reach would enable me to make; and having obtained some interesting results, I now wish to present them to the Taylor Society.

So far as I know labor turnover is by everybody presented as a percentage arrived at by dividing the denominator of a fraction into the numerator of that fraction, and the controversy centers on what elements should enter into the two terms of this fraction.

Thus, one set of advocates seems to contend that the average working force for the period considered, as ascertained from the number of workers on the total payroll, should be made the denominator of the labor turnover fraction, while another set contends that the working force so to be used, should include only the average number of workers actually in attendance during that period.

As to the numerator, some advocates contend that this should consist of the total number of separations during the period considered, while others contend that only the number of actual replacements of the separated workers should be used. This makes possible altogether four distinct ways of calculating labor turnover, all of them probably in use; and it is needless to say that until only one of these is adopted as a standard, general comparisons cannot be made of labor turnover in different plants or industries. Of course, as is no doubt universally recognized, when the average working force either remains constant or increases during several periods, these alternative numerators are alike, for then all separations are replaced.

My mathematical analysis is entirely confined to throw light on the question of which of the two alternative numerators should be used, and the conclusion reached is in a broad way in favor of the total separations as against the replacements only, regardless of whether the total force is increasing or decreasing. Incidentally it has also led me to believe that, as a matter of consistency, the average total payroll should be made the denominator as against the average total attendance only; for the workers that do not attend during the period considered are not separated so long as their names are retained on the payroll.

In this analysis I consider a working force that is increasing according to some simple mathematical law, through the hiring of more workers than the increase of the force directly demands, on account of the separations that constantly occur and which must first be replaced. These separations I have divided into two classes; viz., separations from the force as it was at the beginning of the period considered (the original force) and separations from among the new workers since hired. To be sure, the new workers soon become more or less amalgamated with the remaining workers of the original force so that no definitely determinable distinction can long be made between a new and an old worker; but by assuming such a division, and also assuming a different rate of separation for each, I figure that I am closer to what actually takes place than by assuming one rate of separation for the total working force at all intervals during the period considered; and when this period does not exceed that usually employed in periodic labor turnover calculations of the one kind or the other, the assumption is legitimate enough for a mere mathematical theory.

Mathematically considered there is no essential difference between an increasing and a decreasing force, a rate of decrease being simply a negative or minus rate of increase, and a constant force at the same time being one whose rate of increase is 0, or the dividing line between the positive and the negative rates of increase. For this reason, any truly mathematical expression for labor turnover that may be agreed upon as being correct for an increasing force, must necessarily also hold good if the rate of the increase

[1]A paper presented at the annual meeting of the Taylor Society, New York, Dec. 5 and 6, 1919.

[2]Consulting Engineer, Philadelphia, Pa.

gradually diminishes; first to 0, when the force then momentarily becomes stationary or constant; next, becomes negative, or, what is then the same thing, becomes a positive rate of decrease, and, with it, the force becomes a decreasing one.

would evidently take place in just $\frac{1000}{100} = 10$ months. This, however, would be an absurd law of depletion of such a force, for it would mean that all of the 100 workers remaining at the end of the 9th month would be separated during the 10th month.

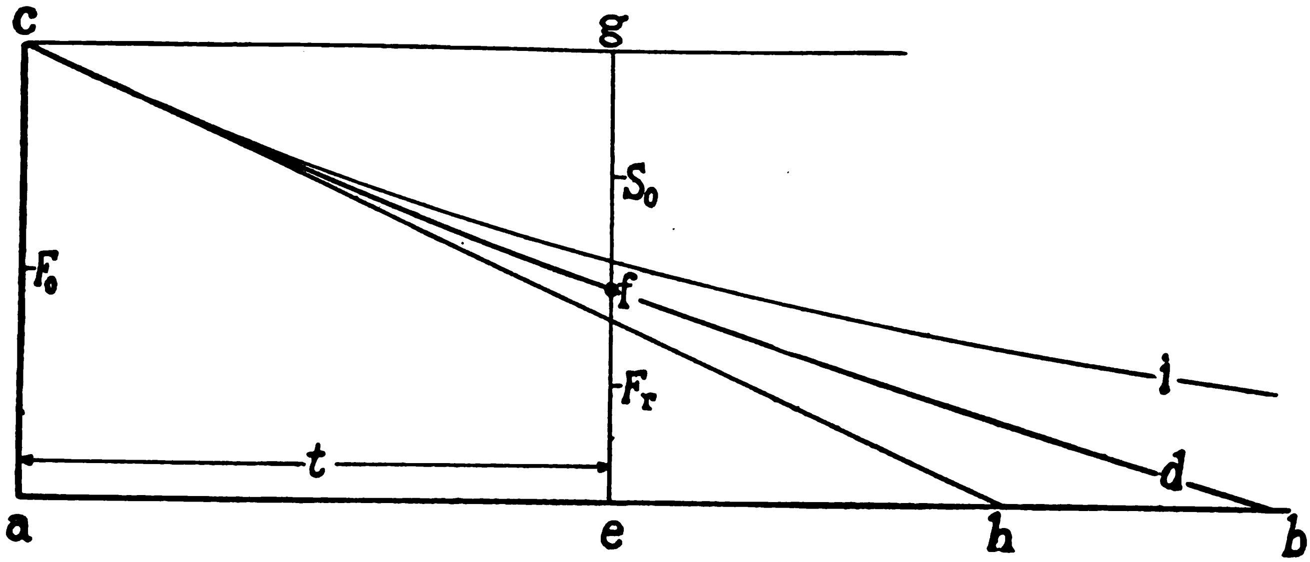

Fig. 1

In the diagram Fig. 1, the vertical line $ac = F_0$ represents the working force at the beginning of the period to be considered (the original force), and the vertical distance $ef = F_r$ represents similarly the remaining portion of the original force at the end of the period of time t (days, weeks or months) which is represented by the horizontal distance ae along the base line ab, while the vertical distance $fg = S_0$ then represents the separations from the original force during the same time t. The first question is then: What mathematical law can we assume to express near enough correctly the relation between the time t and the decreased force F_r in view of the fact that no statistics have probably ever been compiled to show, for even a single plant, how an original force gradually decreases to O through a term of years depending on the degree of "mutual employment satisfaction" and on such unpreventable causes as death, protracted illness, etc.?

Let us assume, for example, an original force F_0 of 1000 workers, and that, to begin with, these separate themselves at the rate of 100 each month. Then, at the end of the first month, there would be left a force of 900 workers. If this rate of 100 per month should keep up until the force is entirely depleted, this

Let us then assume, on the other hand, that the rate of 100 leaving the first month out of an original total of 1000, keeps up indefinitely in the same proportion only, then we would have:

TABLE 1.

At beginning of	Size of Force	Separations during
1st month	1000	100
2nd month	900	90
3rd month	810	81
4th month	729	72.9

and a complete depletion of the original force would never take place, which again is an impossibility, for ultimately the workers must all separate at least through death.

These two extreme, and hence absurd, assumptions are respectively represented in the diagram Fig. 1, by the straight line ch and the curve ci, both of which, to begin with, coincide quite closely with the curve cd which is located between them in a manner to represent more nearly the correct law of depletion of the force.

It will now be realized that, as a mathematical law of depletion can only be an approximate one (just as is the mortality law used by life insurance companies), the mathematical expressions for the straight line *ch* and the curve *ci* will both, for a short period, represent quite closely the approximate law of depletion of the force, as this has been illustrated by the curve *cd*.

Further, if we knew the extent to which an original force would deplete itself through a somewhat longer period, but still one far short of the entire depletion period, a curve of the nature of *ci* in Fig. 1 might be drawn to coincide with the true curve of depletion at the point representing such period of partial depletion, when it then, most undoubtedly, would also be found to coincide very closely with the true curve of depletion between this point and the starting point, as illustrated by the diagram in Fig. 2.

We must next determine upon some law in accordance with which we will wish to increase the original force by hiring new workers; first, to replace the separations from this original force as fast as they occur; and secondly, to increase the thus replenished original force to the point desired at any one time, in spite of the separations that also take place from among the newly hired workers. Of course, a law to govern the increase of a working force must either be in accordance with some decreasing rate of increase, or else in accordance with some constant or even increasing rate of increase, which must then, sooner or later, come to a more or less sudden stop; for it is inconceivable that a force might increase indefinitely under even the most favorable conditions of industrial expansion.

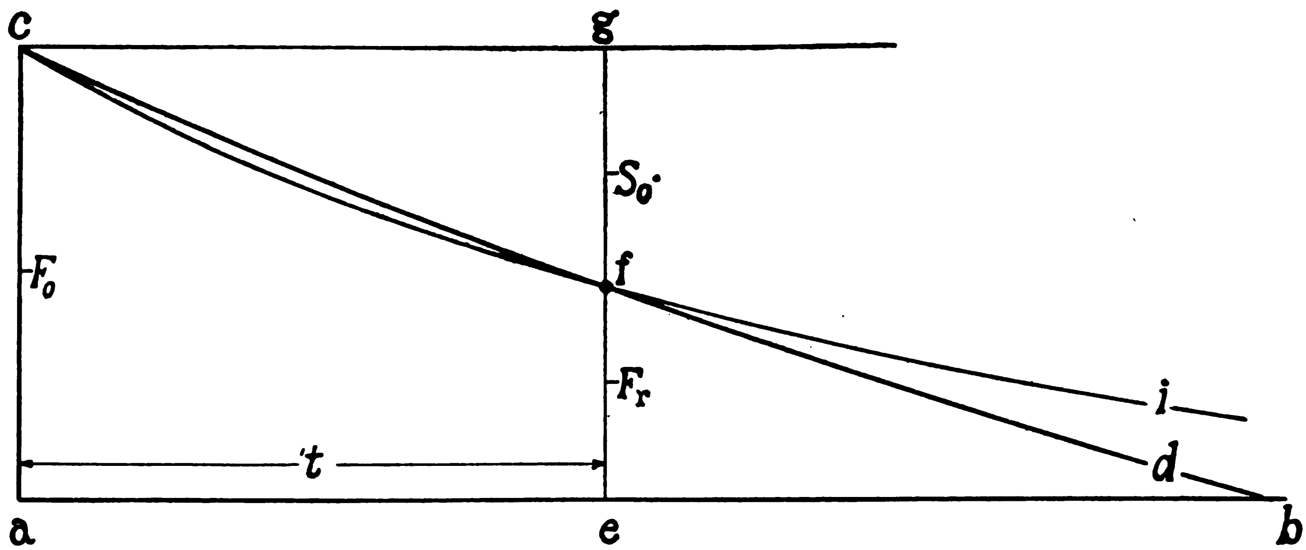

Fig. 2

Hence, for the purpose of this discussion, it will be assumed that the curve representing the gradual depletion of an original force may be approximated by a curve representing a law of depletion similar to that on which Table 1 was constructed. This curve is a logarithmic curve[1] whose equation is

$$F_r = \frac{F_o}{\mathcal{E}^{rt}} \quad , \qquad (1)$$

$\mathcal{E}$ being the base of the Naperian system of logarithms, r the rate of depletion (separation) and t the period of time during which the original force F_o is reduced or depleted to F_r.

[1]Formula (1) may be derived as follows: The original force F_o having been reduced to F_r at the end of the time period t, and the decrease taking place at the rate r as figured on the magnitude of F_r at any time, the decrease (negative increase) during the time element δt following the end of the time period t, may be written

$$\delta F_r = F_r(-r)\delta t, \text{ and } \frac{\delta F_r}{F_r} = -r\,\delta t$$

Integrating, we then get, as $\int \frac{\delta x}{x} = \log_e x + C$,

$$\log_e F_r = -rt + C.$$

To determine the constant of integration C we have $F_r = F_o$ for $t = o$, which makes $C = \log_e F_o$, and

$$\log_e F_r = -rt + \log_e F_o; \text{ and further}$$

$$\log_e F_o - \log_e F_r = \log_e \frac{F_o}{F_r} = rt,$$

which again gives $\mathcal{E}^{rt} = \frac{F_o}{F_r}$; and finally,

$$F_r = \frac{F_o}{\mathcal{E}^{rt}} \qquad (1)$$

In view of the circumstance that labor turnover, while usually converted into the equivalent of an annual rate, is always calculated for shorter periods only, almost any general law of force increase that we may assume and which will readily lend itself to the mathematical treatment contemplated, will answer, just the same as we have already concluded that the law assumed for the separations from an original force must be near enough correct for use in our analysis.

In the diagram Fig. 3, let the curve *ck* represent an ideal law of increase of the original force $ac = F_0$ to the final desired force during the period of time $ab = T$. This curve is then, to begin with, quite closely approximated by its tangent *cm* at the point *C*, and represents the general mathematical law of increase of the working force that I have assumed for the present purpose.

If *i* designates the rate of increase of the force *F* as figured on the original force F_0, the increase of the force at the end of the time period *t* will be

$$A = F_0 i t \qquad (2)$$

and the increased force will be

$$F = F_0 + A = F_0 (1 + i t) \qquad (3)$$

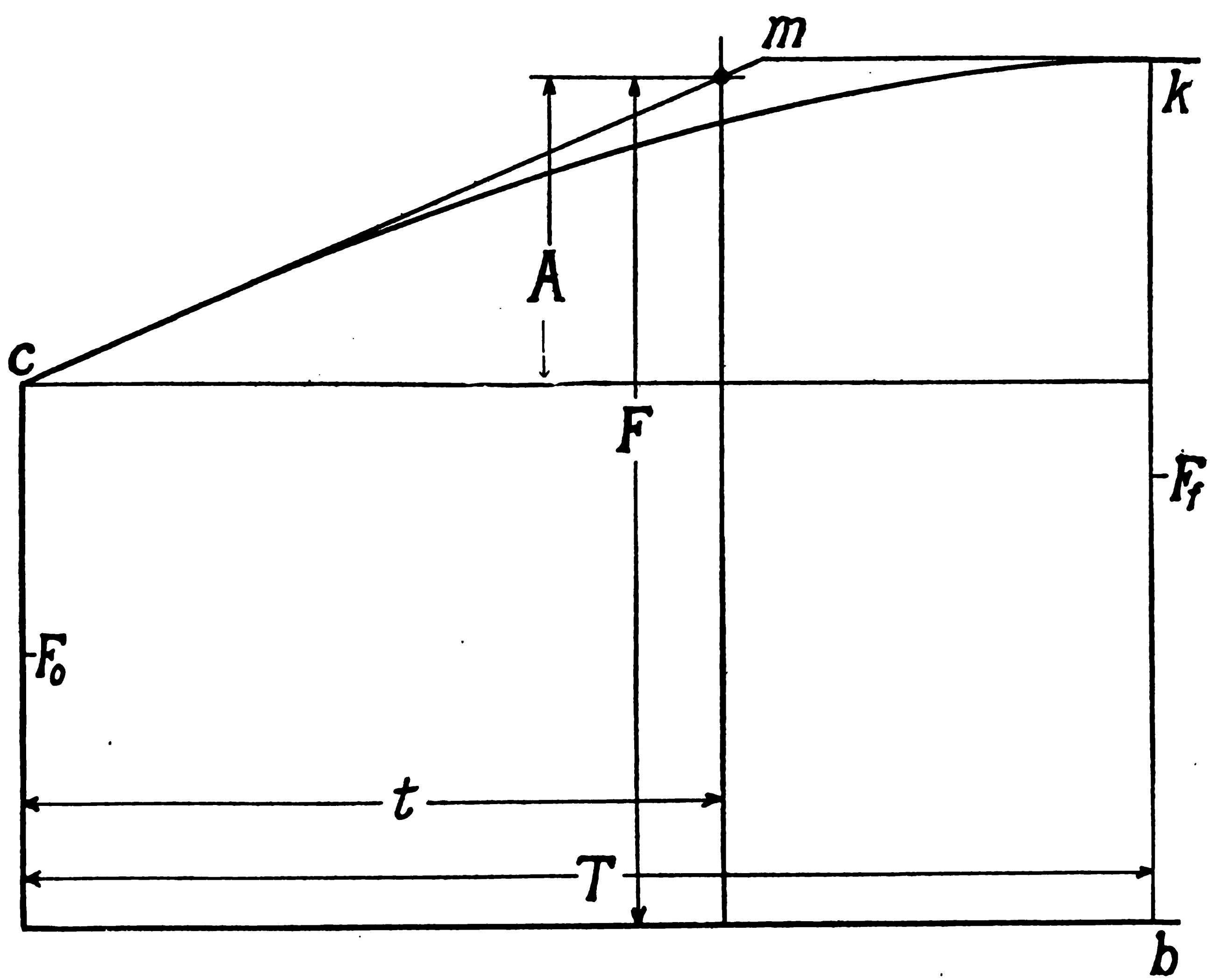

Fig. 3

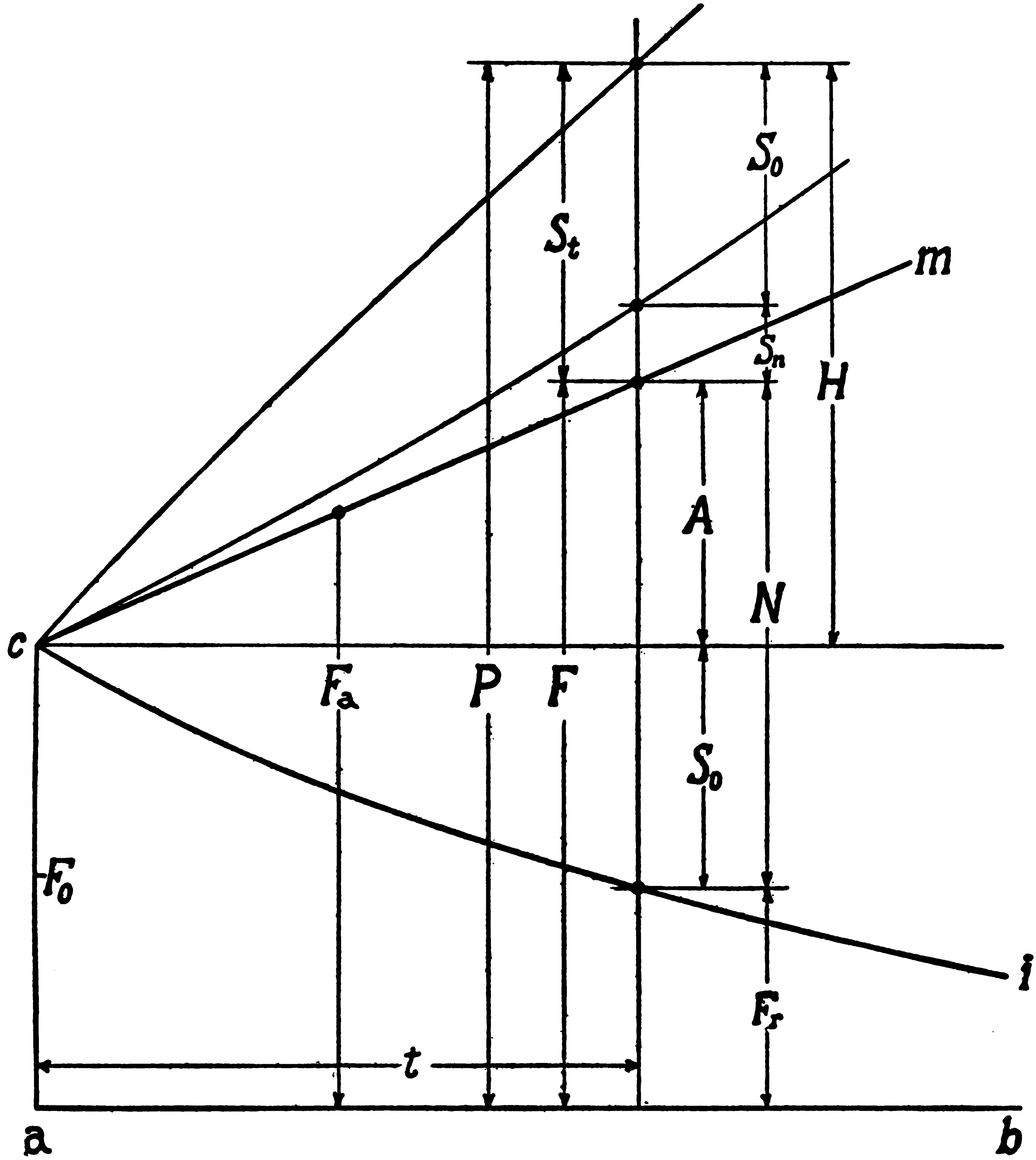

FIG. 4

In Fig. 4 all the elements that enter into our analysis have been represented. Thus, besides the elements already referred to, we have

$S_o = F_o - F_r$ = number of separations from the original force, and by substituting the value of F_r in formula (1), this becomes

$$S_o = F_o \left(1 - \frac{1}{\mathcal{E}^{rt}}\right). \qquad (4)$$

$N = A + S_o$ = total number of new workers on the increased force F, and by substituting the value of A in formula (2) and the value of S_o in formula (4), this becomes

$$N = F_o \left(i\,t + 1 - \frac{1}{\mathcal{E}^{rt}}\right). \qquad (5)$$

F_a = average force during the time period t.

For the simple straight line law of increase assumed for the force, we have

$F_a = \frac{1}{2}(F_o + F)$, which, when we substitute the value of F in formula (3), becomes

$$F_a = \tfrac{1}{2}\left[F_o + F_o(1 + i\,t)\right] = F_o\left(1 + \frac{i\,t}{2}\right) \qquad (6)$$

If by n we now designate the rate at which separations take place from among the new workers N on the force, the total number of such separations during the time period t can be shown to be[1]

$$S_n = F_a\, n\,t - \frac{n}{r} S_o \qquad (7)$$

Adding formulas (4) and (7) we finally get the total number of separations that have taken place, to be

$$S_t = S_o + S_n = S_o + F_a\, n\,t - \frac{n}{r} S_o = F_a\, n\,t - \frac{n-r}{r} S_o \qquad (8)$$

Further

$H = A + S_t$ = total new hires during the period, and

$P = F_o + H$ = total number of names on the payroll during the period.

If we now calculate the total labor turnover for the period of time t by the universally accepted method for an increasing force, viz., making the numerator of the labor turnover fraction equal to the total separations for the period (which for both an increasing and a constant force equals replacements), and using the average force as given by formula (6) as denominator, we get

Total labor turnover

$$L_t = \frac{S_t}{F_a} = \frac{F_a\, n t - \frac{n-r}{r} S_o}{F_a} = n\,t - \frac{n-r}{r} \cdot \frac{S_o}{F_a}, \qquad (9)$$

which divided by t finally gives the labor turnover for the unit time period (rate of labor turnover for the period t).

$$L_1 = n - \frac{n-r}{rt} \cdot \frac{S_o}{F_a} \qquad (10)$$

In this formula all evidence of its having been derived by considering an increasing force only, has entirely disappeared. To be sure, for an increasing force the average force F^a during the time period t would be greater than the force at the beginning of the period (original force), and for a decreasing force it would be smaller than F_o; but in nominally applying the formula we need to know only the magnitude of the average force F_a.

Hence, as I see it, this formula compels us, for the sake alone of the respect we owe mathematical logic and consistency, to figure labor turnover by considering separations and not replacements, in the case of a decreasing force also.

If in formula (10) we make no attempt at distinguishing between the average rate n at which new workers leave, and the average rate r at which workers of the original force leave, it reduces itself to

$$L_1 = n = r \qquad (11)$$

[1]Formula (7) may be derived as follows: Let δS_n = number of separations from the new workers N which takes place at the rate n during the time element δt following the time period t, then

$$\delta S_n = N n \delta t = F_o\left(i\,t + 1 - \frac{1}{\mathcal{E}^{rt}}\right) n \delta t$$

$$= F_o\left[n\,i\,t\,\delta t + n\,\delta t - n \mathcal{E}^{-rt}\,\delta t\right]$$

$$= F_o\left[n\,i\,t\,\delta t + n\delta t - \frac{n}{r}\mathcal{E}^{-rt}\,\delta(-rt)\right].$$

Integrating we then get, as $\int \mathcal{E}^x \delta_x = \mathcal{E}^x + C$,

$$S_n = F_o\left[ni\int t\,\delta t + n\int \delta t + \frac{n}{r}\int \mathcal{E}^{-rt}\,\delta(-rt)\right]_{t=o}^{t=t}$$

$$= F_o\left[ni\frac{t^2}{2} + n\,t + \frac{n}{r}\mathcal{E}^{-rt}\right]_{t=o}^{t=t}$$

$$= F_o\left[\left(1 + \frac{it}{2}\right) n\,t - \frac{n}{r}\left(1 - \frac{1}{\mathcal{E}^{rt}}\right)\right]$$

By formulas (4) and (6) this reduces to

$$S_n = F_a\, n t - \frac{n}{r} S_o. \qquad (7)$$

The labor turnover is then only the average rate at which workers separate from a force for all other reasons than laying off due to lack of work, whenever such a condition exists.

But when all is said and done, I cannot see that anything very valuable is to be learned from figuring the total labor turnover by any method, for it shows merely in a broad and superficial manner whether the labor situation is good or bad. So many different causes combine to produce the total effect which the rate of labor turnover measures, that it would seem as if the effect of each of these causes should be studied entirely apart from the others; and particularly so, as I cannot see that this would involve a great deal more labor and expense. Thus it would seem that separations due to such unpreventable causes as permanent disability, death, etc., should not be merged with those due to dissatisfaction on the part of either employer or employee; and also that separations due to this preventable cause should be studied in classes of employees grouped according to length of service, nationality, etc.

F. S. Crum[1]: While studying the turnover problem for the Emergency Fleet Corporation last year, I didn't realize it was so mathematical;—otherwise I might not have attempted it.

I simply wish to emphasize a question which Mr. Barth has raised,—whether there is a law of normal turnover. I doubt it very much, whether for an industry or for a given plant, because the human element plays too large a part. It seems to me that the essence of the problem is to reduce preventable separations to a minimum by every possible means. The purpose of the records and the calculations is to give the manager information to that end. Even crude records, if they give reasons for separations, are greatly helpful.

While on my feet I should like to say that I believe that the formula proposed at the Rochester convention and adopted by the Employment Management Association is theoretically wrong;—they figure turnover on the basis of attendance and not of payroll. It seems to me that payroll must be the basic factor. Of course the payroll should be cleared periodically. Moreover there are other things desirable and necessary to calculate,—for instance absenteeism,—and I believe that should be calculated on the basis of the payroll.

S. H. Slichter[2]: I am not a mathematician and would not venture to discuss Mr. Barth's mathematical argument. There are, however, two points I wish briefly to bring up. Like Mr. Crum, I question whether there can be discovered a law of normal turnover, there are such variations by cycles of prosperity and depression, by seasons, by industries, by regional conditions, by plant conditions, by occupations within each plant, or region or industry. We may in time accumulate data sufficient to give us a formula, but the progress of management during the period of accumulation may render it non-representative; also we must remember that the more dispersed the data the less significant the average and the formula.

With respect to the preference for replacements or for separations as the measure of turnover, my conviction favors the use of separations, even during periods of a decreasing force. The use of separations, for instance, prevents the management from hiding from itself the facts that jobs are becoming extinct; the necessity of replacing a man is simply a question of time,—not tomorrow, perhaps, but several months hence. Something is lost by losing a man. It is part of a manager's job to keep his eye on jobs necessary to be performed in the long run, and not to allow them to become extinct. Separations which require ultimate are as important as those which require immediate replacement. And, if you stop to think, from the worker's or from the public standpoint, separations are much more important than replacements.

[1]Asst. Statistician, Prudential Insurance Co., Newark, N. J.

[2]Princeton University, Princeton, N. J.

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Professor Bob Emiliani
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Too many Lean practitioners incorrectly think Scientific Management was about driving people harder and dehumanizing them. These are the words of Richard Feiss, president of Joseph & Feiss Co. (clothing business). "Although this may be contrary to popular conception, scientific management, nevertheless, obtains increased individual output, not by drive, but by the elimination of waste." Learn more about Mr. Feiss here
https://en.wikipedia.org/wiki/Richard_A._Feiss

Am J Public Health (N Y). 1917 Mar; 7(3): 262–267.

SCIENTIFIC MANAGEMENT AND ITS RELATION TO THE HEALTH OF THE WORKER.

RICHARD A. FEISS,
The Clothcraft Shops, Cleveland, Ohio.

Presented before the Section on Industrial Hygiene of the American Public Health Association, Cincinnati, Ohio, October 25, 1916.

SCIENTIFIC management, as the name suggests, applies the scientific method to all the activities of management. This means that the management assumes the responsibility for thorough investigation and procedure based on accurate knowledge. Not only are materials and equipment scientifically studied and methods for their use and up-keep established, but the human effort expended in their use must also be studied from the point of view of continuous up-keep. In fact, scientific management is the management of conservation. As such it must deal primarily with the conservation of human effort. This is true not only from the humanitarian point of view, but also from the economic. Taking the pure business aspect, there is nothing more profitable nor more essential.

2. In considering conservation of human effort the steadying of employment is of the greatest importance. The loss both to the management and to the worker through the constant change of personnel one finds in the ordinary industrial organization can hardly be conceived. It has often been estimated that the cost in dollars and cents of replacing an old employee by a new one amounts to anywhere from fifty to two hundred dollars. The loss to both the organization and the worker in effort, morale and efficiency, while less tangible, is far more important. A manufacturing concern in Detroit, employing fifteen hundred men, employed some thirteen thousand men, or over 800 per cent. of its total standing payroll from the spring of 1915 to the spring of 1916. A brass foundry in New England employing three thousand, employed during the first eight months eight thousand. The latter replacements would be at the rate of twelve thousand a year, or over 400 per cent. A large rubber concern in Ohio employing over ten thousand men and women is said to have a labor turnover of 150 per cent. At the Clothcraft Shops of The Joseph & Feiss Company an attempt has been made to approach this subject from the point of view of scientific management. The percentage of replacements during 1915 was 48 per cent., and for the first nine months of 1916 was no greater. This result comes from a realization of the importance of conservation of human effort, and of the fact that employment is not a mere matter of hiring and firing but, from the scientific viewpoint, is a matter of hiring and keeping.

3. For the purpose of scientific employment The Joseph & Feiss Company have established an Employment and Service Department. The

functions of this department are conducted from the point of view of keeping every position in the organization filled with fit men and women. The fitness of the worker involves primarily his health. It is apparent on the face of it that a worker under the handicap of even a minor ailment is going to suffer materially in his steadiness and efficiency. His health, therefore, must be conserved in the most scrupulous manner. For this purpose an adequate medical department is considered an essential part of the employment and service function. A medical examination is not only essential for the new employee but a periodical reëxamination and follow-up are also an integral part of the work. In this way alone can the results of the work upon the health of the worker be properly checked up and a course consistent with the best health of each individual worker be followed. Some of the details of this work and its effect have been touched upon elsewhere *

4. In connection with the health of the workers in industry, home conditions are of vital significance. No real educational or constructive work can be done without keeping this fact constantly in mind. The carrying of educational work into the home is of inestimable value. For a very capable description of this kind of work refer to an article entitled "The Relation of Home Conditions to Industrial Efficiency"† by Mary B. Gilson, Superintendent of the Service and Employment department of The Joseph & Feiss Company.

5. The poor health of a worker is commonly laid at the door of industry. Conditions contributing to the ill health of workers, however, are not inherent in industry, but are the result of unintelligent or unscientific management. While it is true that the conditions under which people work are responsible in some instances for ill health, a thorough investigation of the facts in each case would often disclose the ill health of the worker to be entirely due to personal habits or home conditions. It is common not only for the layman, but, also, for the physician to jump at conclusions in this matter. Physicians are often only too ready to lay the cause of an ailment to a man's work and to advise him, without any real investigation, to quit his job or not to work in a factory. It is very easy to make sweeping assertions as to factory work and to advise workers to leave their jobs on the slightest pretext of ill health, but professional men, above all, must realize not only the difference that exists between industries but also between various establishments in any one industry. The giving up of a job, even temporarily, is a matter of very great moment to the worker, and we question the right of any one assuming the responsibility of giving such advice without thorough investigation.

* "Personal Relationship as a Basis of Scientific Management." A paper read by R. A. Feiss before the Society to Promote the Science of Management, Philadelphia, Pa., Oct. 23, 1915.

†Appearing in *The Annals* of the American Academy of Political and Social Science, Philadelphia, May, 1916. Publication No. 1009.

6. By reason of the tremendous increase in the productivity of the worker which results under scientific management it has been accused of injuring the health of the worker. Scientific management not only recognizes the basic value of continuity of employment and longevity of the worker, but represents the only scientific attempt to increase production through the conservation of his health and effort. Although this may be contrary to popular conception, scientific management, nevertheless, obtains increased individual output, not by drive, but by the elimination of waste.

7. It is erroneous to assume that speed affects the health of the worker. Speed in itself is not injurious. Under scientific management it is the result of improving conditions of work which under ordinary management tend to contribute to his ill health. There are conditions under which operating at half the best possible speed is more fatiguing and more injurious to the worker's health than operating at the best possible speed under proper conditions. As a matter of fact when conditions have been properly standardized and operations are taught by an adequate system of instruction, motions become reflex. It is well known that reflex motion is not only essential to the best possible speed, but requires a minimum of physical and mental exertion. We call your attention in this connection to the statement of the eminent psychologist, William James:*

*James, "Psychology," Vol. 1, p. 102.

"Habit simplifies the movements required to achieve a given result, makes them more accurate and diminishes fatigue."

8. The enormous saving of time effected under scientific management not only results in increased achievement, but also makes it possible and profitable to bring about that generally desirable end,—the shortening of hours. Greater achievement makes possible the payment of the higher wages of scientific management and at the same time the shortening of hours without increasing the cost of production. Fatigue is not only minimized by the reduction of the hours of work, but also by the conservation of effort while at work. Scientific management directly concerns itself with the elimination of all factors of fatigue. To quote from a recent work on fatigue study:†

"Even where fatigue is not materially cut down during working hours, because measurement shows that the worker is not getting overfatigued, the general health is apt to improve because of greater regularity in habits of work, and because of better physical and mental habits, while doing the work. The path along this line is a continuous, never-ending, upward spiral. Fatigue is eliminated by establishing proper habits. Proper habits improve health. The improved health allows of more work with less fatigue, etc."

9. Under scientific management not only the physical condition of the worker in relation to his work, but also

†"Fatigue Study," by Frank S. and Lillian M. Gilbreth, p. 143. Sturgis & Walton Co., 1916.

the physical conditions under which he works are made subjects of scientific study. A study of proper ventilation, lighting and sanitation results in a direct effect upon the quality and quantity of his output. The management must not only assume the responsibility for standardizing and perfecting these physical surroundings, but all other conditions relating to the work before it can proceed with the standardization of the job itself with a view toward setting a fair task for the worker. Standardization of tools and equipment by means of time study and other research methods—of which the primary object is to eliminate unnecessary effort on the part of the worker—is an essential step in the increase of output. Materials also must be controlled by means of a proper routing system in order to insure an uninterrupted supply of work. By these means alone it is not uncommon under scientific management to effect an increase in output of 100 per cent. or more, while lessening rather than increasing the effort expended by the worker. Finally when time and motion study is applied to the job itself, the efforts of the worker are still further conserved by the elimination of wrong or unnecessary movements and by setting of a definite accomplishable task. No one realizes the amount of hopeless effort which is expended by the worker, nor the amount of time and output which is lost because of neglect of these important factors under irresponsible management.

10. Speaking of scientific management, Josephine Goldmark, in her exhaustive study on "Fatigue and Efficiency,"* says:

"The new organization of work has brought also a new emphasis upon the workers' physical surroundings. All those physical inconveniences which waste human strength and comfort and which are common rather than uncommon characteristics of our workshops,—such as bad air, bad light, overcrowding, dirt, and insanitary conditions,—are all marks of inefficiency in the management. They are intolerable to the system which is based essentially on the observation and study of cause and effect. Where the ordinary management sees in the crudest so-called 'welfare work' (better light, air, sanitation and comfort) merely concessions to the labor force, the engineer sees them as indispensable parts of the equipment. They are the mere commonplaces of efficiency, without which the accomplishment of predetermined tasks cannot be expected. . . .

"Scientific management obtains its marvelous results not only by teaching the worker the best possible way of accomplishing his task with the least time and effort, but also by removing all possible external obstacles. The management has, in advance, perfected his equipment and sees that it is always in perfect order and that the worker is regularly supplied with material in perfect order and condition. . . .

"One of the chief aims has been precisely to regulate the flow of work so that it shall be even and continuous. . . . Compared with such a régime, the crudity and chaos of ordinary sys-

*Pp. 201–202–203. Russell Sage Foundation.

tems stand out in glaring contrast. A revolution has been effected; a terrible waste has been checked, of that capital which alone is common and equal for all mortal beings: of time. . . . Hitherto hours, days and weeks of employment have been habitually lost to the workers through no fault of their own, but through the sheer incompetence of the management in performing its obligations and supplying materials and equipment fairly. No page in industry's history is more dreary and disheartening than the 'time lost' by competent and willing workers, waiting, unpaid, for employment which might be fairly regularized. Indeed, the daily delays and irregularities of work involve more than the direct loss of wage and earning capacity. They are more subtly interfused into the day's work; and the psychological gain which springs from the elimination of such daily annoyance and friction is undoubtedly an important factor in heightening working capacity under scientific management."

11. This brings out another important factor relating to the health of the worker. The psychological result which springs from the elimination of daily annoyance and friction is, as Miss Goldmark states, of vast importance in heightening working capacity; but is of even more significance in its effect upon the health of the worker. Scientific management replaces the old system of bosses with its petty annoyances and injustices by a system of functional foremen who are responsible for the development and training of the worker in all of his various functions. This functionalizing implies the assumption of direct responsibility by the management for all conditions and activities, including the important one of personal relationship. This, as Miss Goldmark has said, assures to the worker the "elimination of daily annoyance and friction" of paramount importance both to his good spirits and his good health. In the words of the late Frederick W. Taylor, "More than all . . . close intimate coöperation and constant personal contact . . . will tend to diminish friction and discontent."*

12. Mr. Gantt† not only shows by graphic charts how the capacity of the workers is definitely increased under scientific management, but also points out a marked improvement in right habits of work, self-respect and good health. Too much stress cannot be laid upon the connection between mental and physical well-being. For this reason, alone, scientific management can be credited with being one of the most important forces contributing to the health of the worker.

13. Every one who has visited a plant where scientific management has been practiced for any length of time is immediately struck by the apparent good spirits and good health of the workers. If the individual records of the workers at the Clothcraft Shops of The Joseph & Feiss Company were investigated, they would reveal not only consistent evidence of good health, but also in the majority of cases a

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*"Principles of Scientific Management," p. 143. Harper Bros., New York.

†Gantt, H. L. "Work, Wages and Profits." Engineering Soc., 1911.

marked improvement. As evidence of the good effect of scientific management upon the health of the workers of this organization attention is called to the comparative stability of its working force as shown above. Although a large majority of the workers are women, over one-third have been in the continuous employ of this organization for a period of five years or more. During the year of 1915 with an average standing payroll of seven hundred sixty-two, the average daily absences for all causes amounted to less than seven and one-tenth persons, or about nine-tenths of one per cent.

14. Scientific management has as its object the maximum of prosperity for both management and worker. This object is attained not only by safeguarding, but also by directly contributing to the health of the worker.

RED CROSS SEALS RAISED A MILLION.

Red Cross Christmas seals raised in the 1916 sale $1,000,000 for the tuberculosis campaign, according to the National Association for the Study and Prevention of Tuberculosis, which announced recently the results of the recent holiday campaign. All reports are not in, but carefully revised estimates of the few yet outstanding indicate that more than one hundred million seals were sold.

All the proceeds of the sale, amounting to a tax for health work of one cent on each person in the country except the insular possessions, are devoted to preventive tuberculosis work in the states and communities in which the seals are sold.

The National Association points with gratification to the fact that it realized its slogan "one seal for each inhabitant in the United States." Seals have been sold annually at the holiday season, beginning with 1908. They have been the means of raising a total of $4,206,051 for tuberculosis work. In addition to the thousands of tuberculosis beds which this sum has made possible, the seals have also aided in the establishment of hundreds of open-air schools, employment of thousands of tuberculosis visiting nurses, and have been an indirect cause of tremendous advances in the whole field of public health work.

Tuberculosis committees have been organized in practically every community of any size in the country. Every state in the union now has a state society engaged in state-wide anti-tuberculosis work. Hundreds of thousands of open windows, letting in unwonted quantities of fresh air to sleepers, may be traced directly to the public health educational effect of the Red Cross Christmas seals.

Last fall agents sold seals in every state and territory of the United States, except Guam, Tahiti and Samoa. Counting the school children, some 300,000 the total number of agents of the country approached 500,000. These included club women, school teachers, merchants, bankers, postmasters, and in fact, every kind of business man and woman.

The educational features of the seal campaign were developed in 1916 on a larger scale than ever before. School teachers received and read to their pupils one hundred and fifteen thousand story talks on tuberculosis. During Tuberculosis Week in December three hundred and fifty thousand pieces of educational literature, containing suggestions for sermons on tuberculosis and recommendations for medical examination of employees were distributed.

"Without the coöperation of the press of the country unstintedly given, as it always has been, these tremendous results from the Red Cross seal sale would have been impossible," said Dr. Charles J. Hatfield, Executive Secretary for the National Association, in making public the results of the sale. "Both directly and indirectly the newspapers of the country have, through the Red Cross Christmas seal sale, contributed to the alleviation of human suffering and to the total of human happiness, to a greater degree than any other single agency."

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Demonstrating the illogic of politicians who were opposed Scientific Management, as told through the parable of "The Stop Watch and the Lawnmower" (1916). Someone should write a parable about CEOs who oppose Lean management -- "The Spreadsheet and the Operator." It likely will not change any minds, but it would be a touchstone of our times.

Efficiency Society Journal, Volume 5, No. 8, August 1916, p. 441-444

The Stop Watch and the Lawn Mower

To the Editor:

THE great danger of the Tavenner bill now before Congress is the almost complete lack of popular knowledge concerning premiums and bonus systems of wages, and concerning time studies, the hated symbol of which to the opponents of progressive management is the stop watch. This bill would prohibit in all Government shops the payment of bonus or premium in addition to regular wages, and the use of the stop watch or other time-measuring device. It might be made to apply also to private establishments undertaking contract work for the Government. Fully as important is the influence which would extend in some degree to all industrial establishments, in retarding the extension of systems of management which have proved to be profitable both to employer and employee and which are held in high favor by good workmen, skilled and unskilled, who have had experience with them.

The whole subject may be illustrated in a familiar way, to bring its principles home to those who have not made their acquaintance, probably including some members of Congress. At Mr. Tavenner's home, or that of some other Congressman, is a large lawn which is mowed, at 30c. an hour, by Thomas, who also takes care of the grass in the yards of various neighbors. One afternoon the Congressman notices that the noise of the mower, which has been clicking away since early morning, gets on his nerves. He goes to a window and watches the laboring Thomas. The pace up and down the lawn looks to be unnecessarily slow, and a closer observation discloses the further fact that the width of the cut, the feed of the machine, so to speak, is pretty narrow.

So the Congressman, unjust and unnatural though it be, pulls out his watch and times Thomas on a trip across the grass. It may or may not be a stop watch. It tells him that the trip consumed 3 min. 40 sec. A further timing shows that 20 sec. is consumed at the end of each cut in turning and resting, giving a total of 4 min. The Congressman does not feel stingy about it, but he resents the extra hours of irritating noise.

When Thomas goes home he leaves the mower behind him, and the Congressman decides to make a few tests. Had the workman known what was to happen he would have gnashed his teeth with rage, according to some of the labor leaders. However, his employer pushes the mower at what he considers a fair pace the length of the lawn, timing the trip, mind you, and does it in 2 min. 50 sec. Then he times the turn and decides that 10 sec., including a few moments for a deep breath or two, is a proper allowance. His total is 3 min. The width of the lawn is 100 ft. Why not a broader swath? he asks himself.

So he gets out another instrument of precision, a yard stick. He finds that the cutting blades of the mower are 18 in. long, while the cut made by Thomas was but 8 in. Now he is really interested. He experiments and finds that, allowing a suitable lapping over of swaths, a 15-in. cut would be about right.

The Congressman, little realizing that he is making a scientific time study, continues the investigation in his library, with paper and pencil: "Thomas has been taking 150 trips; the 15-in. swath would mean but 80 trips. Thomas takes 4 min. a trip; he could do it easily in 3 min. The broader cut would mean very little additional muscular exertion. His total time is 4 min. x 150 equals 600 min., or 10 hr. My time would be 3 min. x 80, equals 240 min., or 4 hr. At 30c an hour the saving of 6 hr. would be $1.80, to say nothing of the wear and tear on my nerves, while I am preparing my bill to prohibit the use of the stop watch and the payment of premiums for labor in Government shops."

The Congressman knows Thomas to be no intentional laggard, but rather a man who has established his labor in an ambitionless, unthinking rut. He is mowing lawns according to the customs established by his trade. His employer does not wish to discharge him, and so he works out a neat little plan which should be of benefit to both of them, he believes. A day or two later the monthly bill is presented, and one item reads: "Labor mowing lawn at 30c. per hour, $3."

When the Congressman pays it he broaches his idea to Thomas: "See here, your bill is all right and here is a check for it. Now you know I hate the clatter of that mower, so I'll tell you what we'll do. I'll pay you the same 30c. an hour for your time and I'll divide with you the wage for all the time you save from 10 hr. We'll call that the standard time. If you cut the grass in 8 hr.—and do it well, of course—you'll get 30c. an hour for the 8hr. and also 30c. for one additional hour. If it takes you only 4 hr., you'll get 30c. an hour for that and the same rate for 3 hr. additional, half of the 6 hr. you have saved. So you'll receive 7 hr. pay for 4 hr. work, which is $2.10, or 52c. an hour. Pretty good isn't it? I'll save 6 hr. of noise and the difference between $2.10 and $3. You can put in those saved 6 hr. on some other lawn, which at 30c. an hour will give you $1.80, making your total for the 10 hr. $3.90. That's better than $3. Get the idea?"

Thomas thinks it over and figures it out, and finally says: "It seems a pretty good plan, but supposing the grass is wet or something else is wrong and the job takes me 12 hr. What then?" "Oh," replies the Congressman, "that would be all right. You would get your 30c. an hour anyway. I guarantee you the hourly wage."

Inspiration comes to Thomas under the spur of a new ambition. He works out speeds and feeds of his own. The trip time he reduces to 2 min.; he clips the lapping to 1 in., and borrows a neighbor's lawn mower having 24 in. blades, giving him a 23-in. swath and reducing the number close to 50. His total time is 2 min. x 50, or 1 hr. 40 min. He receives his wage for 5 hr. 50 min., which is $1.75, or more than $1 an hour for his actual working time. He feels well contented with himself, but is a little shy about telling the Congressman about it, because he does not know what will be said concerning that 24-in. lawn mower.

The Congressman laughs at him. "You're all right, my boy. The idea was yours. You're entitled to the results of it. And you've reduced my bill to $1.75. The broader the cut the better. Get a 24-ft. mower, if you want to, or a horse mower. We're partners, you see."

Then a neighbor, who is perchance the president of the Lawn Mowers' Union, hears of the arrangement and goes to the householder. "Look here, Mr. Congressman, you ought to be ashamed of yourself. The idea of holding a watch on an honest American workman! And paying him a premium for his labor! Shame!

There ought to be a law on the statute books to protect men like Thomas against such an outrage."

And the Congressman, as any sane lawn owner would, tells his critic to go hence. What right has a neighbor or any one else to interfere in a strictly private transaction. "Thomas is pleased; I am pleased so they can all go hang."

Thomas's viewpoint of industry has been changed. He has found that it pays in dollars and cents to do his best work. He is using his brain to better advantage. He is trying to get his other employers to adopt the same system. And the wise ones (to conclude the parable) are doing so.

JOHN NELSON.

Worcester, Mass., June 1, 1916.
The Iron Age.

Need of Health Protection

A GREAT health movement is sweeping over the entire world. Hygiene has repudiated the outworn doctrine that mortality is fatality and must exact year after year a fixed and inevitable sacrifice. It aims instead to set free human life by applying modern science. Science, which has revolutionized every other field of human endeavor, is at last revolutionizing the field of health conservation.

The practice of medicine, which for ages has been known as the "healing art," is undergoing a gradual but radical revolution. This is due to the growing realization that an ounce of prevention is worth a pound of cure. As teachers and writers on hygiene, as trainers for college athletes, as advisers for the welfare of large industrial plants, and in many other directions, physicians are finding fields for practicing preventive medicine. Even the family physician is in some cases being asked by his patients to keep them well instead of curing them after they have fallen sick.

Furthermore, the preventive methods of modern medicine are being applied by the people themselves, as witness the great vogue today of sleeping out of doors; the popularity, not always deserved, of health foods and drinks; the demand for uncontaminated water supplies, certified milk, inspected meat and pure

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Final article (1/4). A speech by Frederick Winslow Taylor from 7 April 1914. He brilliantly explains Scientific Management and presents the rationale for it based on human behavior (worker and managers) and the needs of business and society. Remember, the early 1900s in the U.S. was a time of increasing consumer demand that was not being met adequately by industry, as well as a general state of unrest between management and labor (which is recurring today). Hence, the need for Scientific Management, to the benefit of owners, managers, workers, customers, and society.

The Journal of the Efficiency Society, Vol. 3, No. 8, September 1914, pp. 13-19 and 22-35

SCIENTIFIC MANAGEMENT

By Frederick W. Taylor.

The most important fact which is connected with the working people of this country, in fact of all civilized countries now, is the great fact that the average workman—not the average workman, but that nineteen out of twenty workmen all over the country, all over the world, feel that it is for their interest to go slow and not fast. They are firmly convinced that they are serving their best interests when they do as little work as possible for the money which they are receiving instead of as much as possible.

Now this is the most serious, the most vital fact which faces the working people of all civilized countries, and I say it without any hesitation. There are two causes for this fallacy, two prominent causes for neither of which, in my judgment, the working people themselves are to blame. For one of these causes perhaps the men of our class and the labor leaders are to blame, but certainly the rank and file of the working people are not at all; for the second of these causes no one is to blame.

In speaking of working people I have in mind only that class of working men who are engaged in co-ordinated industries, or who work in groups. I have not in mind at all the isolated worker, the coachman, or the gardener or the man who works by himself; so that in any centralization that I made of working men I have in mind men who are working in groups. I want that clearly understood; that is very important to bear in mind because what I am going to say is only true of men working in groups; not the isolated worker.

If you are to go to any set of workmen; if you go to the members of any trade union; if you go to any group of men who are working at any trade and suggest to them that it would be to their interest and for the benefit of their trade to turn out more work per man—we will say double the output of each man in the trade—there would be but one answer by those men. Ninety-nine out of one hundred would say, "Well, I do not know anything about men who are engaged in any other trade than my own, but I just happen to know something about my own trade, and there could be but one result following an increase in the output in our trade, if we were to double the output in our trade; the next two or three years, half of them would be out of a job; that would be all there would be to it." Now there would be no reasoning with them; there would be no arguing with them—it is an absolute certainty in the mind of the average man. He would say, "In my own trade I know the business and you do not know it; there would be but one result following an increase in output in our trade; half would be out of a job."

Now this seems absolutely self-evident. It certainly seems self-evident to every workman and I find that perhaps nineteen out of twenty intelligent, well-educated men appear to believe the same thing; a good many of them think the very opposite, but in a general way they firmly believe that there can be but one result following an enormous increase in output, that it would throw a lot of men out of work. The labor leaders are—all those connected with the labor unions are all, practically without an exception, legislating in the direction of restriction of output. It is almost universal.

And yet the fact is that directly the opposite is true—directly the opposite. I defy any man to give to me an instance of a single trade in the country in which directly the opposite has not been true, any trade where, for instance, labor saving machinery has been introduced which will give, twice, three times, six times, ten times, twenty times the work that was formerly done by hand. Invariably the result of this introduction of labor saving machinery, never mind how efficient that machinery may be, is to make work for more men in that trade—never to throw men out of work.

Now, gentlemen, look back in the history of any trade and you find that absolutely so. I find the labor leaders all over this country do not know it, or if they know it, they won't act on it, they won't take it; they still restrict output. Most of them I really think do not know it; or if they have heard of it they do not believe it. I find all that you have to do is to go into any trade, it makes no difference what that trade is, you will see the same thing to be true.

It is well worth while to take one—to give at least one illustration of it because this is such a fundamental fact; it is a fact of such vast importance that I look upon it as the most important one now facing the civilized world; and that is the danger of the restriction of output.

Let us take the cotton trade; that is a very common one; we all know something of cotton goods. In 1840 the power loom superseded the old hand loom. Of course, we all know that the power loom was invented some fifty years ago, but that it came into use very slowly and it was only about 1840 that the men who were running the hand looms in Manchester, in England, realized that the power loom was going to come. Now those men knew beyond the shadow of a doubt—there were five thousand of them in Manchester—they knew that when this power loom was introduced that it would do three times the work that the hand loom did, and that instead of there being five thousand weavers in Manchester, England, that there would only be fifteen hundred of them left. And those men did just as you or I would do under similar circumstances—I do not mean to say literally—but when you realize in those days the great immovability of labor, the impossibility for the workman in one trade to go into another trade, the impossibility in many cases for the workman to move even out of his own country—an immovability inconceivable to us now—then you see what these men faced; they and their families were confronted with starvation or they believed this to be true. So when they saw the introduction of this power loom come, they did what one can hardly blame them for. Of course, I am not defending arson, murder or anything of the kind, but they did what you or I would do; they fought the introduction of this new scheme which was to drive them out of their livelihood; they fought it to the limit. They broke into the establishments where the power looms were being introduced; they smashed them up; they burned them down; they beat up the scabs who were running them; they did everything in their power to prevent the introduction of the power loom. But the power loom came right straight along; all of their fighting, all of their opposition hardly retarded its introduction, and that is the history, gentlemen, of all labor saving devices; whatever may be the opposition to them if they are real labor saving devices nothing stops them; they go right ahead and the poor working people of generation after generation have to find that out at their cost; in every trade and in each generation they have had to go through the same bitter fight to find out the impossibility of stopping any device, whatever it may be, which is really a labor saving device.

The power loom came. I am not sure that its introduction was not accelerated by that opposition; I rather think it was. I am very sure that the opposition to the introduction of Scientific Management is accelerating its introduction, and that opposition is founded exactly on the same ground that has caused the opposition to all labor saving devices; they are opposed to Scientific Management merely because it is another labor saving device, fighting it to the limit and the more they fight the faster it will come.

Now let us see what happened in the case of the power loom. In 1840 there were five thousand weavers in Manchester, England. For every man in the trade in Manchester, England, where there was one yard of cloth produced in 1840 there are now ten yards of cloth. The improved machinery, the improved methods have at least multiplied the output by ten for every man engaged in the trade. Now surely that ought to have throw a lot of men out of work.

In 1840, less than a century ago, there were five thousand weavers in Manchester, England. There are now two hundred and sixty-five thousand and each of those men turning out ten yards of cloth where a single man in 1840 turned out one. Now multiply that up and you will see that for every yard of cloth that came out of Manchester, England, in 1840 there are now at least five hundred yards coming out, and the population of England hardly doubled.

Now what is the meaning of that; what is the meaning of it; what is the fundamental meaning. The real meaning of it is that all that you have to do is to bring wealth into the world and the world uses it; that is the real fundamental meaning of it. Wealth comes from two sources, that which comes out of the earth, and that which man produces, and all that you have to do, properly speaking, is to bring wealth into the world and the world uses it.

Now, of course, there must be a fairly even balance of the wealth that is brought in; we could not all make cotton goods; we could not all make hats. We have got to gradually feel our way to a fairly even balance in this new production of wealth. We all know that there are periods of over-production due in almost all cases, due ninety-nine cases out of one hundred, to the fact that the world goes too fast, that the world attempts to start more new industries, more new establishments than there is liquid capital for, than there is available capital for, and we get then a diseased state, and have a condition of over production, but that is no excuse for any set of men, whether of manufacturers or workmen, to adopt as a permanent policy, restriction of output.

Any set of men who adopt as a permanent policy restriction of output are nothing but robbers of their own kind, the worst kind of robbers—as a permanent policy, gentlemen, I am not speaking of a temporary policy, but any set of workmen or any trade union or combination of manufacturers who adopt restriction of output as a permanent policy are the worst enemies of mankind; they simply stop the good things that ought to come into this world from coming into the world, and particularly the poor laboring people, or combination of labor leaders, whether in the form of trade unions or whether they are merely a great public nation of the general workmen of the country, any such men—any men who restrict their output in their trade, who try to hold down the output of the men in their trade are merely robbing their own kind, their own people because: Remember, nineteen-twentieths of the real wealth of this world is consumed, not by the rich people. but by the poor people, so that the men who restrict output, the workmen who restrict output, are merely robbing their own kind.

Now I am dwelling on this because it lies at the very root of scientific management. Scientific management has for its object a material increase in the output without materially increasing the burden of the men. If it is a bad thing to increase the output of men, then Scientific Management is a bad thing, and vice versa.

Now the second reason for the restriction of output, the workmen are in no way to blame, not in the least to blame. If you are manufacturing any article—an article of any kind, we will say a pen or a spoon, whatever it may be, let us assume that it is a spoon and this can be made by a single man, that is a process of operation to be performed by a single man; that a man is making ten of these a day and is receiving $2.50 a day. Now if he has any kind of a foreman, if he has a foreman that amounts to anything, his foreman will suggest to him that it would be very good for him to manufacture these spoons by the piece and instead of being paid

$2.50 per day, and to make them for twenty-five cents a piece. The workman thinks that is very good, and at the end of a year say, through his own efforts, through the help of his foreman, through the help of his friends and through his own ingenuity he finds himself instead of turning out ten spoons a day, he finds himself turning out twenty a day, and instead of earning $2.50 per day he is earning $5 a day.

Now the workman is happy over that; he is delighted, and his foreman, if he is any sort of a man, is delighted, too, because with the same establishment, the same number of men, the foreman is turning out over twice as much work as he was before. But right here come the men of our class—it is merely an unfortunate condition in industry. Some member of the Board of Directors is sure to ask to see the pay roll if he is doing his duty; he is not doing his duty if he does not ask to see the pay roll of his company, and that member of the board finds to his horror that his workmen are paid $5 a day whereas the workman in other similar establishments are only getting $2.50 per day. "Why," he says, "this won't do at all; we are simply ruining the labor market in our part of the country. This won't do; we cannot pay $5 to a man when other people are paying only $2.50." And then the foreman is sent for, and in a no uncertain way is informed that he must stop ruining the labor market. And the foreman with sadness is obliged to go and cut that piece work price down so as to allow his workmen to earn perhaps at the outside $2.75 a day or $3 a day; at the very outside a limit of $3 a day.

Now, gentlemen, there is a very great difference of opinion as to what the working people of our country are now. One set of men think they are getting to be a set of infernal scamps, loafers and all that sort of thing; another set of men think they are little demigods, but whatever your views on that point as to what the workmen are, as to whether or not they are rascals, or the other way, there is one thing I can say that the working people of this country are not; the working people of this country are not fools; put them down for anything else, but they are not fools, and all that it takes is just one lesson of that kind to make a workman soldier for the rest of his life; after that he carefully watches the clock and he says to himself, "These people limit my earnings to just $2.75 a day. I might easily, where I am now turning out five pieces, I might easily turn out twenty, but what good would it do me to turn out twenty. I will watch that clock with the greatest care, and just finish my fifth piece when the day ends." And that soldiering is practically universal throughout this country, throughout the civilized world. And you cannot blame the workmen for it. Just you try having your wages cut down because you have been exceptionally efficient—what would you do—soldier—soldier just as I did when I was serving my apprenticeship, and as every intelligent workman does—every time.

I am not blaming the manufacturers for it; I am not blaming the workmen for it; it is simply a misfortune of industry; it is a great misfortune. It represents simply one of the blemishes of industry.

I want to emphasize the fact that the first step that was taken toward the development of that set of principles which have come to be called the principles of Scientific Management, the very first step that was taken, was taken in an honest endeavor to remedy that fault of soldiering; that is how Scientific Management had its first start—in an honest endeavor to remedy the necessity for soldiering, the necessity for cutting prices in that way. And, gentlemen, every other step that has been taken in the development of the principles of Scientific Management has been taken in exactly the same way, has been taken in an effort, an honest effort, to remedy some perfectly palpable defect that existed in the former management.

I want to emphasize the fact that Scientific Management has been from the beginning to the end an evolution; that it is not an invention; that it is not some scheme or other that some one, or some one set of men or one man proposes or that is being tried out to see whether it is good or whether it is bad. I want to emphasize the fact that at every step it has been an evolution, and so much so that no one ever took the pains, until within the last few years, the last eight or nine years, to analyze in any way the principles of Scientific Management. The thing existed; it was a fact; it had to come.

These principles had come because they were the survival of the fittest; because they had fought their way against the principles of the older management and had won out. I want to emphasize that fact because personally I am profoundly suspicious of every new invention, of every new idea, profoundly suspicious of it.

We are perfectly safe in saying that nineteen out of twenty new inventions are worthless, or next to worthless. Nineteen-twentieths of new ideas are wrong, whether they be in the zoological field or whether it be in the field of invention, nineteen-twentieths of the new things are wrong. I want to take Scientific Management entirely out of that class. It is no new invention—it is an evolution.

Scientific Management exists in a large number and variety of companies. I think now, something like 200,000 men are working under the principles of Scientific Management—a very insignificant number when compared with the workmen of this country, but to those companies which are working under Scientific Management it is safe to say that on the average the output per machine or workman has been doubled through the introduction of the principles of Scientific Management; that is the result, in very materially diminishing the cost of manufacture and therefore in increasing the profits of the manufacturer and also in many cases where it has been in operation long enough, in lowering the selling price and giving the general public the benefit of the new scheme.

The greatest good, however, has, without doubt, come to the workmen who have come under Scientific Management. These men, automatically, when they come under Scientific Management, receive from thirty to one hundred per cent. higher wages than are paid by their competitors right in the adjoining buildings. And yet this great increase in wages—I say it without any hesitation, is the smaller of the two gains that has come to the workmen who come under Scientific Management; it is the lesser of the two gains. The greatest gain that has come to the workmen of any trade who have come under Scientific Management, is that they have come to look upon their employers as the best friends they have in the world. That enmity has been replaced by friendship, that war has been replaced by peace; that, without the slightest shadow of a doubt, is the greatest good that has come to the workmen under Scientific Management, far greater than the increase in wages which they have received.

Now that sounds like rather a broad statement, it sounds a little difficult to believe, and yet, gentlemen, I think you will believe it when I state that in the thirty years in which Scientific Management has been going, and during that period it has been introduced into industries of the most competitive kind, not in isolated industries free from competition, but in all kinds of industries subject to the most severe competition, in all those years there has not been a single strike of men working under the principles of Scientific Management, not one. There have been strikes of men who were coming under Scientific Management, who were starting to work under Scientific Management, but never a single one after they were working under Scientific Management in thirty years, never one.

When we consider this we know that there must be some reason for it, and the reason for it is just what I have stated; that they have come to believe, they have the firm conviction that their employers are the best friends that they have in this world.

Now what is Scientific Management? Before starting to say what it is I think I can clear the deck probably by pointing out what it is not. I find that ninety-nine out of one hundred people have a misapprehension as to what Scientific Management is. Scientific Management is no efficiency device, nor is it any group or collection of efficiency devices of any sort. It is not a new pay system, it is not a bonus system, it is not an award system; it is no new scheme for paying men; it is no new cost system; it is not motion study, nor time study; it is not the functional or divided foreman, it is not any of the devices with which they are associated in the minds of men, nor is it all of these devices together.

Now I am not sneering at a new cost system, nor am I sneering at new schemes for paying men, bonus systems, nor piece work systems, nor am I sneering at divided foremanship, nor at any of these things; they are all useful, but they are equally useful under Scientific Management, under other types of management.

What I want to emphasize is that Scientific Management is not any of these schemes, nor all of these schemes combined. It does not exist—Scientific Management does not exist until there has been a complete mental revolution on the part of the workmen who come under it as to their duties towards themselves and towards the companies that they are working for, and a complete mental revolution on the part of the management in their duties toward themselves and toward their workmen, and until this great mental change has been brought about on both sides Scientific Management does not exist.

Now the woods are full of men who are introducing Scientific Management, who will say that they can introduce Scientific Management in three months or six months or a year: that is simply an absurdity—ridiculous to think that you can change the mental outlook of any set of workmen in a year or any set of men on the management side in a year. The introduction of Scientific Management is a matter of years, two to five years at the very least, and there is no possible hope of completely changing the mental outlook of a set of workmen in six months or a year. It is preposterous, and those men who are claiming to introduce Scientific Management in any short time are unintentional or intentional fakirs—most of them unintentional fakirs. They do not understand the subject that they are dealing with.

I do not want to say hard things, but it is such a difficult matter to make this change, that it is unjust to any set of men, to any set of workmen, to any management to assume that it is possible to make any great change in three months or six months or a year. It can't be done.

Now I quite understand that the assertion that there is a great mental change is probably meaningless to most of you. What I am going to try to do is to point out the exact nature of that mental change that takes place; to show you the mental revolution that takes place; that is my chief object. But before going on I want to point out, I want to make it clear, to give at least one illustration of what I mean by this mental change which takes place.

Again if you are making an article like the spoon, into it will go a part of the cost of the material, the raw materials that go into it, and if you will take the cost of those materials and then add to that, the cost of the overhead expense, that is the general expense, the taxes, insurance, depreciation, power, light, heat, salaries of general officers, the proper share in other words of the general expense, no part of which touches or forms any part of this spoon, if you add to the cost of the materials a proper share of the general expense and then subtract that from the selling price, you have what is called the Surplus, and it is over the division of this Surplus that all labor disputes have occurred in the past.

The workmen naturally want all they can get of that surplus in the shape of wages and the manufacturer wants all he can get in the shape of profits; the eyes of both sides of all industries in the past have been directed toward the proper division of that surplus. And, gentlemen, anything that goes to either side, the side of the manufacturer or the workman, it is perfectly evident must come out of that surplus. Shorter hours come out of that surplus; better working conditions, larger profits, higher wages, anything that goes to the workmen or goes to the management must come out of that surplus, and the eyes of both sides have been centered on the division of that surplus, mark you, the division.

Now under Scientific Management this great revolution takes place, that both sides come to see that if instead of pulling apart and fighting for each other's scalp over the division of this surplus (their interests in the past have been opposed to one another in the division of this surplus; there is no question about that) they come to realize that if instead of pulling apart if they turn around and work together and co-operate they can, by working in the same direction, make that surplus so enormous that there is no occasion for quarreling.

That is one of the great mental revolutions that comes under Scientific Management, when both sides see that the division of the surplus is not the important thing, but the really important thing is to make that surplus so large that there is no cause to quarrel over it. This is a great mental revolution; it is one of the great mental changes that comes under Scientific Management. I do not want to leave that subject of this mental revolution without giving you a clear mind of what I mean by the mental changes that take place; that is one of them; I hope to point out the others, or many of the other changes later on.

Now I am still far from saying what Scientific Management is. I want to try to make clear to you what it is by pointing out what I believe you will recognize as the best of the older type of management, and then contrast Scientific Management with this best of the older types. If you have an establishment with say five hundred or a thousand men you will have at least fifteen or twenty trades in that establishment. Now all of the men in those trades have learned what they know practically through tradition. They have learned—they have not gone to school; they have not read anything about it; they have learned what they know merely by watching other men who are around them; their foreman perhaps has taught them a little—not very much; they watched the man who is next to them; they ask a few questions of him; their neighbor makes a few suggestions, and I suppose the same thing still exists, you can gradually pick up a trade; that was the expression almost universally used, you literally picked up your trade. You pick up a trade; you find it wherever you can get a piece of it. You are not taught a trade. That is about as true now as it was forty years ago, when I served my apprenticeship. I served an apprenticeship in two trades, one as a pattern maker and one as a machinist, and during that time I think my reading was confined to about two and a half hours, and that is about all I could read, and I rather think the same thing is true now.

I saw a number of young friends lately who have gone in to serve their apprenticeship—I am not saying to be taught a trade—my own boy among them, and I made him a present of a whole lot of books relating to his trade, good books, the best books that I could get, and so far as I could see he never opened them; he had no time to open them, he was too busy to look up things; he was picking up his trade just as I did forty years ago.

Now, in spite of the fact that this knowledge is obtained in the rankest rule of thumb way, just as it was in the middle ages, it does not make the trade any less valuable. The trade now is the workman's greatest asset just as it was in the middle ages. It is his greatest possession and any manager or any foreman who knows anything about the game, who amounts to anything, must realize that his first duty, that the most important thing for him to do, is to get the initiative of his men, is to get those men who have this knowledge to use the knowledge for their benefit, to work hard, to use their ingenuity, to do the best they can, to turn out as much work as can be done. If any manager amounts to anything he must realize that is the biggest problem that faces him. But if that manager has been living with the men, if he has been a workman himself, he knows, no one knows better than he, that it is the object of every workman under him not to give him his best work, but to do just as little as he can for the money which he is getting, and the only way he has of getting his workmen to do a fair day's work is to deliberately set out to give those workmen something more than his competitors are giving to them, something better than, something more than they are giving to the ordinary workman.

Now the manager who deliberately sets out to do that, and if he will keep it up long enough, if he will stick to it—keep to the determination to treat his men better, to give them higher wages, better working conditions, do more for them than other managers are doing for their men in every case, if he will keep it up long enough, the workmen will respond in the nicest kind of a way—in the most loyal kind of a way, and they will give him a great deal more net return than is given to them; that is my experience.

My experience with workmen is that they are as generous, as decent, and as nice a set of fellows as any class in the community. Of course, there are a lot of mean fellows among them, but so there are in every class in the community, but my experience is that they are just as trustworthy and just as fine a set of men as you will find anywhere. They are naturally suspicious; they are naturally slow to change their ways, but all that you have to do is to show them that you propose to do better by them than other people are doing by them and they will respond in a most loyal way.

Now, I think that represents the highest type of management of the old school, that is the type of management in which the manager deliberately proposes to do something more for his workmen than is ordinarily done, give them something better than other men ordinarily give their workmen, and they give their employer more and a great deal better service than is ordinarily given. I think you will all recognize that as the best of the older type of management.

This type of management would not be backed up by the Board of Directors. They could not see why their men should be paid more than the men employed by their competitors and they cannot see why they should be treated any better than the men employed by their competitors. It is a rare type of management, and I think you will agree with me that it represents the highest and best of the older types of management, and I am setting that type up because I wish to contrast it, the best of the older type of management, with the principles of Scientific Management, and I want to try to prove to you the utter impossibility, even of that high type of management, competing for an instant with the principles of Scientific Management; I hope to try to prove that to you—the utter impossibility of this type of management competing with the principles of Scientific Management.

Why, because properly speaking under Scientific Management in the first place you get the initiative of the men, that is their hard work, their good will; their determination to do everything they can for their employers is obtained with absolute certainty. The workmen always work faithfully and well under Scientific Management, regularly, whereas under even this older type of management they are rather spasmodic in their work. They become doubtful every now and then as to whether it is best for them to work hard; whether they should give their support to it; whether or not it is some trick. But under Scientific Management you obtain the initiative of the men with absolute regularity, but without hesitation I say that that is the least gain that comes under Scientific Management. The great gain that comes under Scientific

Management comes from the new and absolutely unheard of duties and burdens which are voluntarily assumed by those on the management side; the new things which are voluntarily done by those on the management side constitute the great superiority of Scientific Management over the other, and these new duties have been divided into four groups and have been rightly or wrongly called the principles of Scientific Management, and it is to the principles, the new duties undertaken by the management, it is to the principles of Scientific Management that I desire to draw your attention.

The first of these principles, the first of the principles of Scientific Management is the deliberate gathering in of this great mass of traditional knowledge which in the past has been in the heads, not only in the heads, but in the knack, in the body, in the habit, the daily habits of every workman throughout the establishment, the gathering in of this great mass of traditional knowledge and recording it, tabulating it, reducing it to laws, to rules and in many cases to mathematical formula, so that when these laws and when these rules and formula are applied through the co-operation of the management to the every-day work of the workmen they result in an enormous increase in the output of the worker. Now this represents the devolopment of a science to replace the old rule of thumb knowledge of the workman. This represents the co-ordinating of knowledge, the classifying of knowledge as against the old antiquated, the old rule of thumb knowledge which is in the head of the workman.

A great many people object to the use of the word "Scientific" as applied to management. They feel that it is a very high-sounding name. Now I want to defend the use of this expression of Scientific Management because so far as I know it is as appropriate a name as you can have for the new management. The worst people who have attacked Scientific Management, perhaps the worst, are of two classes; one the professors of our universities, and the other the labor leaders, and one of the professors who has attacked it perhaps more vigorously than anyone else, the head of one of our large scientific colleges, himself has given perhaps one of the very best definitions of the word "Science." His definition of the word "Science" is classified or organized knowledge, and I want to know what it is except classifying and organizing this knowledge to gather in all this great mass of traditional knowledge which was heretofore in the heads of the workmen, and classifying it and then using it. If that is not the development of science according to that definition I do not know what it is.

Now the second new duty undertaken by those under Scientific Management, the second principle of Scientific Management, is the scientific selection of the workman, and then his progressive training and development. It becomes the duty, the deliberate duty, of every man, every manager under Scientific Management, to study every man who comes under him; every one of the ten thousand men in their establishment becomes the subject of individual study. That man becomes a problem; his abilities are studied; his disabilities are studied, and then it becomes the duty of the management to deliberately set out to train that man so that he can rise to a higher, a better class of work than he was able to do before, and after he has risen and is able to do better and higher class work he is then paid higher wages. Now that becomes one of the regular new duties assumed by the men on the management side. the deliberate study, training and development of every man in the establishment, and after he has raised that man to a higher state than he was in before, to a state of higher efficiency, to pay him higher wages.

The third is the bringing of the science and the scientifically selected and trained man together, because you may have the science, but unless there is something to make those workmen work in accordance with the laws of that science they will work the same old way.

Now "making" is rather a strong word; that perhaps is a little too strong. There are many ways of making; perhaps the most important is to offer that man, deliberately offer a premium of thirty percent. added to his wages whenever he performs his proper day's task; that is a very powerful make. You tell a man that when he is raised to such and such a level of efficiency you at once increase his wages thirty per cent., that is a powerful make. Then constant teaching, supervision, the knowledge that every day he has to measure up to a certain standard is a make.

I find, however, that the labor leader is very much excited whenever I speak to him about the efficiency make. "We have been doing the making for the last thirty years; I want you to understand no one is going to make us do anything; we have been the fellows that have been doing the making." But the thing is softened in the eyes of the workman when you say we need them in our business.

Every resistance throughout the world to the new type of management—nine-tenths of our trouble comes in making those on the management side do their duty; only one-tenth—we have no trouble practically with the workman, but we have infinite trouble in making those men on the management side take their new duties and do them right; that is the great difficulty under Scientific Management.

Now the fourth principle of Scientific Management is perhaps the blindest of all. Unless one has seen life in a shop under Scientific Management you can hardly believe that it is there, the work is so nicely divided. The work is divided in two large parts, and one of those parts is deliberately handed over to the man on the management side; that is, work which in the past has been done by the workmen is taken over and done by the men on the management side. And it is this great team work, it is the actual division of the work between the management and the workmen which makes for the fact more than anything else that there has never been a strike under Scientific Management. There may have been strikes when the men were coming under Scientific Management, but when both sides are working as a team, when the success of the men every time depends upon their doing their work, and when the men realize that it is impossible for them to earn their premium of thirty to sixty per cent. without the co-operation of the management, without the help of the management, they cannot be enemies; you cannot be against a man on whom you are absolutely dependent for your increase in wages. Of course the management realizes that it cannot get its increased profit unless it has the co-operation of the men. So you cannot fight; there is no such thing—you have got to co-operate under Scientific Management.

Under Scientific Management there is no more bickering and fighting, a condition which under the older type of management you are sure to have. That is entirely ceased under Scientific Management. You have an entirely new condition in which the workmen themselves have just as much interest in the success of the establishment as the men on the management side have.

Now I am through with the theory of Scientific Management. I want to try to prove to you the power of these four principles of Scientific Management, the immense power that they have when they are applied to a variety of work, and to different kinds of work. I am going to try to show this by a series of illustrations, but in these illustrations I hope that what you will see is not something that may merely interest you, but I want you to see the power of these four great principles.

I begin with the most rudimentary form of labor that is known, absolutely the simplest kind of labor that I know of. I want to show that these principles are absolutely universal in their application; that they are just as applicable to one kind of business as to another—to any kind of human endeavor where men work in groups. Therefore, I begin with the most elementary form of labor, the handling of pig iron. It is the only kind of work in which an absolutely uniform piece of metal, a pig weighing 92 lbs. is taken in the hands of the men without any other implement. If I had time I would go into this matter and prove to you beyond a doubt that science does exist in the handling of pig iron.

Now I am going to take for the first illustration shovelling. I suppose you will say that there is no science there. I am sure that if a problem of shovelling were presented to you and it was your business to analyze it and find the science of shovelling, that inside of two days of thinking you would have laid out enough work to last three or four months.

When I first went to the Bethlehem Steel Works there was a lot of laborers shovelling rice coal. They were splendidly occupied at their task. When they got through with the shovelling of rice coal they were directed to go to another part of the yard, to a pile of ore from the Messabarange, about half a mile away, and the same men with the same shovels were directed to handle that ore. When they were shovelling rice coal they had a load of 3¾ lbs. on their shovels, and when the same men with the same shovels on the same day were shovelling ore from the Messabarange they had from 38 to 39 lbs. on their shovels.

It does not take very great reasoning power or very great brilliancy to see that if a load of 3¾ lbs. is right, a load of 38 lbs. is wrong.

Under the old type of management which one of these two ways was correct was settled in two ways: One way was to sit down and write letters to your friends who knew about it, and when you got that information in, that became the standard; that is the fact. The more common way is to send for the foreman, and put the question up to him as to what is the proper load for a shovel. He probably does not know anything about the subject, but that does not make any difference to him. He answers 12½ lbs.—and 12½ lbs. becomes the standard—"Pat said so." That was the old way.

Now I want to show you the new way. We sent for two big, powerful shovellers and set them to work with a clerk to keep tab on their accomplishments. They were told that there was to be no shirking or loafing on the job; that they had to play straight. The laborers accepted and they played straight.

We started them in two different parts of the establishment to shovel a pile of material which was very heavy on the shovel. All the details of the job were carefully written down; among other things the number of shovelfuls thrown during the day, and then at the end of the day the materials shovelled were weighed up and by dividing the number of pounds into the number of shovelfuls we found that they were shovelling between 38 and 39 lbs. as a load. After two or three days of experiment we found what the proper average was. We found that more was shovelled with a 36 lb. shovel that with a 38. We cut the shovel off again to 30 lbs., and again the quantity shovelled went up. We cut it again and again until we reached 21½ lbs., when the amount of material shovelled reached its maximum. We cut it to 18 and the amount shovelled fell off; to 16, 14 and so on down, but the amount fell off—the 21½ lbs. shovel gave the maximum results; therefore that was the scientific shovel.

At one of the steel works we built a large shovel and tool room, and we kept from eight to fifteen different kinds of shovels —I have forgotten just how many. There were employed at that plant from four to six hundred men, and each man was treated as a unit and had his own tools. There were statistics kept of the amount shovelled by each man during the day, and when a man came in in the morning he was told whether he had been a success or not on the day previous. We insisted that no man could work in our establishment who did not earn more than was ordinarily paid laborers in that neighborhood.

If their work was not satisfactory they were given a yellow slip, and those men realized fully that when they had three or four of those yellow slips that something was going to happen. Under the old system of management he would have been fired, but under the new system he was reasoned with and shown how to shovel properly. In fact the workmen did not wait, when they had three or four of those yellow slips they knew that something was going to happen and they generally called upon the office for help. If they were sick they were given an easier job for the time being. If not they were told to go ahead and shovel under the supervision of some one from the office.

Time after time we found that the man was doing something wrong; he had forgotten something of the instruction which had been given him; instead of shoving with the weight of their body behind it they were shoving with their arms. That is merely one of the twenty ways in which a shoveller can go wrong.

He is told the right way and under Scientific Management the workmen look upon the management as a friend; that is what I want to emphasize to you tonight. The great function of Scientific Management is to give each workman a task which is entirely within his capabilities and therefore suited to his job.

At the end of three and a half years we had a very good chance to see whether Scientific Management at the Bethlehem Steel Works had met with success, for at the end of that time we found that one hundred and forty men were doing the work that was originally done by from four to six hundred men, and these one hundred and forty men were all receiving more than sixty per cent. higher wages than were paid to any men in that part of the country. They were living better; they were the most happy and the most contented lot that could be found anywhere in that part of the country. So much for the men.

On the Company side we found that under the old system of management it had cost between seven and eight cents to handle a ton of materials, and there were several million tons handled every year in that yard. This is a low cost, if you gentlemen know it; it usually averages between nine and ten cents in the average yard. Now after paying for all these extra salaries, for the tool room and all the various expenses connected with it, we found that the cost was reduced from between seven and eight cents to between three and four cents—and that justifies Scientific Management, and only that will justify it. The actual saving to that Company in the last six months in that labor department alone ran between \$75,000 and \$80,000 a year; that was the profit that came to the Company and that justifies Scientific Management.

Now, I just want to give you one more illustration. I am sorry that I cannot give you eight or ten of them, because that is the only way that you can convince people of the value of Scientific Management—by showing them a great variety of cases. I want to show you what happens in the case of a high-class mechanic. I want to make it perfectly clear to you that it is impossible for a high-class mechanic who is fit to work at his trade to understand the principles of his trade, because if he did understand them he would cease to be a mechanic at once. I want to make it clear to you why that is so and therefore take the machinist's trade.

Now a machinist has perhaps an average education of three years' schooling. He has been a man running the same machine for many years. Now he presumably would become especially skilled in the running of that machine; that is the general impression. I want to show how far wrong that impression is. Again I want to give a concrete illustration. In a large machine shop there were some three to four hundred men turning out machines. They had been in this same department for about twelve years, and therefore the men had become very skilled in their work, and each man of the three to four hundred who were working there had his particular job.

Now under these circumstances you have a high-class mechanic running the same machine year in and year out, and having the opportunity to become so intimate with the machine that there is very little hope of any science helping that man. That would be the general conclusion; that was the opinion of the owner of the establishment. My friend Barth told him that he could double the output. My friend Barth started out to develop the science of running those machines.

A record was kept of just how long it took to do every piece of work and that was then used as a basis for developing the science of running that machine.

There is a little implement that will tell you just what pressure, just how many pounds pressure it takes with any size tool, any shape tool, and this implement will tell you how fast you can run your tool without burning it out.

By the means of those implements Mr. Barth was able to analyze the machine, make a study of it, and in about two hours he was able to respeed that machine. And this seems like an extraordinary statement to make—but I made it before the Tool Builders' Convention at their Third Annual Convention. They asked me to speak and I made this assertion before them that I make to you, that nineteen out of twenty machines in their own shops, those tool builders who were building the machine tools of the country—I said nine out of ten of your machines are speeded two or three hundred per cent. wrong. Why, because the machine tools of the country have been speeded by guess, without any science. They were speeded years ago by guess and have never been changed.

In 1881 I was at the end of a long fight of three years with the machinists of the Midvale Steel Works. I went with the concern in 1878 because I could not get work elsewhere, and I had after a good deal of hesitation consented to take the foremanship of the shop. It was a long dragged-out fight to drive those fellows into doing a decent day's work. The men had been soldiering very successfully, and I cannot say that I blamed them for soldiering under the circumstances. We finally succeeded in about doubling the output of that machine shop.

Another problem we undertook was the study of the laws of cutting metals. We experimented with locomotive tires weighing about 2,000 lbs. of uniform fine high-grade steel. For the nine years that I was at the Midvale Steel Works we experimented right along cutting up metals into pieces and investigating the laws of cutting metals. Those experiments went on almost without interruption during a period of twenty years and $200,000 were spent in wages. Fifty thousand experiments were recorded and 800,000 lbs. of metal were cut up in investigating the laws of cutting metals.

We found that there were twelve great variable elements that go to make up the laws of cutting metals. Our first discovery of great value was, if you just throw a stream about as big as my finger of cold water right on the chip as it comes off from the tool it will enable you to run forty per cent. faster cutting speed than if you did not.

Grand Central Palace,
New York City, April 7, 1914.

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Final article (2/4). An excellent and extremely informative paper by Dr. Harlow Person (1875-1955), that describes the early stages of Frederick Winslow Taylor's work and struggles developing what came to be known as Scientific Management. Dr. Person was an economist, first Dean of the Amos Tuck School of Administration and Finance at Dartmouth College (1906-1919) -- which hosted the famous first Conference on Scientific Management in 1912 -- and a prominent and tireless advocate of Scientific Management who knew Frederick Winslow Taylor well. Learn more about Dr. Person here https://en.wikipedia.org/wiki/Harlow_S._Person

Bulletin of the Taylor Society, Vol. V, No. 5, October 1920, pp. 191-199

THE EARLY STEPS OF TAYLOR'S TECHNICAL ADVANCE

By

H. S. Person[1]

I. INTRODUCTION

THERE have been—and still are—several misunderstandings of the Taylor philosophy and system of management current among plant managers which have profoundly influenced their attitude towards it and restricted that open-mindedness and receptivity of new ideas and things commonly believed to be characteristic of the American business man. These misunderstandings first appeared about 1911, when scientific management was brought to public attention by the Eastern Rate Case hearings. The first incorrect inference was that scientific management was at that time something new, something recently conceived and suddenly promulgated, a *theory* which had no background of thorough trial; the second was the inference that scientific management had been first conceived as a theory and that the system was simply a body of mechanisms hastily worked out to support the theory; the third was the inference that scientific management, the Taylor System, was a mechanistic thing which could be contracted for—transported, so to speak, through the medium of an engineer—and installed as a fixed mechanical contrivance; and the fourth was the inference that scientific management, during whatever vague past it had enjoyed, had induced labor opposition in many of the plants in which it had been "installed." All of these misunderstandings, inferences made about 1911 when the public first heard of scientific management, have had an astonishing survival in an industrial community of apparently open-minded, boldly experimental and hard-headed executives.

Denials of everyone of these misconceptions have been made by those informed concerning the early history of scientific management, but these denials have been general and unsupported by systematic evidence, and have on the whole been discounted by the misinformed as partisan statements. The purpose of this article is to tell enough of the story—high lights only—of the beginnings and growth of scientific management to relieve those who are laboring under misapprehension.

To correct the first inference—that scientific management was a new and untried philosophy and system of management at the time it first received public attention, in 1911,—it may be said that it had been worked out in its fundamentals by Taylor during the period 1880—1889, and further developed in most of its details during the decade 1890—1899; and that nearly all the story subsequent to that time is a story of refinement which resulted in no fundamental modifications.

With respect to the second incorrect inference,—that scientific management originated as a theory, in support of which mechanisms were subsequently devised,—the fact is that the mechanisms resulted from a series of attempts by a shop foreman to solve practical shop problems, as they appeared one after another, with no thought of a "system;" and that the coordinating of the mechanisms into a system, the philosophizing about them and the formulation of principles were later inspirations.

Of the third incorrect inference,—that scientific management is a transportable mechanism, subject to reproduction in detail in different places with the rapidity involved in mechanical installation,—it should be observed; that in its origin scientific management was a *development* and not an *installation,* that every genuine instance of its appearance in a plant has been a development, and that dependable engineers today undertake to give plants the benefit of it only as a matter of development; and further, that such development is on the whole a problem of *adapting* proven principles and well-tested mechanisms to local conditions, physical and psychological.

Concerning the fourth incorrect inference,—that scientific management has experienced the opposition of workers in the plants in which it has been developed,—it should be said, first, that distinction should be made between plants in which there has been an honest undertaking to *develop* it patiently, as

[1]Managing Director, Taylor Society, New York.

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

[1] *On 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, assisant 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.		
1911	Eastern Rate Case and Watertown Arsenal investigation. Publication of "Principles of Scientific Management"; republication of "Shop Management."	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.
1915	Taylor's death.		

neither dreamer nor theorist. He was a doer. Most things he asked of a worker he could do himself with sufficient degree of skill to establish that he knew what he was talking about; and occasionally for purposes of instruction he relieved a workman at a machine. The mechanisms he advocated or the principles he formulated had either actually been proven by experiment or experience, or they were reasonable deductions from experiment or experience.

This was the kind of man who at the age of twenty-four became a foreman at Midvale.

III. THE FIRST ELEMENT OF TAYLOR'S PROBLEM DETERMINING THE BEST WAY OF DOING EACH JOB

"In the fall of 1880, the machinists in the small shop of the Midvale Steel Company, Philadelphia, most of whom were working on piecework in machining locomotive tires, car axles, and miscellaneous forgings, had combined to do only a certain number of pieces per day on each type of work. The writer, who was the newly appointed foreman of the shop, realized that it was possible for the men to do in all cases much more work per day than they were accomplishing. He found, however, that his efforts to get them to increase their output was blocked by the fact that his knowledge of just what combination of depth of cut, feed and cutting speed would in each case do the work in the shortest time, was much less accurate than that of the machinists who were combined against him. His conviction that the men were not doing half as much as they should do, however, was so strong that he obtained the permission of the management to make a series of experiments to investigate the laws of cutting metals with a view to obtaining a knowledge at least equal to that of the combined machinists who were under him.[1]"...."the original object, for which in 1880 the experiments were started (was) taking the control of the machine shop out of the hands of the many workmen, and placing it completely in the hands of the management, thus superseding 'rule of thumb' by scientific control.[2]"

These words from Taylor's own pen, adequate for a scientific article, do not tell the whole story. He had been worker with the workers and carried into his foremanship positive knowledge that there was systematic restriction of output; also he believed his new duties required the securing of better production. He adopted, naturally, the then usual foreman's methods,—suasion of the drive type (it was 1880 and the *steel* industry!) This led only to bitterness, occasional physical violence, no improvement in production and apparently no possibility of improvement. Taylor thought hard about it and conceived a reason for the difficulty and a way out; he decided he was at a disadvantage because the workers knew more about their skill than he (or management) did; he would learn to know more than they collectively did; then perhaps by advantage of that superior knowledge he could secure what he wanted by its use in negotiation with them. He had no "system;" no philosophy; he had simply a not unusual practical problem of a foreman; and he set out to solve that problem.

To learn the content of the workers' skill, he began what has come to be known as job-analysis by the method of unit time study. He did not set up a laboratory, but did what amounted to the same thing, selected a machine and a worker or workers, controlled the conditions around the machine,—power delivery (which led to "Notes on Belting"), uniformity and availability of materials, control of feeds, speeds, depth of cuts, etc., (which led to "On the Art of Cutting Metals") and made precise and thoroughly scientific (variables under control) observations and records. In a short time he had sufficient data, for certain operations, with which to determine how long a given operation should take under specified conditions.

He also observed that if operations were performed under these conditions the output would be increased per unit of cost; that there would be a net gain, part of which could be added to the wage rate, thereby securing an incentive for increased output to replace the conventional ineffective and disagreeable foreman's method of suasion.

Thus was the first element of the problem solved;—specifications for operations based on precise knowledge of the best methods and of times necessary for their performance, and an extra possible profit, part of which could be used in a higher wage rate to secure the cooperation of the workmen. He sold the idea to enough of the workers to begin to try out the new method of work according to specifications which indicated the "best way" of performing an operation, the participation in the experiments on the part of some workers and the watching of them on the part

[1] *Ibid*, p. 33.
[2] *Ibid*, pp. 39-40.

of others having interested the men and cleared the ground for harmonious relations.

IV. THE SECOND ELEMENT OF TAYLOR'S PROBLEM
STANDARDIZING CONDITIONS IN THE SHOP

Taylor had apparently seen from the beginning that there was a second element of his problem, and that a solution of it was necessary before the new methods of work could be inaugurated. The methods and the times embodied in the specifications were based upon particularly favorable conditions surrounding the machines on which the investigations had been made. If those specifications were given to men on other machines, machines not operated under the precisely controlled conditions of the machines upon which the experiments had been performed, then work in accordance with the specifications would be impossible. Here was a bigger problem than that of learning the content of skill, and Taylor did not refuse to face it. He at once attacked the problem of *standardizing the conditions* in the shop. He would give every worker the perfect opportunity.

To give every worker the perfect opportunity was, therefore, to bring the conditions throughout the shop to the same standard as the conditions surrounding the machines on which the standard methods had been worked out. Before Taylor left Midvale in 1889 he had devised most of the fundamentally important mechanisms of what came later to be known as scientific management;—not in their subsequent finished form and not coordinated into a system, but merely to an extent necessary in a shop of large machines on which the operations were relatively simple and took considerable time. But more important than the mechanisms is the fact that the point of view, the spirit, which inspired this development was as thoroughly scientific management as it came at any later time to be.

We know from the records that during that period there were developed: unit time study[1]; elementary rate fixing[2]; "tables" for tasks and the assigning of tasks[3]; standard conditions for belts[4]; tools[5] and machines; planning in advance, "lists" of work ahead and "chasers" to follow-up work[5]; the shop bulletin board[5] the differential piece rate[6]; and the following elements of functional foremanship—time clerk, instruction card clerk, inspector and disciplinarian (the modern employment manager), each of whom had supervision over workers which was direct and not through the gang boss[7]. In general terms Taylor says there were "all the fundamentals of task management[8]," "the best way of managing men on day work[9]," and the idea that the big losses of poor management came from "incidental delays[10]," to remove which was a principal objective of good management. There was as yet no planning department, separately organized[11], for the shop was so small and the machine work so simple that the planning function did not have to be functionalized. For the same reason probably, there was no functionalized routing and route sheets. It should be borne in mind that the shop in which scientific management had its beginnings at Midvale was engaged chiefly on turning out locomotive axles and tires, and there was none of the complexity and minuteness of scheduling of the machine shop which does miscellaneous work. It was the application of scientific management to this latter type of shop which later compelled refinement and coordination of the mechanisms.

V. THE THIRD ELEMENT OF TAYLOR'S PROBLEM
MAINTENANCE OF STANDARD CONDITIONS

It is well known to experienced executives and foremen that good conditions do not automatically "stay put." A shop or office well tuned up today will begin to become slack next week. So it was in Taylor's experience with the standards established throughout the shop at Midvale. Immediately he had before him the third element of the problem,— *the maintenance of the standards set.* It should be observed that, in fact, although these three elements of the problem were both logical and chronological, they were more logical than chronological. All were crowded upon Taylor practically at the same time.

The maintenance of standards is a much more complicated element of the management problem than either job analysis or the establishment of standards, for the obvious reason, among others, that the latter

[1] *A Piece Rate System,* §44.
[2] *A Piece Rate System,* (Introduction)
[3] *Notes on Belting,* § 43.
[4] *Notes on Belting,* § 42, 111.
[5] Reported in interviews with persons now living who were acquainted with conditions in Midvale.
[6] *A Piece Rate System,* (Introduction).
[7] *Shop Management,* p. 107.
[8] *Shop Management,* p. 44.
[9] *A Piece Rate System,* (Introduction).
[10] *Notes on Belting,* § 4.
[11] *Shop Management,* p. 118.

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 co-operation. 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.

in undertaking the course of logical and complete development.

Taylor gave his services to these companies without charge, and worked chiefly through younger engineers, secured upon his recommendation for the detail work. Mr. Carl G. Barth and Mr. H. K. Hathaway were his responsible representatives, and both—particularly Mr. Barth, the elder—made their mark upon the development of the Taylor methods. Mr. Taylor remained in the relationship of unpaid consultant and supervisor. Assured of a modest competence as a result of his inventions, he had become able to declare that he was "too busy to work for money."

IX. LATER ACTIVITIES—LABOR'S ATTITUDE

About the time of his interest in Link-Belt and Tabor he began a career of conferences and public speaking concerning his philosophy and system of management which continued until his death in 1915. "He gave his time and his means freely to showing its operation in the Philadelphia plant to conscientious inquirers. In many instances he traveled far at his own expense to address associations and meetings of manufacturers and managers. Out of his own pocket he contributed to the expenses of young and ambitious engineers who were serving their apprenticeship in Philadelphia.[1]"

Although Taylor's career as foreman in the Midvale days had begun with serious controversy with the workers under his foremanship, *under the then prevailing methods of management,* it should be recorded that in the subsequent development of management in accordance with *his own philosophy and methods* he experienced only the most gratifying cooperation of the workers[2]. The first friction which developed was at Watertown Arsenal about 1909 and 1910, due to over-zealous and improperly measured steps of development by local authorities, especially to the extension of time study to a shop in which the conditions had not been properly prepared. No serious internal trouble developed, but the occasion was seized upon by organized labor as an opportunity for organized opposition from without the Arsenal, and there resulted the famous investigation by a committee of the House of Representatives in 1911. The report of the committee on the results of the new management methods which were being developed was not unfavorable and no legislation was recommended.

However, a few years later, without further investigation, restriction was placed upon the use of time study in government institutions by the so-called Tavenner rider to an appropriation bill. This was in response—not to importunities of workers in plants where scientific management had been developed (their testimony was apparently disregarded!) but to the political pressure of the national organization of labor in accordance with what appears to have been their then larger strategy. As the writer has stated elsewhere[1]: "An almost incomprehensible phase of the history of the scientific management movement is the existence, side by side, of improved industrial relations in those plants in which scientific management has been developed and strong opposition on the part of the management of the American Federation of Labor. The opposition of the management of organized labor seems to have been inspired by fear of the impairment of a fundamental element of their strategy (that their organization must be increased in membership and held intact, for the accomplishment of their large objectives) by one of the least important mechanisms of scientific management, the differential wage system. Inspired by this fear, and taking advantage of certain opinions held by workers (such as the opinion that increased output will cause unemployment) and certain infelicities of speech and illustration on the part of expounders of scientific management (such as the famous Schmidt case), and presenting statements concerning the actual operation of scientific management not based on critical investigation and not conforming to facts (that workmen are speeded up and worn out, that time-studies are secret, that rates are cut, etc.) the management of organized labor undertook a campaign of education of its membership which resulted in an almost solid opposition by the rank and file as well as the officers of organized labor to scientific management. In public discussion, to the opposition of organized labor was added the opposition of many social scientists who, without information derived from either experience or investigation, asserted

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[1]Thompson, *Theory and Practice of Scientific Management*, p. 25.

[2]"The danger from strikes comes from the false steps often taken by men not familiar with the methods which should be used in introducing the system. The writer has never had a single strike during the 26 years he has been engaged in this work." *On the Art of Cutting Metals*, p. 54.

[1]*Bulletin of the Taylor Society*, Vol. IV, No. 5, p. 13.

that scientific management would make impossible the achievement of any ideal of industrial democracy. Throughout all this controversy the natural confusion of polemical discussion was worse confounded by absence of critical investigation of facts, inadequate information, and particularly by a failure to distinguish in the discussion of scientific management as a social problem, between management and administration. In this controversy the arguments against scientific management as a system of management technique were ineffective because not supported by the facts; on the other hand the arguments against scientific management with respect to its social implications were significant and of influence, but they were really arguments concerning administrative policy governing the use of management technique, and not more pertinent to scientific than to any other form of management. Superficial critics failed to perceive the point that the effective working of the scientific management mechanisms in particular depends so vitally upon sympathetic cooperation between planner, supervisor and operator, that anti-social administrative policy is inconsistent with its development and technical effectiveness...The status of scientific management has been profoundly influenced by the war. Three influences are noteworthy: (1) Although the prejudice of workers engendered by the sharp controversy preceding the war has not disappeared, open and active hostility of labor has been discontinued and apparently will not be resumed; (2) the demand for output during the war, supported by labor, compelled a wider extension of efficient production methods, in some instances of the methods of scientific management, not only in the United States but also in Europe, and both labor and management have learned by experience that scientific management technique is not inconsistent with wise, humane and cooperative and administrative policies; (3) labor and management have observed that during and following the war managers of scientific management plants and scientific management engineers have been in the van of those inspiring and directing the establishing of the most humane and cooperative administrative policies, in accordance with the most far-sighted principles of industrial relationship. War seems to have cleared away prejudice and misunderstanding and to have made possible an appreciation of the value of scientific management as an instrument for the increase of the productivity of human effort under wise administration."

X. CONCLUSION

To summarize: Scientific management (first called by that name about 1910) was begun to be worked out by Mr. Taylor as long ago as the decade 1880-1889, and has been steadily developing since that time; it arose not out of a preconceived theory but out of the attempt to solve practical problems of production as they appeared one after another; theorizing and the formulation of principles came after the mechanisms had been thoroughy tried; in the course of developments which represented a smoothing out and coordinating of the system there was experienced only the minor and normal friction with workers—in general a splendid cooperation.

In addition it should be observed that in the story there is a lesson for executives and engineers of to-day. The steps through which Taylor first developed scientific management are essentially the steps necessary for any successful specific development today. Experience has taught that the only practicable order of development in any specific instance is: preliminary analysis as a basis for standardization of conditions; standardization of conditions; provision for maintenance of the standardized conditions; and then the detail job analysis and the setting of rates by the method of unit time study in the environment of standard conditions. Out of the job analyses which follow standardization of conditions may come instruction cards, precise scheduling, bonus or other differential wage systems,—a precise general and specific control. Any other order in the improvement of management in accordance with Taylor principles is almost sure to be ineffective and to lead to trouble.

ATTENTION of members of the Taylor Society is called to the session of Wednesday afternoon, Dec. 8, of the annual meeting of the A.S M.E. (New York, Dec. 7-10.) At that session will be offered, under the jurisdiction of the Management Section of the A. S. M. E., a program on the constructive work in management of the late Henry L. Gantt.

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Professor Bob Emiliani

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Final article (3/4). Frederick Winslow Taylor passed away unexpectedly on 21 March 1915 at the age of 59. These two articles memorialize Dr. Taylor, highlighting his work and what he was like as a colleague and person. Also have a look at a monograph containing speeches delivered at his funeral by more than a dozen luminaries who were instrumental in advancing progressive management https://www.google.com/books/edition/Frederick_Winslow_Taylor/hdcpAAAAYAAJ

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The Journal of the Efficiency Society

Appreciations of

Frederic Winslow Taylor

by

Joseph French Johnson
H. S. Person
H. K. Hathaway
Lee Galloway
Harrington Emerson

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Published exclusively for the membership

April 1915

The Journal of the Efficiency Society

Publication Office, 41 Park Row, New York

Vol. 4 APRIL, 1915 No. 4

Foreword

THIS is the first issue of the Journal of the Efficiency Society in the new form. The number is devoted principally to the appreciations of the life and work of Frederic Winslow Taylor, the father of scientific management. It has also been necessary to publish the prospectus of the Society so that new members may have a better understanding of the aim and purpose of the movement. The succeeding numbers of the Journal will furnish a well-balanced table of contents covering the many interests and activities of the Efficiency Society.

We are arranging for a short series of articles on scientific management of the Church.

We have asked the Life Extension Institute for several papers on physical efficiency. These papers are to discuss the conservation of health from the point of view of the business man.

We are planning to have short, pithy articles each month on such topics as Scientific Management, Personal Efficiency, Office Efficiency, Welfare, Distribution, Production, Accounting, Time Study, Fatigue, Standardization, Organization and Management. These papers are not to be reprints of speeches, but practical "tell how" talks from men who are actually conducting efficiency methods in their shops and factories. The body of the magazine will be given over to these scientific discussions of methods.

While the Journal will be kept a scientific periodical for a scientific society, it will try to reach out to the young men in business who have not identified themselves with the efficiency movement. The Journal will expect the active coöperation of members of the Society in this work.

Mr. Taylor as I Knew Him

By H. K. Hathaway

FREDERIC WINSLOW TAYLOR, a great American, a great engineer, a leader in the forward march of civilization, has passed away. Through his untimely death the world has suffered a great loss, but he has left behind him a priceless heritage to mankind.

His attainments as an engineer are known in every corner of the world into which civilization has penetrated. His writings have been translated into virtually every language; and from every section of our own land, from every country of Europe, and even from far-away Japan, learned men and students came to him for guidance.

Among his admirers and friends were numbered those from every rank of society; his passing is a source of sorrow to men in the humblest walks of life as well as to those who through merit have attained the topmost ranks. Mechanics, laborers, scientists, and statesmen were proud to possess his friendship, as he was to possess theirs.

His attainments as an inventor and an engineer alone were enough to make him famous; by his invention of high-speed steel and the process of its treatment, enabling the cutting of metals at five times the speed before possible, he gave to the engineering world a boon of untold value. For this he will be long remembered and praised by those engaged in the industries which this great discovery helped. This invention, so simple in its nature, yet of such importance as to revolutionize an industry, was no chance discovery, but was an outcome of his never-ceasing search after truth.

His experiments on the use of leather belting completely superseded all previous conceptions, and the resulting laws came to be regarded as the authority. Such work as has since been done in this field has served only to emphasize the soundness of his conclusions, which the later experiments of others simply amplify and bear out.

Mankind will for all time be indebted to him for having shown the way to the ultimate attainment of those things which make for greater happiness. He was the first to expound the doctrine that management is a science as true and exact as chemistry. He was the first to show the path by which industrial peace may be reached, and that by bringing to bear the light of truth upon the gloom of ignorance in which industry had been shrouded the mutual distrust, deceit, and hatred that had grown up between employer and employee must be dissipated. He made the employer assume responsibilities which he had never dreamed of, and made the square deal a necessary part of management.

Strong, resourceful, and patient, difficulty and opposition only spurred him on to greater effort; and it is to the quality for which he was criticized most frequently—that of unwavering adherence to the principles which he believed to be right—that today the industrial world owes the science of management. During his early work he received little sympathy from workmen, and less from employers. All through life he might have made his own path smoother had he been willing to compromise with his opponents, yielding here and there to public sentiment and current opinion. Even at times ridiculed and always harassed, not only by those who could not see far enough ahead to understand and appreciate, or whose selfish interests did not accord with his ideas, but by those from whom he should have received sympathetic support, yet he kept courageously onward, undaunted and undismayed. So great was the opposition he encountered that at a certain stage of his career he was unable to find an employer sufficiently hardy to permit the working out of the Taylor theories in his plant; but it is a consoling thought that before his untimely death he was accorded in a large measure that recognition to which his work and character entitled him.

My own association with Mr. Taylor dates back to 1902, at which time the Taylor system was being installed under the direction of Mr. Carl G. Barth in the works of the Link-Belt Company, where I was assigned by Mr. Barth to looking after certain features of the system's development. I can well remember my first meeting with Mr. Taylor and the profound impression that his personality made upon me. Some years previous, while an apprentice at the Midvale Steel Works, I first heard of Mr. Taylor, who had been away from Midvale for a number of years but whose spirit had been so thoroughly infused into the organization that its effect was still quite apparent. Mr. Taylor's work at Midvale gave that company an impetus which it has never lost.

During the Spanish War, while acting as an inspector on Government work in a plant in northern New York State, the manager of that works, Mr. D. W. Payne, himself a pioneer in the field of engineering, presented me with a copy of Mr. Taylor's paper on the "Differential Piece Rate," which interested me greatly, and which must have made a far greater impression upon me than I realized at the time, as a few years later when I had become a foreman I found myself using the principles of elementary time study in making estimates of the time work should take and fondly imagining that I was doing something original.

A little later on I became superintendent of the shop in which I had served as an inspector, and a copy of the paper on "Shop Management," presented before the A. S. M. E. by Mr. Taylor, came into my hands. I well remember sitting up night after night with the manager of the company studying this paper. How ridiculous our efforts to apply the things which Mr. Taylor advocated now seem! Later I found, after having had the privilege of working and studying under Mr. Barth, that we had misunderstood more of Mr. Taylor's writings than we had understood.

During those years before I met Mr. Taylor I had come to regard him as being almost a demigod in the field of engineering and management, and to my utter amazement when I met him I found him to be a kindly and sympathetic man who evidently did not regard himself as being in the slightest degree better than the rank and file, and who did not appreciate himself nearly so much as he was appreciated by others. He had a faculty of placing himself on a common level with those with whom he came in contact, or rather of raising them up to his own level. The effect of this was that at times I found myself regarding him as being a quite ordinary individual and losing sight of those attainments for which he was even then celebrated. From this condition of mind I was on more than one occasion startled into quite a different point of view by his displaying a profound knowledge concerning some subject or branch of engineering that I had never suspected in the slightest degree. I remember now my surprise at learning that Mr. Taylor was regarded as an authority on concrete work.

Looking back upon my first responsible work in applying the Taylor system, I have a vivid picture of the disheartening and discouraging difficulties which I encountered, and I greatly fear that without the sympathetic support which I received from Mr. Taylor at that time I should never have had the strength to carry the work through. During this period I was amazed to find how often Mr. Taylor was right in matters where the judgment of others as well as my own was to the contrary. I learned that by following absolutely his advice and instruction I could confidently count upon the successful outcome of an undertaking.

Those of us who have had the great good fortune to regard him as master and as friend, and who have been associated with him in the carrying on of his work, will all feel imbued with a sense of the great responsibility which his passing lays upon us, and will be spurred on to greater effort and inspired by his example so to carry on our work and so to lead our lives as to reflect credit upon his memory and the movement which he regarded in the light of a sacred mission.

"Habit is habit, and not to be flung out of the window by any man, but coaxed down stairs a step at a time."—Mark Twain

As a Seeker of Truth

By H. S. Person

Director of the Amos Tuck School, Dartmouth College

INVARIABLY when I have thought of Mr. Taylor and attempted to value his services to mankind, an impelling desire to compare him with Darwin has seized me. I am conscious of the bias resulting from personal acquaintance and of the lack of historical perspective, and would not presume to push a comparison too far. Mr. Taylor's profession was that of a seeker after truth. His epoch-making discovery of a new tool steel, his greater discovery of a body of consistent principles of organization and management, his hundred or more minor discoveries recorded in the patent office, all were but incidental to his profession.

His accuracy in observation, infinite patience, and capacity for analysis were manifested in the twenty-six years of careful experiment before he considered the results worthy of announcement. His constructive imagination was manifest in the vision he had of the benefit to industrial society of the *proper* and *not perverted* application of his principles of management; and the intensity of his conviction was declared in his resolve to dedicate himself to the inspiration of a group of young men who should succeed him as leaders in a great work. As a man he was modest, friendly, lovable, just, and the embodiment of practical idealism. He has laid the foundation of a great and continuing city wherein many men and women may live, and wherein work may be but a phase of living.

"The dreams of those who faithfully labor are the only ones that ever come true."—Dick Sand

Mr. Taylor's Real Contribution

By Joseph French Johnson
Dean of the School of Commerce, Accounts and Finance
New York University

FREDERIC W. TAYLOR is known to the industrial world as the father of scientific management. The scientist will remember him as the inventor of epoch-making improvements in machinery to increase the cutting efficiency of tool steel. The public at large will identify him with his heroic discipleship of the religion of efficient working and living.

As a schoolmaster, as a working partner of boys and men who are being directly prepared to go out into Mr. Taylor's great world of shop and factory, I have come to look upon his life and work from a very personal viewpoint. I have always liked to think of Frederic Taylor as the first man to show us how to take the tremendous machines and overwhelming routines of the later nineteenth century and put them in their proper relation to life. In that first stupendous era of the machine it seemed to some that there was grave danger that the mechanical power might subordinate the human welfare.

I can well remember my first scrutiny of Mr. Taylor's working philosophy. My thought was that here was another movement to force human procedure into mechanical paths. But it did not take me long to realize that at last we had found the man the industrial world had been waiting for. Here was the genius to show us that if work were done according to scientific methods, if machines and routines were really scientifically conducted, they would automatically create, for man, time and opportunity for the pursuit of those "durable satisfactions" of life for which men originally fashioned tools of stone and bronze.

It will be impossible for this generation to appreciate Mr. Taylor's work. At best we can only recognize the first stirring of revolutionary forces in the evolution of man toward the mastery of his hand and mind.

Mr. Taylor as an Economist

WA By Lee Galloway
Professor of Commerce and Industry, New York University

TAYLOR SYSTEM" and "scientific management" appear to have become permanent additions to the vocabulary of the economist who would speak of the industrial development and the organization of business enterprise of this century. Yet so far as Mr. Taylor was concerned, neither of these terms received his entire approval. He objected to the first because it did not express enough, and to the second because it suggested too much. Persons who appealed to Mr. Taylor to describe his system were always told that he had no system, meaning of course no cut-and-dried formulas of filing letters, keeping accounts, etc. Furthermore, he could never see why the public should connect his name to a system which, as he often said, was simply applied common sense. As for scientific management, Mr. Taylor only accepted this term to express the movement for better business organization and greater production efficiency because it seemed to lie between this and the word "efficiency"; of the two, he chose the former. "Yet," as he told me once, "what a pompous word to designate so simple a process as (1) finding out what has been done, (2) what is being done, and (3) what should be done in a factory!"

This last phrase, "in a factory," is resonant with meaning in interpreting Mr. Taylor's point of view as an economist; for although he saw the applications which could be made of his principles in other directions, he seldom tried to defend or to illustrate them in other terms than those of his own experience, and this was largely confined to industrial and engineering firms. It is not surprising, therefore, to find little in Mr. Taylor's writings or speeches which bears upon anything outside of the field of production. Here he did a big inductive work, and he stands out in bold contrast, both in methods and emphasis, to the academic professors who have found more play for their imaginations in the field of distribution. Mr. Taylor spoke of production in terms of tools and men and material. Academic professors prefer productivity theories and abstractions based on static conditions. Mr. Taylor was dynamic in life and thought.

He was always fond of telling how he began his studies in scientific management. As a day laborer, by using a little thought he saw that savings could be made for himself as an individual. When he became foreman he saw that these same common-sense methods could be used to increase the output of his department. As a manager, he rounded out these ideas into a system of "functional control" with the purpose of increasing the profits of the firm. Even to the very last he declared that no scheme of management was worth a continental if it didn't pay the proprietors a fair return upon the money invested.

But by this time Mr. Taylor had moved a long way from his original point of view. And it was this broader outlook which made him so impatient with those who insisted upon speaking of his methods as the "Taylor system." Before he died, Mr. Taylor saw that more efficient production only touched one-third of the closed circle of economic life. There were problems of distribution and consumption which his scheme did not embrace. However, he did not leave these fields untouched, and in his purely practical way he attempted to demonstrate inductively that a workingman should be given advances in wages according to a predetermined scale of increases, since it affected his consumption. He proved to his own satisfaction that certain classes of laborer only degenerated when their wages were increased suddenly and out of proportion to their accustomed standard of living.

In the field of economic distribution he did not get much farther with his economic doctrine than the proposition that the proprietor could not expect to compete successfully nor to sustain his accustomed profits unless the losses due to bad organization and poor management were corrected, and that the laborers need not look for any substantial gain in their income if they persisted in the trade-union doctrine of restricting output.

To trace the growth of Mr. Taylor's economic ideas from the time he began as a day laborer to the time he became the recognized leader of a great social movement would disclose for us a general tendency found in all business men who take the trouble to ask themselves, What is the meaning and purpose of all this work and worry over business? Mr. Taylor at first looked at economics in the light of a business man seeking bigger personal income, but as he gained a broader vision and saw that no real progress could be made without the coöperation of the laborer and the public, he discovered that the true purpose of industrial enterprise rests on the same basis as all human activity. He saw that functional and specialized management could not be explained satisfactorily in terms of more product alone. Society must be taken into account, and this change of view also makes a change of attitude. When Mr. Taylor saw scientific management lessening the hours, relieving the burdens and drudgeries, and raising the standard of living of the workingman, then he began to feel the enthusiasm known only to those who put social service above private gain. The man of science became a great industrial evangelist. No man ever met F. W. Taylor during the last few years of his life without feeling that he had come in contact with a great and sincere man—a man with a vision.

The "Taylor system" had grown into an industrial program and "scientific management" had become a substitute for trade unionism. Mr. Taylor is entitled to be known as the greatest of those nonacademic professors through whom the business world is giving some real meaning to our political economy.

"Unless a man undertakes to do more than he possibly can do, he will never do all that he can."—Henry Drummond

As an Analytical Investigator

By Harrington Emerson

IN Mr. Frederic Winslow Taylor I found the initiative and energy of the American, the imagination and logic of the French in whose schools he was partly educated, the painstaking scientific investigations of the Germans, and the dogged persistence of the English. No wonder that he made one of the biggest marks on the face of the modern world!

Mr. Taylor was known the world over for his epoch-making work in high-speed tools for cutting metals. In America he was additionally known as the father of scientific management in machine-shop practice. In French the word for steel shaving or chip is *limaille* (literally, a filing), and we have scarcely to go back more than one hundred years to find that filings were all the metal that could be removed, filing weighing a few ounces an hour. Advances were gradually made, superior qualities of steel were tempered so as to cut metals, and even as late as 1900 twelve to twenty pounds an hour weight of chips was considered good machine-shop practice. Owing to Mr. Taylor's researches, inside of a few years twelve hundred to two thousand pounds an hour were possible. It is little to say that the ability of man machine has been increased tenfold. Mr. Taylor's method was to watch, to observe, to pick out the exceptional, to find the reasons for the exceptional, and, if the exceptional was bad, find a remedy; if the exceptional was good, make it permanent.

A boy of fourteen, I once found an English knife rusted beyond recognition. With excess of honesty I carried it to the teacher in the German school. He looked at it contemptuously, took it and hurled it far away as useless. I hunted it up and this time felt free to keep it. I soaked it in oil, cleaned it, sharpened it; it proved to be the best steel I ever possessed. With it I made successfully my first attempts at shaving, but also I used it to carve cocoanut shells. I held onto it, fearing I could never find again another blade so good. It never occurred to me that all blades might be made as good as this one.

Before Mr. Taylor's time, rarely superior tools would occasionally be found, and they were appropriated and carried around as a reason for employment. It never occurred to any of these tool sharps that all tools might be made as good. When such a piece of exceptional steel came to Mr. Taylor's attention, he was not content to thank Allah and blindly wait for other streaks of good luck.

Mr. Taylor started out to find why and then consciously to produce the superior quality. He found the secret partly in the alloys used but chiefly in heat treatment, and he explored and found reward in heat regions hitherto considered taboo. The rare good pieces of steel that had previously occurred were those that had been negligently overheated and been suddenly cooled. Mr. Taylor discovered that he could make all pieces equally good, and he discovered this fact because it was the habit of his mind to know and to control.

By submitting all the tools, all the machines, all the materials worked on, all the workers, to critical analysis, it was revealed that enormous and preventable wastes were occurring, and after they were revealed the next step was to eliminate them, which he did with influential and uncompromising thoroughness. Nothing was too big to defer attempt, nothing too little to be overlooked.

The world always needs some spectacular demonstration. Mr. Taylor had been preaching to deaf ears until he began to carve pieces of steel as big almost as broomsticks from the bar, but then all the world sat up and took notice, its eyes were opened, and all around, everywhere, similar wastes were discovered, so that Mr. Taylor's methods were multiplied many fold, not only by his disciples but by those wide-awake outside of his circle. He gave an immense stimulus to analytical investigation of American industrial methods and plans. It is fortunate that his researches and industrial skill early brought him wealth and leisure, still further to push his investigations and to promulgate the theories of scientific management.

"God bless the man with a scheme, an idea! It may be visionary, but in any case it certainly must be better than to be resting all the time."—Leslie M. Shaw

The Efficiency Movement in American Cities

By Benjamin P. DeWitt
Author of "The Progressive Movement"*

IN no other department of government in the United States has there been such marked improvement in the last twenty-five years as there has been in the administration of cities. This improvement in municipal government has been partly due to the tendency to give to cities greater freedom in the exercise of their functions under constitutional home-rule provisions. The home-rule movement which has brought constitutional home rule to cities in twelve states has tended to diminish the interference of state legislatures with city affairs and thus to give cities the opportunity to adopt needed reforms. The improvement in municipal government has been partly due also to the so-called charter movement which has resulted in the adoption by over three hundred cities of the commission form of government and in the adoption by a score or more of an even more advanced type of government known as the city-manager plan. These new forms of city government, eliminating as they do the cumbersome checks and balances of the former types of government, make it possible to place city administration on a sound businesslike basis.

There has grown up in recent years, along with the home-rule movement and the charter movement and as a kind of supplement to them in the work of municipal regeneration, a movement commonly known as the efficiency movement. The movement is incapable of any concise definition, and in fact of any definition at all, because it is itself a protest against

* The Macmillan Company

Efficiency Society Journal, Volume 4, No. 8, November 1915, p. 43-46

understand, is his capacity for dreaming. I believe of all the dreamers of the ages, that here in America we are the greatest. (Applause.)

For we have dared to dream the great dream of democracy,—the dream which joins all mankind into a social and political system, built upon the notion of brotherhood,—not of special privilege;—and as a part of that great dream, some of us have dreamed of the application of democracy even to the prisons, and we are trying to materialize that beautiful dream into reality, and we want you to help us. (Protracted applause.)

THOMAS MOTT OSBORNE.

The foregoing address was read and approved by Dr. E. Stagg Whitin of Columbia University, Executive Chairman of the National Committee on Prisons and Prison Labor, who has been closely associated with prison reform in New York State, and has co-operated with Warden Osborne in his work at Sing Sing. Dr. Whitin is Secretary and Treasurer of the New York State Commission on Prison Reform, and has served as an expert in work for the New York City Department of Correction, and the Wisconsin State board of Public Affairs. It is interesting to note at this time that Columbia University is giving a course covering the work done at Sing Sing Prison, as well as other penitentiaries in and about New York City, under the direction of Dr. Whitin.

Frederick W. Taylor Memorial Meeting.

The Society to Promote the Science of Management held a meeting in Philadephia October 22nd and 23rd, that took the form of a memorial to the late Frederick W. Taylor, the pioneer in Scientific Management.

It is worthy of note that every speaker gave emphasis to the personal relationship of employer and employee as fundamental to successful application of Scientific Methods of industry.

Among the speakers was Louis D. Brandeis, noted lawyer and economist.

"It is greatly to be regretted," said Mr. Brandeis, "that labor, the class which Mr. Taylor strove to benefit by his systems of scientific management, should be the one to appreciate him the least.

"It was the ambition of this great man to devise methods whereby labor should be enabled to increase its productiveness with less waste, not only of materials and time, but of energy. It was his hope that labor would eventually be made so attractive, through shortened hours and direct effort, that work would become the greatest pleasure of life.

"Mr. Taylor was a man years before his time. We see industry today striving to reach the level which he established a generation ago. And it will be another generation before the prejudices, born of misunderstanding, give way to a deserved appreciation by organized labor of the real motives of this man."

Mr. Brandeis' eulogy followed an address by Mayor Blankenburg, who paid a glowing tribute to Mr. Taylor as one of the great men of the present day who brought fame to Philadelphia.

"Frederick Winslow Taylor," he said, "was to me a paradox. On one hand we find his rugged intellect blazing its way through layer after layer of conventions formed by prejudice, tradition and ignorance until he became recognized as the world's greatest industrial leader, and on the other hand his gentle-mannered, generous and courtly nature.

"We of Philadelphia who have seen him come and go as our friend and neighbor only dimly comprehend that the world has been listening to his teachings for years as one of the master minds of his time. Today his fellow-townsmen, as the entire world is coming to be, are alive to his principles and methods.

"Mr. Taylor had a keen desire to help everyone to larger intellectual pursuits. This was one of the ends he hoped to attain in struggling against the waste of energy and time, which accompany not only industrial labors, but those of everyday life.

"The essence of his doctrine was 'To better the conditions of the laboring classes, and to increase the general pleasure in work.'

He did not get tired of pleading with both sides. The war-torn world has lost a great leader in Mr. Taylor at a time when it needed him most."

Other speakers were Provost Smith, Carl G. Barth, James M. Dodge, Henry L. Gantt, Harlow S. Person, and Sanford E. Thompson.

Many original records of Mr. Taylor's work were on exhibition at "Boxly," his beautiful home in Chestnut Hill. There also the members and guests of the society were interested to learn from Mr. Harold Van Du Zee of Mr. Taylor's application of his methods to the study and experiments on the growth of grasses. Admiral Goodrich, formerly Commandant of the Brooklyn Navy Yard, gave full credit to Mr. Taylor for many of the improvements in the operation of that yard, he having freely given much of his time and thought to that work. His attitude is perhaps best expressed by the opening paragraph in his original notes for a lecture on Success, where he says, "The best road to success lies not only in doing the thing that needs to be done, but in adding something nice that is not required and is unexpected."

The paper by Mr. Richard A. Feiss, Manager of the Clothcraft Shops, on "Personal Relationship as a Basis of Scientific Management," created much discussion at the Saturday evening meeting.

This paper ascribed the wonderful results secured by the author to the fundamental conception of the shops as a place to make men, the manufacture of high grade clothing being considered as a means to that end.

The fact that 28 per cent. of the floor area is given over to service to the employee indicates that Mr. Feiss believes and practices what he preaches.

With 40 per cent. increase in output, 33 1-3 per cent. increase in the average weekly wage, 10 per cent. reduction in cost and a change from 150 per cent. to 33 per cent. in the floating portion of the payroll, it is hard to question the fundamental soundness of the author's argument. Mr. Noyes, manager of the German American Button Co., and Mr. Carl G. Barth, consulting engineer, each took exception to the phraseology in the paper which inferred that the proper relationship was the BASIS of Scientific Management. While each gave full recognition to it as an element, and an important one, they looked on this as the goal rather than the basis. As the latter expressed it, the basis is hard, grinding, digging work, unearthing and classifying facts and standardizing equipments and conditions.

Reported by W. HERMAN GREUL.

Monthly Meeting, New York.

The first regular monthly meeting of the season was held at the Merchants' Association rooms, Woolworth Building, October 21st. The topic was Preparedness in Business, Commerce and Finance, and the speakers Mr. John Calder, President of the Manufacturers' Equipment Company of Boston, and Mr. Arthur S. Marsh, editor of the Economic World, New York. Mr. H. M. Sweatland, President of the United Publishers' Corporation, was chairman.

Mr. Calder's address was a study of the scientific basis of the efficiency of preparedness in business. His paper will later be printed in full, but a few keynote paragraphs should be quoted here. He said:

The new element in preparedness is the use of the "scientific method" in attacking problems. The scientific method, however, is not any particular system nor is it a tool that you can keep handy on the shelf for occasional use only. . . It is essentially an attitude of the mind which influences our business conduct, plans and decisions, and causes us habitually to observe, describe, analyze and classify with accuracy the phenomena which recur in our daily round. The result is that we apply these analyses and experiences to regular later affairs and shape all our records so that they are interpretative and constructive. . .

The first element in business preparedness is to start right, trusting to no adventitious aid from capital or influence to attain that for which we have not laid secure foundations. . .

Linked in

Professor Bob Emiliani

Please visit bobemiliani.com

Final Post (4/4). What have we learned from my recent postings on management history? We have learned, first and foremost, to respect and appreciate our past innovators in management thinking and practice; that Frederick Winslow Taylor was not the evil man people think he was; that Scientific Management was not an evil system driving and dehumanizing workers; that that people's understanding of Taylor and of Scientific Management are almost entirely the opposite of the facts; that the history of Scientific Management is uncomfortably similar to TPS and Lean management with continuing difficulties to gain acceptance among CEOs in 2021 -- the causes for which were not fully understood until a just few years ago. If you want to learn why please see https://bobemiliani.com/wonder-no-more/

Learning From Management History

Over the past several days, I have posted a carefully curated sample of articles and links to seminal works in Scientific Management written by industry leaders and management consultants in the then new field of management science. These are primary sources dating from ca. 1903-1922. • **Why was it important to do this?** Four reasons: 1) Provide facts to correct rampant misinformation about Frederick Winslow Taylor, his colleagues, Scientific Management, its "installation" in companies, and the outcomes to company, managers, and workers. 2) Demonstrate to Lean community leaders and practitioners that TPS was built on the foundation laid by Scientific Management (which was global in its reach). 3) The problems we see today in efforts to advance progressive management are uncomfortably similar to those more than 100 years ago. 4) Most secondary and later interpretations of the work by Taylor *et al.* are unreliable, partially wrong, or completely wrong. • **It is often said that "Lean is all about learning."** Thus, the value of these primary sources is that you obtain information directly from people who developed the ideas and who did the practical work of improving management thinking and practice. It allows you to learn, without any filters, their assumptions, facts, intentions, methods, and outcomes – struggles, successes, failures, controversies, and so on. • **Flawed interpretations of Scientific Management abound, driven by many causes singly or in combination:** 1) Lack of understanding of business. 2) Lack of understanding of manufacturing. 3) Lack of understanding of the relationship between process and results. 4) Not understanding the problems that Scientific Management was seeking to solve in relation to varied business, worker, and social needs. 5) Unintentional misunderstanding. 5) Intentional misrepresentation driven by business or political interests. 6) Relying on what others say rather than putting in the effort to seek out primary sources of information. • **There are five lessons to learn:** 1) The importance of checking facts yourself, not blindly accepting what people say because they are or appear to be an authority. 2) Rising to the challenge of thinking for yourself. 3) Much of what happened 100+ years ago remains relevant today and is a source of improvement ideas. 4) Be open minded; learn from others 5) Learn from the past and improve. Then, maybe, Lean won't go the way of Scientific Management.

Learning From Management History

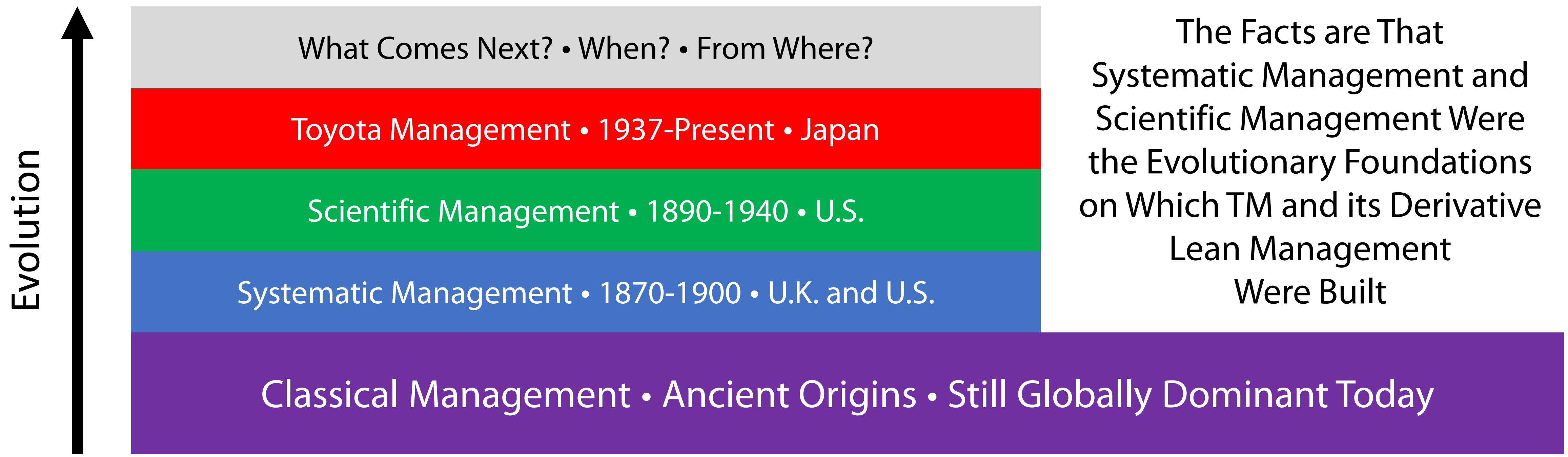
Hopefully, You No Longer Believe that Scientific Management is the Opposite of TMS or its Derivative, Lean Management

Opposites? No.

Scientific Management

Toyota Management and Lean Management

Evolution, Yes



The Facts are That Systematic Management and Scientific Management Were the Evolutionary Foundations on Which TM and its Derivative Lean Management Were Built

Learning From Management History

Next Time You Hear Someone Say Things Like…

In the lean movement, Frederick Taylor continues to cause us trouble 101 years after his passing. Fredrick Winslow Taylor was a con-man that peddled pseudoscience. The guy falsified his data. He should never be considered as "progressive." His work has led to the increasing dehumanization of workers. Taylor was neither a scientist or engineer. Taylor literally accomplished nothing but build a cult of personality. His methods have nothing to do with science. His theories are unfalsifiable. Nothing Taylor postulates corresponds with the actual modern scientific understanding of how human beings work effectively. His work proves that he had no fundamental understanding of either the scientific method or basic engineering principles. Super Taylorism is to blame for Lean's problems.

Ignore it or Fight Back with Facts from Primary Sources of Information

Addendum

Posts by Prof. Bob Emiliani on the
Subject of Scientific Management

Few More Interesting Things
Worth Including in this Compendium
of Scientific Management Papers

May and June 2021

Linked in

Professor Bob Emiliani

Please visit bobemiliani.com

A wonderful paper by Dr. Harlow S. Person explaining what Scientific Management is and is not. “Scientific Management is an attitude of mind rather than a physical thing. It is a body of principles rather than a mechanism… (1) Continuous and intensive investigation of facts. (2) Prediction, so far as it is possible , on the basis of the facts ascertained. (3) Precise control of materials and processes so as to make actual operation conform to the facts ascertained by investigation.”

THE HANDBOOK SERIES

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MODERN INDUSTRIAL MOVEMENTS

COMPILED AND EDITED BY
DANIEL BLOOMFIELD
AUTHOR OF "LABOR MAINTENANCE." EDITOR HANDBOOK "EMPLOYMENT MANAGEMENT," ASSOCIATE EDITOR "INDUSTRIAL RELATIONS."
BLOOMFIELD AND BLOOMFIELD, BOSTON, CONSULTANTS IN EMPLOYMENT MANAGEMENT AND INDUSTRIAL RELATIONS.

WITH AN INTRODUCTION BY
MEYER BLOOMFIELD
AUTHOR OF "LABOR AND COMPENSATION," "YOUTH, SCHOOL AND VOCATION," "MANAGEMENT AND MEN," ETC.
EDITOR, "INDUSTRIAL RELATIONS, BLOOMFIELD'S LABOR DIGEST."

THE H. W. WILSON COMPANY
NEW YORK CITY
1919

in lithographing establishments, in the manufacture of typewriters and optical instruments, in construction and engineering work, and in establishments not commonly regarded as business, and recently to some extent they have been introduced by the United States Government into the manufacturing departments of the Army and Navy.

SCIENTIFIC MANAGEMENT[1]

Basic Principles—Social and Industrial

What are the basic principles of Scientific Management, industrially and socially? Historically, Scientific Management was not worked out as the expression of any basic, industrial principles: that is to say, it did not originate in the mind of any man as a detailed and concrete expression of some body of principles in his mind. Mr. Taylor, a foreman over a group of working people, was concerned with the practical problem of making his foremanship successful, and worked out certain detailed methods of control, and made investigations related to the problem of control for a great many years. If he started with a basic principle at all, it was this: investigate thoroughly before you conclude what to do and how to do it. He investigated thoroughly, came to conclusions how to solve certain practical problems relating to the control of the operations of a shop, and then after going over these practical conclusions discerned that there were in them certain universal principles of management. These he presented in a paper before a body of engineers. But few of his auditors grasped their significance; one or two did, and these men in discussion said they were revolutionary, not only from the point of view of management, but also socially and industrially. Since then there has been a growing appreciation that Scientific Management represents new industrial and social as well as managerial principles.

The fundamental industrial and social principles are two:

I. It is a method of management which permits a greater satisfaction of human wants from a given quantity of material, capital and labor. It is a fundamental principle which is not

[1] By H. S. Person, Managing Director, The Taylor Society. From a lecture delivered before the Filene Coöperative Association, an organization of the employees of Wm. Filene's Sons Co., Boston, Mass., in its business course. Printed here by permission.

disputed, that the total income of all of us, in the form of wages, interest, rent and profits, is limited by the productivity of the combination of labor, machinery, raw materials, and so forth, at our disposal and we cannot have a larger income than can be derived from the best known technical methods of combining these. There is no way of increasing one's share of the total income except at the sacrifice of another party, or by making total production more efficient. Now Scientific Management means greater technical efficiency, and therefore greater total income, which will result in greater profits, higher wages, or a shorter working day, or in a combination of these, and in general in the satisfaction of more wants than we are now able to satisfy under present operating methods.

II. The second fundamental principle—I think it may surprise some of you—is the principle of democratization. There are a great many who conceive of Scientific Management, through its centralized control, as working against the democratization of the whole combination of working people. It means the reverse, I believe, for the following reason: It seeks exact information, which it does not conceal. It pools the information ascertained so that everybody can have it. It is recognized that it makes much more efficient and independent the average of ability. You can go into a Scientific Management plant and you will find that the Order of Work Clerk, the Production Clerk, those in immediate supervision of control of the processes, have nearly all been drawn from the ranks of working people. It discovers, records, and pools information in such a way as to make more efficient and much more productive the average ability, such as we all have; and as a result it makes it possible for industry to rely less on genius and on intuition. Another reason for its influence towards democracy is that it is conditioned upon co-operative good will.

There are two fundamental principles: (1) the industrial principle of greater satisfaction of human wants from a given amount of equipment and material; (2) the social principle of greater democratization in industry.

Plans and Policies

I interpret "Plans and Policies" to ask me what is the object of Scientific Management and what does it purpose to do in actual operation? First, I want to speak about the plans and purposes of Scientific Management as concerning productive processes; after that I want to say a word about the plans and policies as they concern the distribution of the income which results. Keep those two points separately in mind.

1. *Aims, plans, policies and methods as they concern productive processes.* As I analyze it there are three principal aims in it:

(1) Seeking of more precise information through investigation, experiment, etc.

(2) As great an amount of prediction of what is going to happen in business operation as is possible on the basis of the unusual amount of exact information acquired.

(3) Precise control of the processes of conducting the business by various functionalized people in such wise as to bring about as precisely as possible the predictions which have been made on the basis of the exact information required.

I think that is a somewhat new analysis of the aims of Scientific Management, but I believe it is absolutely sound.

(1) Seeking of more precise information. It is in the Scientific Management plant that investigation and experiment,—the establishing of an experiment room with adequate equipment under the direction of capable investigators, have been worked out. It is in connection with this investigation and experimentation that time study has come in. I cite it as a method of acquiring precise information. Time study simply means a method of acquiring exact information with respect to the time which it takes a person to do a certain thing, with certain definite equipment, under certain definite conditions. If you know that—the time it takes a person to do a definite thing, with definite equipment, under definite conditions—you have a piece of precise information which you can use in prediction if you receive an order to make something. There has been a great deal of abuse of time study, because it is one of those things of which it is easy to comprehend the possibilities; because it is easy to buy a stop watch; because it is easy to put over the bluff of using it properly. The stop watch has been used injuriously by unskilled persons. The scientific use of the stop watch is to take unit times. It has been applied to a good many varieties of work. Take brick laying, because that is a classical case of the application of time study as a method of scientific investigation. Brick laying has a great many variables, such as windows, corners, the nature of the

courses, etc. Now, Scientific Management investigators have worked out the time it takes an ordinary skilled brick layer to lay a single brick under each of every conceivable condition. They did not find out how long it takes to lay fifty feet of wall with all sorts of conditions; but how long it takes to lay one brick under any condition of bricklaying. Suppose a contractor receives an inquiry to bid on laying a wall. He receives the specifications and analyzes them: so many corners; so many windows; so many feet of plain wall between; so much face brick; so much filling; etc. By multiplying the number of bricks to be laid under each varying condition by the average time of laying one brick under each condition, he can compute readily an average over-all time for laying fifty feet of wall with all the specified conditions of windows, corners, etc. I give you that as an illustration of the extent to which this precise information is sought, and also as an illustration of the exact prediction possible in the light of precise information.

(2) Precise Prediction. If one by time study and other investigation has secured and filed information telling the time of performing a unit operation with certain tools and materials under certain conditions, then if an order comes in to do or make something which represents a combination of these unit operations, by a simple mathematical calculation it is possible to determine how long it will take to fill the order, what materials and tools must be provided, what conditions established, when work on each part should begin, when and how they should be assembled, etc. In other words, an accurate layout of work on the job becomes possible. In most plants layout is by guess. Guess involves waste. An accurate layout of separate jobs means accurate layout and dovetailing of all jobs, and economical and efficient operation of materials, equipment and labor; in other words, more precise control.

(3) Precise Control. This means that to each of a number of persons shall be assigned, with authority, the responsibility of maintaining one or more of the standard conditions on the basis of which the prediction or layout of a job is made. The principal standard conditions to be maintained are

(a) Standard materials. All materials purchased should conform to carefully-worked-out, detailed specifications. It is surprising, if this is not done, how great variations there may be in materials received, without violation of the terms of the purchase and grounds for rejection. Materials purchased by detailed specifications, however, should never vary, and should give always the same reaction to the application of the labor of foreman and workman.

(b) Standard storing and issuing of materials. Materials should be under the custody of a person who will issue them only at the time, to the workman, and in the quantity specified by the person who lays out the job. Thus is avoided that surprising, unintentional waste which results from permitting Tom, Dick and Harry to help themselves to material at their pleasure.

(c) Standard conditions under which work is performed. Someone to whom such responsibility has been assigned should relieve the workman of the necessity of maintaining the most favorable conditions of work. The most favorable conditions of work involve many elements: heat, light, availability of material, perfect conditions of machine, bench, tools, belting, etc.

(d) Standard methods of performing operations. This is the responsibility of the foreman and workman. When a job is to be performed, it should be performed by the workman according to the best known method determined by experiment, and nothing should detract the workman from that responsibility. His standard materials have been brought to him; the perfection of the conditions in which he is to work has been provided for; another has seen to it that his machine and tools are in perfect condition and ready; his responsibility is to perform the operation. And he, as well as the person who has laid out his job, should know how long it will take him to perform it, for every condition of operation is predetermined.

There are other elements of precise control which I might describe to you, but I feel that I have made clear the nature of it in describing control of materials, conditions and processes. Do you not see that much waste of material, labor, machine, time, etc., is impossible with such control?

Through what machinery are the three primary aims of Scientific Management (investigation, prediction, precise control) accomplished? This machinery is described in the words *functional organization.*

You have functional organization in this merchandising house, and you know what it is. It is carried out to an unusual degree in manufacturing plants by Scientific Management. First, there is functional organization in the large; planning is separated entirely from doing. Now, in an ordinary manufacturing plant an order is received to make something. That is sent down to the foreman with an order to "make twenty-five of these by the 25th of June." The foreman turns to the workman and says, "Start on these day after tomorrow." There your foreman has planned who is to do it; how long it will take; how it is to be done; and so on. Under Scientific Management, on the other hand, in a room called the planning room, where is kept on file all the information which has been gathered regarding all phases of operation, the planning is done. First, a list is made of the operations involved in filling this order, and of the materials and equipment required; second, an estimate is made of the time it takes to do each one of the operations with due allowance for uncertainties; third, a day is determined when work on the order is to start in order to meet the date of promised delivery. All planning of that sort is done, and proper orders are made out. On the proper date these orders are issued to the man who has charge of the material, telling him to send it to such and such a machine; and to the workman at that machine, telling him to start the work. Accompanying the order issued him is the analysis of the job and definite instructions for its performance. You know the story of the German General who made warfare scientific. The story is that he was awakened from his sleep and notified that war with France had been declared. He said "Pigeon-hole A" and went to sleep again. When he awoke, mobilization was on. He had filed in the pigeon-hole "A," ready for the emergency, precise directions for conducting it when it should come, and precise telegrams to commanders and officers. That is what planning in Scientific Management means.

I have been speaking about functional organization in the large—the separation of performing, planning and investigating. There is also functional organization in detail. The best illustration is any shop where working people are. In the ordinary manufacturing plant there is one foreman directing the work of the shop. He hires the workmen and discharges them; he tells them what to do; when to do it; how to set up the machine; he inspects results; and so on. Now under Scientific Management the way that would be handled is this: Suppose you have several shops in your plant, each with a foreman with all these responsibilities. One of these men is extra good at directing workmen how to do the work; another man is very good as what we call a disciplinarian,—he can talk tactfully with the workman who is not doing his work right, and straighten out the situation without causing friction; another one is excellent in the technical side of setting up machines. Now, you say to them that instead of each man having a room, and being responsible for everything pertaining to that room, each shall be responsible in all four shops for that in which he is particularly strong. One man, perhaps, will do nothing but instruct workmen in all four rooms; another will be disciplinarian; another will do nothing but hiring, because he is strong in that; etc. This is functionalization in detail.

I have been talking concerning plans and policies as regards productive processes. A word about plans and policies as concerns sharing in the rewards.

II. *Aims, plans, policies and methods as they concern the distribution of the total income which results.* The particular productive processes which I have described to you produce more with a given combination of materials, equipment and labor than any other productive processes that have been worked out. What is the theory of Scientific Management with regard to the sharing in this extra income? Now Scientific Management is not tied up to any theory of sharing at all. That should be clearly kept in mind. You can have Scientific Management under a regime in which the proprietor takes every bit of the extra income. You can have Scientific Management under a regime in which the workmen get all of it. There is no definite relation between your theory of distributing your income and this technique of management. You can have Scientific Management under the present prevailing system of what we know as individual ownership and control; you can have it under that possible and, as some people believe, probable form of control in which through co-operation the working people own the business and hire a manager. There is no fixed relation between the philosophy of management and of distribution. Scientific Management can be applied at any stage of our industrial progress, under the particular philosophy of ownership and distribution then prevailing. Under the prevailing theory of individual ownership and management, it would be possible for the surplus of income of Scientific Management all to go to the proprietor. As a historical fact it does not. The managers have always shared this increased productivity with the working people by increasing wages, and with the consumer by lowering prices. This is how it works. I am saving on costs.

I am convinced that the saving will be permanent. To get more trade I lower my selling price slightly. I lower it to the extent necessary to get the trade, and increase my business to the extent I want. Thereby I am sharing part of this increased income with the consumer in lower prices. Furthermore, this policy of precise investigation, precise prediction, and precise control of operations so as to bring about what is predicted, is based on, and conducted on, a spirit of goodwill and co-operation of all workers concerned, and therefore, historically, without reference to any theory of distributing social income, simply as a method to secure the goodwill of everybody concerned, the management has in every case increased wages voluntarily. This precise control requires that everybody shall agree to assume responsibility for doing the particular thing assigned to him or her without fail. It never will work without the spirit of co-operative assumption of responsibility, and one of the first moves of the managers who put in this type of management, whose whole bringing up would be to take all the profit they can get as long as they are paying running wages, is to increase wages very considerably in order to get those things absolutely essential to precise control—goodwill and co-operation. If Scientific Management is working successfully in any plant, it is proof that there is fine spirit there, because it would fail without that spirit. This increasing of wages and salaries by owners because they do so as a means of securing the goodwill essential to precise control, has developed with discussion and with the enlightenment and broadmindedness that has come from discussion, so that the dominant motive today as contrasted with ten years ago is to share the increased profits as a matter of social justice, a very radical modification in motive resulting from largeness of mind. That is one of the effects of this philosophy of management.

Range of Application

In the first place Scientific Management has been applied almost entirely in manufacturing establishments, for the very obvious reason that manufacturing operations are capable of much more precise control than merchandising operations, and the operations of auxiliary businesses. Second, the demand for the services of the men capable of applying Scientific Management in these manufacturing industries has been so great as to absorb nearly all of their time. They have not had deliberately to pick out the hardest industries. A number of applications were first worked out in machine shops, and most illustrations are naturally from that industry. As a matter of fact, without any literature resulting from it, the philosophy of Scientific Management has been applied to a great variety of industries, represented by such a variety as iron and steel, books and binding, textiles, clothing, building construction, and even banking.

It is very interesting to know that the exponents of Scientific Management are now educating the public with respect to something they have known but which the public has not—that Scientific Management is not a rigid thing. It is not the same here and there, but must be different in every kind of plant, because of different local conditions; and in different types of industry different features of the mechanics and principles must be emphasized. They have worked out three principal types of industries:

1 Industries with continuous processes; uniform product with uniform specifications; single purpose machines; uniform operations; simple routing. Illustrated by the manufacture of paper and pulp.

2 Industries with non-continuous processes; uniform product with varying specifications; single purpose machines; uniform operations; simple routing. Illustrated by the manufacture of envelopes, books, and handkerchiefs.

3 Industries with non-continuous processes; varying products with varying specifications; multiple purpose machines; varying operations; complex routing. Illustrated by machine shops.

Effect on Production and Distribution.

Where real Scientific Management has been applied there is observable the following effect on productive and distributive processes,—all resulting from precise control made possible by intensive continuous investigation:

1 Greater efficiency of the individual workman, without greater expenditure of physical and nervous energy.

2 Greater efficiency of equipment.

3 Greater efficiency of material.

4 Resultant lower costs, greater profits, higher wages, and in many instances lower selling prices.
5 Greater precision in deliveries.

Effect on the Industrial Workman

I do not know of any phase of the subject about which there are more incorrect statements, based either on prejudice or ignorance, than the influence on the workman. There is only one safe way to know what the facts are: that is to go and visit real Scientific Management plants. You cannot rely on printed literature. These misleading statements are in many instances deliberate falsehoods, but on the whole, I believe, rather a misrepresentation of facts because of the bias of some industrial philosophy. I am going to present the following generalizations based on personal observation and inquiry, concerning the effects of Scientific Management on the individual workman.

First: The health of working people is not impaired, but on the other hand is usually improved by the better general working conditions established.

Second: There is always increased wage. In some cases it is very considerable—twenty-five or thirty per cent. Where it is not as considerable as that it takes the other form of shorter hours. In many cases it is a combination of increased wage and shorter hours.

Third: The attitude of mind and spirit of the working people in the plants I have inspected is conspicuously better than the attitude of mind and spirit I have seen under other types of management. Scientific Management to survive, depends upon that thing. The idea of precise control is impossible without it.

Fourth: Contrary to your first impressions, based upon misinformation and upon a misconception of the nature of standardization, Scientific Management offers a greater opportunity for the promotion of working people freely from one position to another.

Fifth: According to my observations, as a result of the spirit in the plant, and increased wage, and sometimes shorter hours, the standard of living of the working people is more satisfactory than that which accompanies ordinary conditions of management. This results not merely from the ability to enjoy more things; it arises also from a different attitude toward things and toward each other.

Finally: I think I see in it the opportunity for regularizing employment. One of the serious social problems confronting us is irregularity in employment. I do not see any possibility of regularization without precise knowledge of facts, ability to predict, and precise control; and one plant—a Scientific Management plant—has had the nerve to tackle the problem of regularizing employment by deliberately not making all it can in full season and holding production over to the dull season. It feels confident of what it is doing, because of precise knowledge and precise control of its operations.

These effects of Scientific Management on the individual workman, reflected in the home and multiplied by the number of homes, represents its effect on the community. Higher wages make possible the enjoyment by the community of a greater number of things of life, and shorter hours of work afford the time for this enjoyment. The spirit of "the best way" and of "the reason why," developed in the shop, is carried into home and community life, as is also that broadmindedness and tolerance which develops with co-operative activity.

Modifications of Scientific Management

Just as there were fake physicians and shyster lawyers when medicine and law were young professions, so we have at present fake organizing engineers. They do as much damage to the plants by which they are engaged as the fake physician did to the health of his patient. I wish it were possible by some sort of prescription to abolish these fake and damaging self-styled organizing engineers. I do not see how that can be done. We must rely upon the education of the employer, his refusal to employ them, and their ultimate extinction by starvation. The point I have just made does not concern the topic "Modification of Scientific Management," but it does concern the modification of the circumstances in which real Scientific Management finds itself.

I would not suggest any modification of Scientific Management, for Scientific Management is an attitude of mind rather than a physical thing. It is a body of principles rather than a mechanism. Who would suggest a modification of the three fundamental principles I have attempted to bring out? (1)

Continuous and intensive investigation of facts. (2) Prediction, so far as it is possible, on the basis of the facts ascertained. (3) Precise control of materials and processes so as to make actual operation conform to the facts ascertained by investigation. I cannot think of three more satisfactory universal principles.

Their honest application involves the idea that there shall be a strict regard for the exact facts surrounding the conditions of any particular application of the principles of Scientific Management. The consequence of that is that the mechanism and external manifestations of Scientific Management must in any particular plant be more or less different from those in any other particular plant. In that unreal sense of the word "modification," we may say then that there must be a modification of the mechanism of Scientific Management with every application of its principles; but its principles remain the same, for it is a corollary of the principles enumerated above that accurate investigation of every separate plant will find a separate combination of facts that will require separate application of the principles.

RELATION OF SCIENTIFIC MANAGEMENT TO LABOR[1]

Until recently the problem of the relation of scientific management to organized labor had, as one of its practitioners said, "merely an academic interest." There was no attempt to develop the system in closed shops. In other shops no one inquired or knew whether there were union men or not; nor, if there were such, did they offer any objection to the development of scientific management. About 1910 however, or even earlier, in some of the railroad brotherhoods, the attention of professional labor leaders was directed toward the possibilities of this type of management. Their reaction was unfavorable; but except for the refusal of locomotive engineers to accept the bonus proposals on the Santa Fe railroad, no opportunity to express their organized opposition to scientific management presented itself until that system was extended to a detail of the Watertown Arsenal, which is part of a highly unionized branch of the government service. This was seized upon by

[1] By C. Bertrand Thompson. From an article in Quarterly Journal of Economics. 30:330-40. February, 1916.

LinkedIn

Professor Bob Emiliani
Please visit bobemiliani.com

Scientific Management was globally influential in the first half of the 20th century. Taylor, Gantt, the Gilbreths, Cooke, Thompson, Hathaway, etc., visited many countries to give talks at meetings and conferences. Learn more about Yoichi Ueno here https://journals.aom.org/doi/pdf/10.5465/ambpp.1981.4976637 and here https://www.jstor.org/stable/313124?seq=1

BULLETIN OF THE TAYLOR SOCIETY

August, 1925

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The Taylor Society Abroad

Organization of Japanese Branch

ONE of the most significant developments of this year is the increasing interest in scientific management in countries other than the United States. This has been reflected in increasing interest in the Society abroad and most recently by steps taken by the membership in other countries and by the Board of Directors, leading to the organization of branches abroad.

The Japanese Branch of the Taylor Society is the first to effect complete organization. By letter ballot June 15 the Japanese members elected officers: Yoichi Uyeno, Managing Director, and Shinzo Uno and Goro Togano, Directors; and established the office of the branch in the Institute of Industrial Efficiency, Tokyo. There are at present fourteen members in Japan.

It is expected that this branch will do important and constructive work for Japanese industry and will eventually come to have great influence for better management.

Meanwhile members in England have been conferring with reference to the formation of a British Branch, and there is every indication that the organization of this important branch will be consummated by the end of the year.

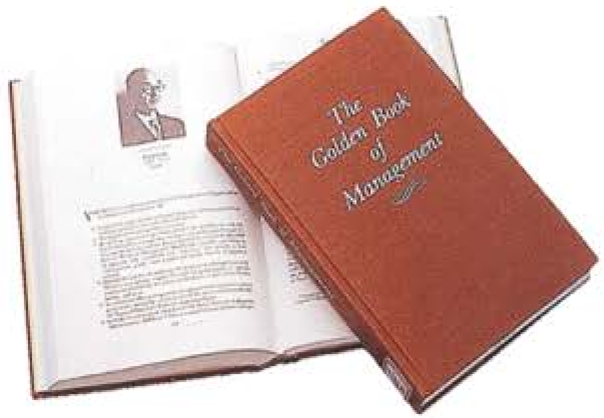
SANNO UNIVERSITY

Founder

Yoichi Ueno(1883-1957), our founder, was a scholar of Business Administration and Industrial Psychology. He graduated from the Tokyo Imperial University's Philosophy Department major in Psychology. After graduating, he studied business efficiency and scientific management and became a specialist in field.

He thus has been referred to as the father of business administration in Japan. As the first management consultant in Japan, he introduced American management concepts and techniques to the industrial community in Japan.

Thanks to these achievements, Ueno was introduced in "The Golden Book of Management" and became widely known througout Europe and the U.S. His management philosophy, a blend of F. W. Taylor's scientific management system and Oriental thoughts, has garnered much attention and acclaim.



The Golden Book Of Management

SANNO UNIVERSITY

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Too bad there is nothing like the Taylor Society today. “It is a constant purpose of the Taylor Society to contribute its influence, on behalf of executives and engineers, to raising the standing of the profession of management engineering. On behalf of executives - for they are in many instances the unconscious victims of incompetent, pseudo-scientific, self-styles management engineers whose interest is in fees instead of genuine service; on behalf of dependable engineers - for they are the victims of a repute given the profession by the incompetent and unprofessional. Management engineering, as did law and medicine in their early history, suffers from the shyster and the quack; so also do the executives who unwittingly employ the latter. It is the hope of the Society, by a continuing educational influence with respect to the principles and practices of good management and good management engineering, to aid executives to a discrimination between the competent and the incompetent in professional service. ...scientific management...is one of the greatest of social services.”

BULLETIN OF THE

TAYLOR SOCIETY

A SOCIETY TO PROMOTE THE SCIENCE AND THE ART OF ADMINISTRATION AND OF MANAGEMENT

HANDBOOK
of the
TAYLOR SOCIETY

Origin, Purpose, Activities

Constitution, Membership

Officers, Miscellaneous

Engineering Societies Building
29 W. Thirty-Ninth St.
New York

DECEMBER, 1921 SUPPLEMENT VOL. VI., No. 6

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ORIGIN AND ACTIVITIES OF THE TAYLOR SOCIETY

ORIGIN

The Society to Promote the Science of Management, now known as the Taylor Society, was organized in 1911. In 1916 the name was changed to honor the memory of the greatest contributor to the development of science in management, Frederick W. Taylor, who had died in 1915.

The Society was organized just after the Eastern Rate Case hearings (1911) had aroused an intense public interest in scientific management. To a group of men to whom management was a problem for most serious study, the manner in which this public interest was beginning to be misled by extravagant and false claims concerning the "installation" of "systems" was a cause for deep concern. Incalculable damage might be done to industry if a new philosophy and technique of management were taken from the field of scientific study and development and made the property of commercial exploitation. This group of men believed some competent organization should step into the breach and become the guardian of safe and sane study and education with respect to management. Such a guardianship would naturally have fallen to one of the major engineering societies, but they were too intensely engaged in problems of pure engineering to be willing to assume the new burden. It was recognized that under the circumstances a new and specialized engineering society would have to come into being, and the Society to Promote the Science of Management was organized.

Prior to and during the war the Society was a small, close-knit group of active persons, earnest in the desire to carry forward the torch of science applied to management. There was no commercial motive and therefore no seeking of publicity and building up of membership more rapidly than sympathetic-minded individuals came to learn of the Society and desire its privileges. Since the war, however, the increase in membership has been accelerated, for the industrial consequences of the war made evident to many the necessity of attacking managerial problems fundamentally and with thoroughness, and that there stood ready the Taylor Society, disciplined by a decade of quiet and disinterested, but persistent and thoroughly sound effort, for just such a larger service.

ACTIVITIES

The activities of the Taylor Society best known to the public are educational in their nature—meetings at which fundamental problems of management are considered in authoritative papers and discussions, and a bi-monthly *Bulletin* which aspires to attain the highest standing as an authoritative and trustworthy medium, free of commercial motive, for exposition of the *fundamental* problems of administration and of management, stimulate interest in the best which has been achieved in management, and inspire imagination and independence in thinking about problems of management. Activities less known to the public—but more exhaustive of its resources—represent service to members and constant effort to elevate the professional standing of management engineering, with respect both to technical ability and the ethics of service.

EDUCATIONAL

Meetings. The programs of meetings are planned with a manifold purpose: (1) to combine consideration of problems which are of current and vital interest with constant review of principles and methods of management which seem to be fundamental and permanent : (2) to inspire in members a realization of the unity in the management problem—that departments are but convenient divisions of an organization which is an integral whole and not independent enterprises, and that all elements of an enterprise must work together with a mutual understanding to the ac-

Supplement to Volume VI, No. 6, December, 1921, of *Bulletin of the Taylor Society.* Published by the Taylor Society at 29 West 39th Street, New York, N. Y. Entered as second-class matter, December 17, 1921, at the Post Office at New York, N. Y., under the act of March 3, 1879.

complishment of a common purpose; (3) to pursue constant inquiry concerning the extent to which the principles of scientific management as developed for the production department are applicable in other departments, and in other enterprise than manufacturing; (4) to afford members having special functional interests an opportunity to exchange experiences and consider principles and methods pertinent to their respective interests. The Society, at its meetings and in its BULLETIN, is not interested in speculation, petty devices and "stunts." Its interest is in the fundamental and thought-provoking.

At a recent meeting, for example, the papers and discussions covered the following range of subjects: a critical examination of the technique of the appraisal of waste by Hoover's Committee on Waste; a technique of general control by major executives; a report of a study of the organization of sales departments; a report on the application of the principles of scientific management in the development of better methods in a bank, a department store and the general offices of a factory; the extent to which a system of operations is modified by varying business conditions; the "formula" for an efficient workman; combination routing of small lots through production processes.

Section Meetings. Regional sections have been organized in various localities for the purpose of closer relationship of members and more intimate discussions of mutual problems and exchanges of experiences.

The Bulletin. The editorial policy of the BULLETIN is governed by the same manifold purpose which governs the planning of programs of meetings. Its object is to give permanent record to papers and discussions of long-run value—things which are worth re-reading and study because fundamental to sound managerial policy.

SERVICE

The greatest asset an organization can have is an atmosphere of live interest in the best management principles and practice, and the greatest asset an individual can have is a disposition to search for the best in principles and practice and a knowledge of how to go about the search. The service which the Taylor Society endeavors to render its members. individuals and contributing firms, is precisely these things—counsel in the attack on specific problems of management and cooperation in the development in an organization of an atmosphere of interest in the best in management.

The Taylor Society does not have a research organization and does not attempt to conduct the research involved in a member's problem. But any member of the Society or member of a contributing firm may submit direct inquiries concerning managerial problems, in person or by letter, to the Managing Director of the Society. These inquiries will receive his personal attention, and cooperation will be forthcoming in the nature of direction of the inquirer to the numerous special sources of information, in management literature and in the experiences of executives, engineers and firms. The office of the Society strives to keep informed concerning demonstrated developments in the science of management in this country and abroad, and to make this information available. It strives to render a member every pertinent general and detail service within its capacity. It aims to create for members a center—where problems of management are made the object of serious study—of consultation regarding general and specific problems of management.

Mr. Taylor found it necessary to set aside certain days of the week to receive the large number of executives who made long journeys to call at his residence for information concerning scientific management—what it is; what has been accomplished; how to go about it; what the engineers can do; what the executive must do; how this and that detail problem has been solved and so on. It is the aim of the Taylor Society to maintain in its office a similar center of inquiry—a center of counsel, information, personal introductions, and direction into the right paths for the solution of members' problems of management.

THE PROFESSIONAL STATUS OF MANAGEMENT ENGINEERING

It is a constant purpose of the Taylor Society to contribute its influence, on behalf of executives and engineers, to raising the standing of the profession of management engineering. On behalf of executives—for they are in many instances the unconscious victims of incompetent, pseudo-scientific, self-styled management engineers whose interest is in fees instead of genuine service; on behalf of dependable engineers—for they are the victims of a repute given the profession by the incompetent and unprofessional. Management engineering, as did law and medicine in their early history, suffers from the shyster and the quack; so also do the executives who unwittingly employ the latter. It is the hope of the Society, by a continuing educational influence with respect to the principles and practices of good management and good management engineering, to aid executives to a discrimination between the competent and the incompetent in professional service.

THE VALUE OF A PROFESSIONAL SOCIETY TO THE MANAGER AND THE MANAGEMENT ENGINEER

A member is inclined to appraise the value of the Society to himself in terms of the concrete things he sees come to himself from it—The *Bulletin*, meetings, circulars, replies to inquiries for information and advice. That is his privilege and more of such things are planned for him. But that is not all of his privilege, and to make possible such service is not all of his obligation. There are for him in membership bigger things than that, whether he be engineer, manager, or young man shaping his course to become engineer or manager.

To become engineer or manager requires a large investment of study and experience in developing and maintaining one's knowledge and facility; to become owner-manager requires an additional investment in a business which, to maintain its value, must be kept a going concern in a changing world. Whatever one may be, one's goal is a moving one. It is especially so in these days. He who is up-to-date today is, if he rests satisfied with that tomorrow, already out of date. The broad highway of industrial progress is strewn with the bones of never-weres and has-beens.

One does not maintain, let alone enhance, the value of his investment in self as engineer or manager by keeping within the narrow circle of his own achievements, and never going out to observe the achievements in methods, principles and ideals of those who are cooperating and competing with him.

And if he is far-sighted enough to go out for such a purpose, he cannot profitably go it alone. The search requires cooperative effort which brings together those who wish to observe and learn and those who have the things which are to be observed and learned. No individual can afford to sit down and let one talk with him for hours in the quest for new ideas and methods, but any one can afford to let a hundred do it simultaneously. What each one of the hundred draws out of him, and what he draws out of each of the hundred, is gain for all. The world has discovered that through such association is the economical way of doing these things.

And in conserving and enhancing one's investment in self as manager or engineer, there are other measures than merely keeping one's self up to date which must be taken. It is fundamental that one insure one's investment in superior management by extending and intensively cultivating the environment of superior management. An enterprise which attempts to operate with precision and economy finds itself restricted if other enterprises with which it has relations do not operate with a similar precision and economy. The superior manager or engineer cannot realize on his competence in an environment which does not comprehend the significance of his efforts and abilities. One of his major problems is that of creating a suitable environment—of educating the industrial world. It is a problem of significance for each individually, but it cannot be solved by anyone individually. Group effort is required.

Without such an agency as the Taylor Society to help, one who has invested in professional development and in engineering and managerial experience may fail to realize his highest opportunities.

Just now—and it will remain so for some time to come—the world of the engineer, the manager and the business man, is shaken to its foundations. The accomplishment of individual purposes and the betterment of social conditions are difficult. The confusion of the present is in large part the result of a maladjustment of manager, engineer and worker to changes in their environment. Heroic effort to bring about industrial stabilization is essential. To stabilize the industrial environment and to restore a confused world is not possible if one makes one's efforts simply as an individual. Through associated constructive effort only can it be accomplished.

A stabilized industrial environment is the first step towards that greater production the need of which is recognized, but not a sufficient step to replace the losses of war and meet the demands of a higher standard of living. A campaign of education in the only technique — scientific management — which assures greater production and at the same time preservation of the very standard of living we would maintain, is one of the greatest of social services. Such a campaign must be one of associated effort.

The Taylor Society is an association for accomplishing these individual and social purposes. There is nothing else which offers just the same opportunity. *Non-commercial, impartial, professional, shot through with idealism, but practical and with its inquiries directed straight at the world of facts,* it is an instrument for the conservation and enhancement of what one as manager or engineer has invested in self, and it offers an opportunity for contributing one's part in bringing about the stabilization of a confused industrial world, and the production under conditions which make for greater happiness in their enjoyment, of the services and commodities which all desire.

SOME PAPERS WHICH HAVE APPEARED IN THE BULLETIN OF THE TAYLOR SOCIETY

The Society has published six volumes—thirty-six numbers—of the BULLETIN. Some of these numbers are out of print, but about twenty-five are available at the volume rate—$2.50 for six numbers to members; $3.00 to non-members. The following are some of the leading articles which have appeared in past issues:

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"The Three-Shift System in the Steel Industry"	VI,	1,	2
FARQUHAR, Henry H.			
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WOODBRIDGE, C. K.			
"Methods of Compensating Salesmen"	VI,	4,	153

BRIEF BIBLIOGRAPHY OF MANAGEMENT

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CONSTITUTION OF THE TAYLOR SOCIETY

NAME AND OBJECT

C 1. The name of this Society shall be TAYLOR SOCIETY, in recognition of the preëminence of the pioneer work of Frederick W. Taylor in the application of scientific methods to the study of organization and management.

C 2. The objects of this Society are, through research, discussion, publication and other appropriate means:

1. To secure an understanding and intelligent direction of the principles governing organized effort, for the accomplishment of industrial and other social purposes for the mutual benefit of
   A. The Community
   B. Labor
   C. The Manager
   D. The Employer
2. To secure the gradual elimination of unnecessary effort and of unduly burdensome toil in the accomplishment of the work of the world.
3. To promote the scientific study and teaching of the principles governing organized effort, and of the mechanisms of their adaptation and application under varying and changing conditions.
4. To promote general recognition of the fact that the evaluation and application of these principles and mechanisms are the mutual concern of the community, labor, the manager and the employer.
5. To inspire in labor, manager and employer a constant adherence to the highest ethical conception of their individual and collective social responsibility.

MEMBERS

C 3. There shall be five grades of membership, viz.: Honorary Members, Senior Members, Associate Members, Junior Members, and Sustaining Members.

C 4. An Honorary Member shall be any person who shall be nominated for that grade by not less than ten members, and shall be elected by the unanimous vote of the Board of Directors of the Society.

An Honorary Member is entitled to vote and hold office.

C 5. A Senior Member shall be thirty years of age or over. He must have been connected with organization, management, or management engineering, either as one in responsible charge of installing management methods or as an executive or as a social scientist. Or he must have served as a teacher of organization, management, or management engineering or allied subjects for five years.

His application for membership shall be indorsed by at least three members.

A Senior Member is entitled to vote and hold office.

(Initiation fee $15. Annual dues $15.)

C 6. An Associate Member shall be twenty-five years of age or over. He must have been so connected with some organized activity as to be able to cooperate in the work of the Society toward the advancement of professional knowledge.

His application for membership shall be indorsed by at least three members.

An Associate Member is entitled to vote and hold office.

(Initiation fee $15. Annual dues $15.)

C 7. A Junior Member shall be twenty-one years of age and not over thirty years of age. He must have had such experience as will enable him to fill a responsible subordinate position in management or management engineering, or he must be a graduate of an engineering school or a school of administration or commerce of collegiate rank.

When a Junior Member attains the age of thirty years he shall automatically drop from membership in that grade. If his qualifications at this time are such that the Board of Directors consider him eligible, they may elect him either a Senior Member or an Associate Member as his desire and their judgment may dictate. There shall be no additional initiation fee charged when a Junior Member is advanced to a higher grade.

His application for membership shall be indorsed by at least three members.

A Junior Member is entitled to vote and hold office.

(Initiation fee $5. Annual dues $5.)

C 8. A Sustaining Member shall be any individual, firm, corporation, or organization so interested in the advancement of the science of management as to wish to promote the work of the Society by annual contribution. The only requirement for admission shall be the approval of the Board of Directors and the payment of dues of this grade.

Sustaining members shall be entitled for themselves, or for two individuals designated by them, to all rights and privileges of members except the right to vote or hold office.

(Annual dues, $35.)

C 9. Admission to the Society or change in membership grade shall be by vote of the Board of Directors and (except in the case of Honorary Members) the negative votes of two members shall exclude any candidate from election.

Members of the Society shall be notified as to the name and grade of each candidate deemed suitable for membership. And no election to membership by the Board of Directors shall take place until one month after the submission of the names of approved candidates to the members.

DUES

C 10. A candidate for admission to the Society shall pay, upon his election, an initiation fee of $15 if a Senior Member; $15 if an Associate Member; $5 if a Junior Member.

C 11. The annual dues of a Senior Member shall be $15; of an Associate Member $15; of a Junior Member $5; of a Sustaining Member, an amount to be determined by the Board of Directors.[1]

All dues are payable in advance.

[1] As amended December, 1921.

C 12. The Board of Directors may, at its discretion, permit any Senior Member or Associate Member to become a life member in the same grade, by the payment of $100 in four annual installments.[1] Such life member shall not be liable thereafter for annual dues.

C 13. A member in any grade in arrears for dues for a longer period than twelve months may at the discretion of the Board of Directors, be deprived of the right to vote, to hold office, or may be dropped from the roll of the Society.

GOVERNMENT AND OFFICERS

C 14. The regular officers shall comprise a President, two Vice-Presidents, a Managing Director, and a Treasurer. They shall continue in office until their successors are elected and qualified.

Announcement of the election of officers shall be made at the business session of the annual meeting.

C 15. The President and the Treasurer shall be elected by the voting membership for a term of one year.

C 16. The Vice-Presidents shall be elected, one each year, by the voting membership, for a term of two years.

C 17. The Managing Director shall be elected from the membership of the Society by the Board of Directors, and shall hold office for such period as that Board shall determine. He shall be the executive officer of the Society and of the Board of Directors, and shall administer in detail the affairs of the Society, in accordance with its general policies, and any specific policies and instructions voted by the Board of Directors.

He shall maintain and administer the principal office of the Society, shall conduct its correspondence, edit and publish its bulletins, and in general conduct such activities as are necessary to carry out in detail the policies of the Society and of the Board of Directors, and he shall be *ex-officio* a member of all standing and special committees of the Society.

C 18. The duties of other officers shall be those usually pertaining to their respective offices.

[1] As amended April, 1920.

C 19. The regular officers and four members elected, two each year, by the voting membership for a term of two years, shall constitute the Board of Directors. This Board shall have full power to administer the affairs of the Society, including the control of its property and the appropriation of its funds, in accordance with the policies and government of the Society as established by this constitution. A majority of the Board of Directors shall constitute a quorum.

C 20. The Board of Directors shall annually elect a Committee on Practice to consist of three or more members, none of whom shall be a member of the Board. The Board of Directors, the Managing Director, or any member of the Society may bring to the attention of the Committee on Practice any alleged unprofessional conduct on the part of any member without being deemed to have entered a formal complaint against such member.

When its attention is drawn to such a matter it shall be the duty of this Committee to make an examination into the facts and if a *prima facie* case shall appear against the member, so to report to the Board of Directors, presenting a statement of such facts as have appeared at the examination.

The Board of Directors shall hear and adjudge all complaints reported in this manner by the Committee on Practice, at a session which any member of the Society is privileged to attend; and its findings shall be conclusive upon all questions of facts involved in the evidence submitted.

Appeal in writing may be made to the Board of Directors upon question of professional or ethical policy. If satisfied as to the existence of newly discovered evidence material to the issue, the Board may in its discretion recommit the case to the Committee on Practice for a rehearing upon the facts; but save as to the existence of newly discovered evidence, the Board shall hear no evidence except such as may be reported to it by the Committee on Practice.

Should a member of the Board of Directors or of the Committee on Practice be a party at interest in any charge of alleged unprofessional conduct, such member shall not serve on the Board or on the Committee during the examination and adjudication of the case.

The Committee on Practice may issue from time to time, through the publications of the Society, bulletins on the subject of professional ethics, without any formal complaint having been entered against a member or without the subject matter discussed having been made a point at issue. Such publication shall, however, be first approved by the Board of Directors.

C 21. The Board of Directors shall select a chartered certified accountant who shall audit the accounts of the Treasurer at least once a year, and at such other times as the Board of Directors may direct.

C 22. The Board of Directors is empowered to adopt such rules or by-laws for the conduct of the Society as it may deem necessary or proper, and to establish such local and other subordinate sections as in its judgment will forward the purposes of the Society, and prescribe rules and regulations for their governance.[1]

C 23. At the annual meeting a Nominating Committee of five voting members, none of whom shall be a member of the Board of Directors, shall be elected by ballot. This committee shall nominate the necessary candidates for offices and Board of Directors for the ensuing terms. The Nominating Committee shall transmit to the Managing Director not less than two months prior to the annual meeting, names of consenting nominees, and the Managing Director shall submit the nominations to the voting membership by means of an official ballot at least one month prior to the annual meeting.

A member desiring to vote for other candidates than those on the official ballot shall have the privilege of writing on the official ballot the name of any eligible candidate he may desire for any office.

C 24. Vacancies in any office or in the membership of an elected committee shall be filled by the Board of Directors. A person so elected shall serve to the end of the term for which the original incumbent was elected.

C 25. All elections shall be by ballot. A letter ballot shall be construed as conforming with this requirement.

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[1]As amended April, 1920.

MEETINGS

C 26. There shall be not less than two regular meetings of the Society each year, at such times and places as the Board of Directors shall elect. The annual meeting shall be held in November or December.

C 27. The Board of Directors may, or on a written demand of ten per cent of the voting membership shall, call a special meeting of the Society. At least three weeks notice must be given of a special meeting, and the notice also must specify the purpose for which the meeting is called.

EXPULSION

C 28. The Board of Directors may refuse to receive the dues of a member of any grade, who, after due investigation by the Committee on Practice, shall have been adjudged by the Board of Directors to have violated the Constitution or By-Laws of this Society, or to have been guilty of conduct rendering him unfit to continue in the membership of the Society; and the Board of Directors may suspend or expel such person and remove his name from the list of members. A person so suspended or expelled shall have the right of appeal to the Society at the next annual meeting.

AMENDMENTS

C 29. Amendments to this Constitution may be proposed in writing at any stated meeting, and if passed by a majority of those present at the meeting, shall be mailed to the voting members not less than two months prior to the next stated meeting and shall be submitted to ballot not less than one month prior to such meeting. The total number of votes cast for and against the amendments shall be at least a majority of the voting membership, and two-thirds of the votes cast shall be in favor of the amendments to insure their adoption.

LOCAL SECTIONS

Four local sections of the Taylor Society have been organized during the past year—a New York Section, a Philadelphia Section, a New England Section and a Chicago Section. A list of officers of these sections will be found on the inside front cover of this Handbook. Groups of members in other localities are considering the organization of other local sections.

The purpose of the local section is in general to bring the members in a particular locality into closer contact with each other, and to provide local members with the opportunity for investigations more detailed than is possible for the parent society and more particularly related to the problems and industries of the particular region. The meetings of local sections are usually held monthly and are preceded by a dinner.

GROWTH OF THE SOCIETY

The growth of the Society since its reorganization early in 1919 has been as follows:

	Jan. 1, 1919	Jan. 1, 1920	Jan. 1, 1921	Jan. 1, 1922
Seniors	45	114	230	333
Associates	69	77	121	177
Juniors	12	35	81	144
Life	0	0	1	1
Honorary	1	1	2	2
Total	127	227	435	657
Sustaining	9	16	25	22
Total	136	243	460	679

MEMBERSHIP OF THE TAYLOR SOCIETY

AS OF DECEMBER 31, 1921

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UNITED STATES

ACKERMAN, Emory G. (J 1920), Industrial Engr., Stevenson Corp., 120 Broadway, New York City; *mail* 426 Water Street, Kendallville, Ind.

ADAM, William Joseph (S 1912), Consultant, Rm. 1330, 27 Cedar Street, New York City.

AFFELDER, Harry F. (A 1921), Vice-Pres. and Supt., The Wolf Envelope Company, 1749 East 22nd Street, Cleveland, O.

AGRY, George C. (A 1920), Mgr., Industrial Information Bureau, The Lamson Company, 100 Boylston Street, Boston, Mass.

ALDRICH, John G. (S 1913), Pres., New England Butt Company, 304 Pearl Street, Providence, R. I.; *mail* 223 Bowen Street, Providence, R. I.

ALFORD, Leon Pratt (S 1919), Editor, Management Engineering, The Ronald Press Company, 20 Vesey Street, New York City.

ALOE, Sidney A. (A 1920), Secy.-Treas. A. B. Kirschbaum Company, Broad and Carpenter Streets, Philadelphia, Pa.

AMES, Edward E. (S 1920), Pres., Pioneer Box Company, Commerce Building, Crawfordsville, Ind.

ANDERSON, Mary (S 1921), Director, Women's Bureau, U. S. Dept. of Labor, 20th and C Streets, Washington, D. C.

ARCHBALD, Hugh S. (S 1920), Mining Engineer, c/o Victoria Coal Mining Company, Philipsburg, Centre Co., Pa.

ARKELL, Bartlett (A 1912), Pres., Beech-Nut Packing Company and Arkell Safety Bag Company, 120 Broadway, New York City.

ARKELL, W. C. (S 1919), Secretary, Beech-Nut Packing Company, Canajoharie, N. Y.; *mail* P. O. Box 44, Canajoharie, N. Y.

AUGUSTINE, Sylvester (J 1921), Foreman of Quality, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

AUSTIN, Samuel Y. (S 1921), Vice-Pres. and Gen. Mgr., Hillside Cotton Mills.; Mgr., Unity Spinning Mills; Vice-Pres. and Gen. Mgr., Valley Waste Mills, La Grange, Ga.

AYARS, Christine M. (J 1921), Job Analyst, Planning Dept., R. H. Macy & Company, Inc., Herald Square, New York City; *mail* 609—11th Street, Brooklyn, N. Y.

AYER, Fred R. (A 1915), Pres., Eastern Manufacturing Company, 199 Washington Street, Boston, Mass.

BABCOCK, Geo. D. (S 1912), Manufacturing Executive, The Holt Manufacturing Company, Peoria, Ill.

BAILY, Joseph Carlton (J 1921), 120 Mt. Pleasant Avenue, Mt. Airy, Philadelphia, Pa.

BAKER, Harry (S 1921), Sales Agent, The National Cash Register Company, 37 Exchange Street, Portland, Me.

BAKER, Frank A. (S 1919), 901 Roland Avenue, Roland Park, Baltimore, Md.

BALDENSPERGER, Howard L. (S 1921), 402 Lloyd Bldg., Pittsburgh, Pa.

BALDWIN, Harry S. (S 1921), Vice-Pres. and Operating Director, Baldwin Division, Waldorf System, Inc., 307 Main Street, Springfield, Mass.; *mail* 109 Pineywoods Avenue, Springfield, Mass.

BALLOU, L. Herbert (S 1916), Works Mgr., Lewis Manufacturing Company, Walpole, Mass.

BANCROFT, John (A 1916), Pres., Jos. Bancroft and Sons Company, Wilmington, Del.

BANCROFT, Wilfred (S 1917), Asst. Treas., Stillwater Worsted Mills, Harrisville, R. I.

BARKER, Howard F. (A 1920), Assignment Mgr., Tuttle Whitney and Company, 242 Central Building, Minneapolis, Minn.

BARNUM, C. Leslie (S 1917), 404 West 115th Street, New York City.

BARROWS, Willard P. (S 1920), Counselor in Management, 1024 Land Title Building, Philadelphia, Pa.

BARTER, A. E. (S 1912), Works Mgr. & Secy., Plimpton Press, Norwood, Mass.; *mail* 817 South Street, Roslindale, Mass.

BARTH, Carl G. (H 1912), Consulting Engr., Senior Member, Carl G. Barth and Son, 10 South 18th Street, Philadelphia, Pa.

BARTH, Carl G., Jr. (S 1920), Consulting Engr., Carl G. Barth and Son, 10 South 18th Street, Philadelphia, Pa.

BARTH, Frederick I. (A 1920), The Stein-Bloch Company, 164 St. Paul Street, Rochester, N. Y.

BARTH, J. Christian (S 1916), Consulting Engr., Junior Member, Carl G. Barth and Son, 10 South 18th Street, Philadelphia, Pa.

BARTHOLOMAEI, H. A. (A 1917), Jr. Engr., The Thompson and Lichtner Company, Boston, Mass.; *mail* c/o Nashua Gummed and Coated Paper Company, Nashua, N. H.

BARTLETT, Leslie R. (A 1920), Service Mgr., Frank Mossberg Company, Attleboro, Mass.

BARTON. Frank W. (J 1920), Asst. Director Installation, The Rossendale-Reddaway Belting & Hose Company, Euclid Avenue, Newark, N. J.

BARTON, James (A 1920), Superintendent, The Rossendale-Reddaway Belting and Hose Company, Euclid Avenue, Newark, N. J.

BATCHELOR, James H. (A 1920), 27 Janssen Place, Kansas City, Mo.

BATES, Daniel Moore (S 1912), Vice-Pres., Day and Zimmermann, Inc., 611 Chestnut Street, Philadelphia, Pa.

BAXTER, James Vincent (J 1921), Asst. to Mech. Engr., Rhode Island Tool Company, 148 West River Street, Providence, R. I.

BEALE, John D. (A 1921), Office Mgr., The Pompeian Company, 2400 Payne Avenue, Cleveland, O.; *mail* 1838 East 90th Street, Suite No. 7, Cleveland, O.

BEALL, F. F (A 1915), Vice-Pres. and Gen. Mgr., Gray Motor Corp., Detroit, Mich.

BECVAR, Frank J. (S 1921), Production Supt., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 2101 West Boulevard, Cleveland, O.

BEER, John S. (A 1921), Associate Office Mgr., Jas. McCreery & Company, 5 West 34th Street, New York City.

BELL, George L. (S 1920), Consultant, Industrial Relations and Management, 710 Alaska Commercial Building, San Francisco, Cal.

BEMAN, Lynn W. (A 1921), Head Labor Mgr., National Wholesale Tailors' Association, 178 West Jackson Boulevard, Chicago, Ill.

BENEDICT, Howard G. (S 1912), Consulting Engr. in Management, 2269 Grandview Avenue, Cleveland, O.

BENNETT, Elton J. (S 1919), Executive, Wm. E. Hooper and Sons Company, 3502 Parkdale Avenue, Baltimore, Md.; *mail* 2706 Chelsea Terrace, Baltimore, Md.

BENNETT, H. R. (J 1919), 404 Baty Street, Elmira, N. Y.

BENSON, Joseph C. (A 1921), Asst. Sec'y., Dwight & Lloyd Companies, 29 Broadway, New York City.

BERG, Ernst (S 1920), Director of Sales, Bassick Company, 38 Austin Street, Bridgeport, Conn.

BEYER, Otto S., Jr. (S 1919), Consulting Engr., Labor Bureau, 1 Union Square, New York City.

BIGELOW, Carle Muzzy (S 1921), Chief Engr., Cooley & Marvin Company, 15 Ashburton Place, Boston, Mass.; *mail* 16 Chestnut Terrace, Newton Centre, Mass.

BILL, Florence M. (Mrs. Charles) (A 1921), Supervisor of Employment, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

BIOW, Milton H. (A 1921), Pres., The Biow Company, Inc., 116 West 32nd Street, New York City.

BLACK, Morris A. (S 1921), Pres., The H. Black Company, 1912 Superior Avenue, Cleveland, O.

BLANCHARD, Fessenden S. (S 1920), Asst. to Treas., Pacific Mills, 70 Kilby Street, Boston, Mass.

BLAUVELT, Warren S. (S 1920), Pres., Indiana Coke and Gas Company, Terre Haute, Ind.

BLEECKER, R. B. (J 1920), Packard Motor Car Company, Detroit, Mich.; *mail* Crane Apartments, 163 Charlotte Street, Detroit, Mich.

BLOOMFIELD, Daniel (S 1921), Partner, Bloomfield & Bloomfield, 6 Beacon Street, Boston 9, Mass.

BLOOMFIELD, Meyer (S 1920), Industrial Consultants, Publishers of Bloomfield's Labor Digest, Bloomfield and Bloomfield, 6 Beacon Street, Boston, Mass.

BOAL, William S. (J 1921), Operating Supt., O. W. Richardson & Company, 125 S. Wabash Avenue, Chicago, Ill.

BOGUE, George M. (S 1921), Supervising Engr., The Leffingwell-Ream Company, 327 South LaSalle Street, Chicago, Ill.; *mail* 4160 Drexel Boulevard, Apt. 416, Chicago, Ill.

BOLGER, Daniel I. (A 1921), Supervisor, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 3159 West 116th Street, Cleveland, O.

BOONE, Gladys (A 1921), Instructor, Bryn Mawr College, Bryn Mawr, Pa.

BOWMAN, Harvey R. (J 1920), Industrial Engr., Lycoming Rubber Company, Williamsport, Pa.; *mail* 501 Belmont Avenue, Williamsport, Pa.

BOWMAN, Ralph (S 1919), Investigator, Bureau of Efficiency, 17th and F. Streets, Washington, D. C.; *mail* 1625 15th Street, N. W., Washington, D. C.

BRADBURY, Richard C. (J 1920), Chemist (Research), Barrett Company, Frankford, Pa.; *mail* 826 E. Haines Street, Germantown, Pa.

BRADLEY, Henry D. (J 1921), Asst. Business Mgr., The Toledo Blade Company, 414 Jefferson Avenue, Toledo, O.; *mail* 1718 Madison Avenue, Toledo, O.

BRAINARD, Newton Case (S 1920), Pres., The Case, Lockwood and Brainard Company, 141 Pearl Street, Hartford, Conn.

BREED, Howard (S 1920), Secy. and Factory Mgr., The Crane and Breed Company, 1227 W. Eighth Street, Cincinnati, O.

BRIGGIN, Joseph W. (J 1921), Cost Accountant, Joseph Tetley and Company, Inc., New York; *mail* 1264 Amsterdam Avenue, New York City.

BRIGHAM, Herbert W. (A 1920), Sales Mgr., Rochester Ice Cream Company, Rochester, N. Y.

BRINLEY, Chas. E. (S 1920), Pres., The American Pulley Company, 4200 Wissahickon Avenue, Philadelphia, Pa.

BROWN, Carleton F. (S 1920), Treas. & Gen. Mgr., Corona Typewriter Company, Inc., Groton, N. Y.

BROWN, Ernest G. (J 1919), Plant Engr., The Acme Wire Company, P. O. Box 1820, New Haven, Conn.

BROWN, Herbert D. (S 1920), Chief, U. S. Bureau of Efficiency, Washington, D. C.

BROWN, Morris Vernon (A 1921), Industrial Engr., Landesman, Hirschheimer Company, Cleveland, O.

BROWN, Percy S. (S 1920), Works Mgr., Corona Typewriter Company, Inc., Groton, N. Y.

BROWN, William Horton (S 1921), Supt., Simonds Manufacturing Company, 55 North Street, Fitchburg, Mass.; *mail* Crescent Apts., 22 Blossom Street, Fitchburg, Mass.

BRUCE, John M. (S 1916), Partner, Webb, Kendall & Bruce, Inc., 280 Madison Avenue, New York City.

BRUCHHOLZ, Frederick (J 1921), Salesman, Hayden, Miller & Company, 706 Citizens Building, Cleveland, O.; *mail* University Club, Cleveland, O.

BRUERE, Henry (S 1919), Vice-Pres., The American Metal Company, Ltd., 61 Broadway, New York City.

BRUERE, Robert W. (S 1919), Director, Bureau of Industrial Research, 289 Fourth Avenue, New York City.

BRUNER, Warren D. (A 1919), Supervising Engr., The Leffingwell-Ream Company, 1203 Flatiron Building, New York City.

BUCKLEY, Louis H. (A 1921), Asst. Gen. Mgr., U. S. Envelope Company, 75 Grove Street, Worcester, Mass.

BUELL, Josiah B. (J 1921), Industrial Counselor, N. Y. State Industrial Commission, 124 East 28th Street, New York City; *mail* 100 Convent Avenue, New York City.

BURCHELL, Durward E. (A 1920), Professor of Industrial Acct., Graduate School of Business Administration, Harvard University, Cambridge, Mass.; *mail* 37 Dana Street, Cambridge, Mass.

BURKHARD, Paul L. (A 1921), Consultant on Industrial Training, Burkhard-Griswold Co., 362 Lennox Building, Cleveland, O.

BURLEIGH, Nathaniel G. (S 1919), Prof. of Business Organization and Management, Amos Tuck School, Dartmouth College, Hanover, N. H.; *mail* 1 Webster Terrace, Hanover, N. H.

BURNETT, J. Henry (S 1920), Business Mgr., Mercer University, Macon, Ga.

BURNS, Herbert A. (S 1920), Prod. Mgr., New Home Sewing Machine Company, 36 South Main Street, Orange, Mass.

BURSLEY, J. A. (S 1914), Dean of Students, University of Michigan, Ann Arbor, Mich.; *mail* 2107 Hill Street, Ann Arbor, Mich.

BUSCH, Henry A. (J 1920), Asst. Supt., J. F. Tapley Company, Metropolitan Building, Long Island City, N. Y.; *mail* 1522 Overing Street, New York City.

BUXBAUM, William (S 1919), Supt. New Products, Winchester Repeating Arms Company, New Haven, Conn.

BYRNES, Edward D. (A 1919), Mgr. of Sales, Acounting Devices Company, 564 West Monroe Street, Chicago, Ill.; *mail* 5650 South May Street, Chicago, Ill.

CANNON, Bernice M. (S 1921), Educational Director, Wm. Filene's Sons Company, Boston, Mass.

CANNON, Nelson A. (S 1921), Supt. of Supplies and Equipment, The Joseph and Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 10402 Edgewater Drive, Cleveland, O.

CAREY, William J. (J 1920), Asst. Instructor, Harvard Graduate School of Business Aministration, Cambridge, Mass.; *mail* 784 Broadway, So. Boston, Mass.

CARLIN, Joseph A. (A 1915), Vanity Fair Silk Mills, Reading, Pa.; *mail* 825 Fayette Street, Conshohocken, Pa.

CARLSSON, Carl Gustav W. (J 1921), present address unknown.

CARMODY, John M. (S 1920), Production Mgr., The H. Black Company, 1912 Superior Avenue, Cleveland, O.

CARNEY, M. T., Major (S 1920), Office Mgr., Watertown Arsenal, Watertown, Mass.

CARR, Francis J. (J 1919), 11 Brooks Street, Atlantic, Mass.

CARROLL, Frederick H. (J 1920), LaSalle Extension University, Chicago, Ill.; *mail* St. George Hotel, 60 and Blackstone, Chicago, Ill.

CARROLL, G. V. S. (S 1921), Sales Mgr., Dennison Manufacturing Company, Framingham, Mass.

CARTER, Winthrop L. (S 1919), Treas. & Gen. Mgr., Nashua Gummed and Coated Paper Company, Nashua, N. H.

CATE, Allan Miles (J 1921), Instructor in Business Organization and Management, Amos Tuck School, Hanover, N. H.

CHADBOURNE, Wm. M. (A 1920), Chadbourne, Hunt, and Jaeckel, 165 Broadway, New York City.

CHADWICK, Noel (A 1920), 158 Bay State Road, Boston, Mass.

CHAMBERLIN, Wm. F. (A 1921), Supt., Group Dept., The Travelers Insurance Company, Hartford, Conn.

CHAPMAN, Frank E. (A 1921), Director, Mount Sinai Hospital of Cleveland, 1800 East 105th Street, Cleveland, O.

CHENEY, Horace B. (S 1921), Asst. Secy. & Treas., Cheney Brothers, South Manchester, Conn.

CHERINGTON, Paul T. (S 1920), Secy-Treas., National Association Wool Manufacturers, 50 State Street, Boston, Mass.

CHODOROV, Frank (A 1920), General Mgr., Clothing Manufacturers Association of New York, Inc., 10 Broadway, Springfield, Mass.

CHURCHILL, William L. (S 1921), Pres., McDonald-Churchill Corp., 103 Park Avenue, New York City.

CLARK, B. Preston (S 1918), Senior Partner, B. C. Clark & Company, 55 Kilby Street, Boston, Mass.

CLARK, Edward W., 3rd (A 1918), Member, E. W. Clark & Company, 321 Chestnut Street, Philadelphia, Pa.

CLARK, Franklin Taylor (A 1920), Secy. & Asst. Treas., Huntington Development & Gas Company, E. W. Clark and Company, 321 Chestnut Street, Philadelphia, Pa..

CLARK, Helen Young, Mrs. (A 1921), Asst. Supt. of Personnel, Warner Brothers Company, Bridgeport, Conn.; *mail* 764 Myrtle Avenue, Bridgeport, Conn.

CLARK, Mabel A. (A 1921), Pres., W. N. Clark Company, Rochester, N. Y.; *mail* 125 Strong Street, Rochester, N. Y.

CLARK, Wallace (S 1916, Industrial Engr., 50 West 12th Street, New York City.

CLOTHIER, Robert C. (S 1920), Vice-Pres., The Scott Company, 751 Drexel Building, Philadelphia, Pa.

COBAUGH, Harry A. (S 1920), In Charge of Development, Rossendale-Reddaway Belting and Hose Company, Euclid Avenue, Newark, N. J.

COBURN, Frederic G. (S 1916), Sanderson & Porter, 52 William Street, New York City.

COHN, Herman M. (S 1920), Member of firm, Mgr., H. C. Cohn & Company, 214 Andrews Street, Rochester, N. Y.

COLEMAN, Geo. W. (S 1921), Pres., Babson Institute, Wellesley Hills, Mass.

CONNELL, Wm. H. (S 1920), Coördinating Engr., Philadelphia Rapid Transit Company, Philadelphia, Pa.

COOKE, Mildred S. (A 1921), Standards Department, The Landesman Hirschheimer Company, 1323 West 9th Street, Cleveland, O.; *mail* 1756 East 90th Street, Cleveland, O.

COOKE, Morris L. (S 1912), Consulting Engr. in Management, 1109 Finance Building, Philadelphia, Pa.

COONLEY, Howard (S 1920), Pres., Walworth Manufacturing Company, 88 Pearl Street, Boston, Mass.

COONLEY, John S. (S 1921), Sec'y and Asst. Treas., Walworth Manufacturing Company, 1905 Peoples Gas Building, 122 S. Michigan Avenue, Chicago, Ill.

COPLEY, F. B. (S 1919), Writer, 9 Franklin Avenue, Yonkers, N. Y.

COPP, Tracy (S 1921), Special Agent for Industrial Rehabilitation, Federal Board for Vocational Education, Washington, D. C.

CORNELL, Milton L. (S 1920), Partner, Cornell Iron Works, 601 West 26th Street, New York City.

COTTON, George W. (S 1921), Head Planning Dept., Walworth Manufacturing Company, Kewanee, Ill.

CRENSHAW, William P. (J 1921), Production Mgr., E. Sperling Company, 2212 Superior Avenue, Cleveland, O.

CROCKETT, Chas. J. (A 1920), Sales Mgr., American Lady Corset Company, 1060 W. Fort Street, Detroit, Mich.

CROSMAN, Loring P. (J 1920), Secy., G. A. Crosman and Sons Company, Deering Junction, Portland, Me.

CROZIER, William—General (S 1919), U. S. A. retired, 1735 Massachusetts Avenue, Washington, D. C.

CURLEY, Wm. E. (S 1919), Senior Engr., The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.

CUTHBERT, John G. (A 1921), Pres., Cuthbert Bros. Company, 604 Bessemer Building, Pittsburgh, Pa.

DANIELS, Charles Harrison (A 1921), Pres. and Mgr., The Northwestern Finance Corporation, Ground Floor Equity Building, Detroit, Mich.

DARLING, Clinton S. (A 1921), Managing Editor, Factory; A. W. Shaw Company, 660 Cass Street, Chicago, Ill.

DART, William C. (S 1914), Pres., Rhode Island Tool Company, 148 West River Street, Providence, R. I.

DAVENPORT, Arthur T. (S 1920), General Mgr., Sweet-Orr & Company, Inc., 15 Union Square, New York City.

DAVIES, Clarence E. (S 1921), Managing Editor, American Society of Mechanical Engineers, 29 West 39th Street, New York City.

DAVIS, Charles C. (S 1921), Pres., Pennsylvania Forge Company, Bridesburg, Philadelphia, Pa.

DAVIS, Harold M. (S 1920), Senior Engr., The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.; *mail* Nashua Gummed and Coated Paper Company, Nashua, N. H.

DAVIS, Robert T. (A 1920), Supt. Methods Dept., Nashua Gummed and Coated Paper Company, Nashua, N. H.

DAY, Charles (S 1912), Pres., Day and Zimmermann, Inc., 611 Chestnut Street, Philadelphia, Pa.

DEACON, Edward F. (A 1921), Production Mgr. and Cost Accountant, The Brecht Co., 12th Street and Cass Avenue, St. Louis, Mo.; *mail* 5381 Pershing Avenue, St. Louis, Mo.

DeFIELD, Wm. R. (A 1916), Owner, Wm. R. DeField and Company, 306 Perry Building, 16th and Chestnut Streets, Philadelphia, Pa.

DELANEY, R. C. (A 1921), Mgr., Jefferson Safety Storage Warehouse Company, Jefferson and Ewing Streets, Trenton, N. J.

DENISON, Orville B. (A 1920), Prod. Engr., Simplex Wire and Cable Company, 201 Devonshire Street, Boston, Mass.

DENNISON, Henry S. (S 1917), Pres., Dennison Manufacturing Company, Howard Street, Framingham, Mass.

DICKERMAN, Geo. W. (S 1920), Vice-Pres., Remington Typewriter Company, 374 Broadway, New York City.

DIEMER, Hugo (S 1912), Director, Dept. of Modern Foremanship, LaSalle Extension University, 4046 Michigan Avenue, Chicago, Ill.

DIETER, Clifford (A 1919), The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.

DISSTON, William D. (S 1921), 3rd Vice-Pres., Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa.

DODGE, Kern (S 1920), Consulting Engr., 5135 Pulaski Avenue, Germantown, Philadelphia, Pa.

DOLESH, Stanley W. (J 1921), Foreman, Scheduling Division of Planning Dept., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

DONHAM, Wallace B. (S 1920), Dean, Harvard Graduate School of Business Administration, 17 University Hall, Cambridge, Mass.

DOREMUS, Philip (A 1919), Salesman, Dennison Manufacturing Company, 711 Niagara Life Building, Buffalo, N. Y.

DORIOT, Georges Frederic (J 1921), Student, Harvard Graduate School of Business Administration, Cambridge, Mass.; *mail* 14 Story Street, Cambridge, Mass.

DOUGLAS, Hammond Burns (S 1921), Supt., Wire Goods Company, 28 Union Street, Worcester, Mass.

DOWD, M. S. (S 1912), 721—5th Avenue, Williamsport, Pa.

DOWNHAM, John O. (J 1920), 208 Pusey Street, Chester, Pa.

DRAKE, Clyde I. (S 1916), Asst. to the Pres., Walworth Manufacturing Company, 88 Pearl Street, Boston, Mass.

DRURY, Horace B. (S 1919), Economist, 5025 Wisconsin Avenue, Washington, D. C.

DUNLAP, John R. (L 1919), Editor and Proprietor, The Engineering Magazine Company, 120 West 32nd Street, New York City.

DUNLAP, Robert T. (A 1921), Production Supervisor, Foundries, Jones & Laughlin Steel Company, Pittsburgh, Pa.; *mail* 740 Kelly Avenue, Wilkinsburg, Pa.

EAGAN, John J. (S 1919), Chairman Board Dir., American Cast Iron Pipe Company, Citizens Southern Bank Building, Atlanta, Ga.

EAGER, Walter B. (A 1921), Adjustment Mgr., Jas. McCreery & Company, 5 West 34th Street, New York City.

EATON, Doane (J 1919), 74 Main Street, Waterville, Me.

EATON, James Shirley (S 1920), Railroad Expert, The Concord, Washington, D. C.

EATON, William H. (A 1915), Treas., Eaton, Crane & Pike Company, 75 South Church Street, Pittsfield, Mass.

ECKSTEIN, Theodore C. (A 1920), Time Study Man, Gorton Pew Fisheries, Gloucester, Mass.; *mail* Y. M. C. A., Gloucester, Mass.

EIGELBERNER, J. (A 1921), Consulting Engr., LaSalle Extension University, 4046 Michigan Avenue, Chicago, Ill.; *mail* 6412 Kimbark Avenue, Chicago, Ill.

ELFELT, Charles L. (A 1920), Merchandise Mgr., Specialty Stores Assn., 6-8-10 East 32nd Street, New York City; *mail* 57 West 75th Street, New York City.

EMMET, Boris (S 1920), Labor Mgr., Henry Sonneborn and Company, Inc., Baltimore, Md.

ENGEL, Sadie (A 1921), Asst. in Industrial Studies, Russell Sage Foundation, 130 East 22nd Street, New York City.

ENSTEN, Edwin J. (A 1921), Director of Sales, The Printz-Biederman Company, 425 Lakeside Avenue, Cleveland, O.

EVANS, Donald P. (A 1920), Investigator, U. S. Bureau of Efficiency, Washington, D. C.

FAILE, E. H. (S 1919), Gen. Mgr., National Magnesite Products Corp., 501 Fifth Avenue, New York City.

FARQUHAR, Henry H. (S 1919), Industrial Management, 727 Pleasant Street, Belmont, Mass.

FEISS, Geo. J. (S 1919), General Mgr., The Superior Foundry Company, 3542 East 71st Street, Cleveland, O.

FEISS, Julius (A 1921), Chairman of the Board, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

FEISS, Paul Louis (A 1921), Vice-Pres., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

FEISS, Richard A. (S 1914), Vice-Pres. & Manufacturing Mgr., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

FIELDS, Arthur M. (S 1920), Prod. Mgr., Schwartz and Jaffe, Inc., 578 Broadway, New York City.

FILENE, A. L. (S 1919), Treas. and Gen. Mgr., Wm. Filene's Sons Company, 426 Washington Street, Boston, Mass.

FINCK, David H. (J 1920), Management Engr., Cassady-Fairbank Manufacturing Company, 6126 S. LaSalle Street, Chicago, Ill.; *mail* 5028 Michigan Avenue, Chicago, Ill.

FINK, Geo. R. (A 1920), Manager of Sales, West Penn. Steel Company, Brackenridge, Pa.

FINKELHOR, Francis (J 1921), Asst. Production Mgr., Finkelhor Bros., 906 Broadway, New York City.

FINNEY, Frank (S 1920), Pres., Street and Finney, Inc., 171 Madison Avenue, New York City.

FISHER, Boyd (S 1919), Service Dept., Lockwood, Greene and Company, 60 Federal Street, Boston 9, Mass.

FISHER, John A. (S 1919), Prof. of Industrial Management, Ohio State University, Columbus, O.

FLATHER, Frederick A. (S 1920), Treas., Boott Mills, 79 Milk Street, Boston, Mass.

FLEISHER, Alexander (S 1921), Asst. Secy., Metropolitan Life Insurance Company, 1 Madison Avenue, New York City.

FLETCHER, F. Richmond (S 1921), Resident Engineering Partner, Scovell, Wellington & Company, 110 State Street, Boston, Mass.

FOERDERER, Percival E. (S 1920), Pres. and Gen. Mgr., Robert H. Foerderer, Inc., Franklin Bank Building, Frankford, Philadelphia, Pa.

FOLSOM, Eugene L. (S 1915), Asst. Supt., Waltham Watch Company, Waltham, Mass.; *mail* 101 Washington Avenue, Waltham, Mass.

FORD, C. Moffitt (S 1921), 30 South Merriam Street, Pittsfield, Mass.

FORRESTAL, James, Jr. (J 1919), Resident Engr., The Thompson & Lichtner Company, 136 Federal Street, Boston, Mass.; *mail* 9 Reservoir Street, Nashua, N. H.

FOURNIER, Geo. H. J. (J 1920), Chief Clerk Construction Division, Packard Motor Car Company, Detroit, Mich.; *mail* 1492 Pennsylvania Avenue, Detroit, Mich.

FOX, Grover F. (S 1919), Prod. Mgr., Wilmer Atkinson Company, 230 South 7th Street, Philadelphia, Pa.; *mail* 616 Parry Avenue, Palmyra, N. J.

FRANCKE, Hugo (A 1921), Instructor, Industrial Management, Harvard Business School, Cambridge, Mass.; *mail* 3 Berkeley Place, Cambridge, Mass.

FRANK, Lawrence K. (A 1920), Business Mgr., New School for Social Research, 465 West 23rd Street, New York City

FRANKLIN, Benjamin A. (S 1921), Vice-Pres, Strathmore Paper Company, Mittineague, Mass.

FRANKLIN, Emmanuel (A 1921), Management Engr., The Leffingwell-Ream Company, Flatiron Building, New York City.

FRASER, LeRoy B. (S 1917), In charge of Manufacturing & Textile Sales, The Greist Manufacturing Company, New Haven, Conn.

FRAZER, George E. (S 1920), Partner, Frazer and Torbet, 208 South LaSalle Street, Chicago, Ill.

FREELAND, Willard E. (S 1920), Supt. Sales Production, Winchester Repeating Arms Company, New Haven, Conn.; *mail* Hotel Duncan, New Haven, Conn.

FREEMAN, Ward B. (J 1920), 512 Fairfax Avenue, Norfolk, Va.

FRENNING, Alfred B. (J 1921), Student, Harvard Graduate School of Business Administration, Cambridge, Mass.; *mail* 35 Clover Street, Belmont, Mass.

FRY, C. Luther (J 1921), Industrial Bureau, The Merchants' Association of N. Y., 233 Broadway, New York City.

FULLER, C. Tracy (J 1919), Industrial Engr., Marcellus, N. Y.

FULLER, Harold C. (J 1920), Planning Dept., Lycoming Rubber Company, Williamsport, Pa.

FULLER, Walter D. (S 1916), Secy., The Curtis Publishing Company, Independence Square, Philadelphia, Pa.

FULLING, Lester Paul (A 1921), Mechanical Supt. of Color Dept., Nashua Gummed and Coated Paper Company, Franklin Street, Nashua, N. H.; *mail* 55 Franklin Street, Nashua, N. H.

GABINE, B. (A 1920), 500 West 144th Street, New York City.

GALLOWAY, Dr. Lee (A 1913), Vice-Pres., The Ronald Press, 20 Vesey Street, New York City.

GARSON, Isaac J. (A 1921), Sec'y, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 2685 Euclid Boulevard, Suite No. 4, Cleveland Heights, O.

GAY, Edwin F. (S 1920), Pres., N. Y. Evening Post, Inc., 20 Vesey Street, New York City.

GESELL, Wm. H. (S 1920), Gen. Mgr., Lehn and Fink, Inc., Bloomfield, N. J.; *mail* 235 Christopher Street, Montclair, N. J.

GIFT, Lyle Henry (J 1921), 1201 Perry Avenue, Peoria, Ill.

GILBERT, Edwin C. (A 1920), Prod, Executive, The Chapman Valve Manufacturing Company, Indian Orchard, Mass.

GILBERTSON, Henry S. (S 1920), Labor Mgr., National Wholesale Tailors' Association, 1300 Medinah Building, Chicago, Ill.

GILBRETH, Frank B. (S 1912), Pres., Frank B. Gilbreth, Inc., 68 Eagle Rock Way, Montclair, N. J.

GILLIS, Malcolm W. (S 1921), Supt, of Designing and Manufacturing, B. Kuppenheimer and Company, 415 S. Franklin Street, Chicago, Ill.; *mail* 2135 Orrington Avenue Evanston, Ill.

GILSON, Mary B. (S 1920), Employment & Service Supt., The Joseph and Feiss Company, 2149 West 53rd Street, Cleveland, O.

GITCHELL, Byres H. (S 1920), 602 West 139th Street, New York City.

GLENNY, B. B. (A 1916), Vice.-Pres., Barcalo Manufacturing Company, 225 Louisiana Street, Buffalo, N. Y.

GOLDBERG, Harry M. (J 1920), 1850 North 8th Street, Philadelphia, Pa.

GOLDBERG, Solomon Lewis (A 1921), Sales and Advertising Mgr., The Wolf Company, 511 East 72nd Street, New York City.

GOLDMARK, Pauline (S 1921), Engineering Department, American Telephone & Telegraph Company, 195 Broadway, New York City.

GOLDSMITH, Oliver (A 1921), Pres. and Treas., Buffalo Shirt Company, Urban and Kehr Streets, Buffalo, N. Y.

GOLTRA, Sidney E. (A 1921), Engr., The Leffingwell-Ream Company, 1310 Flatiron Building, New York City.

GONZALES, Leon (J 1921), Industrial Organization Division of Commerce and Industry, Manila, P. I.

GOODELL, Francis (S 1914), Engr., The Leffingwell-Ream Company, Flatiron Building, New York City; *mail* 63 Park Street, Montclair, N. J.

GORDON, Mack (S 1921), Industrial Engr., 226 Marion Building, 1276 West 3rd Street, Cleveland, O.

GORDON, Wm. D. (J 1920), Instructor in Industry, University of Pennsylvania, Philadelphia, Pa.

GORDY, Charles B. (A 1921), Asst. Professor, University of Michigan, Ann Arbor, Mich.; *mail* 1926 Norway Road, Ann Arbor, Mich.

GOULD, Harold P. (A 1916), Pres., H. P. Gould Company, 5 South Wabash Avenue, Chicago, Ill.

GREEN, Arthur B. (S 1916), Management Engr., The Parker-Young Company, Lincoln, N. H.; *mail* Lincoln, N. H.

GREEN, Harold E. L. (J 1921), Supervisor of Planning and Employment, Andrews Wire & Iron Works, Preston Street, Rockford, Ill.; *mail* 1920 N. Court Street, Rockford, Ill.

GREEN, Irving A. (S 1921), Planning Dept. Mgr., The Wire Goods Company, 28 Union Street, Worcester, Mass.

GREEN, James A. (A 1920), Statistician, Maxwell Motor Sales Corp., 12,200 Jefferson Avenue E., Detroit, Mich.; *mail* Y. M. C. A., Adams Square, Detroit, Mich.

GREENBERG, Morris (J 1920), Prod. Mgr., S. F. & A. F. Miller Company, Paca and Lombard Streets, Baltimore, Md.

GREENE, Ralph L. (S 1919), Attleboro, Mass.

GREENE, S. Harold (S 1921), Pres., Lockwood, Greene and Company, 60 Federal Street, Boston, Mass.

GREGG, Cecil D. (S 1917), Pres., Evens and Howard Fire Brick Company, 920 Market Street, St. Louis, Mo.

GREGG, Frank D. (J 1921), Engineering College, Cornell University, Ithaca, N. Y.

GRIFFENHAGEN, Edwin O. (A 1919), Director, Griffenhagen and Associates, Ltd., 116 So. Michigan Avenue, Chicago, Ill.

GRIFFIN, Claude W. (S 1920), 927 Ruby Street, Woodhaven, L. I., N. Y.

GUILD, Henry J. (A 1919), Vice-Pres., Eastern Manufacturing Company, 199 Washington Street, Boston, Mass.

GUINANE, Joseph E. (J 1920), 318 East 36th Street, New York City.

GUSTAFSON, Arthur (S 1921), Wm. E. Hooper & Sons Company, Baltimore, Md.; *mail* 15 Queen Anne Road, Windsor Hills, Baltimore, Md.

GUTHRIE, Harry D., Jr. (J 1921), 2202 Loring Place, Bronx, New York City.

GUTHRIE, Marion J. (A 1916), P. O. Box 125, Birmingham, Mich.

HALL, James A. (A 1920), Associate Prof. of M. E., Brown University, Providence, R. I.

HALL, Keppele (S 1915), Supt. of Planning, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

HAMBURGER, Adolf L. (J 1920), Isaac Hamburger & Sons, Baltimore and Hanover Streets, Baltimore, Md.

HANDS, Ronald C. (S 1921), Industrial Engr., Eastman Kodak Company, Kodak Park, Rochester, N. Y.

HANSEN, Edward H. (S 1921), Supervising Engr., The Thompson & Lichtner Company, 136 Federal Street, Boston, Mass.

HATCH, Frank S. (S 1920), Asst. Treas., Moore Drop Forging Company, 38 Walter Street, Springfield, Mass.

HATHAWAY, H. K. (S 1912), Consulting Engr., 1109 Finance Building Philadephia, Pa.

HAYDEN, Harold B. (A 1917), Treas., Dennison Manufacturing Company, Framingham, Mass.

HAYNES, Rowland (A 1921), Director, Cleveland Recreation Council, Room 607 Electric Building, Cleveland, O.

HAZEN, John N. (J 1921), Secy.-Treas., Taylor Logan Company Papermakers, Holyoke, Mass.

HECKMAN, J. C. (S 1919), Cheney Bros., 215 Fourth Avenue, New York City.

HEINTZMAN, Cass J. (J 1920), Foreman, The Holt Manufacturing Company, Peoria, Ill.; *mail* 218 N. Perry Avenue, Peoria, Ill.

HEMMERLY, Wm. D. (S 1917), Management Engr., 119 Livingston Avenue, Lowell, Mass.

HENDERSON, Leon (A 1921), Instructor in Industry, Dept. of Geog. and Ind., Wharton School, University of Pennsylvania, Philadelphia, Pa.; *mail* Shirer Apt., Swarthmore, Pa.

HENNAN, Mary (A 1921), Gen. Supervisor of Routing and Assignment, The Joseph and Feiss Company, 2149 West 53rd Street, Cleveland, O.

HERRMANN, Charles (S 1917), Proprietor, Herrmann Embroidery Works, 23 Gordon Street, South River, N. J.

HERRMANN, Karl (S 1916), Gen'l Mgr., Herrmann, Aukam and Company, Lebanon, Pa.

HERRMANN, Milton C. (S 1914), 245 West 75th Street, New York City.

HERROLD, Russell P. (J 1920), The Mosaic Tile Company, Zanesville, O.; mail 955 Brighton Boulevard, Zanesville, O.

HERZOG, Herman Alfred (J 1921), Plant Research Chemist, Gorton Pew Fisheries, Gloucester, Mass.; *mail* 221 Prospect Street, Lawrence, Mass.

HETHERINGTON, Charles G. (A 1921), Master in Science and Mathematics, Harstrom School; *mail* 1234 College Avenue, Alpine, N. Y.

HEXTER, Irving B. (A 1921), Vice-Pres., Asst. Gen'l Mgr. and Production Mgr., The E. Sperling Company, Cleveland, O.

HICKEN, Henry E. (S 1919), Senior Examiner, U. S. Shipping Board, Washington, D. C.; *mail* Brandywine Summit, Route No. 2, Pa.

HIGGINS, Edward William (J 1921), White Motor Company, Cleveland, O.

HILLES, Edith (J 1921), Staff, Bureau Women in Industry, N. Y. State Dept. of Labor, 124 West 28th Street, New York City; *mail* 41 Charlton Street, New York City.

HILTON, Cecil Max (A 1919), 34 Ohio Street, Bangor, Me.

HIRTH, Emma P. (S 1921), Director, Bureau of Vocational Information, 2 West 43rd Street, New York City.

HOBBS, Arthur Everett (J 1921), Western New England Mgr., Hoyt's Service, Inc., Third National Bank Building, Springfield, Mass.; *mail* 19 Continental Street, Springfield, Mass.

HOFFMAN, Arthur C. (S 1920), Factory Mgr., The Printz-Biederman Company, Cleveland, O.

HOLLAND, Walter H. (A 1917), Leesburg, Fla.

HOLMES, Ferdinand M .(A 1917), Vice-Pres., Old Colony Trust Company, 17 Court Street, Boston, Mass.; *mail* 50 Warren Street, Everett, Mass.

HOLT, Alfred B. (A 1921), Vice-Pres., The Holt Manufacturing Company, Peoria, Ill.

HOPF, Harry A. (S 1919), Organization Counsel, Federal Reserve Bank, 120 Broadway, Rm. 2524, New York City.

HOPKINS, L. B. (S 1920), Treas., The Scott Company, 751 Drexel Building, Philadelphia, Pa.

HOPKINSON, Ruth W. (A 1921), Supervisor of Payroll and Costs, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 14720 Lake Avenue, Cleveland, O.

HORN, Norman E. (J 1920), Supt., Sales Service Dept., Winchester Repeating Arms Company, New Haven, Conn.

HORST, Amos L. (J 1920), 15 Ivy Close, Forest Hills, L. I., N. Y.

HORWITZ, Harry B. (S 1921), Supervisor, Methods and Layout, The Joseph and Feiss Company, 2149 West 53rd Street, Cleveland, O.

HOSKINS, Mrs. Jean (S 1920), Personnel Work and Employment Management, 4 West 40th Street, New York City.

HOTZ, Harry P. (A 1921), Sales Mgr., Jos. Schlitz Beverage Company, Milwaukee, Wis.

HOWARD, Earl Dean (S 1921), Labor Mgr., Hart, Schaffner & Marx, 36 S. Franklin Street, Chicago, Ill.

HOWELL, Edward I. H. (A 1917), 560 Bullitt Building, Philadelphia, Pa.

HOYT, Mrs. Florence V. (A 1921), Personnel Mgr., Lincoln Twist Drill Co., Taunton, Mass.; *mail* 336 West 46th Street, New York City.

HUDSON, Ray M. (S 1917), Mgr., Methods and Personnel, The Holt Manufacturing Company, Peoria, Ill.

HULL, Carrie G. (S 1921), Pres., Dutchess Manufacturing Company, 15-17 Crannel Street, Poughkeepsie, N. Y.

HUNT, Edward Eyre (S 1920), Sec'y, Conference on Unemployment, Dept. of Commerce, Washington, D. C.

HUNT, John O. (S 1921), Factory Mgr., Joseph Tetley & Company, Inc., New York City; *mail* 16 Cornell Avenue, Yonkers, N. Y.

HUSBAND, Richard Wellington (A 1921), Associate Dean of Dartmouth College, Hanover, N. H.

HUTKIN, Herman J. (S 1920), Foreman, Methods and Layout, The Joseph and Feiss Company, 2149 West 53rd Street, Cleveland, O.

IMLAY, Robert (J 1921), Industrial Engr., Eastern Manufacturing Company, Bangor, Me.

INGERSOLL, Wm. H. (S 1921), Pres. and Gen'l Mgr., Positype Corporation of America, 246 Fifth Avenue, New York City.

JACOBSTEIN, Meyer (S 1920), Labor Mgr., The Stein-Bloch Company, 164 St. Paul Street, Rochester, N. Y.

JAMES, Gorton (S 1921), Instructor, Harvard Graduate School of Business Administration, Cambridge, Mass.

JELLEME, Wm. O. (S 1920), Technical Supt., Brighton Mills, Passaic, N. J.

JENKIN, A. Sidney (S 1919), Secy., Wilmer Atkinson Company, 230 South 7th Street, Philadelphia, Pa.

JENNE, Lyle L. (J 1914), Chemical Engr., State Road and Pennypack Street, Holmesburg, Philadelphia, Pa.

JOHNSON, Edwin Clifford (S 1921), Pres. H. A. Johnson Company, 221 State Street, Boston, Mass.

JOHNSTON, John F. (S 1921), Asst. Mgr., Union Construction Company, Oakland, Cal.; *mail* 2575 Cedar Street, Berkeley, Cal.

JONES, Arthur B. (S 1919), Vice-Pres., Clark, MacMullen and Riley, 101 Park Avenue, New York City.

JONES, Gurdon B. (S 1920), Head of Organization and Methods Section, Walworth Manufacturing Company, 88 Pearl Street, Boston, Mass.

JONES, Harold F. (S 1921), Management Engr., The Leffingwell-Ream Company, 327 S. LaSalle St., Chicago, Ill.;

JOPLING, Morgan W. (S 1921), Partner, Jopling and Perrin, 18 Exchange Place, New York City.

JOSEPH, Isaac (A 1921), Vice-Chairman of Board, The Joseph & Feiss Company, P. O. Box 690, Cleveland, O.

JOSEPH, Ralph S. (S 1921), Advertising and Sales Mgr., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

JOSEPH, Siegmund (A 1921), Pres., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

JURGENSEN, Jess C. (S 1919), Consulting Industrial Engr., Acme White Lead and Color Works, St. Aubin Avenue, Detroit, Mich.

KARABASZ, Victor S. (J 1921), Instructor, Wharton School, University of Pennsylvania, Philadelphia, Pa.; *mail* 1518 N. Fourth Street, Philadelphia, Pa.

KARSTEN, Karl G. (A 1921), Statistician, Consulting Service, 308 West 22nd Street, New York City.

KAUFMAN, Joseph (J 1921), Planning Dept., Development Engr., Lycoming Rubber Company, Williamsport, Pa.

KAYNOR, Warren Fox (A 1921), Sec'y and Gen'l Mgr., Waterbury Button Company, Waterbury, Conn.

KEITH, Harold C. (S 1920), Pres., Geo. E. Keith Company, 23 Station Avenue, Campello, Mass.

KELLER, Carl Tilden (S 1921), Mgr., Lybrand, Ross Bros. & Montgomery, 261 Franklin Street, Boston 9, Mass.

KELLER, Wm. A. (A 1921), Pres., The Keller Knitting Company, 5100 Euclid Avenue, Cleveland, O.

KELLER, Wm. H. (S 1921), Pres. and Gen'l Mgr., Keller Pneumatic Tool Company, Fulton Street, Grand Haven, Mich.

KELLY, Timothy (S 1912), Factory Mgr., Brighton Mills, Manhattan Avenue, Passaic, N. J.

KEMP, Elda M. (A 1921), Foreman of Balance of Stores, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.; *mail* 4410 Franklin Avenue, Cleveland, O.

KENDALL, H. P. (S 1912), Manufacturer and Banker, 60 Congress Street, Boston, Mass.

KENNEDY, Norman F. (J 1921), Lewis Manufacturing Company, Walpole, Mass.

KENNEDY, R. Oakley (S 1920), Director, Cluett, Peabody and Company, Inc., 433 River Street, Troy, N. Y.

KENT, Edward R. (S 1920), Supt., Celluloid Company, 290 Ferry Street, Newark, N. J.; *mail* 61 Ely Place, East Orange, N. J.

KENT, Jay P. (J 1920), Resident Engr., The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.

KENT, Robert T. (S 1912), 41 S. Fullerton Avenue, Montclair, N. J.

KERNOHAN, R. B. (S 1920), Asst. Gen. Mgr., Jones and Laughlin Steel Company, 3rd Avenue and Ross Street, Pittsburgh, Pa.

KERR, George H. (S 1921), Mgr., Sales Record Bureau, E. I. duPont Company, Wilmington, Del.; *mail* P. O. Box 277, Wilmington, Del.

KIBBEE, Austin S. (S 1920), Treas. & Gen. Mgr., Lewis A. Crossett Company, North Abington, Mass.

KILDUFF, F. W. (A 1921), Mgr., Claims and Statistics, The Holt Manufacturing Company, Peoria, Ill.

KIMBER, Wm. M. C. (S 1919), Vice-Pres. & Prod. Mgr., Leeds and Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa.

KING, Frederick A. (A 1921), 69 West 11th Street, New York City.

KING, Julius, II, (A 1920), Advertising Mgr., Julius King Optical Company, 12 Maiden Lane, New York City.

KINGSTON, Harold C. (J 1921), Asst. Merchandise Mgr., James McCreery & Company, 5 West 34th Street; New York City; *mail* 19 West 35th Street, New York City.

KIRK, William W. (J 1921), Asst. Merchandise Mgr.. James McCreery & Company, 5 West 34th Street, New York City.

KNIPHER, Frederic C. (S 1920), Electrical Engr., Sprague Works of General Electric Company, Bloomfield, N. J.; *mail* 735 Springdale Avenue, East Orange, N. J.

KRAUSE, Edwin (S 1916), Vice-Pres. & Gen. Mgr., The Harley Company, Page Boulevard, Springfield, Mass.; *mail* 141 Wilbraham Road, Springfield, Mass.

KRESS, A. L. (J 1919), Industrial Engr., Lycoming Rubber Company, Rose Street and Erie Avenue, Williamsport, Pa.; *mail* 330 Centre Street, Williamsport, Pa.

KROMER, Oswald C. (S 1920), Supervisor of Time Study, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

KRUEGER, Elmer R. (A 1921), Factory Supt., The P. A. Geier Company, 5112 St. Clair Avenue, Cleveland, O.

KUNZE, Franklin J. (S 1921), Mgr. of Production Control, American Multigraph Company, Cleveland, O.

LAMSON, Frederick L. (S 1916), Treas., Norwalk Tire and Rubber Company, Norwalk, Conn.

LANE, Henry R. (S 1920), Sales Mgr., Lewis Manufacturing Company, 60 Congress Street, Boston, Mass.

LANSBURGH, Richard H. (A 1920), Asst. Prof. of Industry, Wharton School, University of Pennsylvania, Logan Hall, Philadelphia, Pa.

LARSON, Fred C. (J 1921), Lycoming Rubber Company, Williamsport, Pa.

LATT, Walter E. (A 1917), Asst. Supt. Planning, Rock Island Arsenal, Rock Island, Ill.: *mail* 726 Ridgewood Avenue, Davenport, Iowa.

LAUER, Conrad N. (S 1912), Secy. & Treas., Day and Zimmermann, Inc., 611 Chestnut Street, Philadelphia, Pa.; *mail* 233 West Hortter Street, Philadelphia, Pa.

LEA, Charles L. (J 1921), 1221 Columbus Avenue, Sandusky, O.

LEEDS, Morris E. (S 1921), Pres., Leeds and Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa.

LEESON, Robert A. (S 1921), Treas. Universal Winding Company, 95 South Street, Boston, Mass.

LEFFINGWELL, W. H. (S 1919), Pres., The Leffingwell-Ream Company, Flatiron Building, New York City.

LEFTON, Al Paul (J 1921), Mgr., Mail Order Dept., Strawbridge & Clothier, Philadelphi,a Pa.

LEISERSON, William M. (S 1921), Chairman, Labor Adjustment Board, 416 Beckley Building, Rochester, N. Y.

LENZER, Hugo (A 1920), Labor Mgr., Clothing Manufacturers Association, 752 Broadway, New York City.

LEWIS, E. St. Elmo (S 1919), Vice-Pres. and Mgr., Campbell-Ewald Company, 18 West 34th Street, New York City; *mail* 60 Sherman Avenue, Glen Ridge, N. J.

LEWIS, Wilfred (S 1912), Pres. & Treas., The Tabor Manufacturing Company, 6225 State Road, Philadelphia, Pa.

LEWISOHN, Sam A. (S 1921), Member, Adolph Lewisohn & Sons, 61 Broadway, New York City.

LICHTNER, Wm. O. (S 1912), Partner, The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.; *mail* 34 Woodcliffe Road, Newton Highlands, Mass.

LIES, B. Eugenia (J 1920), Director of Planning, R. H. Macy and Company, Inc., Herald Square, New York City.

LILLEY, W. A., Jr. (A 1919), Senior Examiner, Emergency Fleet Corp., 140 N. Broad Street, Philadelphia, Pa.; *mail* 6225 Spruce Street, Philadephia, Pa.

LINDBLOM, William V. (A 1919), Head of Planning & Statistics Dept., Walworth Manufacturing Company, 88 Pearl Street, Boston, Mass.; mail Lock Drawer 26, Boston, Mass.

LINDSAY, James C. (S 1921), Industrial Engr., Pacific Steamship Co., Seattle, Wash.; *mail* 1158—15th Avenue N., Seattle, Wash.

LOMBARD, Marshall L. (J 1921), Colebrook, N. H.

LOUCKS, Walter Bott (A 1921), Production Mgr., Geo. A. Hormel & Company, Austin, Minn.

LUBIN, Simon J. (S 1921), Pres., Weinstock, Lubin and Company, 400 K Street, Sacramento, Cal.

LYALL, Wm. L. (S 1912), Pres. & Treas., Brighton Mills, Passaic, N. J.

McAUSLAN, Arthur A. (A 1921), Asst. Production Mgr., Universal Winding Company, Auburn, R. I.; *mail* 217 Lexington Avenue, Providence, R. I.

McDERMOTT, Luke B. (A 1921), Plant Engr., H. H. Franklin Company, 123 Marcellus Street, Syracuse, N. Y.; *mail* 812 Park Avenue, Syracuse, N. Y.

McDONALD, Adrian J. (J 1921), Head Dept. of Production and Orders, Electric Drill and Grinder Division, Burke Electric Company, Erie, Pa.

McELWAIN, J. Franklin (S 1919), Pres., W. H. McElwain Company, 354 Congress Street, Boston, Mass.

McKAY, Evelyn C. (J 1921), Job Analyst, Planning Dept., R. H. Macy & Company, Herald Square, New York City.

McKINSEY, James O. (S 1921), Partner; Resident Mgr. of New York Office, Frazer and Torbet, 50 Broad Street, New York City.

MacNAMARA, Matthew J. (S 1921), Works Mgr., The S. S. White Dental Manufacturing Company, 211 South 12th Street, Philadelphia, Pa.

MacNEILL, Arthur W. (A 1916), Efficiency Engr., Detroit Pressed Steel Company, 6660 Mt. Elliott Avenue, Detroit, Mich.

McSHANE, Elizabeth (J 1920), Research Worker in Industrial Clinic, Massachusetts General Hospital, Boston, Mass.

MACHOL, Morris R. (S 1920), Organization Engr., 274 Central Park West, New York City.

MACK, William J. (S 1921), Impartial Chairman, Ladies Garment Industry, 401 Racine Building, Cleveland, O.

MADDEN, James L. (A 1920), Supervisor, Policyholders Service Bureau, Metropolitan Life Insurance Company, 1 Madison Avenue, New York City; *mail* 7 Roman Avenue, Forest Hills, L. I.

MAIZE, Frank P. (A 1916), Master Mechanic, Portland Railway Light and Power Company, East 17th and Center Streets, Portland, Oregon.

MALLERY, Otto T. (S 1921, Member Industrial Relations Comm. of Industrial Board of Pennsylvania, 1513 Walnut Street, Philadelphia, Pa.

MANN, Arthur L. (A 1921), Supervisor of Training, Eastman Kodak Company, Kodak Park, Rochester, N. Y.

MARBLE, Edwin Tyler, 2nd (J 1920), Purchasing Agent, Curtis and Marble Machine Company, 72 Cambridge Street, Worcester, Mass.

MARKS, Julian I. (S 1921), Examiner, N. Y. State Legislative Committee to Investigate the Affairs of the City of N. Y., 38 Park Row, New York City; *mail* 610 West 180th Street, New York City.

MATEER, Raymond C. (A 1917), Purchasing Agent, Scott Paper Company, Front and Market Streets, Chester, Pa.

MATHENY, C. A. (A 1920), Tool Engr., The Holt Manufacturing Company, Peoria, Ill.; *mail* 905 N. Perry Avenue, Peoria, Ill.

MAY, Meredith R. (J 1921), Engr., The Leffingwell-Ream Company, 327 S. LaSalle Street, Chicago, Ill.

MAYO-SMITH, Richmond (S 1916), Director, Plimpton Press, Norwood, Mass.

MEDCALF, Gregory (J 1920), Spec. Work Org. and Methods, Noyes Brothers and Cutler, Inc., St. Paul, Minn.; *mail* 945 Hague Avenue, St. Paul, Minn.

MEISINGER, Roy N. (J 1919), Investigator and Designer, The Holt Manufacturing Company, Peoria, Ill.; *mail* 311 North Bourland Avenue, Peoria, Ill.

MERKEL, Harold L. (A 1920), Fashion Park, Rochester, N. Y.

MERRICK, Dwight V. (S 1912), Consulting Engr., 34 Gramercy Park, New York City.

MICHELIN, Jules H. (S 1920), Gen. Mgr., Michelin Tire Company, Milltown, N. J.

MILES, C. C. (S 1916), P. O. Box 32, Lancaster, Mass.

MILLER, Fred J. (S 1919), Management Engr., 50 West 12th Street, New York City.

MILLER, Theodore D. (J 1919), Pres., General Construction Company of Williamsport, Pa., Room 1, Goldenberg Building, Williamsport, Pa.; *mail* 111 Market Street, Williamsport, Pa.

MILLS, C. M. (A 1921), Industrial Consultant, National Industrial Conference Board, 10 East 39th Street, New York City; *mail* 490 West End Avenue, New York City.

MITCHELL, Fred B. (J 1917), 584 Market Street, Paterson, N. J.

MITCHELL, Shirley R. (S 1921), Mgr., Walworth Manufacturing Company, Kewanee, Ill.

MITCHELL, T. W. (S 1916), Consulting Management Engr., 1100 Finance Building, Philadelphia, Pa.

MIXTER, C. W. (A 1921), 1726 Eye St., N. W., Washington, D. C.

MOREHEAD, F. Hugh (S 1921), Mgr. Boston Works, Walworth Manufacturing Company, 88 Pearl Street, Boston, Mass.

MOREY, Chester T. (A 1917), Rhode Island Tool Company, 148 West River Street, Providence, R. I.

MORRILL, C. G. (S 1920), 3 Willowdale Court, Montclair, N. J.

MOSHER, Harrison Hume (J 1921), R. A. Fife Corporation, Mamaroneck, N. Y.

MOULD, Arthur E. (A 1920), Industrial Engineering, A. E. Mould, 239 Powers Building, Rochester, N. Y.; *mail* 103 Atkinson Street, Rochester, N. Y.

MURPHY, Jerry E. (A 1920), Supt. of Materials, The Holt Manufacturing Company, Washington Street, Peoria, Ill.

NEUMARK, Leo W. (A 1921), Adv. and Mdse. Mgr., The Printz-Biederman Company, 425 Lakeside Avenue, Cleveland, O.

NAUMBURG, Robert E. (J 1920), Research Engr., Saco-Lowell Company, Lowell, Mass.

NEUSTADT, Richard (S 1921), Consultant Industrial Relations and Management, 710 Alaska Commercial Building, San Francisco, Cal.

NEWMAN, Emanuel (A 1921), Planning Mgr., The H. Black Company, 1912 Superior Avenue, Cleveland, O.

NIESER, Joseph F. (A 1921), Production Mgr., The Arco Company, Cleveland, O.; *mail* 9500 Kinsman Avenue, Cleveland, O.

NORTHIME, Frank E. (S 1917), Comptroller, Aberfoyle Manufacturing Company, 3rd Street and Morton Avenue, Chester, Pa.; *mail* 703 East 21st Street, Chester, Pa.

NORTON, William W. (A 1921), Mgr. Export Dept., Irwin-Harrisons & Crosfield, Inc., 127 Water Street, New York City.

NOYES, Henry T (S 1912), Treas. & Gen. Mgr., Art in Buttons, Inc., Rochester, N. Y.

O'CONNOR, Chas. W. F. (S 1919), Prod. Mgr., Universal Winding Company, Providence, R. I.; *mail* 158 Armington Street, Edgewood, R. I.

ODENCRANTZ, Louise C. (A 1921), Employment Mgr., Smith & Kaufmann, Inc., 549 West 132nd Street, New York City.

OLSON, Otto A. (S 1921), Vice-Pres. and Supt., Simonds Manufacturing Company, Chicago, Ill.

OSGOOD, Merrill W. (A 1921), Methods Director, Jordan Marsh Company, 450 Washington Street, Boston, Mass.

O'SHEA, Peter F. (S 1921), Editorial Representative and Contributing Editor, *System and Factory*, A. W. Shaw Company, 660 Cass Street, Chicago, Ill.

OSLER, Frank (S 1921), Mgr. of Production, The Harley Company, Page Boulevard, Springfield, Mass.; *mail* 5 E. Central Park Apts., Central Avenue and 20th Street, Indianapolis, Ind.

OTTERSON, John E. (S 1915), Pres., Winchester Repeating Arms Company, 275 Winchester Avenue, New Haven, Conn.

OUTHWAITE, Leonard (A 1920), Bureau of Industrial Research, 289 Fourth Avenue, New York City; *mail* Bennington, Vt.

PAASCHEN, Edwin V. (S 1921), Staff Member, Scovell Wellington and Company, 27 William Street, New York City

PACE, Anderson (S 1921), Sales Mgr., American Wholesale Corporation, Liberty and Baltimore Streets, Baltimore, Md.

PALMER, Elbridge W. (A 1916), Secy. & Gen. Mgr., J. F. Tapley Company, Metropolitan Building, Thompson Avenue and Court Street, Long Island City, N. Y.

PALMER, Gladys Louise (J 1921), Instructor, Economics Department, Vassar College, Poughkeepsie, N. Y.; *mail* 2244 North 29th Street, Philadelphia, Pa.

PALMER, Virgil M. (S 1920), Engr. of Industrial Economy, Eastern Kodak Company, Kodak Park Works, Rochester, N. Y.

PARTRIDGE, F. H. (A 1921), Auditor, Hayes & Hayes, Bankers, Aberdeen, Wash.

PARTRIDGE, Irving E., Jr. (J 1920), Industrial Engr., The Case, Lockwood and Brainard Company, 141 Pearl Street, Hartford, Conn.

PECK, Paul Noble (A 1920), Investigator, U. S. Bureau of Efficiency, Washington, D. C.; *mail* 1718-22nd Street, N. W. Washington, D. C.

PERRIS, Norris M. (J 1921), Organization Engr., Board of Education, Cleveland, O.; *mail* 10018 Westchester Avenue, Cleveland, O.

PERSON, H. S. (S 1912), Managing Director, Taylor Society, 29 West 39th Street, New York City.

PETERS, Ralph E. (A 1920), Works Engr., J. F. Tapley Company, Metropolitan Building, Thompson Avenue and Court Street, Long Island City, N. Y.

PETERSON, Edward (S 1921), Staff Asst. to Mgr., Walworth Manufacturing Company, Kewanee, Ill.

PHELPS, Stephen B. (A 1920), Organizing Engr., Jones & Laughlin Steel Company, 27th & Carson Streets, Pittsburgh, Pa.

PIDOT, Samuel Louis (S 1921), Consulting Industrial Engr., 109 N. Dearborn Street, Chicago, Ill.

PITT, William (S 1920), Vice- Pres. & Gen. Mgr., Irving-Pitt Manufacturing Company, 405-11 East 8th Street, Kansas City, Mo.

PLOEGER, Helen E. (J 1921), Supervisor, Assignment Division, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

POLAKOV, Walter N. (S 1915), Walter N. Polakov and Company, Inc., 33 West 42nd Street, New York City.

POLIAKOFF, R. (S 1919), Managing Trustee, Russian Remington Rifle Contract Trustees, Room 1014, 709 Sixth Avenue, New York City.

PONCET, John (S 1921), Sales Mgr., Cravat Dept., Cheney Brothers, 215-219 Fourth Avenue, New York City.

PORT, Arthur C. (S 1921), Sales Mgr., The Kaynee Company, 6925 Aetna Road, Cleveland, O.

POWER, Earl D. (J 1921), White Motor Company, Cleveland, O.; *mail* 8821 Euclid Avenue, Cleveland, O.

PRAY, Maynard Edward (J 1921), Asst. to Manufacturing Executive, The Holt Manufacturing Company, Peoria, Ill.

PRESCOTT, Allen B. (J 1921), 1624 Hazel Drive, Cleveland, O.

PRESCOTT, Chas. J. (S 1919), Vice-Pres., W. H. McElwain Company, 354 Congress Street, Boston, Mass.

PRINTZ, Alexander (S 1921), Pres., The Printz-Biederman Company, 425 Lakeside Avenue, Cleveland, O.

QUATTLANDER, Paul (A 1921), Vice.-Pres., James McCreery Company, 5 West 34th Street, New York City.

RAMAKER, Benjamin A. (S 1921), Asst. Production Mgr., Bausch & Lomb Optical Company, Rochester, N. Y.

RAY, Martin H. (S 1919), Vice-Pres., Murphy-Ray, Inc., 165 Broadway, New York City.

REAM, Myrton E. (S 1920), Vice-Pres., The Leffingwell-Ream Company, 327 South LaSalle Street, Chicago, Ill.

RECKFORD, John K. (J 1920), Secy., American Lead Pencil Company, 220 Fifth Avenue, New York City.

REED, Harry K. (J 1920), Student Engr., The Tabor Manufacturing Company, 6225 State Road, Tacony, Philadelphia, Pa.; *mail* 3528 North 21st Street, Philadelphia, Pa.

REED, Hudson Wm. (S 1921), Production Mgr., Henry Sonneborn Company, Inc., Paca & Pratt Streets, Baltimore, Md.

REGAN, Joseph C. (S 1912), 155 West Main Street, New Britain, Conn.

REILLY, Philip J. (S 1920), Head of Personnel and Organization Division, Retail Research Association, 225 Fifth Avenue, New York City.

REINTHAL, Arthur J. (J 1921), Mgr., Planning Dept., The Bamberger-Reinthal Company, Cleveland, O.

RETICKER, Ruth (J 1921), Foreman in Service Dept., The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

RHOADES, Herbert Le Roy (J 1921), Research, Metropolitan Life Insurance Company, 1 Madison Avenue, New York City.

RIBLET, Ronald F. (A 1921), Supt. of Expense Control and Methods, James McCreery & Company, 5 West 34th Street, New York City.

RICH, Alfred B. (S 1916), Asst. Mgr. of Works, Dennison Manufacturing Company, Framingham, Mass.; *mail* 15 Ardmore Road, West Newton, Mass.

RICHARDSON, Ralph (S 1920), Pres., Chicago Carton Company, 4433 Ogden Avenue, Chicago, Ill.
RICHARDSON, William Samuel (A 1921), Head of Production Dept., Boston Woven Hose & Rubber Company, 26 Hampshire Street, Cambridge, Mass.
RICHON, J. L. (S 1920), Management Engr., Henry Heide, Inc., 313 Hudson Street, New York City.
RICKETTS, William B. (S 1919), Director of Research, J. Walter Thompson Company, Lytton Building, Chicago, Ill.
RIKE, Frederick H. (S 1919), Pres., The Rike-Kumler Company, Main at Second Street, Dayton, O.
ROBINSON, Prof. Edward (A 1914), Prof. of Mechanical Engineering, University of Vermont, Burlington, Vt.; *mail* 25 Colchester Avenue, Burlington, Vt.
ROGERS, Rowland (A 1921), Vice-Pres. & Gen. Mgr., Picture Service Corp., 51 East 42nd Street, New York City; *mail* 65 West 83rd Street, New York City.
ROUNSEVILLE, Roy W. (S 1921), Supt. of Shops, Walworth Manufacturing Company, Kewanee, Ill.
RUMBERGER, B. F. (J 1920), Engineer, Edgar Thomson Works, Carnegie Steel Company, Braddock, Pa.; *mail* 513 Holmes Street, Wilkinsburg, Pa.
RUMMEL, Fred J. (J 1920), The Stevenson Corp., 120 Broadway, New York City.
RYAN, W. D. (A 1920), Production Control, Art in Buttons, Inc., Rochester, N. Y.; *mail* Central Y. M. C. A., Rochester, N. Y.
SABIN, Carlton R. (J 1921), Engr., Grasselli Chemical Company, 1400 Guardian Building, Cleveland, O.
SCHAUFFLER, Mary (A 1921), Service Supt., Warner Div.; Bay State Cotton Corp., Charles Street, Newburyport, Mass.
SCHEEL, Henry V. R. (S 1912), Asst. Treas., Brighton Mills, Passaic, N. J.
SCHMEH, John C. (J 1920), 29 South 2nd Street, Lebanon, Pa.
SCHMIDT, Emil J. (A 1916), Industrial Engr., Sewell-Clapp-Envelopes, 23 North Desplaines Street, Chicago, Ill.
SCHOONMAKER, Oliver J. (S 1920), Treas., W. F. Whitney Company, South Ashburnham, Mass.
SCHREIBER, Louis (J 1921), Asst. Planning Mgr., The H. Black Company, 1912 Superior Avenue, Cleveland, O.
SCHREMP, Edward J. (S 1921), Sales Mgr., U. S. Hoffman Sales Company, 105-4th Avenue, New York City.
SCHULZ, Arthur K. (A 1919), Chase National Bank, 57 Broadway, New York City; *mail* 55 Hanson Place, Brooklyn, N. Y.
SCHULZ, Gustav E. (S 1917), Jones and Laughlin Steel Company, Pittsburgh, Pa.; *mail* 6730 Thomas Boulevard, Pittsburgh, Pa.
SCHULZE, J. William (A 1916), Pres. & Gen. Mgr., Alfred Vester Sons, Inc., 5 Mason Street, Providence, R. I.
SCHWAB, Arthur (S 1921), Industrial Engr., Room 605—320 Broadway, New York City.
SCOTT, Albert L. (S 1919), Vice-Pres., Lockwood, Greene and Company, 60 Federal Street, Boston, Mass.
SCOTT, Rumsey (W. (S 1921), Vice-Pres., Chemical National Bank, 270 Broadway, New York City.
SCOTT, Walter Dill (S 1920), Pres., Northwestern University, Evanston, Ill.
SCOVILLE, John Harris (S 1915), Asst. Engineer, Bethlehem Shipbuilding Corp., Ltd., Moore Plant, 57 First Street, Elizabeth, N. J.; *mail* 137 Springfield Road, Elizabeth, N. J.
SELEKMAN, Ben Morris (J 1921), Staff Member, Russell Sage Foundation, 130 East 22nd Street, New York City.
SELLEW, W. Welles (J 1921), Production Man, Gorton Pew Fisheries Company, Gloucester, Mass.
SENCINDIVER, H. E. (A 1919), Credit Mgr., Knox Hat Company, Inc., New York City; mail 330 West 85th Street, New York City.
SHAW, A. W. (S 1920), Pres., A. W. Shaw Company, 660 Cass Street, Chicago, Ill.
SHAW, Winfield L. (S 1919), Vice-Pres., W. H. McElwain Company, McElwain Central Plant, Manchester, N. H.
SHELTON, Henry W. (S 1916), Consulting Engr., 804 Pennsylvania Building, Philadelphia, Pa.
SHEPARD, J. R. (A 1921), Branch Office Mgr., Remington Typewriter Company, 110 South 9th Street, Philadelphia, Pa.
SHEPHERD, Miriam G. (A 1921), Executive Sec'y, International Congress of Working Women, 1423 New York Avenue N. W., Washington, D. C.
SIDES, Edwin E. (J 1920), Mgr., Cost Dept., Rice & Hutchins, Inc., Rockland, Mass.; *mail* 105 Plain Street, Rockland, Mass.
SIEGRIST, Charles E. (J 1921), Bankers Trust Company, Foreign Exchange Dept., 16 Wall Street, New York City.
SIMEON, Charles John (S 1920), Prod. Mgr., Morgan Construction Company, 15 Belmont Street, Worcester, Mass.; *mail* 22 Dayton Street, Worcester, Mass.
SIMONDS, Alvan T. (S 1920), Pres., Simonds Manufacturing Company, 470 Main Street, Fitchburg, Mass.
SIMPSON, J. Henry, Jr. (J 1921), Organization and Methods Dept., Jones & Laughlin Steel Company, South Side Works, Pittsburgh, Pa.
SMITH, George T. (J 1921), Gen'l Supervisor of Production, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.
SMITH, Harold Lyman (S 1918), Industrial Engr., Winchester Repeating Arms Company, New Haven, Conn.; *mail* 95 Foster Street, New Haven, Conn.
SMITH, Howard A. (J 1921), Supt., Warner Brothers Company, Bridgeport, Conn.
SMITH, James H. (J 1920), Bureau of Commercial Economics 72 W. Adams Street, Chicago, Ill.
SMITH, W. Bush (J 1920), Supt., Ferris Shoe Company, Monmouth and Janney Streets, Philadelphia, Pa.; *mail* 112 Kathmere Road, Brookline, Upper Darby P. O., Pa.
SMYTHE, J. J., Jr. (A 1920), The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.; *mail* 1715 Edgely Street, Philadelphia, Pa.
SNYDER, Theodore R. (J 1921), Instructor in Industry, Wharton School, University of Pennsylvania, Philadelphia, Pa.
SOLOMON, David (A 1921), Sec'y, Pansy Waist Company, 145 West 30th Street, New York City.
SOLOMON, William (A 1921), Vice-Pres., Pansy Waist Company, 145 West 30th Street, New York City.
SOLOT, Benjamin F. (A 1920), Cost Engr., Day and Zimmermann, Inc., 611 Chestnut Street, Philadelphia, Pa.
SONNEBORN, Siegmund B. (S 1920), Pres., Henry Sonneborn and Company, Inc., Pratt and Paca Streets, Baltimore, Md.
SOULE, George (S 1921), Director, The Labor Bureau, Inc., 1 Union Square, New York City.
SOULE, Geo. Carroll (S 1920), Vice-Pres. & Gen. Mgr., Marine Hardware-Equipment Company, South Portland, Me.; *mail* 95 Vincent Street, South Portland, Me.
SPOONER, E. H. (S 1921), Supt. of Bindery, Plimpton Press, Norwood, Mass.; *mail* 122 Newberg Street, Roslindale, Mass.
STANFORTH, Richard (S 1917), Director of Research, Art in Buttons, Inc., Champeney Terrace, Rochester, N. Y.
STAUBACH, Charles P. (S 1921), Agency Mgr., Burroughs Adding Machine Company, 31 Clinton Street, Newark, N. J.
STEWART, Louis, Jr. (S 1920), First Vice-Pres. & Gen. Mgr., James McCreery and Company, 5 West 34th Street, New York City.
STEWART, Weir (J 1920), 32 Franklin Street, Auburn, N. Y.
STOKER, Harold C. (J 1920), Salesman, Metropolitan Life Insurance Company, Group Life Sales Division, New York City; *mail* 87 North Mountain Avenue, Montclair, N. J.
STONE, N. I. (S 1919), Labor Mgr., Hickey-Freeman Company, 1155 Clinton Avenue North, Rochester, N. Y.
STUART, Francis Lee (S 1920), Consulting Engr., 949 Broadway, New York City.
STUNZI, Jean Jacques (A 1919), Consulting Engr., Lancaster Steel Products Corp., Lancaster, Pa.
SUTTON, Frank W. (A 1920), Chief Engr., Chas. E. Bedaux Company, 4500 Euclid Avenue, Cleveland, O.

SWARTZ, Nelle (S 1921), Chief, Bureau of Women in Industry, New York State Department of Labor, 124 East 28th Street, New York City; *mail* 41 Charlton Street, New York City.

SWEENY, Louis Morenci (J 1921), Research & Standard Depts., Dutchess Manufacturing Company, Poughkeepsie, N. Y.; *mail* 30 Hammersley Avenue, Poughkeepsie, N. Y.

SWEETSER, Frank L. (S 1921), Gen'l Mgr., Sec'y and Treas., Dutchess Manufacturing Company, Poughkeepsie, N. Y.

SWEETSER, John A. (S 1921), Treasurer, Boston Manufacturing Company, 1901, 48 Franklin Street, Boston, Mass.

TABOR, Leroy (S 1912), Supt., The Tabor Manufacturing Company, 6225 Tacony Street, Philadelpia, Pa.; *mail* 2513 South Gainet Street, Philadelphia, Pa.,

TARBELL, Ida M. (S 1919), Writer, 120 East 19th Street, New York City.

TAYLOR, Edward Winslow, Jr. (J 1920), Student Worker, The Tabor Manufacturing Company, State Road, Wissinoming, Pa.; *mail* Wissahickon, Apt. A 1, Queen Lane, Germantown, Philadelphia, Pa.

TAYLOR, Mrs. Frederick W. (A 1921), Highland Station, Chestnut Hill, Philadelphia, Pa.

TAYLOR, Kempton P. A.—Dr. (J 1920), Physician, Highland Avenue, Chestnut Hill, Philadelphia, Pa.

TAYLOR, Otto F. (S 1920), Certified Public Accountant, Thompson and Worley, 14 Wall Street, New York City.

TAYLOR, Robert P. A. (J 1920), Asst. to Consulting Management Engr., Jones and Laughlin Steel Company, 27th and Carson Streets, Pittsburgh, Pa.

TEAD, Ordway (S 1920), Department of Industry, New York School of Social Work, 105 East 22nd Street, New York City.

TERRY, Edward James (J 1919), Supervisor Mach. & Oper. Analysis, The Holt Manufacturing Company, Peoria, Ill.

THOMAS, Leon Irving (S 1921), Associate Editor, A. W. Shaw Company, 660 Cass Street, Chicago, Ill.

THOMPSON, Frank H. (S 1921), Industrial Engr., Dennison Manufacturing Company, Framingham, Mass.

THOMPSON, Sanford E. (S 1912), Partner, The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.

THURBER, William E. (S 1921), Production Engr., Rhode Island Tool Company, 148 West River Street, Providence, R. I.; *mail* 120 Abbott Street, Providence, R. I.

TINGLEY, Harleigh V. S. (J 1921), Research Dept., Dennison Manufacturing Company, Framingham, Mass.; *mail* 57 Lawrence Street, Framingham, Mass.

TOWNE, Henry R. (S 1919), Chairman of the Board, Yale and Towne Manufacturing Company, 9 East 40th Street New York City.

TRAUTSCHOLD, Reginald (S 1920), Consultant, 522 Fifth Avenue, New York City; *mail* 305 N. Mountian Avenue, Montclair, N. J.

TRAYSER, Lewis W. (S 1921), Sales Research, Woodward & Tiernan Printing Company, 309 North 3rd Street, St. Louis, Mo.

TRESCKOW, Walter (A 1920), 122 Hastings Street, Bridgeport Conn.

TRULL, Lyman A. (A 1921), Asst. Supt., Lycoming Rubber Company, Williamsport, Pa.; *mail* 1025½ Rural Avenue, Williamsport, Pa.

TUTTLE, Morton C. (S 1919), Gen. Mgr., Aberthaw Construction Company, 27 School Street, Boston, Mass.

TUTTLE, Walter I. (S 1920), Pres. & Gen. Mgr., Frank Mossberg Company, Lamb Street, Attleboro, Mass.

UNDERWOOD, Charles N. (S 1920), Resident Engr., Frank B. Gilbreth, Inc., Montclair, N. J.; *mail* 405 West 6th Street, Erie, Pa.

UPHAM, Edwin O. (S 1919), Production Engr., U. S. Rubber Company, P. O. Box 606, New Haven, Conn.

VALLE, Paul B (J 1921), Purchasing Agent, Diamond State Fibre Company, Bridgeport, Pa.; *mail* 269 Hathaway Lane, Wynnewood, Pa.

VAN GEYT, Peter J. (J 1920), Labor and Production Mgr., Levy Brothers Clothing Company, 169 St. Paul Street, Rochester, N. Y.

VAN KLEECK, Mary (S 1919), Director, Division of Industrial Studies, Russell Sage Foundation, 130 East 22nd Street, New York City.

VEZIN, Charles, Jr. (S 1921), 261 Palisade Avenue, Yonkers, N. Y.

WALDO, John A. (S 1921), Vice-Pres. and Sales Mgr., Farley Harvey Company, 141 Essex Street, Boston, Mass.

WALDRON, Frederick A. (S 1921), Consulting Engr., 37 Wall Street, New York City.

WALKER, William L. (S 1920), Management Engr., Professional Work, 28 Union Street, Worcester, Mass.

WALLACE, F. R. (S 1916), Partner, Boyd and Wallace, 1613 Chestnut Street, Philadelphia, Pa.; *mail* c/o Dr. E. W. Taylor, Queen Lane, Germantown, Philadelphia, Pa.

WALLACE, John M. (J 1921), 610 East South Temple, Salt Lake City, Utah.

WALSH, D. J. (S 1914), Sanderson & Porter, 52 William Street, New York City.

WARREN, George L. (A 1920), Supt., Dept. of Personnel, Warner Brothers Company, Inc., 325 Lafayette Street, Bridgeport, Conn.

WEBB, Stuart W. (S 1916), Partner, Bond and Goodwin, 30 State Street, Boston, Mass.

WEBBER, William Sutton, Jr. (J 1921), Employment, Dept., Gorton-Pew Fisheries Company, Gloucester, Mass.; *mail* 16½ Washington Square, Gloucester, Mass.

WEIL, Edward S. (J 1921), Rosenwald & Weil, Chicago, Ill.

WEIL, S. D. (A 1920), Vice-Pres., The Arco Company, 6408 Euclid Avenue, Cleveland, O.

WELLMAN, Harry R. (S 1921), Prof. of Marketing, Amos Tuck School, Dartmouth College, Hanover, N. H.; *mail* Hanover, N. H.

WELLS, Arthur K. (A 1920), Resident Engr., The Thompson and Lichtner Company, 136 Federal Street, Boston, Mass.

WELTON, Benjamin F. (S 1921), Industrial Engr., Sterling Salt Company, Cuylerville, Livingston Co., N. Y.

WEMBRIDGE, Harry A. (J 1921), Student Foreman, The Joseph & Feiss Company, 2149 West 53rd Street, Cleveland, O.

WESSMANN, Robert H. (J 1919), Office Mgr., J. F. Tapley Company, Metropolitan Building, Thompson Avenue and Court Street, Long Island City, N. Y.

WEST, William T. (S 1920), Secy. & Treas., The A. Colburn Company, 2228 North Tenth Street, Philadelphia, Pa.

WHERRY, Henry P. (S 1920), Mgr., The Rossendale-Reddaway Belting and Hose Company, Euclid Avenue, Newark, N. J.

WHITAKER, S. Edgar (S 1913), Auditor, Street and Finney, Inc., 171 Madison Avenue, New York City; *mail* 111 Merriam Avenue, Bronxville, N. Y.

WHITE, Luther Clark (A 1920), Employment Mgr., Clothing Manufacturers Association of Boston, 99 Chauncy Street, Boston, Mass.

WHITEHILL, Morton S. (J 1919), The Wolf Company, 511 East 72nd Street, New York City; *mail* 801 West End Avenue, New York City.

WILLIAMS, Alfred H. (A 1921), Asst. Prof. of Industry, Wharton School, University of Pennsylvania, Philadelphia, Pa.

WILLIAMS, Henry H. (S 1919), Boyd & Wallace, 1613 Chestnut Street, Philadelphia, Pa.

WILLIAMS, J. Harvey (S 1921), Pres., J. H. Williams & Company, 150 Hamilton Avenue, Brooklyn, N. Y.

WILLIAMS, Mrs. Jane Comey (S 1920), Personnel Director, Plimpton Press, Norwood, Mass.

WILLIAMS, John H. (S 1912), New York Mgr., Day & Zimmermann, Inc., 2 Wall Street, New York City.

WILLIAMS, Leroy D. (S 1919), Supervisor Schedules & Despatch Sections, The Holt Manufacturing Company, Peoria, Ill.

WILLIAMSON, Wm. R. (S 1921), Williamson & Burgdolt, 400 N. Michigan Avenue, Chicago, Ill.
WILLITS, Joseph H. (S 1916), Prof. of Industry, Wharton School, University of Pennsylvania, 36th and Woodland Avenue, Philadelphia, Pa.
WILSON, Chester W. (S 1921), Supt., B. O. & G. C. Wilson, Inc., Boston, Mass.; *mail* 5 Adams Street, Medford Hillside (57), Mass.
WILSON, Edward A. (A 1921), Pres. & Treas., B. O. & G. C. Wilson, Inc., 196 Cambridge Street, Boston, Mass.
WILSON, Jesse Harold (S 1921), Pres., La Meda Manufacturing Company, Chicago, Ill.
WINSLOW, J. Devereux (A 1920), Director, Lockwood, Greene and Company, 60 Federal Street, Boston, Mass.; *mail* 158 Mt. Vernon Street, Boston, Mass.
WISE, Samuel D. (A 1921), Pres., The Arco Company, 6408 Euclid Avenue, Cleveland, O.
WOLF, Robert B. (S 1915), Pres., The R. B. Wolf Company, 42 Broadway, New York City.
WOLF, W. Irving (S 1921), Vice-Pres. and Gen'l Mgr., The Wolf Company, 511 East 72nd Street, New York City; *mail* P. O. Box 765, Woodmere, N. Y.
WOLFF, Bertram (J 1920), Manager, H. Wolff Estate, 518 West 26th Street, New York City.
WOLMAN, Leo (S 1921), Teacher of Statistics and Labor, New School for Social Research, 465 West 23rd Street, New York City.
WYMAN, Phillips (A 1921), Executive Sec'y, Periodical Publishers' Association of America, 200 Fifth Avenue, New York City; *mail* 12 Odell Avenue, Yonkers, N. Y.
YODER, Claude A. (A 1919), Time Study Clerk, Jones and Laughlin Steel Company, 27th and Carson Streets, Pittsburgh, Pa.

AUSTRALIA

GUTHRIE, E. G. (S 1920), 1 Abbott Street, Launceston, Tasmania, Australia.

CANADA

COHEN, Nathan B. (A 1921), Supt., The Freedman Company, Sommers Building, 37 Mayor Street, Montreal, Quebec, Canada.
FELS, Peter (J 1921), Production Mgr., Fels & Lippé, 202 St. Catherine Street W., Montreal, Quebec, Canada.
ILER, Allan C. (A 1921), Adv. Sales Mgr., Western Canada Flour Mills Company, Ltd., Toronto, Canada.
MORROW, Ellis H. (S 1921), Dept. of Extension Work, Queen's University, Kingston, Ontario, Canada; *mail* 48 Victoria Street, Kingston, Ontario, Canada.
RAMAKER, Geo. W. (S 1920), Labor Mgr., Clothing Manufacturers Association of Montreal, Southam Building, Montreal, P. Q., Canada.
STEELE, Geo. F. (S 1920), Gen. Mgr., Canadian Export Paper Company, Ltd., Sun Life Building, Montreal, P. Q., Canada.

CHINA

BAILIE, Joseph (S 1920), Prof. of Industry, Peking University, Peking, China.

FRANCE

ANTOINE, Jules A. (A 1921), Ingenieur des Ponts et Chaussees, 39, rue Erckman, Chatrian, Strasbourg (Bas-Rhin), France.
BOISTEL, Julien (S 1921), General Secy., de la Societe des Chantier et Ateliers de Saint-Nazaire, 6 bis. rue Auber, Paris, France.
COMPAGNON, Joseph (S 1920), Branches Mgr., Schneider and Cie-Rouen Branch, 1 Boulevard, Gambetta, Rouen (Seine-Inf. France); *mail* 7, Impasse Giffard, Rouen (Seine Inferieure), France.
de FREMINVILLE, Chas. (S 1919), Consulting Engr., 18 Rue Pierre Curie, Paris, France.
DELALANDE, André (S 1921), Compagnie pour la fabrication des Compteurs et Material d'Usines, 16 Boulevard de Vaugirard, Paris, France.
LAVALLEÉ, Leonce (S 1921), Engr., Penhoet Works, of St. Nazaire, 6 bis, rue Auber, Paris, France.
Le CHATELIER, Henri (H 1918), 75 Rue N. D. des Champs, Paris, France.
MAROGER, Henri A. (S 1921), Engr., Penhoet Works of St. Nazaire, 6 bis, rue Auber, Paris, France.
MICHELIN, Marcel J. (S 1919), Asst. to Gen. Mgr., Michelin & Cie, Clermont-Ferrand, France.
NEGRIER, Paul (S 1919), 42 Boulevard Richard Lenoir, Paris, France.
NOEL, Georges (A 1920), 22 rue St. Michel, Nancy, (Meurthe & Moselle), France.
NUSBAUMER, Eugene (S 1919), Consulting Engr., Glassworks, Thouverrin Vierzon-Forges and Foundry of Rosiers; *mail* Vierzon-Forges, (Cher), France.
OGIER, Michel Gustave (S 1921), Asministrateun Delegue, Societe Ardoisiere de l'Anjou, rue Commartin, 32, Paris 7°, France.

GERMANY

ten BRINK, Charles H. (J 1920), Spinnweberei Arlen, Arlen (Baden), Germany; *mail* 146 Freudenbergstrasse, Zurich, Switzerland.

GREAT BRITAIN

ALLINGHAM, Henry W. (S 1920), H. W. Allingham, St. Hilda's Court, Highwood Hill, London N. W. 7, England.
CLAUSEN, Alfred (S 1920), Director, J. A. Stevens, Ltd.; Acton Street, 16 W. C. I. Eng., London, England; *mail* Thornbury Avenue, 9, Osterley, Isleworth, Middlesex, England.
LEGG, J. G. (S 1920), Works Mgr., Sir Wm. Angus, Sanderson and Company, Ltd., Birtley, Durham, England; *mail* Lamsley, Gateshead-on-Tyne, Durham, England.
STUART, William (J 1919), Director, Stuart & Jack, Ltd., Esk Mills, Musselburgh, Scotland.

HUNGARY

MEHELY, Koloman de (S 1921), Professor of the University for Economical Sciences, Fo-Utca 19, Budapest, Hungary.

ITALY

GALEAZZI, Roberto (S 1920), S. A. I. Gio Ansaldo and C., Genoa, Italy.

JAPAN

ABE, Keiichi (S 1920), Mech. Engr., Mitsubishi Zosen Kaisha, Ltd., No. 1 Yaesucho Itchome, Kojimachiku, Tokyo, Japan.
HOSHINO, Yukinori (S 1920), The Kajima Bank, Ltd., Osaka, Japan.
HUGA, A. (S 1921), Asst. Yard Mgr., Asano Shipbuilding Company, Tsurumi, Japan.
WATANABE, Jokichi (S 1921), 2732 Sanno, Oniori, Tokyo-Fu, Japan.

JAVA

HEIMESSEN, Henrik (A 1921), Gen. Agent, National Cash Register Company, Dayton, Ohio; *mail* 8 West Tanah Abang, Weltevreden, Batavia, Java.

NORWAY

IHLEN, Nils N. (J 1920), Strommens Vaerksted, Strommens St. pr Kristiania, Norway.
KRISTENSSON, Robert E. (J 1921), Civil Engr., Norsk Kulclager, S. K. F., Kongensgate 11, Kristiania, Norway.

SWEDEN

ANDERSSON, Ruben (J 1919), Asst. in A. B. Sveriges Litografiska Tryckerier, Klara Vestra Kyrokogata 9, Stockholm, Sweden.
BACKSTROM, Sten (A 1920), Munktells Machine Works, Eskilstuna, Sweden.
EKVALL, Waldemar (A 1921), Aktiebolaget Svenska Handels-Banken, Arsenalsgatan 11, Stockholm, Sweden.
FALK, Ragnar (A 1921), Shop Supt., Munktells Works, Eskilstuna, Sweden.
HESSELGREN, Kerstin (S 1920), Yrkesinspektris, 27 Lilla Nygatan, Stockholm, Sweden.
NORDIN, John A. (S 1921), Works Mgr., The Stal Turbine Company, Finspong, Sweden.
THUNBERG, Ernst (S 1921), Works Mgr., Munktells Works, Eskilstuna, Sweden.
TORNQVIST, Gerhard (J 1919), Asst. in A. B. Sveriges Litografiska Tryckerier, Klara Vestra Kyrokogata 9, Stockholm, Sweden.

SWITZERLAND

BALLY, Iwan (S 1920), Managing Director, C. F. Bally, Ltd., Schoenerwerd, Switzerland.
SENDER, Charles (S 1920), Chartered Accountant and Organizer, Wausenhausstr, 4, Zurich, Switzerland.
WEIDMANN, Gottlieb (A 1920), Basle, Clara Street, No. 7, Switzerland.

SUSTAINING MEMBERS

ART IN BUTTONS, Inc. (1919), Rochester, N. Y.
BERNHEIM, G. (1921), Manager, Societe Parisienne de Confection, 54 rue de Provence, Paris, France.
CLARK, E. W. & Company (1920), 321 Chestnut Street, Philadelphia, Pa.
COOKE, MORRIS L. & ASSOCIATES (1919), 1109 Finance Building, Philadelphia, Pa.
DAY & ZIMMERMANN, Inc. (1920), 611 Chestnut Street, Philadelphia, Pa.
DENNISON MANUFACTURING Company (1919), Framingham, Mass.
EATON, CRANE & PIKE Company (1917), Pittsfield, Mass.
EVENS & HOWARD FIRE BRICK Company (1919), St. Louis, Mo.
HOOD RUBBER Company (1919), Watertown, Mass.
HOOPER & SONS Company, Wm. E. (1919), Baltimore, Md.
JOSEPH & FEISS Company (1916), 2149 West 53rd Street, Cleveland, O.
THE LEFFINGWELL-REAM Company (1920), Flatiron Building, New York City.
LEWIS MANUFACTURING Company (1917), Walpole, Mass.
LEWISTON BLEACHERY & DYE WORKS (1919), Lewiston, Me.
MILLER, FRANKLIN, BASSETT & Company (1921), 347 Madison Avenue, New York City.
PACIFIC MILLS (1921), Lawrence, Mass.
PLIMPTON PRESS, The (1917), Norwood, Mass.
SUPERIOR FOUNDRY Company (1920), Cleveland, O.
TABOR MANUFACTURING Company, The (1917), Philadelphia, Pa.
THE THOMPSON & LICHTNER Company (1919), 136 Federal Street, Boston, Mass.
WALWORTH MANUFACTURING Company (1919), Lock Drawer 26, Boston, Mass.
YALE & TOWNE MANUFACTURING Company (1919), Stamford, Conn.

GEOGRAPHICAL SUMMARY

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Michigan	12	
Minnesota	2	
Missouri	5	
New Hampshire	11	
New Jersey	23	
New York	165	
Ohio	66	
Oregon	1	
Pennsylvania	88	
Rhode Island	11	
Utah	1	
Vermont	2	
Washington	2	
Wisconsin	1	
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A MANAGEMENT ENGINEERS' CREED

The sublimest duty of the engineer is to keep the faith:

The faith of the client that he will not undertake what he knows to be beyond his ability; and that with respect to what he undertakes he will give conscientious service to the limit of his ability;

The faith of his fellow engineers that he will remain true to his science and will magnify and not cheapen it; and that he will base his efforts for public recognition upon ability, scientific attainment and actual performance, and not upon ambiguous self-laudation;

The faith of the community that he will undertake no service inconsistent with the public welfare; and that in service consistent with the public welfare, but in which the interests of groups appear to come in conflict, he will judge carefully and sympathetically the claims of rival interests, and attempt to establish that unity of purpose which promotes the public welfare.

S. S. Pol.

Professor Bob Emiliani
Please visit bobemiliani.com

Wonderful article by Keppele Hall. 100 years later, not too much has changed. “What I have told you about the opposition from the worker and the mechanical difficulties of doing whay you want to do, the opposition that you are going to get from the foreman and superintendent fade into insignificance when you encounter the man who sent for you to save the plant or his life or the world, - who told that you were just the man he wanted to do this job for him - he is the man that before you get through with what you want to do, is going to have misgivings.” Had efforts been made 30+ years ago to understand the difficulties experienced by those associated with Scientific Management, the trajectory of Lean might have been much different in terms of gaining interest and support for progressive management, from worker to CEO.

DAILY PROBLEMS OF THE ORGANIZER[1]

By KEPPELE HALL[2]

A GOOD many years ago, I obtained a degree of Electrical Engineer from the School of Electrical Engineering of Princeton University. In those days that course was a two years' course, presided over by the doctor and scholar, Doctor Brackett, who is one of the most learned and wise men that it has been my privilege to know. The course was an exceedingly difficult one, and there was no snap to it. Our textbooks were largely in French and German, and we got into higher mathematics so high that you couldn't see over the top. When we did get through, and there were about eight of us out of some forty or fifty, we felt that we were pretty hot stuff, and that when we stepped out, the arms of the world would be just aching for us, and that anything that we wanted would be ours. Dr. Brackett called us together with him for a talk before we received our diplomas. "Well, boys, you are through with this work, and if you are satisfied with what you have gotten out of this thing, I am satisfied; but there are two things that I hope you have learned, and if you have learned those two things, I shall feel that your time and my time have been well spent. The first thing is, I hope you have learned that you do not know a thing. The second—that when you get up against a problem which has to be solved, I hope that you have learned the way to go about to solve that problem."

Now when we first heard that, it was a sort of a blow because we thought that we did know a lot. But the longer I live, the more I appreciate how little I know, and the more grateful I am that I have had the opportunity to have the foundation which would permit me to work out problems that had to be worked out, and build on it the structure that had to be built. In starting my talk with a remark of that kind today, I am not saying it with the idea of discouraging you with the work you are about to take up, but simply to let you know that the experience that we have when we get out and commence to apply the things which we have been studying, we are bound to run into all sorts of oppositions that, if we were not prepared for them, would be discouraging.

Now let me outline to you the kind of difficulties that we run into when we go out and attempt organization work. It does not matter whether it is the organization of an office, or the organization of a factory, or what kind of organization it is,—whether it is followed up by efforts to increase production of some kind or another or not, you will always run into a certain set of difficulties, and the first of these, I think I would call a purely mechanical difficulty. It is a very difficult thing in itself to go in and physically make some change in an existing organization, even if everything else is favorable and satisfactory—if the people for whom you are working tell you the world is yours,—go ahead and do what you please,—and even if you go out with an excellent training in the technique of what you want to do,—when you come to actually apply that technique, you are going to find out what a hard thing it is to do of itself.

I had an experience of that kind in a leather factory some years ago. This matter of organization had to do primarily with manufacturing, but when I am talking of manufacturing, you may apply the same thing to office organization. Everybody was perfectly willing for us to come in and do whatever we pleased. I had some training in Philadelphia at the Tabor Manufacturing Company, and had gone through all of the minutia of the technique. I had seen how easily this worked out at the Tabor Manufacturing Company, and thought it would be very simple for us—simply to outline the organization with the definite functions of the different people, have clear planning, good routing of work, give out time tickets, and issue material. In this leather shop, we were told to go ahead and do it. Now, the thing didn't work. I was a little green at it, but I thought I could do it. I thought it was easy from the things I had observed, and that it was the easiest thing in the world to do in this leather factory.

[1]Address delivered before the students of the Wharton School, University of Pennsylvania.

[2]Superintendent of Planning, Joseph & Feiss Co., Cleveland.

I had lost sight of the fact that what I had seen work was the result of the daily experience of years of hard work. When I started out with my route sheets, and time tickets, the workmen did not pay any attention to the time tickets and the clerk did not properly check up the route sheets. In less than no time I found an accumulation of incorrect sheets, misused blanks, and the whole thing in an awful mess, and I had to start and dig in and smooth the thing out again. This was the result of my lack of practical experience. I should have had this fundamental instruction which I did have backed up by some practical experience in working with some men who had been through this game, and knew it. Until we get that sort of experience, we are never going to be able to get things through without always running into mechanical difficulties.

I am talking largely about factory work. If I illustrate with the experiences I have had from the factory, please understand that the same sort of thing applies in any kind of organization work.

One of the first difficulties will be from the fellow doing the work in any organization in which you go. With your eyes that have been trained by the theoretical and technical experience that you are getting here, you will see the weaknesses of any organization into which you go, but you will also find, on the part of the people you are dealing with, a perfectly natural and instinctive opposition to doing anything new,—and that is to be clearly understood from the start. It is not an unnatural thing. Because you have a very much better way of doing something than some other fellow is no assurance that the other fellow is going to welcome it. Later on,—perhaps after he has had a chance to try it out, and see for himself that your way is a better way than his, will he be glad to do it. It is perfectly natural and instinctive for any man to oppose something new.

I had an experience in a paper mill, where we had made some very intense studies of the best way of arranging or organizing the work of trimming some paper,—a very simple operation. Our study led us to believe that the man who was operating the trimming machine could turn out on an average twice as much work as he had been turning out with no more expenditure of effort,—or with practically less expenditure of effort—than he had been employing on the work as he was doing it. But do you suppose that this meant the minute we told him this, that he did it our way? Not at all. The thing was, "What do you know about trimming paper? I have been running this trimming machine for fifteen years. Did you ever run a trimming machine?"

"No, I didn't."

"How are you going to show me how to trim paper?" I had to go on and explain to him how we had studied this, and we knew that we were right about it.

"Well, that is all right, but I trimmed paper before you were born, and now you are coming around here to show me how to do it."

It's a perfectly natural thing. That fellow was taking a pride in his work, and was doing his job successfully, and he could not see how we were going to offer him any advantage. We could not say to him, "Now, it has got to be done this way," but we had to be very patient and tactful, and little by little, as opportunity offered, show him how our way was better than his way, and incidentally accompanied by an increased earning in case he did it in the way in which we outlined. Presently one of the fellows tried it out our way and found it worked, and then the thing became comparatively easy. We had to get over that stage with the man who was actually doing the work himself.

Another form of opposition that you will encounter is from the men above the fellow who is actually doing the work,—the foreman or the superintendent or the man in charge. You are going to find that that opposition is greater than the opposition from the worker. This man is a man who has had more education than the fellow who is doing the work. This is the man who has probably outlined to the man under him how he was to do the work. If, in an office, this man himself planned the present form of organization, and you are treading on his toes when you try to do a thing of that kind, he wants to know what is to become of him. Let me illustrate that to you by a practical experience which I had. This also was in a paper mill, but a different mill from the other I mentioned, and was a different problem,—that of calendering paper. Our study of that process led us to find that, with very little change in the arrangement of paper as it was brought to this machine and the speed with which the machine could be run, very much more work could be turned out in a given time than had been done before. Now you must be absolutely sure that you are right in any of this work before you make any statement. The eyes of everybody are riveted on you, and are looking for the least little defect, and if you make an assertion and cannot back it up, everybody is going to know about it.

In this mill, the superintendent was the highest paid person in it, and was said to be the highest paid superintendent in the country, and was deriving the high salary because the management of that company said he was the best man in the United States, and that they couldn't run their business without him. That was a terrible indictment for that company! That concern was in a rather dangerous condition. No method of organization of management can afford that sort of thing. Before we had made a suggestion as to what we were going to do, we absolutely demonstrated to our own satisfaction that what we said, could be done. We were going to have opposition from this superintendent, who had been all the time opposing the thing that we had been suggesting. I went to the manager again, and told him what we wanted to do, the work we had done, and the conclusions we arrived at, and what was to be expected. The general manager suggested calling the superintendent in right away. Since the superintendent was familiar with the experiments we had been making, I was glad to have him called into the room. I had been in this establishment possibly eight months, and it was only the second paper mill that I had been in. The general manager of the company said to the superintendent,—"Now these people have made some studies on calendering paper, and beginning next Monday morning, they are going to start," (and so on, etc. ,etc.) I will never forget what happened! Up got this high-priced superintendent—and he had a violent temper, too,—and he walked up and down the room—and said to the general manager of the company,—"All right. If that is what you want to do, do it, but I wash my hands of what happens to your plant. If you want to take the opinion of this 'boy' who has never been in a paper mill until he came here, against mine,—go ahead and do it. It is up to you."

The general manager was sort of up against it, but told us to go ahead and do it. Then the superintendent said, "What are you paying my salary for? This thing he says can be done *cannot* be done and I will stake my reputation or my life on that fact."

When the general manager of the company was put up against that sort of proposition, it made me wonder about "this boy," and how about this $25,000 person. And it was right then and there that the general manager showed his spunk, and simply said to the superintendent, "I am sorry you don't agree with him, but it is going to be tried out." If we had not been absolutely sure of what we were going to do, beforehand, —what a monkey the "boy" would have looked like! That kind of opposition is bitter. You are going to run into it, and the people who take you by both hands when you come, and say "I am so glad to see you, and you are giving me just the thing I have been wanting," etc., etc.,—and when you get there and commence to tread on their toes—which you will have to do—they are going to turn and bite you.

The next difficulty that you are going to encounter comes from the top itself. What I have told you about the opposition from the worker and the mechanical difficulties of doing what you want to do, the opposition that you are going to get from the foreman and superintendent fade into insignificance when you encounter the man who sent for you to save the plant or his life or the world,—who told that you were just the man he wanted to do this job for him —he is the man that before you get through with what you want to do, is going to have misgivings. He is going to see how much money this will cost, and whether he is doing the wisest thing, and he is going to find this sub-official and that sub-official and superintendent and foreman, and the people in that class— and the heads of the departments—they are going to say that this won't do. And the $25,000 superintendent is going to say it. Some other foreman is going to say it. And the cumulative effect of that on the man at the top is something that you are going to have to encounter, and face, and is the hardest thing of all because the man at the top is the man who finally says "yes" or "no"; he is the man who has the final say as to whether or not you are going to stay, and whether what you want to do is going to be done or not. This will outline the character of the difficulties that you are going to encounter in your work. I think that what I have said so far is sufficient to indicate the kind of opposition that you are going to have.

How are you going to overcome it? In the first place, you go out as engineers in organization or management work, and you have got to be people of absolute honesty and integrity. I don't care how much you may learn,—I don't care much how wide your experience has been, unless you can go into an establishment with a knowledge on the part of the people you are working with, that you are absolutely honest and that you are of unimpeachable integrity, you sooner or later are going to get into trouble. This is the only foundation on which this whole engineering profession must be based, if it is to successfully fulfill the obligations that have been placed upon it by society. There must not be the faintest whisper that what you are about to do is for the exploitation of somebody. There must not be a question of the means of incentive that perhaps this fellow has some motive for doing this thing that is going to give one fellow an advantage over the other. You can't do it! You must play the game clean. Lay your cards on the table. Look every man in the eye with the consciousness that you are doing the right thing. I cannot emphasize that too much.

Now there are certain qualifications, in addition to these, that are very essential. In the first place, you must have knowledge of what you are trying to do. You cannot go in and carry out this work on the basis of bluff. You can do that sometimes with things of little importance, but you cannot do it on the things that are worth while. You had better admit that you are sorry you do not know, and don't be ashamed of doing it. Know what you are talking about.

You must have a large quantity of three qualities. They merge into each other so closely that in my notes I put a bracket around them. They are:

(1) Perseverance
(2) Patience
(3) Consideration

You cannot give up when things begin to go wrong. You must persevere. And things are bound to go wrong. The things that we accomplish in this life without things going wrong are not the things that amount to very much. We must be unwavering in our perseverance. Next, you must be patient. This kind of work will try your patience as nothing else that I know of. People appear to be awfully stupid. You cannot understand why they are so dumb. You have the inclination to put on your hat and go out! And the thing that will make you patient is the third thing—your "consideration" for other people. That word "consideration" means a great deal. You must be considerate,—you must sympathize to a large extent with the other fellow's point of view. You should fully understand why it is that he feels the way he does, and says the things that he does, and you must be very considerate of him.

And then, you must have vision. God help you if you cannot look ahead when things are sort of black. You've got to be sort of an idealist. By "idealist" I don't mean a wish-washy sloppy fellow, but I mean a fellow who fixes his sight on something high, ennobling, and good,—who is not going to let anything that happens dim that vision, and who is going to press on to it in spite of anything that happens.

Then, with your vision, put into your work two things,—common-sense and decency. I am interested in scientific management and have been for a number of years. I read a good many definitions of scientific management; I have given a good many definitions of scientific management, studying into things and trying to find out scientifically what the right thing to do is, and what is the right type of organization to have,—and then making everything tie up. This is the object of modern management, or any one of the terms that you hear applied to it. But I have found that if I can keep in the back of my mind these two things, that I have got to have some common-sense, and I've got to be decent,—that I come pretty near being everything that could be included in the term,—"scientific management."

There is a lot of foolishness and a lot of bunk. The late Frederick W. Taylor used to say,—"I haven't invented anything new. I haven't a system, I haven't a panacea for all of the ills of society or an industrial organization, but all I have is what I have taken from other people, and organized and applied some principles of common-sense to,—and that is all it is."

All these things I have been pointing out to you are to guard you against losing sight of that thing that you've got to hang on to—common-sense.

And decency means giving everybody that you come in contact with a square deal, and if you have these underlying qualities that I spoke of at the outset,—honesty and absolute integrity,—you will be able to be decent with the people with whom you come in contact.

I wish I could give you a picture of the sort of things that you run into every day in industry. I wish I could give to you a picture of the crying demand of industry for men who have the training that you are getting right here. There is a terrific responsibility connected with this,—a responsibility so great that it should frighten you every time you stop to think of it. Here is a group of young men who are being trained with the idea of becoming leaders,—who step out in this confusion that the world finds itself in today, and show people the way out. It is a terribly hard thing to do, and we have to keep in our minds this responsibility that we owe to society, and we have trained ourselves and drilled ourselves, so that we can step out in this field, and take the position for which we are fitting ourselves. It is a very serious thing.

The problems that confront the engineering profession today in this country or in the world are tremendous. Those who will solve them are honest people with this kind of training, people in engineering and allied lines, students of economics, students of philosophy, the people really doing the thinking and the planning. These people have a tremendous function to fulfill in the world today. I hope that you will all have in your minds in whatever you undertake, this feeling of your own responsibility, and the feeling that it is your solemn obligation to fit yourself to be a man and to be a man who can stand as a leader of men.

In conclusion, I just want to bring these things to you. In this kind of work, you are bound to deal with a lot of intangible things, and because things are intangible, don't think that they are not real. I think that some of the realest things that we have to encounter are the things that are intangible. What are you dealing with when you go out and take up methods of organization? You are dealing with human beings themselves. What do human beings do? They eat, work, sleep, and they think,—and what they think means just as much as what they work (which you can see), and what they eat (which you can see) and what they sleep (which you can watch) and it is what they think. The thought is the thing that must be at the bottom of every action, because you have to think out something before it can be done. You have to deal not only with people's thoughts, but you have to deal with people's aspirations. You cannot see people's aspirations. It is something inside of a man that is no less a real thing because you can't see it, and makes him aim for something more and something better. You have to deal with them when you are dealing with people.

You deal with people's imaginations. Someone has said that "without vision people perish." Without imagination, there is no building up of some sort of mental image that becomes a real thing to them.

Just carry away that message, if you will. In the first place, be prepared for all sorts of difficulties, but don't be daunted by them. Fit yourself, so that you can tackle any problem that comes, and do it; have some common-sense; be decent; and never lose sight of the fact of your great responsibility and the service that you are rendering your fellow-man.

EXTRACTS FROM REPORT OF A CONFERENCE OF EMPLOYERS
CHIEFLY MEMBERS OF THE SOCIETY OF FRIENDS
SUBMITTED TO LONDON YEARLY MEETING, 1918

I. WAGES

WE believe that the following propositions may be laid down with regard to wages:—

10.—(1) In determining the rate of wage to be paid, a distinction must be drawn between the minimum or Basic Wage and wages above the minimum, which may be referred to as a Secondary Remuneration. The former should be determined primarily by human needs; the latter by the value of the service rendered.

1. *The Basic Wage*

(a) Men.

11.—The wages paid to a man of average industry and capacity should at least enable him to marry, to live in a decent house, and to provide the necessaries of physical efficiency for a normal family, while allowing a reasonable margin for contingencies and recreation.

(b) Women.

12.—The Basic Wage for an adult woman of average industry and capacity should be the sum necessary to maintain her in a decent dwelling and in a state of full physical efficiency, and to allow a reasonable margin for contingencies and recreation.

2. *Secondary Remuneration*

13.—The Secondary Remuneration is remuneration due to any special gift or qualification necessary for the performance of a particular function, e.g., special skill as a tradesman; the special strength of some physical organ, as in the case of a gas stoker; special muscular training and power, such as that of

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POP QUIZ: It is almost universally believed that process improvement will result in speeding people up (a view that has existed for 100+ years and is a huge barrier to advancing process improvement). To see it this way means people further assume there is zero queue time between all steps in processes. Why do you think people do not see queue time? What makes queue time invisible to them? The biggest gain is process improvement is eliminating queue time. The biggest gain is process improvement is eliminating queue time, not speeding people up. Image Source: "Scientific Management" by General William Crozier an address before The Osaka (Japan) Commercial Museum, November 5, 1920 in "Bulletin of the Taylor Society," October 1921, p. 215

It is also almost invariably the case that the order and sequence in which a workman habitually performs a given task are not the best. For example; in the forge shop of one of the arsenals, in the early days of the introduction of scientific management, a very simple instance was one in which the blacksmith, after forging a piece of steel, placed the next piece in his fire and then stood by, with his helper, while it was being heated to the proper temperature. Of course it did not take the specialist long to tell him that the proper way for him to do was to place the new piece of steel in the fire before he took the hot piece out, so that it might be heating up while he was forging the other, and thus diminish the idle time during which he and his helper were uselessly standing around.

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In my book REAL LEAN Volume 2 (2007), I wrote a chapter titled “Manage to the Market” in which I suggested that the management system must change from classical to Lean because markets had changed from sellers' to buyers'. Dr. Harlow S. Person, Managing Director of the Taylor Society, wrote about this 85 years earlier, in 1922. Dr. Person's paper is a must-read for all Lean people and CEOs (as well as my REAL Lean series of books! https://bobemiliani.com/book/real-lean-volume-two/). Here is the start to REAL LEAN Volume 2, Chapter 5, Manage to the Market: “To a surprising extent, most businesses are managed as if they serve sellers’ markets when in reality they serve buyers’ markets. Managers often fail to recognize this inconsistency or how deeply it runs through their business. As a result, they continue to manage the business using mindsets, metrics, and systems designed to serve sellers markets. If you serve buyers’ markets, then you should use the management system that is most responsive to that market. There isn’t much in the way of choices; it’s Lean management."

SHAPING YOUR MANAGEMENT TO MEET DEVELOPING INDUSTRIAL CONDITIONS[1]

By H. S. PERSON[2]

IN THE conduct of any enterprise there is a major function, the responsibility for which resides somewhere in the organization, of determining future policy. In many enterprises this function may be regarded lightly, or even disregarded, on the principle that sufficient unto the day are the problems thereof; but in the larger enterprises, and in all well-managed enterprises of any size, it is not neglected. That is one reason for their good management.

2. The problem of future policy has many phases, of which the following come at once to mind: the commodities or services to be produced and sold; the quantities of these it is safe to attempt to produce and sell; the financial and technical equipment necessary; the technical methods of producing and distributing which shall be employed; the conditions of human cooperation which must be established in the enterprise. These, and many other major phases of policy not here enumerated, break down into numerous subsidiary, but also individually important elements. The difficulty of solving the policy problem is not reflected in the simplicity with which these elements may be enumerated, for they are not clearly separable, but are complicated and cross-sect one another. Furthermore, solution of the policy problem requires measurements and estimates of elusive and changing governing conditions—the variable demands of markets for particular commodities and services; the variable strength of actual potential competition to meet these demands; the availability of financial and technical resources and changes in these; the availability of workers and the changing conditions of their cooperation; restrictions or regulations which may be imposed by governments, and so on. And thoroughgoing measurements and estimates of such things as these lead farther into the consideration of factors still more elusive; changes in the habits, tastes and mental attitudes of peoples; the probabilities of new discoveries and inventions; changes in the social machinery for the conduct of industrial operations; that complex of conditions generally designated by the inclusive term "industrial conditions."

3. It is highly probable that an increasing number of enterprises will come to recognize that policy determination is a function which requires serious and continuous attention. It will involve the ascertainment of and analysis of facts concerning which executives have in the past had little interest, and it will involve above all—much and careful thinking. It is questionable whether the American executive can be characterized as a thinking executive so much as one intuitional in reaction to immediate facts; he himself has been proud rather to consider himself the doer and go-getter *par-excellence*—he who acts and gets while others think. If he is what he believes himself to be, he is the natural product of his economic environment; but one question to be raised tonight is whether there is not evident a sufficient change in the environment to make any such pride now unreasonable.

4. The particular phase of the policy problem which is to be considered tonight is presented in the question, "How must executives shape their managements to meet developing industrial conditions?" This question is fundamental, for a particular kind of management is an expression of decisions on many other matters of policy. The question is not to be understood as asking, "What new principles of management must be discovered and formulated to meet developing industrial conditions?" There are principles enough at our command—many more than have been generally recognized and utilized—to meet any conceivable conditions. We might change to a socialistic or communistic society and still be adequately served by the technical principles and methods already at industry's command. But under even moderately diverse industrial conditions we must utilize these principles and methods in different combinations, must weight them differently, in accordance with the requirements of particular circumstances.

[1] Paper presented at a meeting of the Taylor Society, New York, Nov. 23, 1922.
[2] Managing Director, Taylor Society.

5. Let us give our attention first to developing industrial conditions. A first glance is reassuring, for the revival due to follow the acute depression of 1921 is obviously already under way. This is indicated in all the reports of fundamental lines of activity. Bank clearings, car loadings, the production of basic commodities, and merchandise distributions have increased; stocks and bonds are more active; the spread between commodity prices has been reduced and in general a possible further long-run decline in commodity prices has been checked by price advances; there is an increase in employment and even in places a shortage of unskilled and skilled labor. Executives are reporting that they are "getting the red ink off their books"; and frequently there appear in the press optimistic utterances of captains of industry. We even already hear talk of a 1923 boom on the part of ultra-optimistic business men.

6. But a second, less superficial consideration of conditions causes us to hesitate to join those who believe "it is all over except the shouting." May not this evidence of revival be only the evidence of rebound from the extreme depression, and may not the present rate of acceleration be only temporary, to be replaced by a rate more moderate? May not the projection of a curve into the future on the assumption of a continuance of the present rate of revival be a dangerous basis on which to establish managerial policy for the future? The more thoughtful and cautious fear so. When there is eliminated the activity to supply seasonal and terminable demand, and particularly the intensive activity to supply the abnormal demand for fundamental necessities to which the exigencies of war denied satisfaction—for instance, construction and all the lines of industry attendant on construction—when there is observed the fact that consumers' demand for a wide range of commodities and services is continuing to be hesitant and cautious, there is not left a sufficient amount of evidence to warrant a projection of the curve of industrial activity into the future at its present gratifying slope. This point of view is expressed by a careful special correspondent of a dependable New York financial paper in a report from New England: "The only inference to be drawn (from facts enumerated) is that the bulk of the consuming public has been cutting off one thing after another in order to make its income go as far as possible in the matter of the commodities which it considers essential. Briefly, there are indications of a shrinkage in the American standard of living, which perhaps does not augur well for a long continuance of the present upward trend of industry, so-called." How many in this audience have not reduced their standard of living from what it was during the period of 1914-1921, and how many, because of personal circumstances, do not expect to continue to keep it reduced for some time to come? The demand permitted by the aggregate of personal circumstances is what makes the market.

7. A third and more penetrating analysis, this time of more fundamental conditions, is even disconcerting to those who believe it is all over except the shouting. During the past decade, as a result of the study of earlier cyclic movements, we have learned that certain economic phenomena, such as the quantity of money and credit, have a definite relation to industrial activity. The store of money and credit influences prices and the price movement influences industrial activity. We should recall that the long period of accelerating industrial activity culminating in the frenzy of 1920-21 was coincident with a long upward swing in prices; that in general industrial activity increases in intensity with an upward price movement, is stagnant when there is a downward price movement, and is hesitant and uncertain in the early years of a new stable price level. Of course, the ideal condition is a fairly stable general price level, but when a condition of stable price level suddenly confronts an industrial generation which has become accustomed to a consistent upward price movement over a long period, the new condition of stability, because different from the accustomed, is upsetting to the individual, either as demander or producer, and it takes a considerable period, measured not in months but in years, for him to learn just what he can safely do both in purchasing and in producing.

8. During recent years some sound work has been done in the analysis of fundamental industrial conditions and tendencies, which has given a basis for policy determination more substantial than anything we had previously had. It may be observed that during the past three years of experience wholly new to us, the forecasts of these investigations have "called the turn" more accurately than the prophesies—or guesses—of business men. These investigators have succeeded in making some accurate measurements of basic elements which determine price conditions for a number of years ahead, and the safest judgment to accept is that, in the words of the Harvard Committee on Economic Research, "the present price level is substantially that around which the fluctuations of the business cycle must play" for the next ten years. I make my own private

reservations to that broad statement, for I believe the Committee has failed to take into consideration the capacity of American managerial genius to vastly increase, when put to it under intensely competitive conditions, the quantity of goods for exchange which may be produced from a given combination of plant, equipment, materials and labor; but perhaps the Committee is wise in not taking that into consideration, for it depends upon the wills of owners and managers who are a conservative group when it comes to the adoption of new production methods. I think we should be wise to accept their judgment as the safest basis for business policy.

9. Assuming that forecast to be correct, what is likely to be the effect of a new, high price-level "around which the fluctuations of the business cycle must play?" Simply that you and I are, for a number of years, going to continue to be conservative as purchasers, and also conservative as producers. As producers we are going to wait for demand, and as demanders we are going to wait until we have adjusted our purchases to the new relation between our incomes and the cost of living. It is true that wages are settling at a new high level, but there still remains a large number of consumers whose incomes are not readjusted so easily and quickly, whose incomes are at present and will for some time continue to be adjusted rather to the old price level, and it does not take a very large bloc of maladjusted consumers to keep the market unsteady and uncertain.

10. The conclusion I would have you draw is that for, say a decade, consumers' demand is likely to remain so hesitant and uncertain as to be out of proportion to our capacity to produce. It does not seem necessary for me to give this particular audience any proof that the war has disclosed that our capacity to produce far exceeds anything we had believed it to be. I have talked recently with observing men who have covered the country from Maine to California, and they have reported that the most impressive single fact of their observations is the tremendous capacity of American industry to produce. You will recall President Friday's address at a meeting of this Society two years ago; he stated that one outstanding fact is the increase in our productive capacity during recent years, and that if the war has taught us anything, it is that we allow a large part of that capacity to "run to waste through sheer idleness." Now I put this question to you as practical managers: If our productive capacity is so great, and if it can be made much greater simply by eliminating sheer idleness, and if consumers' demand is fairly certain to be hesitant for the coming decade, have you or have you not a really critical management problem confronting you?

11. However, before considering the kind of management that problem is going to force upon you, I want to make one more, a fourth, analysis of present industrial tendencies, painting the picture upon a large canvas. Let us give the picture a striking American title: The Overland Trail—from a dominant sellers' market to a dominant buyers' market. We all appreciate that we are now in, at least a temporary buyers' market; I am suggesting that we are on the trail to a dominant buyers' market, and that we are possibly already on the great divide. If we are, we shall learn to manage our enterprises differently.

12. A summary review of the industrial history of the United States should make it patent that we have been brought up in a sellers' market. We have been pioneers—explorers, appropriators and exploiters of a vast continent of extraordinary resources. It has been a California of '49, or a Klondike, on the scale of a continent and a century. The exploitation of resources which have always had an immediate world market and cash value, the appropriation of stores of capital and treating it as income, has given our population a geometrically increasing purchasing power. Consumers' demand has kept ahead of and pulled along producers' capacity to satisfy the demand. We consumers have crowded about producers with outstretched hands full of purchasing power, begging them to give us something we could wear, eat, drink, parade before our friends, or otherwise enjoy. We have been drunk with a hoard of wealth and we have spent it like drunkards. As producers we bent every effort to satisfy this demand, and we have constructed for ourselves a tremendous productive equipment; as producers and distributors we were willing to get while the getting was good.

13. But there comes a time in the history of an appropriating and exploiting people, when they cease to be frontiersmen and appropriators; when the stores of nature's wealth are uncovered and appropriated, when future income through exploitation is capitalized at current values, when income becomes real income derived from productive effort and ceases to be in large part the appropriation of capital resources; when there emerges on the one hand a class of *rentiers* and on the other hand a larger class of laborers, clerks, sub-executives, major executives, merchandisers and others whose income is, on the whole, limited by the productivity of

their efforts and whose consumers' demand power tends to become correspondingly fixed. In other words, industrial society tends to become more stratified and stable. There is then the danger of a period of maladjustment when technical equipment and productive capacity have overreached immediate demand, and when, if other markets are not sought, a buyers' market succeeds a sellers' market as the dominant factor in the industrial situation.

14. There were signs before the war that the industrial development of the United States was approaching that stage of evolution. Natural resources had become pretty well appropriated and capitalized—not only such resources as mines, forests and natural transportation routes, but also agricultural lands, for there was before the war an increasing proportion of tenant farmers, paying rent in cash or shares. Serious students were concerned over this tendency. Technical productive equipment was at the same time greatly increased, and there was no sign of a plan or even a clear intent to develop foreign markets. President McKinley's turn, just before his death, towards a reduction of the tariff obstacle to the development of foreign markets made no impression on the dominant political party, and there continued a period of tariff policy which has culminated in the Fordney-McCumber bill. It seemed to thoughtful observers that the quarter century before the war was a period of conscious or unconscious eat, drink and be merry, for today we are getting ours and tomorrow will take care of itself.

15. Then came the war, which was a tremendous shock to the industrial system. On the one hand it caused a still greater development of productive capacity, financed out of future earnings through the mechanism of bonds and taxation, and caused a coincident decline in consumers' demand (the frenzy of 1920 was but an unsubstantial flare up), a decline which is likely to continue for some time because of the continuing heavy taxes and the maladjustments caused by the war. In short, the shock seems to have hastened evolutionary tendencies, which would have developed more gradually and with only relatively minor depressions, and to have thrown us suddenly upon a buyers' market which will last for some time and may be the beginning of a dominant buyers' market.

16. A buyers' market means, for industries that are not competitive, a more radical and restrictive control or regulation, for when buyers look long at the dollar before parting with it, they look longer at the conditions which create the necessity for parting with all of it; and it means, for competitive industries, a strife for the consumers' dollar which makes so-called competition on a sellers' market seem but a children's game. In view of all these considerations, I think you will agree with me that there was never a time when management should have more concern over future policy—and over the quality of its future management.

17. Management on a buyers' market is quite a different thing from management on a sellers' market. On a sellers' market selling is but order-taking; on a buyers' market it must be real merchandising. On a sellers' market production is but the hasty and wasteful process of giving material things a form or other quality which will satisfy insatiable and not overcritical demand; on a buyers' market it must be more precise and economical. On a sellers' market financing is largely borrowing on the assumption of unexploited natural resources or an unexploited upward market; on a buyers' market it is a borrowing on demonstrable future earned profits. On a sellers' market the conduct of a business is easy and management is simple—in fact there does not have to be any real management. But now that you appear to be face to face with a buyers' market and the necessity of developing real management, if you are to be successful in a most intense competition, if your competitor, instead of yourself, is to be the one to disappear in some readjustment of productive capacity to consumer demand, it is expedient for you to inquire into the nature of that real management.

18. The essential practical elements of the problem confronting that management may be summed up as follows: On the side of supply there is a tremendous production capacity involving heavy investments of capital in more or less specialized equipment, to preserve the value of which will require a continuation of the lines of activity for which it was designed. On the side of demand there is a conservative and hesitant market—in fact a buyers' market—which will continue for a considerable period. This will mean intense competition on the part of management to find the individual consumers and to sell them. In that competition selling price and cost of production will be critical factors. The hesitant market will tend to force selling price down, while higher prices of certain elements entering into cost will tend to keep that figure up. The fact cannot be disregarded that, as was the experience after both of our earlier great wars, wages have settled at a new high level, and that the strength of organized labor and new immigration policy seem

sufficient to hold them there during such a period as will determine the success or failure of competing enterprises. It should be observed also that many of the basic materials of industry are more or less closely controlled, and that material costs are likely to remain high. Therefore, management will be faced by high prime costs in the face of great pressure to reduce the selling price of fabricated products. The way out for the successful competitor appears to be this: to develop an inclusive system of management which will more than compensate for high prime costs by cost savings elsewhere, thereby effecting lower factory costs and making possible lower selling prices or making possible a higher quality of product at the original cost and selling price.

19. In the first place that management will give more attention to such problems as we are considering tonight—long-run tendencies in the industrial environment. These matters will no longer be regarded as merely "theoretical"; they will be regarded as very practical. Certain major executives will give more thought to policy and general plans, and not permit themselves to become too much absorbed in operating details and worn out by late afternoon worries. They will not confine their reading to the news headlines and market quotations of newspapers, but will read under the headlines, search for the facts and do some thinking of their own. They will find time for—and consider as important as some of the things for which they now find time—the reading of magazines of fact and opinion relating to administration, management, economics, politics and industrial relations. They will have in their organizations a unit to study and interpret industrial statistics. In illustration, a major executive of a certain medium-sized plant inquired of the Taylor Society the other day where he could find a young man, a college graduate trained in economics and statistics, to study for him the periodic reports of statistical services, and interpret them for the management in terms of the particular business. That enterprise is getting the jump on competitors.

20. That management, in the second place, will provide for a more accurate judgment of the market with respect to the demand for the commodities it has to offer, competitors' ability to supply the demand, and what share of the market it can have reasonable expectation of securing. It is with the consumer that the impulse for industrial activity begins—"the consumer is king"; but on a sellers' market consumers are so numerous and insistent that we forget the source of the impulse and come to believe that it starts with the producer. Under the competitive conditions of a buyers' market, managers will see that in true perspective. Managers will learn that they cannot afford to misjudge demand, either with respect to what it wants, how much of that it wants, or what share of it competitors will permit a particular enterprise to provide. Excessive inventories are fatal on a buyers' market. An enterprise must avoid that by some unit of the organization, whether it be an individual or a group, which will make continuous and precise analyses of the market and provide the data for master plans and schedules. Call it what you will—market research, merchandise research, sales engineering.

21. In the third place, that management will set up in writing, on the basis of the data secured by market research, definite master plans, budgets and schedules of operations for a considerable period ahead, these being supported by definite and interdependent detail plans and schedules for the major operating departments—selling, production and financing respectively. These master plans and schedules, and these supporting departmental plans and schedules, will be standards of performance, goals to strive for, lines to which to hew. To do without such plans and schedules means guessing, taking chances, departments out of alignment, unbalanced inventories, higher costs—losses for which the consumer willingly pays the price on a sellers' market, but which, on a buyers' market, become a loss to the producer which he cannot afford when competition is intense.

22. That management, in the third place, will have to conduct its selling operations with more skill than it has ever displayed before. On a sellers' market the consumer seeks the producer; on a buyers' market the producer must search out the consumer and sell him, in the midst of a keen competition both of other producers of the same commodity and other uses of the consumer's dollar. Just as there must be no misjudgment of the market, lest there be unsold inventories; no failure to make precise plans and schedules, lest there be unsold inventories; so also there must be no failure to search out and sell to the estimated number of consumers, or there will be unsold inventories.

23. Are we able to imagine the detail changes which are likely to follow the development of the new merchandising? Is it not probable that there will be less of that advertising whose object is to create new wants in satisfaction of which consumers would spend surplus dollars, and more of that advertising whose ob-

ject is to convince concerning the quality of staple merchandise offered in competition for the limited supply of dollars? Will not the work of salesmen be something besides either mere order-taking or mere psychological suasion; is not the salesman more likely to spend more time searching out prospects; calling on prospects as well as established customers; skillfully displaying the merits of goods; rendering intelligent—even scientific—service; planning and scheduling his work? Will not the supervision of sales executives and their assistants be more comprehensive and more skillful—again, more scientific—than anything we have seen; salesmen better selected, better trained, their work better planned and scheduled and given more intelligent and effective support by the directing staff? Will not the channels of distribution be more carefully studied and more discriminately selected?

24. I have called attention first to market analysis, master plans and budgets, and selling, as conspicuous features of the new management, not because they are superior in importance to other phases of management, but because they logically come first—the point of origin from which to lay out the operations of an enterprise being the consumer—and because in the sellers' market of the past, these phases have been most neglected. It is not to be assumed, however, that I attach less importance to better production methods as a feature of the new management.

25. There are some who assert that the production problem is solved and that we should now give most attention to other phases of management. I believe they are too hasty in their judgments, especially if we are thinking in terms of a severe competition on a buyers' market. The production problem is far from solved. It is true that we know more about good production management than about good sales management, and that we have a body of production management principles and practices at our command which, if utilized, would eliminate waste, reduce factory costs and permit price reductions to an astonishing extent; but it is equally true that they are not generally utilized, and the educational task of bringing about their utilization in a plant is as difficult and time-consuming a task as developing market analysis and improved selling methods. Perhaps more so, for the development of market analysis, master planning and selling is the problem of a small group of specialists, while the development of superior production methods is a problem involving the precise cooperation of many individuals of varying capacity for cooperation.

26. Furthermore, the more severe the competition the more important become good production methods. For in the final analysis, no matter how accurately we gauge the market, how precisely we prepare schedules of operations, how skillfully we sell, the greatest weapon in competition is the combination of a dependable product, a dependable service and a quotation lower than competitors, and it is superior production methods which contribute most to making this weapon possible. If you can safely and consistently quote a lower price for an identical commodity and have a reasonably good selling organization, your competitors will hold you in dread.

27. In the fourth place, therefore, the superior management of the next decade will develop the production department to a high degree of precision, in accordance with principles and methods already formulated and available. As some strong merchandisers secure their profits by taking discounts, so strong manufacturers can take their profits by eliminating waste—the waste of useless or unused plant; the waste of useless, unused or inefficiently used equipment and tools; the waste of unsuitable, inadequate or lost materials; the waste of inefficient methods; the waste of improperly chosen, improperly assigned, improperly instructed and inadequately inspired workers. Investigations and experiments will be conducted which will disclose the best equipment, tools, methods and materials for the fabrication of the product, and on the basis of the discovered best details will be established standards of product, equipment, materials and processing. Provision will be made for the maintenance of these standards, and these once established and maintained, a control of operations through planning, scheduling, and checking of progress will be possible, which, as has been demonstrated in too few but an adequate number of instances, forges the competitive weapon of lower costs and lower quotations.

28. Finally, that management will win the cooperation of all the personnel of the enterprise, not as a matter of humanitarianism but as a matter of technical necessity. Without such cooperation all other provisions for excellence of management are impaired. The good will of the personnel is in many instances the determining factor in successful competition. The combinations of elements by which this good will is won may be different in different enterprises, but all will be identical in at least two respects: a group of elements which secure the personnel's cordial consent to the standards of all kinds which are established, and a

sharing of the product of combined effort through wages which satisfy the personnel as reasonable and just.

29. The entire personnel of an institution, from major executive to the latest recruit, should be a cooperating group of individualities—cooperating, in the sense that each must play a part in a system of operations; individualities in the sense that each should be an original source of inspiration and new ideas, and a creator of new methods which fit and promote the work of the system. Too many institutions simply inbreed. Individuals lose their individuality and the organization loses its vitality. The greatest asset of an organization is not plant and equipment, cash in the bank, or even an organization of persons; but a spirit of cooperation, an atmosphere of live interest in the best management principles and practice, an *esprit de corps* of search for wiser policies and better methods and individualities which have not lost the power of creation within cooperation.

30. It is not out of place to call attention to a special aspect of the new management—the utilization of a new type of executive. The long sellers' market of the United States has developed highly one particular type of executive—the forceful, acquisitive, go-getter type which drives straight to results regardless of methods and cost. But while the forceful, go-getter type of executive will always be essential, managers have come to realize that an organization must be balanced by the inclusion of the thinking, investigating, planning type of executive who surveys conditions and tendencies, formulates precise plans, establishes schedules and budgets, keeps departments coordinated, maintains precise control of operations, has regard for efficiency and economy of methods, and all the time appraises progress and results in terms of plans. Even the go-getter executive, so useful in the early days of an enterprise, must become a thinking, planning executive after the enterprise is well established as a going concern. The thinking and planning type of executive will play a decidedly important part in the future.

31. In conclusion, it should be understood that I am not pessimistic concerning what I believe are likely to be the developing industrial conditions. At the worst, consider what has been said as a word of warning. In the long run our very capacity for production will solve the problem, as it has in the past solved it under comparable circumstances; but the restorative power of that capacity for production must be realized chiefly through a regulation by better individual managements. We shall have short-time cyclic variations, but fundamental increasing prosperity for industry is general during the decade of correction of maladjustments to new conditions. Note, however, the significance of the words "for industry in general." In the probable readjustment through competition on a buyers' market, some enterprises are certain to disappear, and they will be those particular enterprises which are satisfied with the management which is "just as good as the average," for that mental attitude almost invariably means managements which are poorer than the average. For a quarter century before the war even poorly managed enterprises were helped in their ascent to the heights of prosperity by the escalator of a sellers' market; now that escalator is out of commission, and the ascent to a new prosperity must be achieved in the good old-fashioned way—by good management muscles, good management lungs and good management brains.

WE have probably the highest ingenuity and efficiency in the operation of our industries of any nation. Yet our industrial machine is far from perfect. The wastes of unemployment during depressions; from speculation and over-production in booms; from labor turnover; from labor conflicts; from intermittent failure of transportation of supplies of fuel and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it.—*Herbert Hoover.*

Professor Bob Emiliani

Please visit bobemiliani.com

Ever heard of “Superstandards?” Interesting concept. The authors describe how standards contribute to developing people and how the lack of standards results in backslide. Sound familiar? Note that the “One Best Way” was marketing hype for the Gilbreth's management consulting company. Soon after this article was published, they stopped using “One Best Way” because they were fully aware that there are many better ways to do a thing (they knew this a decade or more before 1922).

SUPERSTANDARDS[1]

THEIR DERIVATION, SIGNIFICANCE AND VALUE

By Frank B. and L. M. Gilbreth[2]

THE value and importance of standards and of standardization as factors and causes of cost reduction is generally acknowledged by all people today, both inside and outside the industries, who have given both the theory and the practice proper investigation and study.

We were convinced of the importance of standards in 1885, but it was not until the late Wm. H. McElwain in 1897 impressed us with the importance of having all minute details of standards put in writing as a permanent record, that we began to put every standard into such permanent record form.

It was not until 1907, at the beginning of our conference with Dr. Taylor, that we decided to emphasize the fact that the *methods of making* the standards themselves should be the first thing standardized. This thought was suggested by the fact that we found there were no two standards in his and our practices exactly alike, even where the objects to be attained were identical. We then decided upon and undertook the course of *intensive superstandardization* and of applying accurate measurement as a prerequisite to making satisfactory standards.

We desire to acknowledge here our appreciation of the great value of the Taylor philosophy, and our emphasis on super-standardization is due in part to Dr. Taylor's emphasis on standardization.

Dr. Taylor's Views on Standards

Dr. Taylor states in "Shop Management"[3]: "It would seem almost unnecessary to dwell upon the desirability of standardizing not only all of the tools, appliances and implements throughout the works and office but also the methods to be used in the multitude of small operations which are repeated day after day." He went on to explain the reason for this, and to show that such standardization was profitable from every standpoint, including that of cost. Since that time, authorities of the management world have accepted the value of standardization, though the world outside management is not yet entirely convinced.

We endorse the above statement of Dr. Taylor and we would especially stress the word "methods," for there has been everywhere a lack of appreciation of the fact that methods as well as equipment must be standardized. We would go further and emphasize the great possibilities for profitable standardization of *repetitive components* of methods, which methods themselves, as a whole, are not repetitive. *The leisurely examination of components of methods, which is now possible, necessary and most desirable, furnishes a completely new viewpoint and practice in standardization, and offers a completely new, fascinating and profitable field for standardization. This field, namely, the leisurely examination of components of methods, covers not only new work, but all old standards that have not been analyzed by the new method.*

Definition of Standard.

Perhaps the best definition of a Taylor standard as so accepted is that given by Mr. Cooke, who says:[1] "A standard under modern Scientific Management is simply a carefully thought out method of performing a function, or carefully drawn specification covering an implement or some article of stores or of product. The idea of perfection is not involved in standardization. . . ."[2]

While the above is a most excellent definition of a standard, it embodies a thought that is quite different from that which we are emphasizing in considering the subject of superstandardization, especially as ap-

[1] A paper presented at a meeting of the Taylor Society, Philadelphia, March 17, 1922.

[2] Consulting engineers, Montclair, N. J.

[3] A. S. M. E. Edition, Paragraph 284; Harper Edition, Pg. 123.

[1] Report to the Carnegie Foundation for the Advancement of Teaching, Pg. 6.

[2] Primer of Scientific Management, Pg. 14, D. Van Nostrand Company, New York.

plied to methods. The standard obtained by superstandardization is much more than "simply a carefully *thought out* method." It is of the essence of superstandardization that it be based on the *leisurely examination of errorless records of methods* and of use. Much of all activity is performed too fast for the eye to see. Therefore, the standard as resulting from superstandardization is the best method known of performing any activity. It implies use of the *best units, methods and devices* of research known. To avoid confusion, this new type of standard may be called a "superstandard," tho, ultimately, the old word "standard" must imply the new derivation and use.

Objections to Standards and Standardization.

Occasionally we hear of objections to standards and standardization, and such objections should be considered before proceeding to advocate superstandardization. They have come from those who misunderstood the relation between standards and individuality and monotony. All such objections to standardization have been easily and completely met; not only with accepted theory but also in actual long practice, not only from the standpoint of necessity but also from the standpoint of desirability. While these objections are usually directed against standard methods, they may also be directed against standard equipment or the maintenance of equipment in standard condition.

It is true that there is nothing more monotonous than working under standards that one knows are inferior, and that one can easily improve upon, with no opportunity for making and installing such improvement, or with no recognition for such improvement. Such conditions are ruinous to ambition, to the development of personal and individual expression, and to fostering of the creative instinct and joy in work. They do not exist where standards are adequate and are better than one can oneself devise, and where interest is stimulated and utilized by other parts of scientific management.

Many people are heartily in favor of standardization in principle, but do not themselves practice it. This is especially true of those who have not had wide experience with the simultaneous effects of standardization of method upon large output, lower cost of manufacture, lower cost of living, higher wages and less fatigue. It is not to be expected that anyone will fully appreciate the benefits of standardization who has not studied *super*standardization and had the opportunity personally to see and to appreciate the relations between superstandardization, automaticity, fatigue elimination, learning curves, the stabilization of employment, and lower costs. With this knowledge comes a real evaluation of standardization.

We are here advocating the superstandard and superstandardization. Our emphasis has increased, and is ever increasing, because of the value of the actual results of long years of actual experience with extreme standardization of things and methods. We are practicing and advocating an advance in management technic. The *principle* is the same for all standardization, but the difference in the degree of refinement of method brings about differences in results that are comparable with the expected results of important inventions. To appreciate this difference it is only necessary to review papers and chapters of books on standardization, and to ask: "Is this standard of thing, condition, or method before us the result of guesswork and rule-of-thumb, or is it based upon refined and accurate measurement of the right units?" When examining the printed standards in the literature of scientific management let us not be deceived by beautiful half tones and elegance of printing, efficiency of expression by the editor, or anything other than the measured merit of the subject itself. Let us use *the method of obtaining the results* as a unit of measurement of their value, and rate the work by the fundamental accurately determined facts it embodies. In examining standards of material or equipment, let us note the presence or absence of standards of "practice" as these vitally affect the specifications set down.

The superstandard is a natural development of the standard and a logical part of the growth of management as a science. A superstandard, then, is a standard which is the result of accurate measurement of data relating to the best obtainable, and which embodies the best practice known. It retains all the value of a standard as to means of improvability, but is recognized as the embodiment of the One Best Way extant and a further step toward the discovery of the One Best Way available—at the time. It is well to state here that superstandardization gives special emphasis to fostering and providing temporary, emergency and permanent change toward or from the superstandard, as may be economically wise and desirable. It conserves and develops individuality by the use of the One Best Way Suggestion System, which we have developed with our clients during the last twenty years.[1]

[1] The One Best Way to Do Work, a paper presented before several Chapters of the Society of Industrial Engineers, May, 1920.

Relation of Superstandards to Standards.

The superstandard supplements and does not necessarily supersede the standard which remains accepted practice during the interim or transitory period. A standard is most useful during the early parts of the installation period,[1] but is developed at the first available moment into the superstandard, which has a far more definite effect upon maintenance, as will be shown later. We desire to emphasize the importance of the relation between superstandardization and maintenance, and to state as our opinion that lack of appreciation and utilization of superstandardization probably is a much greater factor in having installation projects slip back than any other one cause.

Significance of the Superstandard.

The superstandard has great significance from the management standpoint, from the economic standpoint, from the psychological standpoint and from many other standpoints—even from the phychiatric standpoint. From the management standpoint, the superstandard is an indorsement of the philosophy of Dr Taylor and of the underlying principles upon which scientific management rests. It emphasizes the fact that ***measurement, not rule-of-thumb,*** provides the best working methods. It makes clear the point that during these years when scientific management has developed, our belief in standards has continually strengthened, and never for an instant weakened. It indicates that the growing interest in the human element and consideration of the human element has brought out more clearly the necessity for standardization, if the human element is to be conserved and developed. The close and necessary connection between standardization and such development is some times not understood, even by those who have a deep interest in scientific management, and are in the main friendly to it.[2] Therefore, while it may seem elementary and self-evident to management men, it must be continually pointed out and emphasized.

Significance From the Economic Standpoint

The significance of standardization from the economic standpoint has been recognized ever since the days of Adam Smith and his analysis of the division of labor in 1775. The elimination of waste, that most important of economic questions today, with its effect upon production, distribution and consumption, is vitally affected by the new stress upon standardization. This has been well brought out in the Report of the Committee on Elimination of Waste in Industry,[1] and is an underlying thought in the work of the Division of Simplified Commercial Practice of the Department of Commerce, recently established. The economic necessity of production, once questioned, is today increasingly acknowledged. The relationship between increased production and standardization has never been questioned. The economic benefits of standardization and increasing benefits of superstandardization must be self-evident.

Psychological Significance.

The psychological significance of superstandardization is extremely important and must be carefully considered because it is here that possible objections will be found and should be anticipated. There has been an erroneous and widespread impression among those not personally or intensively acquainted with the best forms of Scientific Management as practiced, that standardization has already increased and will continue to increase monotony, dwarfed individuality, prevented the development of individual self-expression, and is disliked by those who work under it. This is not true and never has been, where scientific management worthy the name has been developed.[2] Any intensive knowledge of the writings and practices of Dr. Taylor himself or of those of the best of his co-workers and followers proves that, consciously or not, the human element has developed to a greater extent under scientific management than under any other type of management. Under superstandardization, such conditions and development are not only conserved but increased, for the proponents of the science of management and executives properly trained in the right theory now utilize the findings of the human sciences exactly as they utilize the findings of the material sciences and apply these findings directly in their own fields.

Intensive investigation is applied to the worker, the surrounding conditions and tools, and the methods or motions used. It is thru superstandardization that the more efficient adjustment of worker to work and of method to worker is accomplished. Accurate measurement in the human sciences is leading to a better understanding of human capabilities and possibilities. Superstandardization in industry is leading to a greater understanding of demands and opportunities. The result is not that individuality is stunted, neglected or

[1] See Process Charts, First Steps in Finding the One Best Way to Do Work. American Society of Mechanical Engineers, Journal, 1922.

[2] Reports of the Industrial Fatigue Research Board, "Time and Motion Study," by E. Farmer, M.A., 1921, pg. 17.

[1] Waste in Industry, by McGraw-Hill Book Co., Pg. 11.

[2] Applied Motion Study—MacMillan Co., Pg. 180-184, 208.

misunderstood, but, on the contrary, is appreciated and utilized as it never has been, due to an understanding of, and ability to meet individual demands and capabilities.

Presumably because some engineers have been thought to be lacking in training in psychology and other sciences that concern the human element, and because industry devotes so much attention to material output, this point has often been overlooked. When it is realized that the engineer's training is primarily in measurement and that the industries offer opportunities which no other field of activity can offer, a new aspect is given to the entire matter. Those outside industry do not always realize that leaders in psychology and other human sciences are today, and have been for years past, devoting themselves to investigations and installations in the industries,[1] and that psychology is increasingly devoting attention to industrial problems. This is well exemplified by the splendid work of the Institute of Vocational Guidance of Barcelona, which recently acted as host for an International Conference of Psychologists, which discussed many practical aspects of the relation of Psychology to Industry.[2] It is also exemplified by such new publications as the "Journal of the National Institute of Industrial Psychology, Founded in 1921 for the Application of Psychology and Physiology to Industry and Commerce,"[3] which aims, as it states in the first editorial, to "describe in non-technical language the methods and results of applying scientific knowledge to the human aspects of industry and commerce." Those in the industries do not always realize that their strength lies not in adhering absolutely to tradition but in adapting the new methods and devices at their disposal to meet the increasing demands of the human element for opportunities and development.

Significance From the Psychiatric Standpoint.

Psychiatry, which has so much to do with the study of human likenesses and differences and with adjustment, has a great interest in the development of superstandardization. The phychiatrist has discovered many types in the industries which for one reason or another are mal-adjusted. This does not mean simply the round peg in the square hole, and does not apply merely to those among the lower grades of employees.[1]

For example, there are two types in the industries differing greatly in some respects from the normal, one of which seems unable, without great difficulty, to acquire automaticity, the greatest of free assets of the normal worker. As a result, he actually has abnormal difficulty in performing an activity twice alike. Another type is that which craves routine and is with difficulty persuaded to attempt to learn or to be changed to another activity, even if such work has better prospects for promotion, or more constant and continuous employment.[2]

Superstandardization of method and of work, or of activity, as some of the modern psychologists prefer to call it,[3] is of greater assistance and value in handling these types. It cannot be too often said that superstandardization, like standardization, aims in no wise to do away with initiative or with individual planning of details in work. It conforms to the principle of separating the planning from the performing, with the best planners in the planning department, and having others who may have to do planning start where the best planners finish. It classifies activity according to the amount of planning that can be done before the activity is started, or according to the amount that must be done during the period of the activity itself. It considers not only all subdivisions of processes involved in the activity down to and including the cycles of motions, but their therbligs.[4] It thus furnishes endless opportunity for investigation of and improvement in detail such as will satisfy the most ambitious inventor, while at the same time it sets aside certain work as within the capability of even those of comparatively low mental calibre, or of abnormal mental activity, and furnishes a market for their ideas, or any self-expression that they may have pertaining to superskill in their narrow fields.[5]

Relation to Fatigue.

Superstandardization eliminates fatigue both directly and indirectly. As applied thru Fatigue Study, it measures all those things that have to do directly with fatigue—and standardizes the best available. This

[1] See Psychology of Management, MacMillan Co., N. Y., V. D. I. Berlin.

[2] Anals de L'Institut d'Orientacio Professional, also "The Place of the Psychologist in Industry," presented at the 2nd International Conference of Psychotechnic, Barcelona, Sept., 1921.

[3] Pub. by Natl. Inst. of Industrial Psychology, 329 High Holborn, London, W. C. I.

[1] E. E. Southard, "The Mental Hygiene of Industry," Engineering Foundation reprint, Series No. 1, Feb., 1920. "The Modern Specialist in Unrest—A Plan for the Psychiatrist in Industry," Journal of Industrial Hygiene, II, 11-19.

[2] "Psychiatry in Industry," Independent, March, 1920.

[3] Eric Farmer, "Time and Motion Study," Pg. 16.

[4] June Bulletin Taylor Society, 1921, Pg. 128.

[5] "Motion Study of Epilepsy and Its Relation to Industry," a paper presented before the "National Association for the Study of Epilepsy," June, 1920. "Motion Study for the Handicapped." Dutton & Co., New York.

covers length of work and rest periods, working conditions, tools and equipment, desks, work benches, chairs, posture—all that effects efficient work from the fatigue standpoint.[1]

As applied thru Motion Study, the improved methods induce efficient habits, reduce to habit all repetitive activities that require no individual decisions, and utilize the finest, most carefully taught type of automaticity. This reduces unnecessary fatigue to the minimum, and leaves time and unwearied attention for those decisions that are necessary and interesting.

Relation to Skill.

Since it concerns itself primarily with elements of motions, as applied to study of methods, superstandardization greatly facilitates the transference of skill. It induces confidence in its results, and determines not only the One Best Way to Do Work, but the One Best Learning Process by which to teach it. This is vital as it affects the problem of industrial education.

Need for Such Superstandardization.

A most superficial knowledge of present day conditions makes clear the need for such superstandardization. The world in general and industry in particular is going thru a period that is extremely critical. The need for increased production, the need for the maximum elimination of waste, the need for stability are everywhere evident. The relation of superstandardization to stabilization of industry and employment is, perhaps, least appreciated. Only one who has many times gone thru the experience of entering a plant that has absolutely no stability or system, and later seeing the changes that have actually been made by carefully installed standardization, can appreciate its benefits. The effects of *super*standardization are similar but more intensive, since the changes made are based upon accurate measurement and are much better founded and carry more weight, as anything known to be absolutely accurate must.

Perhaps the least appreciated benefit resulting from national superstandardization is its effect upon stabilization of employment, for in times of panic manufacturers will be far less timid in manufacturing national standards, knowing that their product will surely be salable at some later date, thus turning their raw stores into assets of greater value, and meanwhile, keeping their labor turnover at a minimum figure.

There has been too much unnecessary and wasteful change in this country based upon nothing but a desire for novelty, and embodying no element of permanence. The losses due to frequent and unnecessary change, for no reason, from one kind of work to another are not realized or appreciated by those who have not had intimate connection with a chart department recording intensive outputs and their causes for fluctuation hourly. The true causes of small outputs, high costs and low wages are never properly known by those who have not investigated the psychological factors affecting change. This does not necessarily mean that there should be no change, or less change; it may mean more change. It means less *unnecessary* change. Changes cost time and money. They may, under certain conditions, be worth the money, but the fact remains, as Adam Smith emphasized nearly 150 years ago, that the great cost of changing from one kind of work to another is almost universally unappreciated. Superstandardization maintains what has proved itself of greatest value, always aiming consciously at the ideal of the One Best Way, giving it the stamp of approval of permanence, and making changes that are definite, progressive and stabilizing, and that will pay in money or in durable satisfaction.

Much work in standardization has been done both in this country and abroad, but this standardization has not applied to methods and has not had in mind the One Best Way to Do Work. A careful investigation of the work of the Bureau of Standards and of the most excellent publications of the American Engineering Standards Committee illustrates this. It is an import aim of superstandardization to bring to the attention of our research bodies the necessity for standardizing the *methods* of industry as well as the *equipment*. There has not been in this country to any such extent as abroad a widespread popular interest in standardization and in the work of those bodies that handle this subject, and it is a second aim of superstandardization to arouse this interest, to foster the work already being done, and thus lead to a more rapid advance in this type of work.

Standardization in Europe.

Europe has made the most astonishing progress in standardization during the past few years because of the realization of the importance of the subject and the general cooperation in its development.

For example, in 1917 the Verein Deutscher Ingenieure, at the suggestion of the German government, organized a central national body, called the Normenausschuss der Deutschen Industrie. Its members are engineering societies, manufacturing concerns, indus-

[1] "Fatigue Study," MacMillan & Co., H. M. Vernon. "Industrial Fatigue and Efficiency," Dutton & Co.

Fig. 1. One of 144 Standards Published by Normenausschuss der Deutschen Industry (Germany)

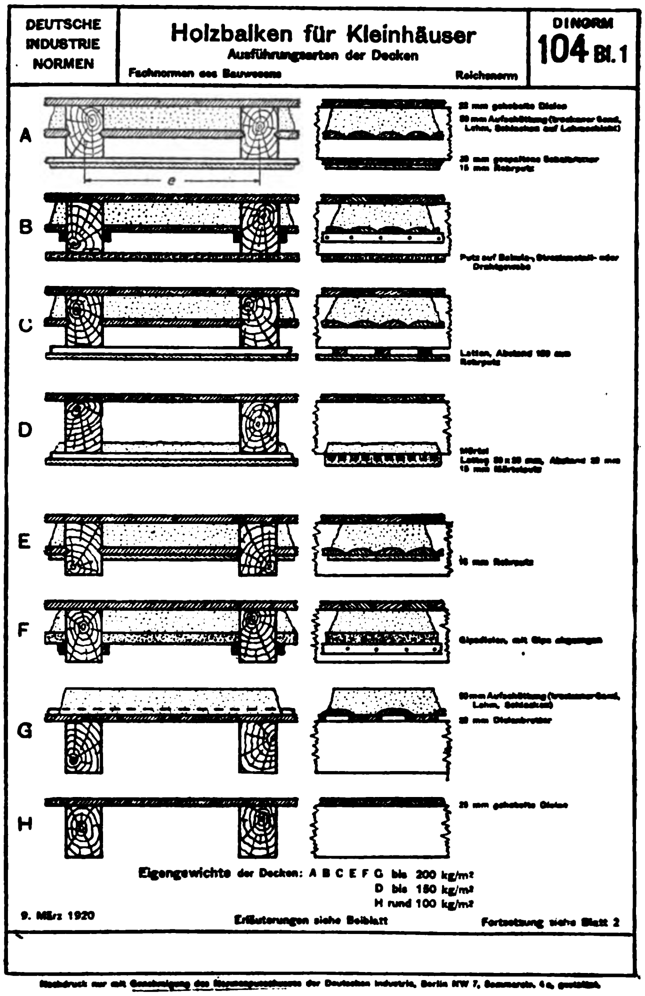

Fig. 2. One of 144 Standards Published by Normenausschuss der Deutschen Industry (Germany)

trial associations and various government departments.

The organization, whose purpose is to foster standardization and to promulgate standards, has attacked many widely separated fields and published much material, ranging from standardization of lines and letters in the draughting room, to standardization of window frames and sashes for many different types of buildings.

During the last four years, 144 of the standards have been actually endorsed, and hundreds that have been issued as tentative standards are being tested and developed. Each standard is embodied in a separate sheet, if possible, so that it can be used as working equipment by the subscriber or purchaser. These standards are supplemented by studies on standardization in all countries that add extensive interest to the intensive information.

Holland has been equally progressive, and the work of the Hoofdcommissie voor de Normalisatie in Nederland is both extensive and intensive. Nothing but a painstaking study of standards issued by these countries can make plain their overwhelming importance. This lies not so much in what they contain, as in what they imply.

Great Britain, Austria, Sweden, Switzerland, Italy, Belgium and Russia, all are at work along these lines.

Europe realizes the necessity of standardization as this country does not. Moreover, other investigators confirm our findings[1] that Teutonic Europe will, partly because of temperament, go into this matter more fundamentally than we of the Anglo-Saxon race will be apt to do, if governed by temperament alone. An unceasing and costly passion for expediency and standards merely for current use has already proved a dis-

[1] "Engineering and Industrial Standardization," Mechanical Engineering, February, 1922.

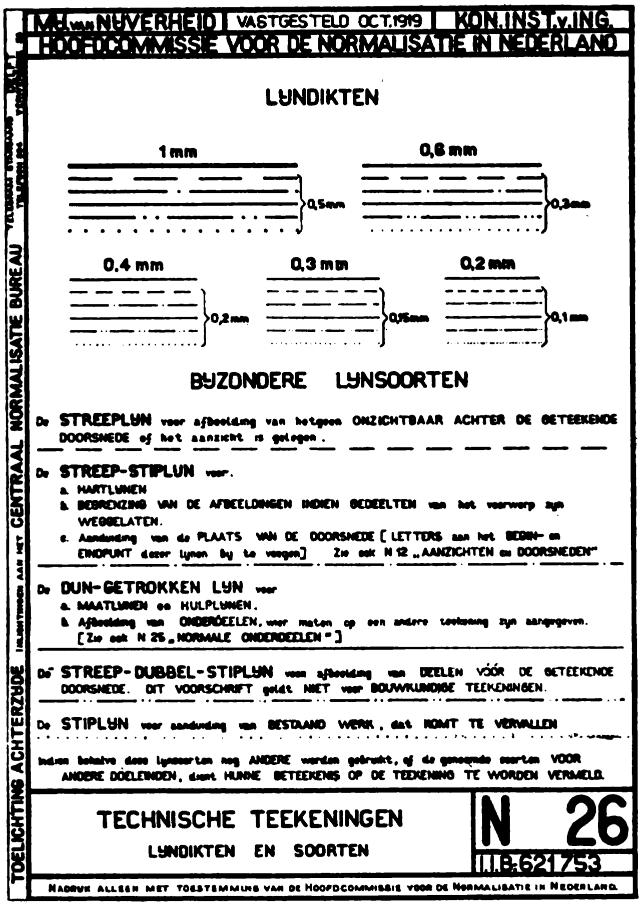

Fig. 3. Standard Published by Hoofdcommissie voor de Normalisatie in Nederland (Holland)

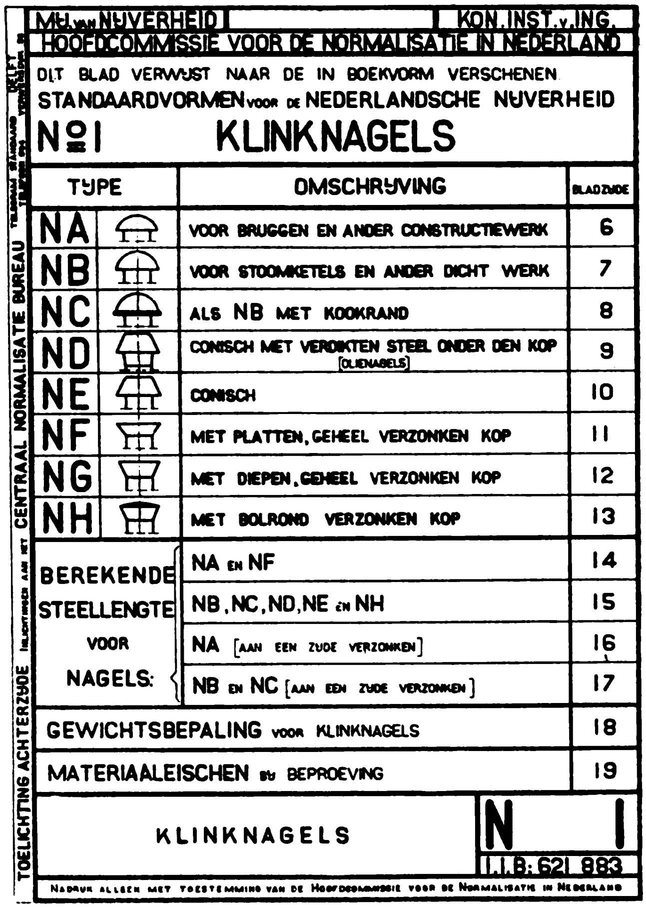

Fig. 4. Standard Published by Hoofdcommissie voor de Normalisatie in Nederland (Holland)

tinct menace to the development of Scientific Management.[1]

Our one hope lies in *superstandardization,* in reducing all possible practice to standards based on accurate measurement and on stressing standardization of *methods.* Here America can be supreme, for it already has the knowledge, the method of attack and the equipment to do the work easily, quickly and inexpensively.

The first thing needed in this country is a change of attitude toward the whole subject. It is vital that the entire nation, and especially those directly interested in industrial management, shall appreciate that our safety lies in superstandardization. We must embody the knowledge of accurate measuring devices and methods at our disposal—measures of both the material and human elements—into standards that can sustain world-wide competition—and win.

We must reconsider such controversial subjects as the use of the standards of the metric system and of simplified spelling in the light of these facts. But, even more important, we must apply standardization, beginning preferably where there is no disagreement as to its needs.

By express stipulation, and thru strenuous suppression, this presentation before this Society is made noncontroversial. We content ourselves for the present, therefore, by calling for a re-examination of the subjects, methods and results of standardization as embodied in the literature and supposed "best practice" extant, as the final argument as to the need of superstanardization.

Relation to Maintenance.

An immediate effect of superstandardization is the simplification of the problem of maintenance. The significance of this in scientific management is great. Everywhere, those most intensively acquainted with the problems of management are acknowledging the importance of maintenance of conditions of cumula-

[1] June Bulletin Taylor Society, "Symposium on Stop Watch Time Study."

tively improving standards. They have to do with the relation between the consulting engineer and the resident production manager, and the stability of the work begun by the engineer, after he leaves the plant and the production manager takes over the entire responsibility. If the installation has taken place thru the instrumentalities of superstandardization, provision is automatically made for the maintenance desired and requisite. The superstandard adequately applied builds up a superstandardized practice that insures maintenance of that which is best until superseded by proved, better superstandard practice.

Superstandardization in Practice.

Altho founded on a better and more definite theory, superstandardization is no less practical than is standardization. Wherever standards are based on and are the outcome of accurate measurement and are in actual use, superstandardization exists. It has been applied not only in all kinds of industrial work but in many types of outside engineering activities as well. It is important not only where it has shown results in a single type of work or in an individual process, for the results of superstandardization are cumulative and nothing is too small or unimportant to be considered or to be worth while to file for review and possible group installation later. The members of this Society and of similar societies should be encouraged to turn in results *no matter how narrow the field of application,* in order that these may be filed and available to all and may be built into a standard common working practice. Also, as has been stated, such measured elements make possible skill transference and fatigue elimination.

Value of Definite Examples of Superstandardization.

An important means toward arousing interest and cooperation in superstandardization consists of definite examples of its application. The plant, the industry, the entire population must be made to *think* in terms of standards. They must be made fashionable and fascinating; they must inspire the beholders with a desire to imitate, the user with a desire to exhibit them and extend their use, for personal and national economies and the consequent reduced cost of living and national prosperity. The standards of method are especially useful here as action is always interesting and leads naturally to imitation.

The cross-sectioned desk, with standard equipment, the standard pencils and supplies rack, the standard rack for inks, the one motion tool room painted white—these have all proved themselves extremely simple, inexpensive thought detonators. Used by many, of general interest, yet seeming to designate no special person as a target for criticism or an example of inefficiency, they furnish admirable starting points as definite concrete examples of superstandards for changing the attitude of an organization toward *methods of work,* and for making motion study a fascinating game.

Such illustrations, because of their elementary nature, prove that superstandardization is simple as well as profitable, and the results have demonstrated an immediate and also a cumulative value, particularly because they cause all types of individuals to think in terms of the variables of elements of motions.

It is extremely important that examples of superstandards and methods of attack of superstandardization be installed that are available to all office and production departments, that the principles be applied in office and shop alike. It is necessary—yes, vital—that papers and meetings that consider standards unify the interest, experience and problems of purchasing, sales, accounting, and production managers, of "office" and "shop" men, and serve as unifying interests and liaison procedure between the various professional groups.

Relation of Superstandardization to Costs.

Finally, we come to the discussion of the relation of superstandardization to the all-important matter of cost. It must be understood that superstandardization is a method of attack. It need not prescribe a new program. It does not attempt to outline a hard and fixed sequence of installations. It does not necessarily attack present practice in any revolutionary manner. It is in no wise a disorganizing or disturbing element. It is a method of stabilizing and securing results. In first cost, like the accurate measurement upon which it rests, it can compete successfully with the too usual and too customary inaccurate methods. In ultimate cost it need fear no possible competition. Because it is a method of attack, it may be applied first where most needed. Its direct product will be the solution of the immediate difficulties. Its indirect product will be a demonstration of its value as a method of attack and the consequent influence as a teacher, making all members of the organization think along these lines. It is not and never can be the possession solely of one man, of one group of men, of one profession or of one nation. It is not merely for current use. It has no boundaries of time or space. The only boundaries or limitations must be those of knowledge. It accumulates all improvements. It is free and available to all who desire to use it. It is true that knowledge of the proper units, methods and devices of accurate measurement are the greatest tools in effecting superstandardization, but many such tools already exist and are available, and as the demand increases, the supply will increase also. The *practice* of superstandardization in a special field of management is a problem for intensive investigation by those best trained for the work. The *theory* of superstandardization is, or should be, a world possession accepted and increasingly used by everyone everywhere. It is the duty of the management engineer who has had experience with standardization, and now with superstandardization, to explain their benefits and to put his experience at the service of thinkers and doers everywhere toward the solving of today's problems and the stabilizing of today's conditions for the benefit of tomorrow. Moreover, an intensive study of standardization in America shows that unless the management engineer takes his natural place as leader in this work he will lose a great opportunity, perhaps forever.

Recommended Practice.

We believe that superstandardization is the One Best Way for obtaining lower production costs and high wages simultaneously. It is the One Best Way and an immediate way, to reduce the cost of living.

This paper is to be followed by another, giving in detail the recent developments in superstandardization, both the latest practice and the theory on which it is founded, and also taken from data at present being collected by personal investigation in England and on the Continent. This will emphasize more strongly the imperative demand for *immediate* superstandardization in this country. It will supplement this present argument, based largely on the inherent need by a more extended review of the external competition.

We would summarize the immediate necessities as follows:

1. The evaluation of existing standards, as to:
   - a, immediate usability.
   - b, place in general plan and development toward perfection,
   - c, accuracy,
   - d, maintenance and full benefits of that which is installed.
2. The promulgation of superstandards in every field of activity.
3. The instruction of young engineers in the making of standards and of superstandards.
4. The advance of those skilled in standardization into superstandardization.
5. The development of the standard, thru accurate measurement, to that point where the "superstandard" of today becomes the "standard" of tomorrow. We cannot afford to stand still.

A RECENT circular of the American Engineering Standards Committee calls attention to the fact that Belgium is another European country which is making great strides towards standardization, particularly in the construction, metals, mining and electrical industries. According to the Association Belge de Standardization, standards for the construction of the following have been approved for issue; steel roof trusses, steel tanks, galvanized and corrugated roofs and partitions, steel bridges, shafts and pulleys, bolts and rivets, requirements for electrical machinery. An electrotechnical vocabulary has been issued and a tentative list of additional proposed standards has been published for criticism.

INDUSTRY in the United States has been in the lead with respect to certain phases of standardization—the interchangeability of parts which enter into mechanical equipment. But that is only the beginning. It will not do for the United States to remain satisfied with past achievement; the movement towards standardization in European countries since the war promises to include standardization of products and of operations involved in their fabrication. What plants with Taylor methods in the United States have been doing for themselves individually, is being done for entire industries in several European countries. It will ultimately give a power in international competition which cannot be ignored.

Professor Bob Emiliani
Please visit bobemiliani.com

Many interesting insights is this 1923 paper which documents the early days of the "Management Movement" beginning in the late 1800s. "Probably the best criterion for the continued growth of the management movement is the interest of the general public in management matters." Indeed. This is where Lean falls down. Failure to engage the public and inform them that a system of management much better than classical management exists.

THE MANAGEMENT MOVEMENT[1]

By Richard H. Lansburgh[2]

COINCIDENTLY with the rise in interest in management matters among the general industrial community there has been developing what may best be termed "the management movement." This movement, which involves personalities, has been progressing together with industry and yet separately from it, actuating industry almost from without. Although attention to operating methods has outlined for us broadly a true era in industry, yet by considering this management movement separately it will be best possibly to trace definitely various stages and paths in the changes that have been going on. Before discussing management methods, with the few thoughts already presented on what management really is and its broad historical background in mind, a discussion of this management movement will aid definitely in clarifying issues, and possibly to some extent in eliminating doubts.

2. The management movement would have come about within a period of perhaps a quarter-century. Of that we can be certain. It had a firm foundation of necessity, and what that foundation was we have already ascertained. However, the exact form of the movement and its starting place was, as is not unusual, determined by the life work of a great man, who, seeing around him the need for the development of management, even as probably many other men saw it, was not content merely to sit and look on, but began the intensive study of corrective measures, which finally led to the development of the science of management, of which he is recognized as the founder.

3. Whatever branch line the management expert may be working in at the present time, or whatever methods he may use in his particular development of the science, the true expert, who has studied the history of the movement, as well as the detail of method, will always gladly say that his work is but the development of the foundations laid between 1880 and 1890 by Frederick W. Taylor. Taylor was the man with the vision, the father of modern scientific industrial management, not only in the United States, but throughout the world. There never has lived a man whose individual work so largely influenced the operation of so many plants in so many and diversified industries as did the work of Frederick W. Taylor. His first work was small in itself and finally largely voided by opposing factions in the organization. His influence, though not dormant, was both consciously and unconsciously disregarded for twenty years, and yet his influence in developing management methods has been greater than that of any other single man.

4. Dr Taylor was himself strongly influenced when still comparatively young, by knowledge of the work of Mr. Henry R. Towne, President of the Yale & Towne Manufacturing Company, who began the application of new management methods as early as 1870 in the plant of that company. It was probably the example of Mr. Towne that caused Dr. Taylor to direct his efforts to the organized study of management as a science and as a profession. But, although Towne may have been the pioneer, Taylor was the great leader of the movement. At the time of Dr. Taylor's death, Mr. Towne himself referred to him as "one of the world's discoverers and creative leaders," and as "the creator of a new science."

5. In 1882, after transferring from the offices to the shops of the Midvale Steel Company, in Philadelphia, Taylor was promoted to machine shop foreman in the Midvale plant. During his previous experience as a workman, Taylor had been constantly impressed by the failure of many of his fellow-workers to produce more than a third of a good day's work. Wages had been on a piece-work basis, and the men were afraid to let the management know how much work they could really do, for fear that the rates would be cut. When Taylor became foreman, he was determined to work out some system of management by which the interests of the management and the men might be made as nearly as possible the same.

[1] Outline No. 3 of the syllabus used in the course in management, Wharton School, University of Pennsylvania. Copyright by Richard H. Lansburgh.

[2] Assistant Professor of Industry, Wharton School.

6. The constant thought in the mind of Mr. Taylor in those days was that the difficulty at the root of the whole matter was lack of knowledge of what actually should constitute a day's work. How could the man be held accountable for his full duty when the management had no idea of the man's capacity? It was on this thought as a foundation that most of his writings, researches and influence over other men were erected. He found that management did not really manage. It would be necessary to entirely change its attitude towards its responsibilities in this direction before it could be expected that the workman would change his attitude with relation to his work. Taylor felt that the management was asking the worker to do its own work as well as his own. Taylor's efforts to secure information at Midvale, concerning ways in which management might really manage, enabled him to develop what he termed the "duties of management" that guided him and many others along newer industrial paths. These duties were changed in phraseology by Taylor from time to time, but their substance was as follows:[1]

7. First: The development of a science for each element of a man's work, thereby replacing old rule-of-thumb method.

Second: The selection of the best worker for each particular task and then training, teaching and developing the workman; in place of the former practice of allowing the worker to select his own task and train himself as best he could.

Third: The development of hearty cooperation between the management and the men in the carrying on of the activities in accordance with the principles of the developed science.

Fourth: The division of the work in almost equal shares between the management and the workers, each department taking over the work for which it is the better fitted; instead of the former condition in which most of the work and the greater part of the responsibility were thrown on the men.

8. Taylor remained at Midvale until 1890. While there he carried on also early experiments in the development of high-speed steel. His discovery of this product, together with Mr. Maunsel White, ranks as an achievement equal to the founding of the modern management movement. The work which he did on high-speed steels was in fact an outgrowth of his attempts to find the right way to do jobs. When Taylor left Midvale it was largely due to factional differences within the organization and this fact naturally led to the undoing of much that he had accomplished. Nevertheless even today many of the practices in the machine shops of this plant can be traced directly back to the time that Taylor was first working with management methods there.

9. For several years Taylor did not have an opportunity to carry on, upon a large scale, the work that he had begun at Midvale. Though engaged in a number of undertakings in which he aimed to improve management methods, several of which, by the way, were largely concerned with improvements in cost accounting, there was no one great work carried on in one plant.

10. At the Bethlehem Steel Company, beginning in 1898, for three years, with the assistance of a large and competent force of assistants, he reorganized the management and methods of two of the larger machine shops and the foundry, and at the same time completed the development of his metal-cutting experiments. It was at Bethlehem that interesting studies of pig-iron handling and shoveling were made which since have become classic in the field of management. One of the more important of the wage-payment systems was also developed during this time. Taylor's early experimental work in management can be said to have been on the same sound scientific basis as his metal-cutting experiments, and any task which he attacked was handled by him in the same manner. This fact accounts for the fundamental nature of his conclusions. As an evidence of the type of work he carried on, Taylor once stated in connection with his metal-cutting experiments that he and his associates had made nearly fifty thousand recorded experiments and many others of which no record was kept. In studying the laws of metal-cutting there were cut up under his direction more than 800,000 pounds of iron and steel. His experiments in management were conducted on the same scale.

11. After Taylor had been at the Bethlehem Steel Company for about three years there was a change in the directorate and executive management of the company. The group who came in were unfamiliar with, and apparently antagonistic to, the methods pursued by Taylor and his staff. Taylor and his associates left. This withdrawal was followed by changes in methods by the new management, and since it so closely followed the upheaval at Midvale it cast a shadow on Taylor's work which it took some years to live down. This very largely accounts for the slow development of his ideas during the immediately succeeding years.

[1] Principles of Scientific Management, F. W. Taylor, Harper & Bros. Pp. 36 (1919 edition).

The manufacturing community as a whole, if not actively hostile, were at least reluctant to give a trial to ideas which had been practically discarded at two of the largest steel plants in America. But Taylor's work had trained a number of disciples, who thoroughly believed in his ideas and work, and there naturally were enough manufacturers who were interested in these new ideas of management to allow for a steady, if slow, growth in the application of these management principles during the succeeding decade. Among the more important plants in which Taylor or his direct associates worked in this period were the Tabor Manufacturing Company and the Link-Belt Company of Philadelphia and the United States Arsenal at Watertown, Mass.

12. Shortly after the beginning of the twentieth century, Taylor withdrew from actively installing management methods and began to philosophize and generalize on his experiences. The far-reaching significance of his principles and methods became clear to him and he began the task of transmitting them to others through writings and addresses. His writings of this period have become the very foundation of modern management literature. The first and best-known of these is "Shop Management." The book was first published in 1903 under the auspices of The American Society of Mechanical Engineers, having been read at a meeting of the society in June of that year. In December, 1906, Taylor presented as his Presidential Address to the same society his other masterpiece, "The Art of Cutting Metals." From that time until his death on March 21, 1915, he devoted himself almost completely to the task of spreading the gospel of scientific management.

13. After Taylor gave up the active practice of management installation, there quickly appeared a number of his direct followers to carry on his active work. Among the leaders of these, who have also made real contributions to the art and science of management, may be mentioned Henry L. Gantt, Carl G. Barth, Morris L. Cooke, Sanford E. Thompson and Horace K. Hathaway. These men have become known as the "Taylor School" in management methods work because their close association with the leader of the movement has caused them to be largely guided in their work by Taylor's own methods. The influence of Taylor was guiding, at this same time, other men in distant parts of the United States, and even of the world, along paths which led to the same goal, but nevertheless took somewhat different courses in reaching it. In the hope of avoiding some of the pitfalls that Taylor's detail methods had fallen into at times, these other methods which were developed, frequently seemed radically different from those of Taylor. As to devices utilized they sometimes were different, but the principles they aimed to reach were his, although the executive might not always have been conscious of this.

14. Taylor's position in the management field is that of the first explorer. His researches, because of his personal ability, carried him personally further than might have been expected. Unfortunately, his abilities did not include that of selling his work in toto to many besides those most closely associated with him, who were always able to see the careful thought and study behind all his conclusions. Being the leader, and years ahead of the industrial community, he has had associated with his name some of the most violent opposition to the introduction of new methods in operation. This became particularly true because he was the first exponent of a cause which, though it has not grown beyond his imagination, has, as he most of all would wish, grown beyond the control of his immediate followers and his or their particular methods.

15. The public, and even the large majority of factory executives, especially outside the metal-cutting trades, had not had their attention focused on scientific management by any of the early work of Taylor or the development work of the Taylor men or others. Although there had been a general tendency towards improvement in management method, in 1910 but little was known of scientific management. In 1911 thousands had a general idea of what it meant, although their concepts were necessarily frequently warped.

16. This change came about through a startling announcement made by Louis D. Brandeis during hearings before the Interstate Commerce Commission, late in 1910, concerning certain railroad rate increases. Justice Brandeis, who at that time took the aggressive against the proposed increase, stated that it was unnecessary because if the railroads of the United States should adopt scientific management the rate increase would be unnecessary. He explained that by this method a saving in operating expense could be accompanied by an actual raising of the wages of the railroad employees. In the same hearings, Harrington Emerson, an installer of management methods who had had wide experience in the shops of the Santa Fe Railroad, stated that the railroads could save $1,000,000 a day by paying greater attention to efficiency of operation. These two statements, both coming from men of un-

doubted reputation, were given wide publicity and electrified the entire country. The general public of the country was as interested then as now in lower railroad rates and this new talking point against increases was more than interesting to them. It was peculiarly fortunate for the growth of the management movement that public attention was first focused upon it in connection with an industry in which the public was so vitally interested and concerning which it came into such daily contact as railroading.

17. Only a few days after the introduction of the evidence the early December magazines gave much space to the dramatic testimony of the witnesses, and proceeded to give accounts of what scientific management was and what the results of its installations had been. Arguments began, debating societies debated the question, industrial executives were quoted as to why they thought scientific management was good or worthless. In March, 1912, the first "efficiency" society was organized in New York for the purpose of applying the scientific management principles of "efficiency" to every department of life, and scientific management as an element in the industrial life of the United States had come to stay.

18. Modern management shortly came to be known under the term "efficiency" and interest in "efficiency" became so widespread that it nearly caused the death of the management movement. It did retard it. "Efficiency men," fakers in every sense, who promised short-cuts to profits through panaceas, and whose knowledge of management was as shallow as their vision was narrow, sprang up over night. They managed to kill the word "efficiency" in American industry most promptly, and they nearly permanently injured the management movement. They failed for various reasons; first, they usually had no knowledge on which to base their efforts; second, if they did have the personal experience to qualify them, they usually lacked the broader concepts which would have permitted their work to be successful. They did not pay sufficient attention to the workers' point of view and they did not or would not cooperate with the regular organization. They tried to run rough-shod over the older members of the organization until the title of "efficiency man" became everywhere the key-word for concerted opposition. Recently the "consultant in management," with far different ideals and qualifications has replaced the "efficiency man," with very effective results.

19. Another retarding influence on the growth of the management movement at this time was the fact that all the literature on the subject concerned the metal-cutting trades. When a manufacturer in another industry became interested in modern management and began to read Taylor's writings, or those of his co-workers, he soon discovered that everything definite about modern management was expressed in terms of metal-cutting. It was, therefore, but natural that they failed to look under the surface of the devices and terminology employed at the principles involved, and said that "it didn't apply to them." It was still to be some years before this difficulty was to be even partially overcome.

20. In the general growth of the management movement the leadership that had been Philadelphia's was largely lost. Sections of the country which were less conservative along lines of management method took to the new ideas more readily and in larger proportions than did Eastern sections. New industries which were developing, such as the automobile and allied industries, had a made-to-measure opportunity to develop management method along with manufacturing technique. These were largely located in the Middle West. The Middle West grasped at the opportunity of increasing effectiveness of operation that was offered by management method, and gradually developed, in many scattered localities, methods of operation which, though built up on the same firm foundations as those which served the early leaders of the management movement, were nevertheless constructed along newer and bolder lines. Of the examples of this work, the best known is that of the Ford Motor Company, whose examples of the economies incident to standardized operation, continuous assembly and newer wage-payment methods have profoundly influenced the whole of American industry.

denied FWT's influence though!

21. At the time that the United States entered the world war the management movement may be said to have been in a condition of deflated interest but gradual growth. The necessities that were outgrowths of our entrance into the war quickly changed this situation to one of awakened interest and rapid growth. The declaration of war by the United States, in April, 1917, made it incumbent upon this country to organize itself for the prosecution of the war immediately and effectively. It meant the organization of the industries of the nation for the one common purpose. Without attempting to lay blame, or to decide whether there was blame, it is nevertheless true that in the several years of the war prior to America's entry into it, nothing had been done towards getting American industry ready

to shoulder the war burdens, other than working upon the European orders which certain American manufacturing plants had received, not as a matter of government policy, but generally almost contrary to the government policy. It was, therefore, found necessary at the beginning of our participation to start from the very ground in organizing the nation for war production. Government arsenals could supply but a small fraction of the war materials which were immediately needed.

22. Those who were in control of government supply bureaus very quickly found it to advantage to employ for the organization of war-time industry men who had made a business of organizing peace-time industry. It was, therefore, usual to find in Washington that the men who were taking active charge of the expansion of those bureaus were emergency men, brought in for that specific purpose, and the regular government officials were contenting themselves to the lending of these men advice on governmental procedure, or the execution of such procedures as might be developed. This was even more true in the organization of industry to aid the government than it was in the reorganization of the bureaus themselves. The men who were brought in to do this work were proven executives, and there was a scramble among the supply bureaus for those men who had proven themselves competent in the distinct field of management. Practically every man who had ever written an article on management was to be found connected with one or the other of the government bureaus before the war was two months old. In this attempt to secure the management talent of the country it was unfortunately true that some of the bureaus were not in a position to select the capable men from the incapable, but nevertheless there was built up quickly a corps of management experts, such as had never before been gathered together. These men, accustomed to the freer ways of the business world, frequently chafed under the binding restrictions of governmental red tape, and therefore, kept constantly in mind the performance of old tasks in new ways.

23. Brought into contact with these men at this time were hundreds of other industrial men, called also into government service, who as yet had not come directly into contact with the management movement. These men became the aides to or cooperators with those of wider modern management experience and soon came to have first-hand knowledge of their methods. Although it is true that some of these men returned to industry with rather a horror of attempting the newer methods, the usual reaction was otherwise. To most of these executives the war became an apprenticeship in the ways of modern management, the knowledge gained being directly utilized after their return to industry.

24. The effect of the war in changing operating methods in American industry and causing a rapid growth in the management movement can hardly be overestimated. Reference was made in the previous chapter to the effect on plants forced out of time-worn ruts by the war. The same effect was experienced by executives as individuals. As the production forces of the government were demobilized, executives returned to their peace-time tasks with new ideas and new concepts, and, above all, jarred out of the habit of doing the same thing in the same way day after day for years.

25. The war served the management movement in another way. It broadened the very men who had been the leaders in the movement in prior years. Particularly is this true of the attitude of the manager of the worker. Whereas much of the opposition to scientific management had been from the worker, because he felt that it was but a further attempt to deprive him of some of his traditional skill, previous to the war, management men had a tendency to regard this as merely one more barrier to be overcome, and not to deal with the fundamentals of the situation. The broadening powers of the war seemed to aid this situation somewhat. Management men seemed now to possess a more fundamental concept of their position towards labor, and with rather a feeling of trusteeship of the rights of labor as well as a trusteeship of the rights of the owners of a business, which they had long felt. This has developed side by side with the growing feeling of the importance of the human factor in industry, previously referred to.

26. There has also developed an appreciation of the difference in reaction likely to be experienced from the workers as various phases of management work are undertaken. For instance, one management problem to which much attention has been given in recent years is the lighting of the workplace. If the manager is seeking to improve the lighting of the workplace, he will find no opposition from any worker or body of workers. He may receive requests for better lighting from the workers, but there will most certainly be no permanent objection imposed to the changing of light conditions in the shop for the better. This is representative of the type of change where the manager is sure

of the full cooperation of the worker, and the type where he will expect no marked opposition.

27. On the other hand, another of the problems of the modern manager is to ascertain just how much production should be attained by an average worker in a given space of time. This knowledge is fundamental in a large number of the decisions of the manager. To secure this information there has been devised the taking of time-studies usually by means of the stop-watch. Large numbers of laboring men, and particularly labor organizations, have expressed their disapproval of the taking of time-studies. It would be foolish to think of the taking of time-studies without the full cooperation of the worker, and yet the manager here is likely to find himself bitterly opposed by the worker. So his management problem in this case takes on an entirely different aspect from the one of improving the lighting of the work-place. In both the human factor must be regarded, but from entirely different angles.

28. Since the war the spread of the management movement has been extremely rapid and the development has been along what seem to be comparatively sound lines. "Efficiency" has passed on and in its stead has come soundly developed management work that considers the fundamentals of all problems, that is based on long perspective, that takes into account the necessities of both booms and depressions. Management has become the profession of the plant executive, not merely the profession of a few who specialize in it. Those who do specialize in management fit into the scheme as specialist cooperators with the managing executives of industry. The consultant in management has become firmly intrenched as one of these specialist cooperators. He fills a very real, although a new niche in the halls of industry. He is a combined product of the age of management and the age of specialization in industry. He specializes in management and sells his services, either along general or specific management lines, to the executive who is in charge of the enterprise. He brings to one plant the knowledge of many, and he serves to rehabilitate run-down concerns by bringing in the refreshing stimulus of an outside viewpoint. He serves the same purpose as does the blood-transfusion operation at a hospital, and at the same time his greatest work is carried on before the patient-concern gets to the point of weakness such as characterises the hospital patient who undergoes the blood-transfusion.

29. The specialist, or consultant, in management is not the only expert who is a product of recent development in industry. He has come in after the certified public accountant, who occupies practically the same position in the accounting field that the consultant in management does in the managerial, and his advent is not so recent as that of the income-tax expert, whose duties frequently partake more of the legal nature than they do of the accounting. But some of the more recent developments in the field of industrial consulting have become rather specialized. For instance, there is the type of industrial consultant who advises only with regard to the construction of a new building or the remodelling of an old one, specializing in such matters as the type of building construction, fire hazard, and the routing of the product through the factory. Or there is the still more recent development, the outgrowth of the labor conditions just referred to, of the consultant who deals only with labor matters. There have been mushroom consultants spring up who are but remnants of the efficiency man, but in the main the consulting field is developing along far sounder lines than did the efficiency movement.

30. Together with the growth of the consultant in management, has come the growth of the idea of having an "inside man" in management. This inside man is a specialist in management who is continuously on the payroll of the employing concern, and who performs the same type of tasks as the consultant. He has no particular duties connected with the actual administrative work of the concern, but acts entirely as a specialist in management, advising and installing new ideas. This development seems in some respects to many to have more possibilities than the development of the consultant, as the latter frequently has to spend so much time in the plant in order to be familiar with local conditions, as to become himself almost an inside man for the time being. If he does not devote that great an amount of time, he is apt to have a high percentage of error in his decisions.

31. In the business depression which began in the late months of 1920, the management movement found a blessing, though at the time it did seem as a blessing to be considerably in disguise. Soon after the beginning of this depression, factory managers being forced to reduce operating costs to the very minimum in order to be able to survive, frequently eliminated production, personnel, or other similar staff departments which have been usually looked upon as part and parcel of the management movement. These departments were usually eliminated with regard for only one factor, imme-

diate pay-roll necessities. For a time it looked as if such adjuncts of management work were only fair-weather factors. As the period of most severe depression passed and prosperity began slowly to return, it was found that frequently that which had been eliminated from an organization could well be spared, that it was really an after-war overdevelopment of a good principle, badly worked out. But plants found out that they needed personnel departments and production departments, if they were established on a sound basis. Examples of well-managed plants that had weathered the storm best of all, through low inventories and quick turnovers made possible through highly developed organizations, came to be well-known, and the sound basis of management work as applied to a particular plant came to be better understood. The feeling that correlation of various departments within a business was of primary importance and operating methods within the departments come afterwards was a distinct outgrowth of the experiences of many plants during the depression. Labor, even union labor, frequently previously hostile to management developments because of misunderstandings or poor operating methods in particular plants, came to be more friendly because of the depression. It saw that there was less unemployment in better-managed plants, less wild wage-reductions, more sympathy for the point of view of the worker from the executives who were working in accordance with modern management principles. All in all, the depression served to squeeze the water out of the management movement and to put it on a firmer, sounder, more appreciated basis in all portions of industry.

32. The management movement has progressed remarkably when its youth is considered. It has grown rapidly from the early beginnings of Frederick W. Taylor, and it seems destined to continue to grow because of the logical trend to operating methods which we have seen is a fundamental condition in American industry. There are a number of factors which are combining to insure steady progress in the development of the field of management. Among these are the growth of societies, whose membership is largely plant executives and whose interests lie entirely with management problems, the increasing literature, both periodical and book, on management subjects, and the attention being devoted by the next generation of factory managers, now in educational institutions, to management as a study.

33. Just as the growth of scientific education in colleges during the last fifty years has aided in revolutionizing American industry, so the growth of management education is likely to aid the management movement in further revolutionizing it. Ten years ago there were not five courses in management given in American universities. Today practically every business and engineering school in the United States is offering courses in Management. While this extremely rapid growth of management instruction has been in response to the demand from industry, yet in many cases it has led the demand, and has, through its graduates, called the attention of industry to the strides that have been made in management in other sections of the United States. It must be put down as one of the most important developments in management in recent years. Particularly is this true in the instances where industry and the colleges have cooperated in management education, for in practically every case where this has occurred, the combination of practical and theoretical instruction has resulted in very distinct advances in the management field.

34. Probably the best criterion for the continued growth of the management movement is the interest of the general public in management matters. Management literature is no longer confined to technical publications, but a large portion of the public is informed of strides towards better management through the columns of the daily press and popular periodicals. Each time that public interest is threatened through some industrial upheaval such as a strike in a basic industry, editorial comment points directly to industries and factories where better management has solved similar problems. The general public, as well as the enlightened factory manager, is coming to know that a solution of a specific controversy between employer and wage-earner lies deeper than mere adjustment of the problems immediately incident to the particular difficulty. It is coming to be daily better understood what the hidden forces are which make for smooth and effective operation of industrial establishments, and that these forces, though sometimes highly technical in their development, must be successfully coordinated by what is known as management to bring about industrial betterments and the industrial peace so sought after.

SPRING MEETING

Hotel Onondaga, Syracuse, June 7-9

Program on page 43

Professor Bob Emiliani
Please visit bobemiliani.com

A U.K. view of scientific management in 1923. “Scientific management, then, is the is the conduct of the work of management according to the scientific method -- investigation, classification, definition, measurement and standardization.” Sound familiar?

THE ART OF MANAGEMENT

FROM A BRITISH POINT OF VIEW

By Oliver Sheldon[1]

IT would be both ungracious and untrue to deny that, in recent years, a very strong impulse towards more efficient industrial management has come to us in Great Britain from the United States. Fresh breezes have crossed the Atlantic, bearing new ideas and scattering old ones. Most cordially I, for one, acknowledge the service which Mr. Taylor and those of his compatriots who worked with him or have since faithfully carried out his great principles have performed to the world at large, and, after the United States, to this country in particular. Wherever manufacturing is carried on, this acknowledgment is due.

Much water has, however, flowed under the bridges since the first beginnings of the new era in management. Scientific management has now come to claim its capital S and its capital M, and has been awarded its inverted commas. With increasing study and a wider and constantly wider circle of readers, teachers, critics and experimentalists, the basic principles have become overlaid and difficult to distinguish. Much knowledge has conduced to obscure the main issues. There are so many trees that one often fails to discern the outline of the forest. There are false prophets to mislead the unwary and confuse the student. A vast enthusiasm to run has made some careless of the goal towards which they are running. The impetuosity of youth has overwhelmed the judgment of age. The quick glance of eagerness has seized upon tangible forms and not penetrated to the underlying spirit, as a man who reads the anecdotes of a book but skips over the conclusions.

Scientific management has accordingly suffered in the process, and has been, as it were, obscured beneath a mask. This applies in a greater degree the further one is from the source. Scientific management has been largely presented to this country in a distorted form. Its mechanisms have been everything; its philosophy nothing. It has come flushed with superficial enthusiasm, equipped with hidebound contrivances, glowing with ethereal promises, and pointing airily towards "short-cuts," along rosy primrose-strewn paths. It has accordingly evoked cynicism, sarcasm and the "cold shoulder." Yet beneath it all, it was patent to those who cared to pierce the spangled cloak that here lay a message of immense portent; and, even to those who scarcely paused to think, the mechanisms themselves suggested some facets of the truth. In general, however, I think one may fairly say that "Scientific Management," frilled out complete with capitals and inverted commas, accompanied by its profligate pursuer "Efficiency," similarly bedizened, has, in externals at any rate, received in this country a chilly reception.

Those who have witnessed its presentation cannot be surprised that this should be so. Day-to-day experience of industry is a fully adequate preventive against the deceptions of the industrial conjurer. Efficiency, as a term of industrial significance indicating a multitude of systems of specious appearance but of dubious value, has consequently come to be the outcast of our industrial vocabulary. The phrase "Scientific Management," though saved from a similarly degrading fate, has become one to be expressed with caution and reservations.

It is vastly important, therefore, if the great principles of scientific management are to become part of the web and woof of our industrial philosophy, that every effort should be made to tear away the glittering garments and reveal the real body which stands behind. When we speak of "scientific management," what is it that we mean? Is it a set of mechanical contrivances, like so many Meccano toys? Is it a transportable system of things, like a ready-made suit of clothes, that one dons and becomes a different being? Is it a complete and definite theory, or is it a general attitude to things? Is it something one installs, or is it a means which one employs? Is it an object to be attained, or is it an attitude of mind to which one must school oneself? I postulate these queries, not wholly in childish

[1] Organization Manager, Rowntree & Company, Ltd., York, England; author of "The Philosophy of Management."

innocence, but rather because I am convinced that the future of scientific management in Great Britain depends upon the answer.

Let me digress for a moment. On the morning of October 8th, 1923, readers of the *Public Ledger* of Philadelphia were confronted with the intriguing headline—"Scientific Management Unknown in Great Britain. Scientists know nothing of business and business men know nothing of science." To a British reader this must have conveyed the sense that one was amongst the ranks of the "great unwashed"—a grimy urchin playing in the dirty puddles of an industrial back-yard. Yet one could not but be struck by the glint of truth in an ambiguous title. After all, one said to oneself, where can one point to any unadulterated application of time-study, functional foremanship, standardization, planning, instruction cards, and task-work? Not here; not there; indeed, anywhere? Perhaps, there, just in one or two isolated instances. Truly, the gloom is darker than a moonless night of winter. Yet, for all that, one felt that there was something—some struggling hands, some forward-looking impulse of many scattered minds, some jerking, spasmodic, tense activity, hardly to be called a movement, yet eminently buoyant on the tide of progress—which gave the lie to all that the headline implied. And, after all, it resolved itself into the fundamental question—"Well, what do you mean by scientific management?"

Let us go back to the words of Mr. Taylor himself. "Scientific management," he says, "fundamentally consists of . . . a certain philosophy which can be applied in many ways, and a description of what any man or men may believe to be the best mechanism for applying these general principles should in no way be confused with the principles themselves." And again he says, "I want to tell you as briefly as I can what scientific management is. It certainly is not what most people think it to be. It is not a lot of efficiency expedients. It is not the printing and ruling of a lot of pieces of blank paper and spreading them by the ton about the country. It is not any particular system of paying men. It is none of the ordinary devices which unfortunately are going by the name of scientific management. It may in its essence be said in the present state of industry to involve a complete mental revolution, both on the part of the management and of the men."

Such statements as these indicate the breadth of vision of Mr. Taylor in a way which no amount of explanation can. They entirely rule out of court those who assess the presence or absence of scientific management by the presence or absence of certain mechanisms. Primarily, scientific management consists of a certain attitude to industrial problems. He, in fact, is an exponent of some branch of scientific management who deals with his factory problems by the scientific method. The scientific method may be described as a series of definite stages, culminating in a "law" or a "standard." The first stage is the accurate, systematic and wide examination of the facts. The basis of all science is fact, truth. The scientist collects his data from as many sources as possible, in as great an amount as he can command. Dispassionately he reviews them—singly and collectively. He then classifies his facts, groups them and re-groups them. Finally, from this accumulation of fact, he derives a principle, a law, or a standard. In order that his facts may be properly grouped and carefully weighed, he insists throughout upon exact measurement and the accurate definition of every tool he uses, be it a fact, a word or a measure. Scientific management, then, is the conduct of the work of management according to the scientific method—investigation, classification, definition, measurement and standardization.

If this conception of scientific management be correct, then it follows that it can be applied to the management of any enterprise, whether large or small, and to any section of an enterprise. The main work of Mr. Taylor was devoted to the application of this general philosophy to operative work and to the immediate supervision of operative work. But he himself fully realized the universal applicability of his principles. Indeed, the recent work of the Taylor Society on sales management and on the higher direction of a business by a chief executive are instances of the scientific method being used in fields somewhat remote from the factory floor. One is applying the scientific method whether, after exhaustive investigation, one determines the standard figures to be supplied to the chief executive or the standard output to be expected from the workman.

Before returning to our main theme, moreover, I think it is vital to distinguish between scientific management and the "Science of Management," of which we are beginning to hear so much. It is the difference between the scientific method as an instrument by which management arrives at certain standards, and the standards themselves. A science is the codified knowledge acquired as a result of the use of the scientific method. If, therefore, the management has applied the scientific method to some operative process— let us say, laying bricks or covering chocolates—the outcome is a science of bricklaying or a science of chocolate-covering, but not a science of management. It is the science, the knowledge, the truth, the standards which the bricklayer has to learn. To achieve a science of management, therefore, we have to apply the scientific method to the tasks of management as distinct from the tasks of those whom the management control. It is fundamental, I suggest, to draw a distinction between operative science (which management, of course, uses) and managerial science, where management itself is the operative. We need standard methods of control, standard managerial procedures, scientifically determined, as well as standard methods of operation. Just as we investigate operative processes, so should we investigate managerial processes. We should investigate precisely how the work of management is performed, sift it into its primary elements, and then reconstruct it into a new set of standard methods. It is, as we know, just as possible to have standard methods of engaging employees, of compiling plans or of routing orders, as of laying bricks—and these constitute the essential science of management. I submit, therefore, that the management has the dual task of formulating a science for every branch of operative work it controls and of formulating a science, by the same methods for every branch—direct and indirect—of that control. The two are, of course, interdependent. The standard methods of management will depend, to a great extent, on the standard methods of operation, as for instance, functional foremanship is a necessary outcome of the setting of operative tasks. But it is important to realize, firstly, that the scientific method is applicable to the work of operative and manager alike; secondly, that the outcome, in both cases, is a science to be learned, and thirdly, that the one science is something distinguishable from the other. Scientific management, therefore, knows no limits, and its object is not only to determine how best to perform operative tasks but also, and of greater importance, how best to control their performance and carry out the many varied activities auxiliary to that control.

It is an easy step from this line of argument to the realization that management is an art. To elaborate a science of chocolate-covering and of all the activities concerned, directly or indirectly, in the control of chocolate-covering is one thing; but to apply and make use of this fund of knowledge is quite another thing. The application of knowledge is an art, and not everyone who knows can successfully apply his knowledge. Even if, therefore, our science of management were as exact as that of law or of medicine, there would still be required the skilful exercise of human faculty, the art, of the manager. But it is clear, I suggest, that management can never be reduced in its entirety to a set of scientific laws. What Mr. Church has described as the "determinative" element in management must always be beyond all scientific standardization. It can be rendered immensely easier, by providing for it a scientific "administrative" element, but it cannot, of itself, be subjected to laws or principles. Neither can the human side of management be reduced to a science. Broadly, management is concerned in two primary elements—things, in the sense of machines, methods and systems; and men. The former is susceptible to scientific treatment, the latter is not. We may set up the most scientific standards of output, the most carefully designed organization of duties, the most elaborate system of planning, but these will be of little avail unless we have the rare human faculty of inducing men to work according to our systems and up to our standards. This is beyond all science. We may have scientific selection of men, we may have admirably devised systems of remuneration, we may establish the most just systems of rating, but when all is finished, there still remains the throb of human interest, enthusiasm, cooperation which alone can set in operation the carefully adjusted wheels of our machine. With a broad basis of tested knowledge, the manager has the means to obtain the very best results—but only, if he himself has that intangible capacity to make use of his knowledge and inspire his staff to apply it. There may be a science of costing, of transportation, and of operation, but there can be no science of cooperation. That is dependent not on scientific principles but on ethical principles. It is a question of ideals, not of systems. It must always remain a problem of mentality and of the spirit. One concludes, therefore, that valuable as is indeed the elaboration of scientific principles, laws and standards to govern the methods by which management may achieve certain ends, there must be added to this a spirit of leadership, based on a fundamental belief in the purpose of industry, and conducing to the utmost cooperation between all the various grades engaged in a common enterprise. The happy union of the two—science on the one hand and what we may call ethics on the other—is essential to the complete realization of one's dream that industrial management is one of the greatest arts which ever existed to benefit and uplift mankind.

I have very briefly emphasized and explained the two points above—the fact that the science of management is something distinguishable from the science of operative work, and the fact that management is an art, calling for leadership, cooperation and human skill as much as for a broad basis of science—because I believe that, without an understanding of these two ideas, one cannot fully appreciate the progress which the art of management is making in this country. Owing to circumstances which would take far too long to discuss in this paper—circumstances arising out of the exceptional mentality of Labor, the form in which the social consciousness has developed, and, still more fundamentally, the particular temperament of Britishers generally—the developments of recent years in industrial management have been and are still rather in the two directions indicated above than in the direction of what one may call "material" science. There is far more being done, more thought being applied to, firstly making management efficient as distinct from making the worker efficient, and secondly, the human relations of industry, than to either the application of the physical sciences to industry or the study of operative processes, as exemplified by the work of Taylor, Gilbreth and many others in America. The progressive British employer is more impressed with the fact that management is a synthetical art than with the equally true fact that it is founded on analytical study. His attention is, therefore, much more drawn to problems of higher organization on the one hand and problems of human association on the other than to the broad basis of operative efficiency on which these must be founded. One finds, therefore, much thought and experiment applied to wage systems, profit-sharing schemes, the question of unemployment, the application of Christian principles to industry, copartnership, industrial welfare, Works Councils, etc., arising from his concern in the problems of human leadership and association. One finds again considerable attention given to such questions as the relation of production to sales, the duties of the higher officials, the training of executives, the organization of control, the use of committees, etc., arising from his concern in the efficiency of his managerial organization. But one finds slow progress in the use of time-study, motion study, the application of science to materials, or the standardization of operative processes. Progress there is, of course—probably more than one hears of—but it is not moving with the same assurance in this as in other directions.

The comments of Mr. Herbert N. Casson—the writer above whose name the *Ledger* of Philadelphia inscribed such startling headlines—may perhaps appear more comprehensible in the light of what has been said. He writes:

> Naturally, the British business world is packed full of exceptions and contradictions. Everywhere you go, you will see patches and makeshifts. There is virtually no such thing in England as "scientific management" outside of half a dozen exceptional firms. . . .
>
> An Englishman rejects the scientific method, not because he fails to appreciate its advantages, but because he values still more highly the human element in his business. He does not regard his workers as automatic and never will. He will break up any scheme of improvement to make it fit a foreman or a sales manager. . . .
>
> He does not put output first. He cannot understand mass production. He persists in making exceptions that destroy the efficiency of any plan of increased production. . . .
>
> There is a spirit of give and take in Britain which many people think is carried too far in business life. . . .
>
> (The English) regard science as only one of the factors that must be considered in the solution of any practical problem. . . .

In the main, these are comments to which I can subscribe, but they do not in any way damp my belief that the art of management in Britain is on the move forward. This movement may not be just on the exact track which it is following in the United States, nor is the movement so rapid. But it is movement, growth, development of an unmistakable kind. As will be gathered, in some directions we are only just beginning, but in others I think we have, at any rate, passed more than a few milestones. Management is certainly in the midst of its "growing pains." Beneath the somewhat hard and weather-beaten skin, there is every evidence of growth. There is a reaching after new ideas, a deeper delving after facts, a more deliberate founding of policy upon scientifically won data, a closer examination of detail, a wider appreciation of costs and measurements of one kind or another, and, perhaps, most significant of all, a slowly developing search for the underlying purpose of industry—a search stimulated by the wide understanding of the need for the human milk of cooperation.

This stirring in the camp of management is singularly unobtrusive. One has to look for it; it does not force itself into the open to be seen by all. Here, we find a firm with a singularly exact costing system; there, a firm which has a carefully developed planning scheme; this firm with a successful profit-sharing scheme; that firm with an effective council system. Yesterday, there was perhaps a conference on foremanship; today, maybe, a conference on salesmanship. Here is a firm developing a carefully devised organization of its higher staff; there is a firm undertaking detailed research into processes. Quite generally, there is an increasing tendency to employ a certain proportion of university and similarly qualified men for the managerial work which, in a decade, has vastly increased in complexity.

Then, apart from the activities of individual firms, beginnings are being made on a more corporate basis. An Institute of Industrial Administration has been begun. A similar body, studying allied problems in a different sphere, is the Institute of Public Administration. The Institute of Industrial Psychology is a very flourishing body of recent growth. The British Association (contrary, I suggest, to Mr. Casson's comment that "the scientific men made no pretense of being of service to the world of trade and commerce") has established a Psychology section which is largely concerned in the industrial application of the science, in addition to its Economics section which again cannot be regarded as a sphere alien to industry. The Industrial Welfare Society has a large membership, and is becoming recognized as the headquarters of the so-called "welfare" work—a branch which administrators, I submit, cannot fail to regard as an integral part of management. A Sales Managers Association has been formed. The Industrial Fatigue Research Board is conducting research of immeasurable potentiality. Some twenty odd research associations have been set up under the Department of Scientific and Industrial Research. The London-Cambridge Economic Service is another recent venture, bringing economics into close touch with administration. Other societies indirectly helping to promote a higher standard of skill in management are the Institute of Chartered Accountants, the Institute of Cost and Works Accountants, the Chartered Institute of Secretaries and various engineering and statistical societies.

Furthermore, this activity is being reflected in the expansion of the curricula of some of our universities. The Manchester College of Technology is not only conducting research work, but is setting up an educational standard in industrial administration and the application of various sciences to industry. London University now includes business administration in its curriculum, and as a part of its economic degree. Leeds and Birmingham Universities are promoting similar study.

Again, in the development of the art of industrial management, one cannot by any means disregard the activities of such societies and bodies as the Industrial League and Council, the Labour Copartnership Association, the National Alliance of Employers and Employed and the Workers' Educational Association, to take a few prominent examples. In promoting the study of the human side of industry and of the problems relative to the place and functions of industry in our social commonwealth, such societies as these are definitely contributing to a wider basis of knowledge, an encouragement of experiments and a higher standard of managerial skill. That these activities are carried on in happy cooperation with Labor is an indication of what Labor may yet contribute to the promotion of the art of management.

All this activity, inchoate as it may appear, indicates a very real stirring in the life of industry, and, more particularly, in all that concerns its direction and management. Unconsciously almost, there is a spreading appreciation of the fact that industry is vastly more complex than it was some years ago, that the difficulties are greater, and, perhaps most of all, that Labor is a mare far more difficult to guide. Consequently, there is a corresponding appreciation, on the one hand, of the increasing need for the application of science to industry and the use of the scientific method in management, and, on the other hand, of the great human responsibility of management and the need for relating that responsibility to some dominant ideal and purpose, some code of ethics which shall be applicable wherever industry is carried on. Management is beginning to feel the intricacy of its task and the weight of its responsibilities. Slowly, with painstaking effort, by cautious experiment, and in a somewhat haphazard fashion, a new management is emerging—a management with new ideals, new methods and new personnel. The tips of its fingers peep out here and there through the old encrusted surface, breaking new ground in this direction and in that. Progress is truly slow. For those who look only for the application in practice of definite systems and recognized mechanisms, there is practically no progress at all. But for those who are prepared to look a little deeper and scan the wider horizon, for those who regard management not only as the function elaborating scientific methods and standards but also as the function charged with the high task of leadership and the pioneer in the development of our daily shifting social order, there is a stir of life which tells unmistakably of the passing of the old order. That this advance will come in conformity with the traditional British caution, use of compromise, and regard for continuity one may be certain. But of its coming, all the stars of heaven are singing, if we could but hear them.

What is lacking in this growth of our art of management is a corporate feeling. Each business is feeling its own way; each society or institute is ploughing its own lonely, rather narrow, furrow. There is little which the manager in one plant would regard as linking him in any way to the manager of another plant. There is, indeed, often enough no live appreciation of any professional bond linking together the various branches and grades of the management within the confines of one single plant. There is little articulate feeling that all who practise any part of the art of management are capable of being bound together in a common profession, based on a common technique, employing a common method, and pursuing a common purpose. That method—the scientific method—is not yet by any means being generally practised. That purpose—the common purpose of management—has not yet by any means been generally adopted. Consequently, the practitioners of management have not yet come to feel any strong and vivid corporate relationship. There is comparatively little corporate organization, therefore little corporate research or corporate literature. We lack our Taylor Society. We lack that free interchange of experience and information between individuals and businesses which, in the United States, has been carried some way and is an essential of all-round progress. We lack, further, that literature on management which forms a practical link between every reader. These will and must come—practical expressions of a corporate feeling. We have our beginnings but they are nothing more. They contribute comparatively little to the leavening of the whole. But I regard the formation of some definite corporate organization, representing the thought and mentality of management—viewed as the guiding partner in industry, welded together in a professional association as the next great step to be taken. It is high time that the dividing walls were razed to the ground, the shutters which hide us from each other, taken down, and all our experiments, experiences, information, standards, practices and plans brought together for the good of the whole. Then truly might we look to management, as a body, achieving a professional status, actuated by a corporate motive and applying to all its problems the proven methods of science.

THE old-time concept of personnel work as "putting square pegs into square holes" is entirely inadequate. Clearly there is a family resemblance between the "square peg" concept and the statement that personnel work consists of man-analysis, job-analysis and the bringing of man and job together. Man-analysis is essentially discovering the shape of the peg; job-analysis is essentially discovering the shape of the hole. The phrase "The right man in the right place" is obviously an echo of the square peg idea.

The inadequacy of the square peg concept arises from the fact that it sharply discriminates between the worker and his job and tends to regard each as a rigid, inelastic entity. Under this concept, industry's task is to bring two rigid, inelastic units together which fortunately are so shaped that they fit. The coldness and mechanicalness of this point of view is obvious; it is not surprising that it results so frequently in an impersonal jig-saw-puzzle attitude toward the problems of industrial personnel. There is no recognition here of the fact that men and jobs are changing in themselves, and plastic, yielding here and giving there to outside pressure. There is no acknowledgment of the common fact that with exposure to a square hole, a round peg (we are speaking of human pegs now) tends to become squarish; there is no appreciation that the square hole takes on a certain round appearance.

This new point of view in industrial personnel differs from the square peg concept in that it recognizes that the job exercises an influence upon the worker and, conversely, that the worker exercises an influence upon the job. . . .

This leads us to the conception of the worker-in-his-work as an entity all by itself. We do not think of the hiring of a worker as the connecting of a man with a job; it is the creation of a worker-in-his-work unit. We do not think of the release of a worker as the separation of a man from his job; it is the destruction of that particular worker-in-his-work unit.

The hiring of a new worker for the job will not reproduce the same worker-in-his-work unit; a new worker-in-his-work unit has been brought about. The transfer of the worker to another job will not reproduce it; again another new worker-in-his-work unit has been created.

Management's task is to make each and every worker-in-his-work unit as effective as possible. The achievement of this task makes it necessary to consider each worker-in-his-work unit from three different angles—from the points of view of Capacities, of Interests, and of Opportunities. (Scott and Clothier, ***Personnel Management***, **pp. 13-15.)**

Professor Bob Emiliani
Please visit bobemiliani.com

An interesting discussion from 1921 between the Gilbreths, proponents of motion study, and Taylor's followers, proponents of time study. Who won? Decades later, TPS, relied on time study to establish baseline standard work (SWCS), followed by motion studies to improve standards. Both are needed, but time study is fundamental when it comes to process improvement. Unfortunately, time study is often absent in Lean practice. You'll notice the discussion talk much about taking the average time of many observations. Mr. Ohno said take the shortest time and use that as the standard, and then train other operators how to do the work to that standard -- the shortest time, not the average time. This is an example of the evolution in thinking from the 1920s to later decades.

BULLETIN OF THE

TAYLOR SOCIETY

A SOCIETY TO PROMOTE THE SCIENCE AND THE ART OF ADMINISTRATION AND OF MANAGEMENT

Published at Hohokus, New Jersey
and
Engineering Societies Building
29 West Thirty-ninth Street, New York

Communications may be sent to the latter address

 Published every other month. Per Year to Members $2.50; to others $3.00. This Issue $1.00

Application for entry as second-class matter is pending.

VOL. VI. JUNE, 1921 No. 3

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COMMENT

AN editor's technique is in many respects similar to that of the teacher; both at times strive to draw facts and ideas and conclusions out of students or contributors, as a stimulus to further and independent observation, investigation, thinking, and the determination of the present state of knowledge about the thing discussed. As part of such technique both frequently assume deliberately a neutral attitude, limiting their contributions to a summing up of discussion or to casual observations which stimulate to further investigation and thought, for frequently participants believe discussions closed when they are but opened. So let it be with respect to the symposium on stop-watch time study printed in this issue.

ONE brings from a reading of the symposium the impression that, although the point at issue is apparently limited and definite, in the discussion issue is not clearly joined. The Gilbreths seem to place most of their emphasis on motion study, determination of the one best way based on a study of the best man available, the determination of ideal or ultimately attainable time standards, and the value to transference of skill and education in its broader aspects of all which the micromotion technique yields. The proponents of the stop watch, on the other hand, seem to concede what is claimed for micromotion technique with regard to the above characteristics (a simple, matter-of-fact concession, however, unaccompanied by any statement of their valuation of what is conceded), and focus their discussion on the determination of standard times and standard rates for current use. The definite point which remains at issue, therefore, seems to be whether the stop-watch technique is so "unscientific" as to be unsuitable for the determination of standard times and standard rates as a basis for current wage contracts.

WE should like to see more data concerning the point at issue. Facts are absent from this discussion; the arguments are essentially *a priori*. *Prima facie* the Gilbreths present a strong argument, in simple form somewhat as follows: *Premises;* the best man available is studied; micromotion technique gives more accurate measurement than stop-watch technique; the film gives and preserves more detail information concerning conditions; a final average can be no more accurate than the most faulty item from which it is derived; *Conclusions;* the unit time resulting from averaging micromotion observations is more accurate than that derived from averaging stop-watch observations; the net operation time computed from these is more accurate; the computed delay and other allowances are more accurate because they have a definite relation to the more accurate net operation time; therefore, the computed final standard time is more accurate. There is in this reasoning that which makes a strong appeal, but it must be admitted also that the proponents of the stop-watch technique present a strong counter *a priori* argument and the burden of proof rests with the Gilbreths—the affirmative in the debate. Therefore the membership of the Taylor Society is justified in asking for evidence,—data in the nature of actual figures of relative average unit times, relative net times, relative standard times and relative costs of securing these.

THE argument of the proponents of the stop-watch technique, which presents such strength as to justify this demand for facts, may be summed up as follows:

1. Granted that the micromotion observations are more accurate, it does not necessarily follow that the unit average of these is more accurate. It is not the whole truth that a final average can be no more accurate than the accuracy of the individual data from which they are derived. The law of compensating error may make absolutely accurate the average of a series of observations practically all of which are inaccurate, especially in the case of repeated observations of the same object. Astronomers and geodesists know that their observations with instruments of precision are inaccurate and compute what they call the "most probably correct" measurement mathematically; it is this computed "true" measurement (which may not coincide with a single observation) which permits the remarkable accuracy in their subsequent calculations. Therefore the computed micromotion net operation time is not necessarily more accurate than the computed stop-watch net operation time.

2. The film *is* superior in recording data for motion studies, and for determining in *minute detail* the one best way to teach a new generation of skilled workers without fixed psycho-manual habits, but only in exceptional operations is it superior in determining new psycho-manual methods for workers with fixed habits, and it is not necessarily at all superior in determining applicable standard times for current use by workers of fixed habits.

3. Furthermore, the micromotion final standard time, like the stop-watch final standard time, includes allowances for rest for overcoming fatigue and for other forms of unavoidable delay and avoidable delay (*Closure*, paragraph 85). Now this additional delay time to be added to arrive at a final standard time is a matter of calculation and judgment and places both methods on practically the same basis with respect to the final standard time. These allowances are considerable and at this point the value of the original micromotion accuracy in observation may disappear.

4. Finally, the micromotion technique introduces a special necessary allowance not introduced by the stop-watch technique with respect to the computation of a standard time for immediate use in a particular plant, in that a time computed on the basis of observations of the exceptional best man must be adjusted for application to men as they average in a plant (*Closure*, paragraph 111, "due allowance must be made accordingly"). At this point the value of the original micromotion accuracy in observation entirely disappears.

5. Therefore, in accordance with the statistical principle cited by the Gilbreths, that "the total can be no more accurate than its most faulty item" (King, p. 76), the accuracy of the micromotion technique *for purposes of determining standard times for current use* can be no greater than the accuracy of the allowances and adjustments no matter how accurate the original measurements may have been. The Gilbreths are not unaware of this point, for they say; "if 'time data' is all that is wanted, a stop-watch probably is close enough. It certainly is close enough for those who are interested in their work only temporarily" (*Closure*, paragraph 46).

FROM the Gilbreths, therefore, we should like to have more data,—descriptions of cases, and figures contrasting micromotion and stop-watch results in determining currently usable standard times and rates. We should like to see the proponents of the stop-watch join with the Gilbreths in making these comparative studies comprehensive and convincing. We should like to have these data for all types of operations, such as the operations of road construction or mining, lathe or boring operations on large and small parts, and machine type-setting or sewing operations. We should like to have also comparative costs, for if the micromotion results should prove to be superior in having a smaller coefficient of error, we should like to know the additional cost, if any, of securing the lesser error. From the proponents of the stop-watch technique we should like to have, not merely acknowledgement of the motion-study value of the micromotion technique, but an appraisal of its social value, in general and particularly in education for the crafts; and an argument for its adoption by research organizations, associated employers, trade associations, trade unions, trade schools and other organizations capable of bearing the cost, if it is greater, of such refined methods as a step towards future improvement of the crafts.

It is a principle of scientific management that no principle or mechanism should be considered permanent; but the burden of proof rests on the advocates of the new.

H. S. PERSON

SYMPOSIUM

STOP-WATCH TIME STUDY

AN INDICTMENT AND A DEFENSE

FOREWORD

AT a meeting of the New York Section of the Taylor Society, December 16, 1920, Frank B. Gilbreth presented a paper prepared by himself and Mrs. Gilbreth on "Time Study and Motion Study as Fundamental Factors in Planning and Control: An Indictment of Stop-Watch Time Study." This paper was printed for private distribution by Mr. and Mrs. Gilbreth.

Mr. and Mrs. Gilbreth's argument against the stop watch and in favor of micro-motion study seemed so significant to the members of the Taylor Society that the first opportunity was seized for a general discussion of the subject. This general discussion was held at a meeting of the Philadelphia Section of the Taylor Society, April 11, 1921.

The original paper presented by Mr. Gilbreth at the meeting of the New York Section is here reprinted as the first contribution to the symposium; the remaining contributions, including Mr. Gilbreth's concluding statement (revised and expanded), represent the discussion at the meeting of the Philadelphia Section.

For the benefit of those readers who are not familiar with the stop watch and the Gilbreth micro-motion apparatus, the following simple explanation of each is added.

The stop watch used is identical in principle with that employed in timing athletic events except that the dial is decimal, i.e., is graduated in hundredths, and the watch is calibrated so that the hand makes one revolution in exactly a minute. Therefore hundredths of a minute can be read. In addition the observer uses an "observation sheet" on which is written the sequence of elements of the operation to be observed in accordance with a preliminary analysis of the operation and data concerning the surrounding conditions. Stationing himself so that the watch and the observation sheet are held in the direct line of observation of the worker, the observer watches the worker and makes notes of the time of beginning and completion of each element of the operation. From these recorded times the lapsed time of each element is afterwards computed. A dozen or more such observations are made, the lapsed times for each element compared, and by consideration of the arithmetic average, mode and median of these a standard time for each element is determined. The sum of these standard times of the elements of the operation plus an estimated allowance for "delays" (fatigue, etc.) becomes the standard time for the operation.

The micro-motion apparatus consists of moving-picture camera, a clock of which the dial is graduated into hundredths and the hand makes a complete revolution in exactly one minute, slates with recorded data and a background (wall) ruled into squares of known dimension. A film is then made of the operation, including clock, slates and background squares. A study of this film, the negatives of which are taken at the rate of sixteen or more to the second, enables one to determine with precision the sequence, direction and duration of elements of the operation, for the camera catches and registers the time of the beginning and conclusion of an elementary motion with an exactness not possible by an observer with the stop watch. By these films the worker can be taught "the one best way" and a standard time can be computed for each elementary motion, a "delay" allowance computed, and a standard time for the complete operation determined.

We hope that a continuation of this discussion will take the form of the presentation of accumulated data. As it now stands it is a record of opinions. When opinions of experienced technicians do not agree the Taylor Society, and the public which it serves, have a right to request the submission of the data on which the several opinions are based. (Editor)

I. AN INDICTMENT OF STOP-WATCH TIME STUDY[1]

By Frank B. Gilbreth and L. M. Gilbreth[2]

Planning and control and all other functions of management depend first, last and all the time upon the standards on which they are based. These standards, in turn, depend upon the fundamental data from which they are derived. The fundamental data for determining standards are obtained by motion study and time study.

2. Dr. Taylor said: "What the writer wishes particularly to emphasize is that this whole system rests upon an accurate and scientific study of 'unit times,' which is by far the most important element in modern management."[3] We wish to give additional emphasis to his words—"accurate" and "scientific."

3. At the time that Taylor wrote this, in 1903, in his classic "Shop Management," professional paper No. 1003, Transactions of the American Society of Mechanical Engineers, the stop watch was the most accurate device and method extant. Today the stop watch is known to be vastly inferior to the method of timing and recording the motions and the attending conditions simultaneously."[4] It has been proved absolutely worthless and also misleading so far as assisting in skill study is concerned.[5] It is unethical because it does not clearly define the subject matter of an implied contract on which the wage payment is based, and it is economically wasteful because it does not preserve the best that has been done.

4. It is the validity of data accumulated by the usual use of the stop watch time study methods that we are assailing in this paper.[6]

5. Every statistician knows, and to most students of science it would seem almost axiomatic, that *final averages are no more accurate than the data from which they are derived.* It is therefore a fact that the accuracy of the standards of Planning and Control can be judged and estimated by the degree of accuracy of their fundamental data, and that effective planning and control, which involve the factors of permanence and maintenance, depend upon the validity and accuracy of the original data from which they are derived.[7]

6. Apparently in ignorance of this fact—papers and books have been written on Time Study in which are advocated the practice and method of crossing out, and discarding, times recorded by the inaccurate stop watch method, which at the time the time study data are worked up are *guessed* to be "abnormal," because they seem to be much higher or much lower than the others. In these papers and books is recommended the practice of making arithmetical calculations based upon averaging the remaining times to the fourth decimal, or *the ten-thousandth of a minute,* although the watch on which the original readings or pressings were made had no divisions smaller than a hundredth of a minute, and no observer claims that his records are always accurate to a fiftieth of a minute.[8]

7. This Society has spent much effort in standardization. It is especially to be congratulated on the choice of subject of Mr. Lichtner's paper delivered on the subject recently, which presents the necessity of deriving standards, and not only calls upon this Society to do something definite, but suggests that such fundamentals as definitions of terms become the subject of discussions and final agreement.[9]

8. It is to be regretted that up to today not one single standard has been made from the results of precise measurement by this Society, in spite of the fact that Taylor wrote, in 1903, "The adoption and maintenance of standard tools, fixtures and appliances, down to the smallest methods of doing all operations which are repeated, is a matter of importance, so that under similar conditions the same appliances and methods shall be used throughout the plant. This is an absolutely necessary preliminary to success in assigning daily tasks which are fair and which can be carried out

[1]Full title:—"Time Study and Motion Study as Fundamental Factors in Planning and Control: An Indictment of Stop-Watch Time Study."

[2]Consulting Engineers, Montclair, N. J.

[3]A. S. M. E. edition, paragraph 133, Harper edition, page 58. This differs here from the A. S. M. E. in omitting the parentheses from *unit times* and in changing *modern* to *scientific*. See also "Shop Management," A. S. M. E., paragraph 154, Harper edition, page 65, and A. S. M. E., paragraphs 323-324, Harper edition, page 148.

[4]"Applied Motion Study," Macmillan & Co., pages 62 and 82.

[5]"Motion Study for the Handicapped," E. P. Dutton & Co., page 70.

[6]For description of other basic defects, see "Fatigue Study" and "Psychology of Management," Macmillan & Co.

[7]Willford I. King, "Elements of Statistical Method." Page 76, "The total can be no more accurate than the most faulty item." Page 77, "The absolute accuracy of a total can be no greater than that of the most inaccurate item composing it."

[8]Dwight V. Merrick, "Time Studies for Rate Setting," The Engineering Magazine Co., page 8.

[9]William O. Lichtner, "Promulgation of Standards by the Taylor Society," Rochester, N. Y., May 7, 1920.

with certainty."[10] Taylor also says, "It would seem almost unnecessary to dwell upon the desirability of standardizing, not only all of the tools, appliances and implements throughout the works and office, but also the methods to be used in the multitude of small operations which are repeated day after day."[11]

9. At the time of the presentation of Mr. Lichtner's paper, we objected to many parts of it and particularly to his definitions of various terms which involved time study and motion study, and their likenesses and differences. What Mr. Lichtner has described as motion study has no resemblance to what we had, or still have in mind, when we coined the phrase, "motion study." We have since supplemented this criticism, which aims to be most definite and constructive, by an indictment of stop watch time study made before the Society of Industrial Engineers at the recent meeting in Pittsburgh, and we shall take his paper up in detail later. Believing, however, that such an indictment should also be made in definite and detailed form before this Society, whose members are fitted by training and experience to appreciate the vital importance of the subject and to judge as to the justness of the criticism, we are today presenting this subject in summary form for your consideration. The data upon which our conclusions are based have been and are still at your disposal. A more lengthy presentation of the subject is in preparation, and that will soon be at your disposal also.

10. You undoubtedly are aware that the usual theory and practice of stop watch time study, as generally practiced, is as follows: The time that it takes "a first-class worker" or "the average worker" to do a piece of work by the usual method is obtained by using inaccurate methods and devices. The records obtained through such timing are submitted to varying processes of arithmetic in which the utilization of "averages" of incorrect data forms an important part in the calculation, with the result that the final data are not correct and neither do they define nor describe nor record the method of work which they time.

11. According to those who still advocate and use the stop watch method of time study only, the time taken to perform the work is the most important element of the final standard, this time being calculated from an "average" time for performing the work.[12]

[10]"Shop Management," A. S. M. E., paragraph 269, Harper, page 116.

[11]"Shop Management," A. S. M. E., paragraph 284, Harper, page 123.

[12]Merrick, "Time Study for Rate Setting," Chapter 1, paragraph 1.

12. We attack the validity of standards for planning and control derived according to any method based on or that uses the practice of averaging inaccurate data, and we attack the validity and the scientific value both of the method and of the results. This constitutes our definite criticism. We base this attack upon stop watch time study, for example: as described in "Time Studies for Rate Setting," by Dwight V. Merrick, copyrighted by the executor of the estate of Frederick W. Taylor, with a foreword by Carl G. Barth, and published 1919. This book, it will be noted, is by a recognized authority in stop watch time study, of recent date, introduced and indorsed by the Taylor Co-operators. It is a masterly presentation of the entire case for stop watch time study —authoritative, detailed and exhaustive, and reflects great credit upon the painstaking effort of the author.

13. In Mr. Barth's foreword, and in Mr. Merrick's preface to his book, and also in Chapter 1, "Objects and Principles of Time Study," and Chapter 2, "Taking An Operation Time Study," are set forth the underlying principles and the accepted practice of stop watch time study. In these first nineteen pages, the following defects in such study from the scientific standpoint are some of those which are noted:

14. Time studies are made of workers *not* extraordinarily expert. (Barth page IX. "It is at all times easiest and best to make observations on a first-class, but not extraordinarily expert operator.")

15. The data are inaccurate. (Merrick, page 8. "An error in reading the stop watch may easily equal the elapsed time for the performance of the particular element under observation.")

16. The quality and ability and suitability of the man observed has not definitely been recorded. (See figures 1, 3, 9, etc.)

17. Judgment instead of measurement is used when a mediocre worker is observed, or when "soldiering" is suspected. (Page 5-6. "The experienced observer, acquainted with the character of work, with effective and efficient methods of performing simple manual and mechanical operations, and who is also a keen student of human nature, soon learns to recognize with certainty any tendency on the part of the operators not to do their best and to make due allowances for the resulting inefficiencies, etc.")

18. Judgment, not measurement, determines the number of observations to be taken. (Page 12. "The requisite number of observations is a matter which has to be left to the judgment of the time study man.")

19. Selections of the records to be used and averaged is left to judgment, not determined by measurement. (Page 12. "The striking out of abnormal values, either excessively higher or lower than the average of all the individual times of the same element, is a detail that calls for fine judgment on the part of the time study man.")

20. While the "curves" given are based on "data from a vast number of time studies" (page 15), the data are all inaccurate. No amount of intricate mathematics and carrying out of results to the —nth decimal point can make the results more accurate than the original data.

21. The preparation time is inaccurate. (Page 16. "The time allowed for performing these operations is standard, being arrived at from previous time study, and, in some cases, is more or less liberal.")

22. The time allowed for probable or possible delays is inaccurate. (Page 16. "To the preparation time an arbitrary allowance of 25 per cent is made to offset any variation, interference, etc.")

23. These are only a few typical objections that can be cited against stop watch time study. They are given here to illustrate the method of this attack. We have already prepared a review of the balance of the entire book in this manner, for future presentation. The reason for criticism will be given later in this paper.

24. Against this method of deriving standards, we place the method of accurate measurement and present a standard from which just and satisfactory allowances will be made for conditions of practice—a standard suitable for the instruction, assistance and profit of those who will actually do the work.[13] This standard is the *one best way to work*.[14] It is the best method obtainable at present, derived from accurate records that are in every case made by instruments of precision, without either the suspicion or the fact of personal error and that enlist the co-operation of the workers because they are indisputably accurate and fair.

25. Previous indictments of stop watch time study have been largely made from the psychological standpoint, psychology being understood as "the science of human behavior."[15] The early history and records of stop watch time study show that there was no recognition of the fact that the worker's craft knowledge, craft skill and co-operation were necessary if interchangeable records of permanent value were to result. Frequently records were made not only without the workers' co-operation, but even without his knowing that such records were being made.[16] This is not to discredit the early users of the stop watch method, but is indicative of the state of industry at that time and of a lack of knowledge of the close relation in both theory and practice between the laws of psychology and the problems of successful management.

26. With the gradual appreciation of the laws of psychology and the importance of their application, some few, but not all, of the causes of the psychological objections to stop-watch time study have been gradually disappearing, until today secret stop watch time study, which was once so common, has become practically a thing of the past, and such things as "hidden watches in watch books,"[17] used for secret time study and for spying upon the workers, are obsolete, not only because they were unethical and in many cases unfair to the workers, but also because any time study made without the full co-operation of the worker is not worth the money value of the time it takes to obtain it. It may be well also to call attention to the difference between "full co-operation" of the semi-passive type and the "enthusiastic, hearty co-operation" that exists when workers desire to contribute their craft knowledge and craft skill in detail to fellow workers and coming generations on the permanent photographic record.

27. These statements and others to follow must in no wise be taken as an implied criticism of Mr. Taylor, the great founder of stop watch time study, who was the first to make practical method of predetermining "the time it takes to do work," or in other words the possibility of prophesying "how much work can be done in a given time," by timing the work periods and the rest periods separately, nor of Prof. Wentworth of Phillips Academy, Exeter, from whom Mr. Taylor says that he first got the idea of using a stop watch for timing work."[18]

28. The recognition of the importance of timing in

[13] "Applied Motion Study," Chapter IV "Motion Study and Time Study Instruments of Precision."

[14] "The One Best Way to Do Work," Society of Industrial Engineers, May, 1920.

[15] Edward Thorndike, "Educational Psychology," Volumes I, II and III. Stephen S. Colvin, "The Learning Process," "Human Behavior."

[16] "Shop Management," A. S. M. E., paragraph 332, Harper, page 152. Note that Taylor does not approve of "spying upon the workman."

[17] "Shop Management," A. S. M. E., paragraph 332, Harper, page 153.

[18] Tuck School Conference.

one group, or as one unit, many cycles of motions, which Taylor called "elementary time units," instead of timing "overall" or "elapsed time" or "production studies" for a complete operation as had been commonly done previously, was a milestone in the progress of management.[19] But it must be remembered that these "elementary time units" were elementary only so far as the limitations of the crude method of stop watch timing was concerned. Also, though Taylor realized the importance of timing the smallest units possible, the most that could be done with the stop watch method was to time units consisting of groups of several cycles of motions. These so-called "elementary time units" must not be confused with the sixteen subdivisions of a cycle of motions or with the methods of motion study used in analyzing and measuring them.[20]

29. The methods used by Mr. Taylor at an early stage in the development of management, the devices used by him early in his career, were the best existing at that stage of the art. The attitude of the management and of the public at large toward the worker was so different then from what it is today that the generation just entering industry can scarcely realize it.

30. One need go back but a few years to find a lack of knowledge of psychology in general and in particular of the laws and phenomena of behavior, of habit formation, and of the phenomena of automaticity, the learning process, especially learning through the eye and the variables of skill study as well as of the effect of the emotions and intellect upon activity to be astounded. It must be remembered, however, that the science of psychology itself has advanced enormously since Taylor's early days.

31. It is less than a decade ago that pschology of management was practically unknown, and often confused by the general public with psychiatry or phrenology or investigations into the field of psychic phenomena. Today the findings of the science of psychology have become tools for thinkers in all lines of endeavor.

32. Most stop watch time study advocates have recognized the justness of many of the psychological criticisms, and have done away with, yes proved away with, "secret" time study.[21] The stop watch method now, in most cases, includes attempts to enlist the cooperation of the worker, and is gradually coming to acknowledge the necessity of recording *behavior* when recording *time*, as well as recording surrounding conditions as variables affecting behavior, fatigue and production.

33. With the stop watch method, behavior cannot be recorded. It is the accurate recording of behavior and the surrounding and influencing conditions that has made motion study a science, and that has made possible the derivation, teaching and perpetuation of the one best way to do work. That the stop watch method can never lead to the one best way can be realized by a moment's consideration of the vast number of possible combinations and permutations of the true "elements" performed in any operation too rapidly for the eye to see. Such consideration will convince anyone that accurate records, fit to serve as a basis of permanent methods and teaching, can be obtained only by motion study. "Motion study," as here used, does not mean the kind of motion study that has been carelessly and erroneously described and written of as being "the same as time study," or "a part of time study." Motion study, as used here, means the science of recording motions, of which "time" is but one of scores of variables.

34. The psychologists have done more than point out the failings, incompleteness and mistakes of the stop watch time study methods. They have indorsed the scientific method of recording the surrounding conditions simultaneously with the motions and the times, with instruments of precision, free from personal error, leaving the motion study man's eyes, mind and attention free for coaching the observed man, that his record may more nearly approach the one best way and be more worthy of the care, skill and film that are used to make the record. They have used such records in their investigations of behavior as affected by habit, fatigue, power of decision and other variables affecting the learning process and the achievement of greatest outputs with least effort.

35. Meanwhile, scientific management has been sneered at and has been the object of constant joking and scorn, because it is perfectly obvious to any scientist that, as often practiced, it has little claim to be called scientific, so long as it depends for its fundamental data upon "averages" of inaccurate stop watch time study that does not record the surrounding conditions at the time that the records are made.

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[19] "Shop Management," A. S. M. E., paragraph 386, Harper, page 169.

[20] "Applied Motion Study," Chapter VII "Motion Study for the Handicapped," pages 25-33.

[21] We have always been and are still unalterably opposed to secret time study and have never practiced it nor permitted our employees to practice it, although our telemicromotion apparatus will record a man's motions and the times a mile away as easily as a "close up."

36. Educators also, especially those interested in visual education, and lately those interested in the education of the crippled and blinded, and all other types of the handicapped, have appreciated the emphasis on the *accuracy* of the original record, the *usefulness* of the standard method of getting the one best way to perform the work, and the *teaching value* of the method embodied in these standards.

37. The indictment of education against the unnecessary inefficiency of stop watch time study has not yet been fully made. It is the most serious of all indictments, and will cover not only the things that have been done that should not have been done, but also the things that have not been done that should have been done.

38. Stop watch time study has, to all effects, recognized the validity of the psychological criticism. This may lead to the anticipation of further educational criticism and to changes in method that will tend to avert this, and also criticism from the ethical standpoint. Another present need seems to be a realization of the value of criticism from the standpoint of the science of statistics, which we present here.

39. This indictment is made primarily upon the use, throughout the entire process of making and using stop watch time study, of that which is "average." In the first place, it is customary to make records of the "average worker" or "one slightly above the average," and some advocates of the stop watch recommend making records only of the indefinite "first-class man." As a matter of fact, there is no such thing as an "average man," and if there were it would require much research to determine and to locate him. The border lines of defining the "first-class man" are as indefinite as the location of a rainbow. There is but one type of worker that is fixed, at least for the time being, that is *the best man obtainable at the time,* at that particular kind of work. This may in reality be represented by the synthesized work of several of the best workers. The synthesis of a best method is obviously impossible with the stop watch methods or with data taken on "average" workers. Any data taken from observation of an "average man" are sure to be inferior to the best method used by the best man obtainable. All scientific methods are based upon the utilization of the best obtainable, and an ideal to come to; such an ideal obtained from the most skillful, and not from the average, is always an inspiration for further attention, effort and learning to everyone—apprentices, learners, workers and teachers. The great principle of having an ideal of method toward which each one is to approach, as near as his capabilities will permit, is entirely lost by those who depend upon averaging times or methods which have been inaccurately observed and inadequately recorded and then averaged.

40. It must here be emphasized that having an ideal of method is something entirely different from having an ideal of *"speed with which work is to be done,"* or as it has been sometimes worded, *"the time that it takes to do work."*

41. The allowance to be figured for calculating the task is more easily figured with relation to the standard man[30] or best man obtainable at that particular kind of work—the most expert worker—than with relation to an unscientifically selected worker, who is guessed to be an "average man" or to be an indefinite "first-class man."

42. It may be possible that in some organizations the "average worker" is still selected for such observation, not because he is supposed to be easy to find, but because it is erroneously supposed that workers will approve of the "average" in efficiency being observed, as typifying what is to be expected of them. The students of labor problems, both in and out of the ranks of labor, realize today that education of the worker is the greatest need, whether or not he will participate in the management, and no form of education for the worker has surpassed that of showing him the micro-motion study records and the simultaneous motion cycle charts of the methods of the best man obtainable. All workers have far too little time to study, and therefore they do not desire to waste time studying the methods of the "average man," or anyone else other than the best. Neither is it necessary that observations be made of the "average man," nor of the man "a little above the average," nor of "the first-class man" for the purpose of setting proper and achievable tasks and in order to make proper planning programs, because, regardless of the source of the data, the task, or quantity of the program, must be set at that point which is achievable by the worker who is actually put to work at it, or the task idea in management will do more harm than good. As a matter of fact, the workers in this country and in the countries abroad, as they come to appreciate the value of real standards and the accompanying benefits to them from better management methods as a means of increasing the purchasing power of the results of their labor are *demanding* not

[30]"Psychology of Management," page 152.

only that they themselves shall be allowed to take part in the investigations as well as in the application, but they are also in favor of the highest degree of accuracy in the recording process. There has not been an instance in our experience where workers have failed to appreciate the accuracy of the recording devices, when this was brought to their attention, nor have we failed to have them realize that the methods which are being recorded ought to achieve the same degree of perfection that the recording devices have already reached. Furthermore, it should always be realized and emphasized that the primary interest is in the problem of obtaining correct fundamental data, in such form that they can be transferred to and used by others and not merely data for temporary, makeshift task purposes, but for a permanent plan of cumulatively perfecting standards, ever holding and improving upon the best way known.

43. This criticism of the use of the "average" is sustained by the laws and best practice of the science of statistics. Statisticians also lay down certain fundamental requirements for proper records, which stop watch time study does not meet. We quote from several recent books by authorities on economics and statistics, who maintain that in order to be worth while:

44—1. There must be the greatest care in recording *quality*. King, in his "Elements of Statistical Method," page 32, section 17, says, "One of the shortcomings of statistics is that they do not always bear on their faces the label of their quality." It is evident that stop watch time study fails in this respect.

45—2. Accuracy is imperative.

(King, page 33, section 18: "The value of statistics depends primarily on the accuracy of the figures.")

(Horace Secrist, "An Introduction to Statistical Method," page 27: "The difficulty is not necessarily one of error in reporting (yet undoubtedly this is an important factor), nor in the accuracy with which such facts ***might be determined,*** but rather with the accuracy with which they ***are*** determined under the conditions of collection.") We have noted that it is impossible to take accurate records of small units by the stop watch method; in fact, the smaller the units the greater in proportion is the error, yet the scientific method always demands the examination of the smallest units possible.

46. Also King, page 76, section 46: "The total can be no more accurate than its most faulty item." And again, King, page 77, section 47: "The absolute accuracy of a total can be no greater than that of the most inaccurate item composing it." Therefore, since the original data are inaccurate, stop watch time study cannot hope for accurate results, no matter how it handles them or how it "works up" the observed times.

47—3. Individual differences must be noted. (King, page 35: "Statistics from the very nature of the subject, cannot, and never will be able to take into account individual cases. When these are important other means must be used for this study.") "Individual cases" in time study are important, for from the study of them and investigations of the causes we often find clues to better methods.

48—4. No mathematical accuracy will compensate for inaccuracy of fundamental data. (King, page 70, section 44: "An exceedingly common error is to give to figures a large degree of fictitious accuracy which arises simply from some mathematical operation. One must guard against such fictitious accuracy whenever numbers containing decimals or giving a decimal as the results are multiplied, divided, raised to a power or the root extracted.") We have already noted the mathematics of determining times, and note here the dangers in their use.

49—5. There is no assurance of increasing accuracy by increasing numbers of observations, if the method is not accurate. (King, page 62, section 38: "It is better by far to have a small number of correct samples than to have a large number of incorrect ones.") Not even the accumulation of a large amount of data will make stop watch records accurate even ultimately. Merrick states that his curves, on page 17 of his book, are "based on the data from a vast number of time studies," but it was non-recordable, inaccurate, unsynthesizable data of the stop watch method.

50—6. The unit to be observed must be accurately determined. (King, page 46, section 25: "Not only must the unit selected be defined with precision, but it must also be of such a nature that it may be correctly ascertained.") This is impossible with stop watch time study.

51—7. The greater the number of items observed, the more danger, if the records are not accurate. (King, page 75, section 45: "When the number of items is larger, compensating errors, if relatively small, are negligible, but, on the other hand, cumulative errors always seriously affect the accuracy of the total or the average.") This shows that the faith put by the makers of stop watch time studies in ***number*** of observations is not well founded.

52—8. The *average* is not only ***not*** accurate, but is a dangerous tool. (Secrist, page 28: "Do not rush headlong into the use of averages. They are commonly but vaguely understood, and it is the particular function of the statistician to adopt that caution and circumspection in the use of numerical facts which the seeming exactness of his tools appear not only to suggest but to make imperative." Again Secrist, page 22: "As caution and analysis are necessary in the employment of averages, no discrimination and judgment are necessary in assigning importance to them when used by others.")

53—9. It is necessary to stress the importance of the *exception*. (Secrist, page 29: "Frequently an exceptional instance which would be ignored in the use of the mode is that particular instance in which one has greatest interest.") We have noted that stop watch time study discards those instances which are "guessed" to be "abnormal." If they were normal enough to record, they should not be discarded merely because they differ from the average. It must also be remembered that these very same so-called "abnormal" times may record the exceptional instances, which are the most desirable to perpetuate. When such times are abnormally high they may be caused by methods and conditions of habit which should be broken and discarded and pitfalls to be avoided.

54. Many more quotations by leading authorities on statistics can be furnished but these few quotations serve to indicate how completely the statistical method can demolish any claims of accuracy or of the scientific method of stop watch time study.

55. The basic criticism of stop watch time study is that the inevitable interference of the human element, when the stop watch is read while it is running or pressed to stop or start, prevents accurate observations and records. Even if one record should happen to be accurate, there is no chance to recognize it, and no chance to inspect, check or repeat the work as then performed, because the surrounding conditions are not also recorded.

56. It must not be supposed, however, that stop watch time study has no uses, for it is much better than nothing. The use of the stop watch also furnishes admirable training for the young management engineer, and it is a necessary, though not an indispensable, part of his education. Without actual experience with the inaccurate stop watch method he will never be able to appreciate the possibilities of interchangeability of micromotion data and their value at any time later to anyone who is either searching for knowledge regarding the best that has been done, or is interested primarily in finding the one best way to do work. In no other way can he realize that micromotion study is less expensive than stop watch time study. We advocate this training, and have three different kinds of watches made exclusively for us, which have black faces and white hands to cause less fatigue, and which, while intended primarily for micromotion study, are also much better adapted to stop watch time study than any others.

57. We believe these types of watches to be the most efficient of their kind, although their records, when not photographed, cannot compare, of course, in accuracy with those made by the micromotion process.

58. Only through personal experience with the difficulties and inaccuracies of stop watch time study can the young engineer come to appreciate the need for a more accurate method, and the benefits of basing the *art* of time study on the *science* of taking times.

59. It is the right of the young men in this society to learn the science of taking times. It must be realized that loyalty to *principle* does not imply loyalty to *technique*. All advocates of scientific management object to restricting its evolution, especially along lines that insure its acceptance as a science.

60. The young men have studied and practiced stop watch time study faithfully and loyally. They deserve something better, more accurate and more valuable. They deserve the best! It is our duty to warn the young men of the Society to accept no statements regarding any science without definite proof, unless the scientific method has been used in deriving the facts. The young men must think for themselves. They must learn to place emphasis properly, and to realize that the stress that has been laid on "the time that it takes to do work" or "the proper rate of speed at which work should be done" or "time study for rate fixing" in no wise dwarfs the necessity for finding the one best way of the best available.

61. The young men should also be warned that, when they hear criticism about the "high cost of accurate photographic time study," they should remember the cost of the scores of years of stop watch time study records that have been totally abandoned because they were so inaccurate that they did not serve as a basis for cumulatively improving standards, and did not include records of surrounding conditions. In money cost and in cost of time the more accurate methods are the most efficient and economical.

62. It is not our aim in this paper to present at length criticism of stop watch time study, or to describe in detail all the advantages derived from the

more accurate method of micromotion study, which includes accurate timing as an integral part and an important by-product of the quest for fewest, most efficient and least fatiguing motions. We do not need to point out the utter uselessness in executive's theatres, foremen's meetings or workingmen's lecture rooms, of stop watch time study, and the possibilities of the utilization of micromotion study film as the basis of craft education and improvements in methods which come through the suggestion system.

63. The part played by micromotion study in determining best results of the three-position plan of promotion will be discussed in one of our later papers.

64. We aim to present for your consideration the objections to the records and devices from the abstract and scientific standpoint, calling to the attention of this Society especially the objections from the statistical side. We desire to emphasize the effect upon planning and control of using data scientifically derived by instruments of precision instead of the non-method-recording stop watch methods.

65. It must not be forgotten that, as Dr. Taylor said in "Shop Management," "time study is an *art*." He hoped that it would be based on a science, and be listed as the first of the four chief duties of the management, that "they develop a science for each element of a man's work which replaces the old rule-of-thumb method."[23]

66. In "A Piece-Rate System," written in 1895, he said he hoped that there would be books of accurate data that would settle once for all and that would describe methods of making, recording, tabulating and indexing time observations, since much time and effort are wasted by the adoption of inferior method."[24]

67. He considered what he said so important that he wrote it again, in the same identical words, in "Shop Management," in 1903, eight years later.[25]

68. The micromotion method is the only method that fulfills all the requirements that he makes. This method has fought a hard fight and it has won by reason of its scientific accuracy, its records in revising the best that the stop watch had done, and by the co-operation it has secured from the workers everywhere, without exception. It is indorsed today by economists, educators, psychologists and workers, and is more and more being accepted by managers, even those who have advocated and practiced the use of the stop-watch.

69. We had the honor to offer the use of this method to Dr. Taylor himself, practically as soon as the devices and methods of measurement were perfected, and we wish to go on record here as having offered this method for use by this Society and the management engineering profession in general.

70. We repeat this offer at this time for the following reason: We know that the stop watch method is now being subjected, and will be increasingly subjected, both in this country and abroad, to the most careful scrutiny. This examination is being conducted not only by enemies of scientific management but by its ardent friends and advocates, who feel that its future depends upon its ability to live up to its claims of being a science. The sooner this state of affairs is realized, and the sooner that this Society prepares to meet criticism, and to justify belief in its principles and practice, the more satisfactory will be the outcome.

71. As advocate of real science in management; as interested in the progress of the art of management; as vitally concerned in the future welfare of this country, and as ready to fight for it industrially as in war; as engineers trying to do our bit in the problem of the elimination of all kinds of human waste and for better management, we, therefore, feel compelled at this time to indict stop watch time study as having outlived and extended beyond its field of usefulness; as having failed to co-operate with micromotion study; as having failed—and in some cases deservedly—in obtaining the hearty co-operation of the workingman; as having failed to put into the hands of the workingmen and the trade and manual-training schools fundamental data regarding craft knowledge and craft skill, and as having failed to furnish interchangeable data relating to time study elements usable in synthesizing the one best way to do work. We make this indictment before this Society with the feeling that the Society should estimate and measure the two methods submitted, impartially, carefully and with the aim of fostering those methods which have the highest scientific value. We should have been glad to have had this indictment presented before the Society by the advocates of the stop watch method, for some of them are now coming to see the importance of accurate unit times. It may seem to some that the economists are the ones who should have presented this indictment. Unfortunately, however, these economists also, in spite of our previous re-

[23]"The Principles of Scientific Management," page 36.

[24]Paragraphs 67, 68.

[25]A. S. M. E. edition, paragraphs 390, 391, Harper edition, page 177.

marks on this subject, have so delayed their presentation that we can no longer reserve for them this opportunity for priority.

72. We have great faith in a happy outcome of this indictment because of the complete success resulting from our previous unsupported attack from the psychological standpoint, which we hope and trust to see repeated here.

73. For permanence and maintenance, planning, control and other functions of management must be founded on cumulatively improved standards derived from correct motion study and time study facts, the handling of which in accordance with the laws of engineering and psychology constitute scientific management.

74. We had the honor to suggest and to start this Society by calling the first gathering of management engineers. This gathering was the first meeting of the "Society for the Promotion of the Science of Management," the first society of management engineers. The name was afterward changed to the "Taylor Society, a Society to Promote the Science and the Art of Administration and of Management." It behooves this Society to determine at once the stand which it desires to take on the subject of accuracy of fundamental data of management and to decide whether it intends to live up to its name as a "Society to Promote the Science of Management"—*or not.*

II. A DEFENSE OF THE STOP WATCH

By Carl G. Barth[1]

1. The object of time studies, as understood by myself and other direct disciples of Mr. Taylor, is to determine a *fair time to allow* a worker for the performance of a task to entitle him to a certain to-be-agreed-upon amount of compensation for the performance of the task within the time thus allowed, and with the additional understanding that, if he performs the task in less than the time allowed, he will receive additional compensation as measured in terms of time taken, in accordance with some rule or other; while, if he falls short of performing the full task within the time allowed, he will suffer a corresponding reduction in his compensation.

2. Because of the diverse absolute abilities of the workers who may have to be used on similar jobs, and also because of the variation in the ability of each individual worker from one day to another, yes even for different periods during a single day, it is hardly conceivable that two time-study men, however well equipped by training and experience and with physical means, would arrive at exactly the same time allowance for any job each might in turn be independently assigned to study. And still, the time allowance of either would undoubtedly be fully satisfactory for use in establishing a *fair* contract between the worker and the management, though the two would not be identical.

3. For this reason, and for the further reason that the same worker does not spend exactly the same time on the same operation every time he performs it during even the same short period of observation, there would certainly seem to be a limit to the degree of accuracy of observation and time recording (whatever the instrument of measurement) that would be of substantial help in reaching a satisfactory time allowance for a task.

4. As a consequence, I cannot agree with the Gilbreths in their condemnation of the use of the stop-watch as absolutely unscientific in making time studies, merely because they have invented and use a far more accurate time measuring device than the stop watch.

5. Of course it would be preposterous to maintain that, even with a somewhat uncertain final quantity to be measured, it would not always be desirable to employ the most refined measuring device obtainable; but with the numerous difficulties that beset the management, or industrial engineer—or what else you choose to call the man usually responsible for the time-study work in an industry—this individual has again and again to be satisfied with equipment that is not what he considers the very best, and thus to content himself when able materially to improve matters around him, even though his accomplishments oftentimes fall far short of what he knows to be possible of attainment, and of what he had aimed at and had hoped to do.

6. And in this he is no different from many a recognized scientist who, either because of his own poverty or that of the institution with which he may be connected, is unable at once to secure the very latest and best equipment for his research work. Thus, for instance, all astronomers cannot have the equal of the most powerful and finest graduated telescope; and many a fine biologist may for a time have to content himself with a microscope that is not the best obtainable; and still, nobody would assert that these men

[1]Consulting Engineer, Philadelphia.

could not be scientists of the highest order merely because of these handicaps, and this in spite of the fact that they are after the discovery and measurement of absolutely definite objects.

7. To my mind it is not so much the *means* as the *method* of using these, that determines scientific as against unscientific procedure.

8. Now, the stop watch is a cheap and hence readily obtainable means by which time studies can be made, as against the Gilbreth motion-picture machine with its beautiful way of recording very fine subdivisions of time simultaneously with the events photographed, but as the latter cannot—any more than a stop watch—automatically pick the most suitable in a group of workers to which to apply it, or overcome the variations in the performance of any worker selected, I cannot see that it can do much more for us than to measure more accurately the elementary operations performed by the particular worker photographed.

9. I venture to say this, though the whole subject of time study has never been more than a side issue with me during the twenty years I have been engaged in the exploitation of scientific management, whereas Mr. and Mrs. Gilbreth have applied themselves to the subject in a most ardent and industrious manner, for several years past. However, I have reasons to believe that their studies have been mostly connected with repetitive work implying exceedingly minute motions and individual time elements, and practically no machine operations as most of us understand them. On the other hand, practically all my work and all the time study work of Mr. Merrick, whose book on this subject and my preface to the same have given rise to this "Indictment of Stop Watch Time Study," has been connected with all around machine shop work, in which the time of machining a piece of work sometimes exceeds by many times the time the operator applies himself directly.

10. With us, therefore, it has so far been more a matter of the study of the possibilities of the machine and the surrounding conditions that are independent of the particular operator, than of the operator himself.

11. Our gains have consequently come more from the re-speeding and often re-building of machines, the institution of improved tool rooms, and so forth, than from the subsequent time studies made of the manual operations involved, though no effort has been spared in also improving these by the elimination of useless motions and other waste efforts, which in connection with the ordinary run of machine shop work that we have encountered, is more a matter of past general experience and the commen sense that goes with it than of a time study comparison of different motions.

12. The final time study of the operator, with the stop watch as our only means, even if not what it might have been with a more accurate time-recording device, we feel, therefore, has been fully accurate enough in a practical sense; for a more refined way could not, as a rule, have enabled us to gain more than a small percentage of purely theoretically more correct task time allowance, which, because of the unfortunately high precentage of special allowance we are compelled to make on the preliminarily determined machining time from the feeds and speeds selected, can never, in this kind of work, be more than making the best of a troublesome matter.

13. This high percentage of allowance on machining time has been forced upon us by the electrification of machine shops, for electrically driven machines are far more subject to speed variations beyond our control than are steam-engine and belt-driven machines whose belts are systematically cared for, and which accordingly require only a small special percentage of allowance on the machining time alone.

14. In referring to their motion-picture machine the Gilbreths also made the statement that their pictures preserve for all times the exact conditions under which a job has been performed. I remember well a picture Mr. Gilbreth exhibited of a turret-lathe job the only time I have heard him speak on the subject, at which time he also made a similar statement in regard to that particular job. At that time the statement impressed me as being a very extravagent one indeed, though perhaps momentarily excusable on the part of an enthusiastic inventor. I could not see then, nor can I see now, how the condition of repairs of the machine, the shapes and correct settings of the tools, the spindle revolutions and the feeds, etc., could possibly be observed even by the application of the microscope to the films themselves. In fact, I could see nothing whatsoever in that particular picture, except the minute divisions of the accompanying timing device.

15. By this I do not mean to say that similar statements may not be, at least approximately, correct with reference to many similar pictures taken of jobs of a totally different nature, and I do not wish to be understood as wanting to underestimate the achievements of Mr. and Mrs. Gilbreth; but I cannot help

believing that their apparatus and methods are not unqualifiedly to be recommended for exclusive use in time studies.

16. Mr. Taylor himself in the following quotation made by the Gilbreths from "Shop Management"—"What the writer wishes particularly to emphasize is that this whole system rests upon an accurate and scientific study of 'unit times,' which is by far the most important element in modern management"—spoke as the enthuiastic originator and performer seeking a following. It did not take me long to learn to make allowances for the enthusiasm and not to take it quite so seriously as all that; just the same as I am not taking the claims and statements made by the Gilbreths quite so seriously as their ardent and persistent work naturally has prompted them to make these. Yes, as has universally been my experience through all these many years, the preliminary and preparatory work and reform that I have had to do to put a concern in a condition for worth-while time studies and task setting of any kind, has been more effective of waste elimination and all around good than the work resulting from the subsequent time studies taken; and I can make the positive assertion that this has not been due to the fact that a stop-watch was used and not a more refined timing device.

17. In regard to the criticism of the manner in which Mr. Merrick chooses each of his final unit times from the records made by his stop watch studies of a great number of each of these, I cannot see but that it is as scientific as a majority of determinations made in other fields of engineering, except when pure mathematics alone is involved. Such determinations are in the end based on certain assumptions that we know to be only approximately correct. Thus we never know the exact ultimate strength or elastic limit of any material we intend to put into an engineering structure; but we nevertheless assume something definite,—that is, we guess, and trust to luck that our guess is near enough correct to serve for practical application in a theroetical formula the correctness of which is even open to some suspicion, but which represents the latest and best available to us.

18. Again, in calculating the weight of a complex structure it is considered the best practice to calculate as closely as possible, on a purely assumption basis of the exact density of the materials implied, the weight of each of its constituent parts, and only, if at all, to round off the final figures of the sum of the individual weights calculated for each kind of material and of the entire structure.

19. Viewed separately each individual weight of such a sum looks indeed as a preposterous pretense at an ability to predetermine with precision that which is fully realized to be a mere approximation. In the final analysis it all means only a consistent manner of guessing at the value of each part, and trusting to the probability of a partial compensation of the individual errors, to give us a relatively more correct weight of the structure as a whole than the weights arrived at for the individual parts. And I surely cannot imagine that anybody would contend that the individual times consumed in performing motions by human beings are more nearly constant than the weight of materials produced from engineering drawings and specifications, or that a small error in predetermining the former as a basis for a fair contract between a worker and his employer, is more serious than an error in the predetermination of the latter as a basis for a fair engineering contract.

20. But when it comes to the criticism of attempting to use a stop watch for the determination of operations so short that probable error in the observation and recording of its time value may equal or even exceed the time value, it certainly is more than justified; and we are all greatly indebted to the Gilbreths for having persisted in their efforts—apparently long since crowned with eminent success—to devise instruments and methods which make the measuring of such minute elements of time possible.

21. They have thereby opened up a whole new world for scientific investigation, comparable perhaps with those that the microscope and the telescope each did, as compared with the circumscribed field of the simple magnifying glass.

22. My contention is meant to be only the equivalent to claiming that the magnifying glass has still its legitimate use along with the microscope and the telescope. In fact, when occasionally a time element is met with which is too short for even an approximate determination by a stop watch, along with time elements so determinable to a satisfactory degree, all we have to do is to fully realize this, and then either neglect it altogether or let a guess at it go in for what it is worth; just the same as it does not make any appreciable difference in the total weight of a large structure, if we either absolutely neglect or overestimate the absolute weight of one or two small parts of it.

23. One reference I think the Gilbreths might well have left out in their indictment of the stop watch, is the fact that, when first used for time studies, it

was often concealed and used in observing a worker clandestinely; for they also admit that this is no longer being done, and I will add, has not been done since I became associated with Mr. Taylor. Hence that statement can have no other effect than to prejudice the reader against the stop watch in an unnecessary and unwarrantable manner.

24. So far as my knowledge goes—with one single and deplorable exception never likely to be repeated—no direct disciple of Mr. Taylor has ever timed a worker without heeding Mr. Taylor's injunction not to do so without properly preparing the way and obtaining the full consent and cooperation of the worker, a thing that is absolutely independent of the kind of timing device used. And still, we must admit that the Gilbreth motion picture-machine precludes even the possibility of clandestine observation; but I cannot see that it necessarily implies the consent and full cooperation of the worker.

25. And now, finally, let us turn to the very opening paragraph of the paper under consideration, namely: "Planning and control and all other functions of management depend first, last and all the time upon the standards upon which they are based. These standards, in turn, depend upon the fundamental data from which they are derived. The fundamental data for determining standards are obtained by motion study and time study," and see if we ought not also to accept that clear and confident statement with reservations as in fact already implied in my previous contentions.

26. Planning in an industry, while the very essence of scientific management, can never be a very exact thing for short periods at a time, for modified requirements by customers and unforseeable accidents to materials and machines, etc., constantly upset our forecasts; but with our plans before us in a very tangible manner, we can re-cast our plans as often as such disturbances occur, somewhat in the same manner as railroad schedules are always subject to accidents and disturbances due to adverse weather conditions.

27. In fact, I know of a concern that inaugurated a scheduling system, more than a generation ago when the idea was a new one, but soon gave it up, not because of the difficulty of estimating near enough for the purpose, from the piece rates in use and the limit put on the worker's earnings, the time each job would take; but because of the constant upsetting brought about by time lost because machine castings contained hidden defects that such partial machining alone could disclose. By the present time, however, we have learned not to let such matters discourage us completely; we resolutely re-arrange our schedules every time such difficulties occur to a greater extent than the time "safety factor" adopted allows for, just the same as the railroads, whose inefficiency we are all wont to deride, never for a moment consider giving up their schedules no matter how often or how badly these become deranged. On the contrary, under such conditions all the available efforts of a railroad management are for the time being concentrated on re-establishing the schedule.

III. A DEFENSE OF THE STOP WATCH

By DWIGHT V. MERRICK[1]

1. There is very little that I can add to what has already been covered by Mr. Barth.

2. Mr. Gilbreth in his remark emphasizes that by his motion picture method he is able to show an operator a one best way of performing his work by a study of a picture taken on the best operator. Mr. Gilbreth further emphasizes that the time element is only secondary and can be used if desired.

3. There are many instances where feed and speed data are far more important factors than the handling time data, and then a study of a picture of a one best method performance becomes secondary. In such cases timing with an ordinary stop watch is close enough. To illustrate: at Watertown Arsenal I set times on jobs covering as much as 120 hours with very little time study preparations, and when I told Mr. Barth of this he expressed considerable surprise; but when informed that the greater portion of the job was machine time, dependent on the feeds and speeds which were determined by the slide rule, he realized that the handling time was an insignificant factor. In some instances this handling time was as low as five per cent of the whole, and in most cases on the large machine tools, on long jobs, it averaged about ten per cent.

4. This was also the case at Bethlehem in the early days. There the rates were set entirely by the slide rule and a small allowance made for handling time.

5. In recent years my work has often been of such a nature that I have felt the need of a more accurate time-measuring device than the ordinary stop-watch. This work was of a highly repetitive kind and required intense application on the part of the observer to record his readings, as the time of performance of each operation was of short duration.

[1]Consulting Engineer, New York.

6. For such work it appears to me that there is no better device at present than the Gilbreths' motion picture machine, as it can be made to illustrate by a picture a best method of performance, and at the same time register the time of performance of each elementary motion.

7. Nevertheless, I do not believe that it is the panacea for all ills as claimed by Gilbreth, for there is a useful field for both methods. I am thoroughly convinced that for ordinary, practical purposes the stop watch will continue to be the most convenient time-measuring device.

IV. A DEFENSE OF THE STOP-WATCH

By Robert T. Kent[1]

1. The speaker is in a somewhat peculiar position. He was associated with Mr. Gilbreth in the development of micro-motion study; in fact he was the first person to whom Mr. Gilbreth confided his invention. He also had no little part in the preparation of Mr. Merrick's book on time study. He is, therefore, in a position to speak with some measure of authority upon both phases of the subject.

2. The speaker at once recognized the value of and has been from the beginning an ardent advocate of Mr. Gilbreth's method of time and motion study for certain classes of work. He believes that the method offers a great advantage over all previous developments for absolute accuracy in the recording of time and the transference of skill. For motions or cycles of motions which are so short and follow each other with such rapidity that it is difficult or impossible for the eye to follow, there can be no question but that the motion picture camera study is in a class by itself.

3. On the other hand, there are certain classes of work for which it is ill adapted. There is time study and time study. Certain studies can be made, with all accuracy needed, with no other instrument than an eight-day clock. Other studies will require instruments of greater refinement — an ordinary watch or possibly a stop watch. For still others, the micro-motion camera is the only device suitable.

4. Time study is simply a method of measuring time. The use of any instrument for time study is exactly on a par with the use of a two-foot rule or any other measuring instrument for the measurement of lengths.

If we are to cut a piece of wood whose length will be close enough if it is within one-quarter inch on either side of a given dimension, a carpenter's two-foot rule will be a sufficiently accurate measuring instrument for the purpose. Having such a rule available, we should be foolish to use a machinist's scale reading to the sixty-fourth of an inch and to attempt to measure that closely. On the other hand, we should be equally foolish to attempt to measure with a two-foot rule, or even with a machinist's scale, a fine job in the lathe which has to be turned with a limit of error of plus or minus two one-thousandths of an inch. We should use the micrometer. Further, if we were making a reference gage, whose accuracy had to be within two or three one-millionths of an inch, no measuring instrument would be suitable except an interferometer. As it is with the measurement of physical objects, so it is with time study. In each case we must use the tool best suited for the job in hand, whether it be the two-foot rule or the interferometer, the stop watch or the micro-motion camera.

V. MAKE TIME STUDY OPEN AND ABOVE BOARD

By Morris L. Cooke[1]

1. Mr. Taylor frequently expressed himself to me as being absolutely opposed to secrecy in time study when the results of such study were to effect in any way the wages to be paid to the individual on whom the observations were to be made. This of course was but one application of a broader principle, i.e., that we should never seek to induce or compel any man to do anything against his will or rather without first having gained his active consent to what it is proposed to do. Compulsion except in the matter of forcing people to live up to bargains freely entered into was abhorrent to Mr. Taylor as it is to any red-blooded man. On the other hand, Mr. Taylor felt that it might be entirely proper to make time studies on people whose interests were to be in no wise affected by them and without their knowing that it was being done. This saved the time required for explanations. I recall that this method was followed in the making of some of the observations needed for "Concrete—Plain and Reinforced" and "Concrete Costs." Such observations were made in the interest of accuracy of statement in the text and were of no interest to the employer on whose work the observations were made or

[1]Mechanical Engineer, New York.

[1]Consulting Engineer, Philadelphia, Pa.

to his employees. In fact the employer knew as little about it as did the workmen who were unobtrusively not to say secretly observed.

2. But I believe the time has now arrived when the Taylor Society should decide that it is unwise to make secret time studies under any circumstances. Under the best of circumstances such practices are likely to be misunderstood. Secrecy is generally out of harmony with the spirit of scientific management. I happen to know of more than one shop where under one excuse or another secret time studies are being made. I am thankful to say that I know of no member of the Taylor Society who makes secret time studies. If we can declare studies so made as unprofessional then the possession of the paraphernalia that goes with them becomes taboo. It would be a good thing if someone would invent a stop watch that barks every time it is taken out of the pocket. Both the stop watch and time study are of a piece with the industry of the future; the less mystery there is about them the more promptly they will come into generally accepted use.

VI. STANDARD TIMES FOR STANDARD "WORK ELEMENTS"

By Thomas W. Mitchell[1]

1. In addition to ordinary time study there is another important purpose for which the Gilbreth micro-motion recording apparatus should be very useful, namely, for the purpose of determining the degree of effectiveness of alternative methods and to determine the best basis on which to select from the mass of varying readings the standard time for an element.

2. It is remarkable in a profession that advocates scientifically determined standards that the very methods of determining element-time standards even when the same instrument, the decimal watch, is used, have not been standardized. Mr. Sanford Thompson uses one method, Mr. Merrick a second, Mr. Knoeppel a third and other practitioners use other methods. Element data obtained by one is not usable by the others. They cannot all be best.

3. It is a common experience in making studies to obtain on successive units of work a number of different readings for the same element. These variations may be produced by three different causes. First there may be a variation in the amount of work contained in the element. Thus one leaf sight back may be a thousandth part of an inch wider than another, creating a greater difficulty in either inserting it into or extracting it from a drilling jig. Second there may be a variation in the worker's performance due either to a greater or less dexterity and speed from piece to piece or to variation in the constituent motions. Third, the variations may be due to errors in reading the running watch.

4. To the observer with the running watch these causes are concealed. A photographic record, however, will eliminate the observer's errors, show the variations in motion combinations and sequences and even many of the variations in the amount of work. Simultaneous studies made by first class decimal watch observers, by observers with H. H. Williams time study machine and by an observer with the Gilbreth apparatus on the same operations and same operators should go far toward giving us criteria whereby to ascertain these causes by an internal examination of the study, and lead us to a standardized procedure and method.

5. Another kind of research that probably would be helpful would be a series of "before and after" studies, i.e. time study made upon experienced operators before they are put on piece work or on task and bonus and time studies made upon the same operators and same operations after they have been put on piecework or task and bonus long enough to have adjusted their speed to the new incentive. A comparison of the readings obtained for the same elements under such before and after conditions should shed a flood of light upon the question of what is the proper basis on which to select the standard time for an element and of what constitutes a satisfactory time study.

6. I still have faith in the idea that out of the myriads of operations there are comparatively few classes of work elements, just as all thought can be expressed by various combinations of less than a hundred written characters. I have had startling success in many instances in closely predicting the time of composite work elements by synthesizing the time I had in mind for such constituent elements as "pick up," "put down" and the like. However, very little progress has been made in this direction. One reason for this is that most of these constituent elementary motions are very short, some of them as fine as .008, .005 or even .002 min-

[1]Consulting Engineer, Philadelphia.

ute. These cannot be timed directly by the running decimal watch, and the percentage of error in measurement by indirect methods is so large as to vitiate the results. For such a study the micromotion study apparatus is excellently adapted. I believe that by going at this subject persistently and systematically in a few years we could have for each of a hundred work elements a graphic chart, like those already attained for many elements at J. H. Williams Drop Forge Works, showing the range of the time of the element according to the size, shape, position and the like of any object to which it applies. Then we could realize our ideal of being able to analyze a new prospective job, write an instruction card for it, apply elementary time data and set a performance standard for it without leaving the desk in the planning department.

VII. TIME STUDY AND HUMAN STANDARDIZATION

By Reynold A. Spaeth[1]

1. In a paper delivered before the New York Section of The Taylor Society on December 16, 1920 by Mr. and Mrs. Frank Gilbreth, an indictment was advanced against stop-watch time study as it is customarily practiced. The validity and the scientific value both of the method and of the results were criticised. The method of stop-watch time study is believed by the Gilbreths to be too crude and they suggest substituting their motion picture technique for it.

2. After a careful reading of the Gilbreth's paper it seems to me that they have lost sight of the fact that the problem of time study is not one involving extraordinary accuracy in measuring time. In their motion picture technique they have concentrated upon a method that will give them a high order of absolute accuracy for the particular function measured, that is, motions in time intervals. This, however, is not the real problem.

3. In my opinion the stop watch, instead of being inaccurate, is already far too accurate. It is, in fact, of a different mathematical order of accuracy from that of the final result. The statistical arguments advanced by the Gilbreths are entirely correct, but they do not apply to stop-watch technique itself. The reliability of statistical data obviously does depend upon the accuracy of the individual components which constitute the final result. Most physiological experiments, however, probably have an error of about five per cent. Some of the real sources of serious error in stop-watch time study are unknown variables as allowances for delays and fatigue, variability of incentives and of individuals, and the mutual suitability of job and man—to mention only a few.

4. The time-study man's job is to set a fair wage on the basis of his observations not only of time intervals, but with the additional of allowances for fatigue, delays, etc. The final result, therefore, whether with a stop watch or with a moving picture technique, is made up of a combination of some very accurate measurements and some guesses. Consequently, your best guess necessarily determines the order of accuracy of the final result. If a chemist has to weigh a definite quantity of a particular substance and takes one fraction and weighs it to five decimal places on an extremely accurate chemical balance and then takes the remainder and "hefts" it with his hand and guesses it to weigh about a pound and a half, the final accuracy of his result depends not on the weighing that he did on the chemical balance but on his ability to guess accurately—whether in other words the other fraction really weighs a pound and a half or not.

5. It is important to bear in mind that the Gilbreths face exactly the same group of variables as the stop-watch time study man when they come to apply their observations on "the one best method" to other people than the particular expert studied. In other words, although the average man is not believed to exist by the Gilbreths, nevertheless it is average men and not exceptional experts with whom we are forced to work in practice. Whatever inspiration may come to the average workman from observing a five foot piece of film with a magnifying glass, I am frankly skeptical just how much such a study will contribute toward the learning of the expert's technique by the average workman.

6. I do not wish to be misunderstood in this criticism. As a research method and as a permanent record of the best way to do work there is much to be said in favor of the fascinating and highly ingenious technical appliances devised by Mr. Gilbreth. The possibility of synthesising a working method from the performances of different individuals is at least a theoretical argument in favor of the motion picture technique. In certain extremely

[1]Associate in Physiological Hygiene, School of Hygiene and Public Health, Department of Physiology, Johns Hopkins University, Baltimore.

rapid processes it may doubtless find an application also. However, when we are asked to abandon the stop-watch time study method and adopt the motion picture technique with the object of improving the accuracy of the final result, I believe this to be fundmentally incorrect and a step in precisely the wrong direction. As a general scientific problem, before increasing our refinements in one direction we should and must attempt to control some of the larger errors in another direction mentioned above. These errors are particularly concerned with the problem of the standardization of the individual.

7. All time-study men will agree that a fundamental preliminary step consists in a systematic standardization of equipment, methods and tools before any time studies are begun. Management engineers have made marvelous progress along these lines. I need not remind this group of the studies of Mr. Taylor and Mr. Barth on the art of cutting metals and the science of re-speeding machines. From reading Mr. Taylor's "Principles of Scientific Management" it is very clear that he appreciated the importance of standardizing the human beings who are to do the work, as well as the equipment. This phase of scientific management has, however, been almost totally neglected up to date. The reason seems to be that it has been nobody's job. Industrial physicians have been concerned with illness; industrial health has not yet been studied systematically. In fact, this work is in its earliest beginnings.

8. There are three general phases of human standardization: (1) physical standardization; (2) physiological standardization, and (3) psychological standardization. I wish to speak briefly about each of these three phases.

9. By a physical standardization of individuals we mean an inquiry into the total muscular strength required by a particular job. The method of measuring total muscular strength devised by Dr. E. G. Martin of Stanford University has already proved successful in industry. In a recent publication of the United States Public Health Service, Dr. Martin has shown that there is a definite correlation between total muscular strength and output. This correlation is not very high to be sure. It has a value of approximately —.50. However, statisticians consider such a value to be within the significant class. The practical value of physical standardization consists of establishing definite limits of strength required to do the particular work successfully. For example, if an individual has a total muscular strength of 3000 pounds on the Martin scale and the weakest individual who is successful at the job has a total strength of 2200 pounds the employment office would not consider engaging a man and placing him on this same job whose total strength did not come up to say 2000 pounds. Dr. Martin's method is extremely practical for it requires only some two minutes to make a single set of observations. Furthermore, the measurements are made with the individual completely clothed, which has obvious practical advantages. How far Martin's method may prove to be applicable in industry in the future I will not venture to predict. It is, however, important for management engineers to know that work is being done and has been done along the lines of physical standardization of industrial workers which has a great and important practical significance. Such standardization is obviously of use principally in jobs requiring a considerable expenditure of muscular effort.

10. The practicability of so-called physiological efficiency tests is less obvious. The physiological tests that have thus far been devised are principally concerned with the efficiency of the heart and circulatory system. You are familiar with the fact that after light exercise the heart rate increases. The time required for the heart to return to its normal rate is used as an index or measure of the heart's efficiency. This subject has been principally investigated in this country by Drs. C. Ward Crampton and Schneider of Wesleyan University. Dr. Schneider's test was used during the war in the selection of men who were especially fitted to become aviators. As in the case of the test for physical strengh the physiological efficiency test would be of greatest importance in jobs requiring much muscular effort. I have in mind women who work in sail lofts and dock workers who handle heavy loads at high speed. Other cases will occur to you.

11. Another group of investigations in which physiologists have been particularly interested has been concerned with the carbon dioxid output of the human machine during work. Without going into great detail in this fascinating subject I should like to call your attention to certain discrepancies or neglected points that occur in making out a so-called workingman's budget. According to the observations of Greenwood, Hudson and Tebb, the individual engaged in heavy labor must spend nearly five

per cent more of his income for food in order to maintain an efficient standard than the individual who is engaged in relatively light work. You are all aware of the fact, however, that the heavy laborer receives the smaller wage. So far as I know these facts are consistently neglected in all attempts to establish a minimum working-man's budget. In England attempts are being made by Dr. Waller to measure the calorie consumption of heavy workers. It will interest you also to know that we find corroboration of the familiar fact that the man on piece work shows a higher carbon dioxid output than the same man on a day wage. In other words, he does more work, he works faster on a piece-work basis than on a day basis.

12. The most complicated phase of the human standardization problem lies in the psychological field. The uncertainty of some portions of the technique makes it peculiarly open to fakirs and charlatans. There is, however, only one recognized method of procedure in psychological standardization in industry. We must select a group of workers of known performance and after a careful analysis of the job, test out any particular tests which we believe to be important on this group of human beings. When we find a test which is done with a high degree of proficiency by workers of known skill, we may reasonably assume that the test has a certain predictive value for use in the employment office. We must, however, pay particular attention to testing the test. Unless this is done the whole problem of psychological standardization is better left alone. We must calculate a coefficient of correlation between our test and the performance of our workers and this coefficient must lie above +.50 before we can accept it as being of practical use. A practical illustration from some experiments that Major Dunham and I have been carrying out with army rifle shoes may perhaps clarify this matter further.

13. We suspect that rifle-shooting ability might depend to a certain extent upon the control of so-called natural tremors in the hands and arms of individuals who were shooting. We tested this question out on a number of individuals by having them hold a small brass stylus in holes of varying size in a brass plate. When the needle came in contact with the wall of the hole an electrical contact registered the touch. It was a simple matter to count the number of contacts and note the size of the hole and in this way we established a basis for scoring the steadiness of different individuals. Through the co-operation of the officers of the Third Army Corps we were able to test out a large number of men at Camp Meade. We found that there was indeed a correlation between steadiness and rifle-shooting ability and that in general men who shot well likewise were very steady. The tendency for rifle-shooting ability and steadiness to fall together, that is the correlation between rifle shooting and steadiness, we found to have a value of about +.60. We have, therefore, tested the steadiness of men of known rifle-shooting ability. It remains for future workers to show whether men can be taught to shoot in the psychological laboratory by learning to control their natural tremors.

14. In the remaining time at my disposal I should like to call your attention to certain interesting phases of the so-called working capacity idea. We customarily plot human output on a base line which is supposed to represent the working capacity of a particular individual. A simple laboratory experiment, however, will convince you that this so-called working capacity is an extremely elusive and uncertain thing. In my laboratory in Baltimore I have an apparatus with which I can measure the amount of work done by a student, the work consisting of raising a weight with one finger. The apparatus which we call an ergograph has one serious defect, in that it does not really show when a man is completely tired. After I can no longer lift seven pounds I find that when I take one pound off I can still raise six pounds for a considerable period. In the case of certain unsuspecting individuals we have found that when they are told that a pound is about to be removed but a pound is actually added, their work continues nevertheless precisely as though a pound had been removed. In other words, such individuals imagine the load to be lighter and consequently work successfully. An even more striking illustration of the power of suggestion is shown by the experiments of the late Doctor Nicholson which were recently published in the Johns Hopkins Hospital Bulletin. Doctor Nicholson placed his subject in an apparatus similar to my own and hypnotized him when he could no longer work. The suggestion of work made the subject continue lifting the weight quite as if he had never been fatigued. I do not wish to be understood as advocating general hypnosis for industrial workers in order to increase production! There is, however, a certain fundamental psychological significance which you will all recognize in these

somewhat crude illustrations. Men and women will work if they feel like working, and if they do not feel like working they simply sabotage whether consciously or unconsciously. The most complicated time-study technique and the finest rate setting in the world will not make human beings work unless they co-operate. The removal of the normal inhibition which keeps human beings from giving their best in industry, in other words, the release of the will to work represents, it seems to me, the most hopeful, untouched field in the whole production problem. The man who can release the complete co-operation of his employees will get production. Mutual suspicion between management and men, however, can never lead to anything but complications. Just how far the attitude of suspicion and mistrust and social unrest is dependent upon certain broad health and happiness factors is shown clearly to my mind by figures recently published by Dr. E. J. Collis. (Table I). These figures show

TABLE I

The Relation between Mortality and Industrial Unrest in Certain English Coalfields.

Coalfields	Deaths from all causes. (1910-12)	Precentage of Miners Favoring Strike. (August, 1920)
(Yorkshire)	(758)	(51) A
Nottingham	570	55
Derbyshire	591	71.9 B
Durham and Northumberland	635	77.9
South Wales	777 C	77.9
Lancashire	941	89.7

A—A strike, affecting this coalfield alone, took place in August, 1919; and the effect of the rest then taken is generally supposed to have influenced the voting.
B—Includes South Derbyshire.
C—Includes Monmouthshire.
The above figures were compiled from Collis and Greenwood, The Health of the Industrial Worker, pp. 75-76.

that in the British coal fields there is a general correlation between the number of coal miners who voted for a strike in August 1920 and the morbidity and mortality rate in the different coal fields. Nottingham had the smallest strike vote and the lowest accident and death rate, whereas Lancashire had the highest vote and the highest death rate.

15. I hope I have made it clear to you that the management engineer must look for a new ally in the physiologist. In my opinion time study will be improved by greater attention to the standardization of the human machine rather than by a further refinement of the technique of time measurement. It is sounder scientific procedure to get after the big errors first. At present these large errors lie along the lines of human standardization and not in the method of time measurement.

VIII. CLOSURE

By Frank B. Gilbreth and L. M. Gilbreth

1. It is not surprising that some management men who have commented unfavorably on our "Indictment of Stop Watch Time Study" should have defended the old practice, because

a. It is associated with the old days of struggle and victory over the "rule of thumb" manager;

b. Dr. Taylor himself used it and advocated its use;

c. They are, many of them, adept in its use compared with beginners, and thus feel that they already have the advantage of years of experience over others in the practice of management;

d. It is their livelihood.

e. A few of them are directly interested in profits from the sale of stop watches, time study devices or books describing stop watch time study methods.

f. They are apprehensive that if the validity of stop-watch time study data is assailed, the tasks and rates based on them are threatened also.

2. As many of these discussions are by men justly prominent in the field of management, they merit the most careful consideration. We shall, therefore, discuss them paragraph by paragraph, reviewing their meaning and answering the criticism in detail.

REPLY TO MR. BARTH

3. We consider first Mr. Barth's "A Defense of Time Study," as he calls it.

4. Mr. Barth is perfectly justified in strengthening his qualifications as a discussor of our paper by calling himself a "direct disciple" of Dr. Taylor, in paragraph 1. It is perhaps permissable to state, if Dr. Taylor's approval is to be used as a standard of measurement of qualifications and the right to define terms officially for the Taylor System, that on the three most important occasions[1] presented for dis-

[1] 1. Meeting on "The New Conceptions of Business and Industrial Efficiency" held under the auspices of "The Civic Forum," Carnegie Hall, April 28, 1911.
2. Answering the questions that were sent to the "American Magazine" for further information on Scientific Management after Dr. Taylor's articles in the March, April and May, 1911, issues. The answers appear in "Primer of Scientific Management," 1912.
3. Western Economic Society's Conference on Scientific Management, March 14, 1913.

cussion of the questions of Scientific Management, and on several other important occasions, Dr. Taylor selected us as his personal representative to handle for him and in his interests his side of the argument, and to explain and answer oral, written and printed questions, without special conference with him at the time.

5. A further indication of Dr. Taylor's approval of our fitness to make decisions in management was his asking us to join him in writing a book on our subject of motion study, which he had never recognized or considered, combined with his subject of time study, which we had never recognized or considered. This exceptional honor, which we have always fully appreciated, we were obliged most reluctantly to decline.

6. In paragraph 1 Mr. Barth has put on record what we have always contended, what Dr. Taylor said, until he changed his views in 1912, and exactly what his "direct disciples" have always believed and practiced, not only before 1912 but also ever since, that "the object of time studies is to determine a fair time to allow a worker for the performance of a task"; or to determine "how long it takes to do work," as set down by Dr. Taylor in "Shop Management." Dr. Taylor changed his viewpoint, as is recorded in his discussion of paper 1378 read before the American Society of Mechanical Engineers in 1912, which we shall discuss at length in our forthcoming "Management Commentaries," but his "direct disciples" still hold to his original views.

7. We have always maintained, and the discussion herein now confirms our contention, that the "direct disciples" have no conception whatever of motion study, other than something that "is the same as time study." Time study does not record elements of skill. *This one thing is sufficient in itself to distinguish the two for all time.*

8. Mr. Barth, now, in 1921, with the statement undisputed by the Philadelphia Section of the Taylor Society, and *"fair time to allow,"* underlined by him, has recorded for all time without ambiguity and beyond recall, that "Time Study is for Rate Setting." That is the exact title of Mr. Merrick's book. There is no question, therefore, that the statements in our paper are justified.

9. It is interesting to note, in paragraph 2, the stress on individual differences. This is indicative of a fundamental change of thought in the entire world in the last ten years. It seems doubtful if he is cognizant of its implications. In this paragraph Mr. Barth states that the fact that no two workers accomplish their work in the same time, is sufficient reason for accepting inaccurate time study made by the non-condition-recording stop watch. Can it be possible that he still does not recognize the great advantages of the micromotion method, which not only does all that the stop watch does, and this without error, but records all the surrounding conditions, which also may show the very *cause* of the lack of regularity? Can he not recognize that times are different, usually, because methods are different? Can he not recognize that without the conditions being recorded the best portions of methods cannot be selected for the One Best Way? Can he not realize that quality of method and speed at the time are always confused, with stop watch times? Can it be possible that he still fails to recognize that *perfect accuracy* of minute times is ***not the direct product*** or the chief aim of the micromotion method, but is a *free by-product* of the record of the motions, that defines absolutely and in detail the method on which the "fair contract" is based? We are not losing sight of the great benefits resulting from the "task" or "program" or "time-table," but they should be, and for best results must be based upon the clearly identified subject matter of a fair contract based upon recognizable facts.

9a. With the micromotion method, the contract *is* fair and the minds of the contracting parties ***have*** met, because the method to be used is identified on the film. With the stop watch method if a "fair contract" means merely an agreement between the employer and employees that the employer will pay the employee the high rate if he makes the number that is called for in the task of a quality that suits the varying whims of the management, then there is also a contract.

9b. Many "tasks" or "fair contracts" are not fair because the method which is supposed to be clearly identified in the instruction card "is not identified at all so far as the motions to be taught and to be used are concerned." For example, the "instruction cards" as shown in Mr. Merrick's book "Time Study for Rate Setting" do not identify the motions at all. If the "fair contract" is not based upon a definite method and sequence to be used to obtain the task time, the minds of the parties have ***not*** met. Furthermore, unless the tolerances and inspection are clearly circumscribed, the minds of the employer and employee have not met and there is no real agreement or fair contract.[1]

10. The two reasons summed up in paragraph 3 for establishing a "degree of accuracy," "in reaching a satisfactory time allowance for a task," i.e., variation between workers and unevenness of the individual worker, neither excuse stop-watch time study for its inability to time the activity accurately, nor belittle the usage of the micromotion method in recording all such differences in errorless unmistakable detail, along with the likenesses, as fundamental data for determining the One Best Way. Here again Mr. Barth *emphasizes his one thought,* namely, *time study* for *tasks.* There is no thought or mention of observations for the worker in his learning period; no thought of recording comparative data as to merit of method; no thought of exposing the best that has been done to the learner; no thought of having a detailed ideal of method to come to; no thought of tapping the infinite experience of the workers of the present and all succeeding generations of workers' cumulative progress in method. No! Only "time allowance for tasks," and "fair time to allow a worker for the performance of a task" and "task within the time allowed," and "if he falls short of performing the full task within the time allowed."

11. The task does excite the workers' ambition and desire to do the work "in the time allowed." The task does not educate him in the best method that has been done, as a base line, upwards from which he may use his inventive ability and experience for advancement. Our paper is not merely about tasks. There is an endless amount of work possible before and after the quantity of the task is established that is of the greatest importance, even if tasks are never set. Yet Mr. Barth ignores, with the apparent approval of the Taylor Co-operators, the principal feature of our indictment of stop-watch time study. Is it because they refuse to see the educational feature and the importance of recording in detail the One Best Way to do work,—or do they prefer to confuse the issue by discussing only the much less important feature of "Time Study for Rate Setting?"

12. In paragraph 4, it is no more fair for Mr. Barth to infer that we condemn stop-watch time study "merely" because we have invented "a far more accurate time measuring device," than it would be for us to say that he defends the stop watch because he has co-operated on a book on stop-watch time study and has put himself on record for all time as endorsing such inaccurate methods. As a matter of fact, the invention of the micromotion method did not come for several years after our condemnation to Dr. Taylor of his stop-watch time study method, and our promise made to him in 1907 that we would design a time study device that would do away with all the faults, inaccuracies and mistakes of stop-watch timing.

13. Note that Mr. Barth now completely concedes the superior accuracy of the *devices* of our method.

14. In paragraph 5 the fact is emphasized that the industrial engineer often has to be satisfied with second best. In what way does this prove that he must or should be satisfied with the inaccurate, non-recording, rule-of-thumb stop watch? Equipment is stressed, therefore, evidently because the newer devices are thought to be too costly, or too difficult to secure, operate or install. We have answered all these objections in our original paper.

15. From paragraph 6, it is evident that the micromotion method is objected to as being too costly. The comparison of the stop-watch time study man to the astronomer and biologist is very flattering,—to micromotion advocates as well as stop-watch men. It certainly implies that only lack of funds prevents the latter from acquiring the more accurate apparatus, for surely no astronomer would remain without a telescope, no biologist without a microscope, if such could be secured, because the micromotion method will pay for its entire cost almost from the beginning of its use. But this is not really a parallel case. It is true that a scientist is a scientist even though he has *no* apparatus, but we maintain that no scientist would *advocate* using unnecessarily inaccurate methods and devices when accurate are available. It is not the question of his *possessions* but of his *attitude* that we are discussing. Does Mr. Barth wish to convey the idea that a time-study man "because of his own poverty, or that of the institution with which he may be connected, is unable at once to secure the very latest and best equipment for his research work," is warranted in going to some of our great colleges and universities and misleading students and their teachers

[1] "The minds of the parties to a contract must meet as to all of its terms.
Lord vs. U. S. 217 U. S. 340.
Fire Ins. Association v. Wickham, 141 U. S. 564.
Minneapolis etc. R. R. v. Columbus Rolling Mill, 119 U. S. 149.
Eliason v. Henshaw 4 Wheaton, 225.
Wheeler v. New Brunswick etc. R. R. 115 U. S. 29.
If any portion of the proposed terms is not settled, or no mode is agreed on by which it may be settled, there is no agreement.
Barrow S. S. Co. v. Mexican Cent. R. R. Co. 134 N. Y. 15."

by deliberately and intentionally advocating the inaccurate stop-watch method of time study, or misinforming the profession as to the best methods of time study, as has been done with his unqualified approval in the book "Time Study for Rate Setting"? Can Mr. Barth cite the possible poverty of an institution as sufficient reason for his first public expression of any praise whatever of the micromotion study plan, coming after our indictment of the rule-of-thumb stop-watch method?

16. The situation in the colleges is serious. Some in this country have already adopted micromotion study, and the securing of accurate times as a by-product of method records. Others, under the influence of stop-watch time study men, and taught by professors, who, realizing their lack of training in Scientific Management, have intrusted the subject of timing to "time study experts," have little knowledge, no knowledge, or misinformation as to micromotion study. A third group have been taught "that the stop watch method and the micromotion method are alternatives" and never find out till they have learned wrong habits of taking times and lived thru the heart-breaking experience of finding their carefully accumulated data worthless, that they have been devoting themselves to acquiring what is fast, and deservedly, coming to be a "lost" art, instead of a science, founded on a rapidly accumulating body of facts.

17. Our indictments of stop-watch time study, psychological and statistical, have been made primarily to inform the young men on the subject,—and the educational indictment to follow in forthcoming books will be developed along these lines.

18. We agree absolutely with paragraph 7. By "means" Mr. Barth evidently means devices. Having conceded the superiority of our devices he turns to a defense of stop-watch time study methods. We wish to state only that Mr. Barth, in his own attempts to make the findings of the stop-watch more accurate by applying his own knowledge of mathematics has shown the untiring devotion of the true scientist. It seems a pity that he has been handicapped so many years by the fact that the inaccuracy of the data he has had to work with has made his task such an ungrateful one. For example, such minute times as are derived by the algebraic equations in "Stop Management," American Society of Mechanical Engineers' edition, paragraph 377-378, Harper edition, pages 172-173, have been recorded in greatest detail as to method and with errorless times by a small boy with three or four revolutions of the handle of the camera.

19. In paragraph 8, Mr. Barth rightly says that our apparatus "cannot automatically pick out the most suitable in a group of workers to which to apply it." We have never claimed any such human intelligence for our devices. It can, however, be said to their credit that neither do these inanimate apparatus warn their users, as does Mr. Barth in Mr. Merrick's book, page IX, not to seek to record the "extraordinarily expert operator."

20. Mr. Barth has never had the experience, and could not with the stop watch, obtain and study new information pertaining to skill study usable for making the workers more productive, increasing their earning powers, and adding to their comfort, that the micromotion method acquires. He therefore criticises it as he does in the concluding part of the paragraph, as follows: "I cannot see that it can do much more for us than to measure more accurately the elementary operations performed by the particular worker photographed."

21. Believing, as he does, that the prime aim of studying the activity is to determine "a fair time," (Barth paragraph 1), and apparently thinking that the micromotion method has for its aim simply getting more accurate times, he naturally fails to appreciate that it bases its superiority on its ability to furnish data for skill study, the obtaining of the One Best Way to do work, and the education of the worker, and regards the times simply as a valuable by-product of its real work, which is the *recording of methods.*

22. In our books "Primer of Scientific Management," page 56, "Psychology of Management," chapter 8, and "Motion Study," page 36, we called attention to the great possibilities resulting from the transference of skill, and, while the majority Committee of the American Society of Mechanical Engineers recognized this principle and made it the subject of their epoch making paper 1378 at the December meeting, 1912, the discussors of our paper in 1921 completely fail to grasp the possibilities of finding and recording the details of the One Best Way and transferring the skill of the most expert to all the others.

23. Mr. John G. Aldrich, an expert on engineering and management, wrote in 1912, "Micromotion Study furnishes a means for the transference of skill from man to machine. More important than this it furnishes a means for the transference of experience from a man who has had it to one who has never had it."

24. In paragraph 9 Mr. Barth apparently has and gives an entirely wrong impression of our work. We

have today for his inspection over nine thousand written standards and standing orders pertaining to management, some of which date back to 1897, two years before Mr. Barth had ever worked for Dr. Taylor. Our work consisted for twenty-six years of handling thousands of men on our own payroll, from Eastport, Maine, to the Pacific, and from Montreal to the Gulf of Mexico. Prior to this we had seven years experience as superintendent and head superintendent in responsible charge of large work, with a grand total of thirty-six years studying and practicing management.

25. The experience has been supplemented by complete installations of Scientific Management. In many instances the work of making micromotion study has been but a small part of this. However, it is true that it is the basis upon which we have founded our standards and standing orders for the installation of management, which have been applied not only to "repetitive work implying exceedingly minute motions," such as textile and cloth handling industries, scientific instrument industries, and all branches of office work, but also to such machine shop work as has to do with automobiles, battleship crank shafts and screw shafts, and many kinds of industries in between. We grant that the micromotion method has been highly successful also on repetitive work that the stop watch demonstrated itself utterly unable to better or cope with, though handled by its most highly trained advocates and users.

26. Mr. John G. Aldrich, President of the New England Butt Company, speaking of the micromotion method and process, stated in 1912[1] "previous times have been reduced over two-thirds." This work can now in his factory be seen being done, today, nine years after, in the same way as we laid it out in 1912, the reason for no change being that it was done near enough to the One Best Way in 1912 to warrant letting it alone ever since.

27. Paragraph 10 is evidence of the weight that Mr. Barth gives to the profit that comes from the study of the machine, as compared with the human element,—not as disparaging the latter, but as an expert in improving the former.

28. We are glad to have this opportunity again to express our appreciation of the fine work of Mr. Barth in respeeding and rebuilding machines, as outlined in paragraph 11. In our installations we do not attempt to handle these thru micromotion study alone, as we have also, of course, available the other methods of betterment of scientific management, yet even in this field we have seen many a machine completely rebuilt as a result of the examination of the micromotion films. As to tool rooms, which he cites, we have seen none that compared in efficiency with those that have been installed with knowledge of and due regard to the underlying laws of motion study that have been derived from an intensive study of micromotion data. The laws of tool handling, moving, storage, repair and tool maintenance, developed in the course of our years of micromotion studying the complete Taylor system, warrant any large organization whose tool rooms have been done without such micromotion experience and view point having them done over again.

29. In one instance a "direct disciple" after long effort succeeded in getting one of our clients to let him try to improve a tool room that had all the Taylor merits and practice plus the refinements that come from such micromotion method of analysis. At the end of a few months his services were dispensed with and those things which he did not understand and therefore changed, were put back to the condition left by the micromotion method. Many similar instances can be quoted where accurate measurement cannot be improved upon by mere knowledge of tradition, without the knowledge of the theory.

30. In paragraph 11 Mr. Barth advocates "past general experience and the common sense that goes with it." He ought to know that these do not forsake the user of the micromotion method, tho their use alone savors of the "rule-of-thumb" that Dr. Taylor so strenuously tried to supersede. The micromotion method gives one a *measured experience*, and common sense backed up by measured proof, that correct and supplement the findings of general observations.

31. In paragraph 12, Mr. Barth again overestimates the emphasis placed by the micromotion method on its ability to get *more accurate* "times" for *rate setting purposes* than does the stop watch. We claim that it costs us nothing to get "absolutely accurate times" since these occur on our records simultaneously with the *record of methods*, the value of the latter paying for *all* the data, even that taken on work that has been already stop-watch time studied. But we also say that no time data, no matter how accurate, can compare in value with motion data.

32. There is no doubt, as Mr. Barth says in paragraph 13, that electrification does add a variable to the study of machines, but this was to be expected and is

[1]See Transactions of the A.S.M.E.—Page 1184.

being successfully handled, and in no wise furnishes an excuse for not obtaining the most adequate and descriptive data of what occurs, in fact it rather furnishes a new reason for accumulating such data.

32a. In paragraph 14, the alleged inability of the micromotion film to record certain important data is criticised. To this we reply that anything that cannot be recorded, in situ, by our motion picture machine to our complete satisfaction is written on slates, which are always provided for that special purpose, and then photographed in the films. In this way much more information can be and is recorded than Mr. Barth lists as essential. It may be interesting to note that if there is any question concerning the particular film that Mr. Barth refers to, it is possible to re-examine it at any time, to decide the matter, without prejudice, for what is once recorded is not dependent upon anyone's ideas as to what occurred and its value is in no way associated with the psychological variables of memory, prejudice, bias, enthusiasm and personal interest, that have so often made stop-watch time study data worthless. The fact that Mr. Barth, as he says, sees no value to the film except the accurate minute times simply shows that he fails to comprehend and appreciate the importance of the capture of the skill of the super-expert and its transfer, the educative value of finding and teaching The One Best Way to do work, and the value in building up an organization of first-class workers, so trained.

33. It was not the "direct disciples" who recognized the benefits of accurate measurement. It was one of our clients who wrote:

"The micromotion study enables us:

a. To capture the experience of the most skilled workman and record it for the benefit of all;

b. To determine the motions of least waste;

c. To teach the best known method only;

d. To analyze, measure and compare new data so that improved methods may be constantly standardized as fast as discovered.

"I believe that the time will soon come when we will have a national bureau of standards of best methods, and micromotion study will provide a means that the government can use for collecting and recording the best practice of the workmen in our industries."

34. We appreciate the attitude of Mr. Barth in paragraph 15, and can testify that he has always been outspoken with praise or blame.

35. In paragraph 16, Mr. Barth says "it did not take me long to learn to make allowances for Dr. Taylor's emphatic statement, as to the importance of the scientific study of unit times." He also speaks of Dr. Taylor's emphasis slightingly when he says that Dr. Taylor "spoke as the enthusiastic originator and reformer seeking a following."

36. We disagree with Mr. Barth, and we agree with Dr. Taylor's statement, exactly as he makes it. Dr. Taylor exhibits here, as in many other cases, an *instinct* for the correct system, even tho he did not possess the correct apparatus or understand the only method which conforms to the descriptions of his philosophy. It is because of this and other instances where the true Taylor philosophy has suffered in the hands of Mr. Barth and of many other loyal friends of Dr. Taylor, that we have written for the benefit of the young engineers a series of Management Commentaries which will be issued in the immediate future.

37. Mr. Barth stresses the point that the same operation done twice may vary in time much more than the difference between two time observations of the stop-watch timing method. Of course it will, but if the method is also recorded and all the individual therbligs are timed, it is then possible to study the unit times with due reference to the method employed and the detailed rèsult. This is what Dr. Taylor meant. If one does not get this point, then he misses that philosophy upon which, as Dr. Taylor said, "this whole system rests." Mr. Barth says that he does not take Dr. Taylor's statement about this "seriously," in spite of the fact that Dr. Taylor emphasizes this in detail in many places in his writings, several years apart. Of course it is not to be expected, then, that he will take the micromotion method seriously.

38. Mr. Barth's belief that in his own case the preparatory work has been of more value than the time studies, is doubtless justified, but such preliminary work can attain its maximum value only when it is based upon the experience of previous accurate motion studies and time studies. We have between nine and ten thousand such standards so derived, complete and ready for selection and immediate installation, unable before "subsequent time studies" are taken. These are based upon long accurate motion study and "the study of accurate times," and they bear out Dr. Taylor's statement to the letter, which Mr. Barth says he does not "take seriously."

39. In paragraphs 18 and 19, Mr. Barth defends Mr. Merrick's unscientific statistical methods. We have only to state that they are opposed by the entire statistical profession. We do not see how Mr.

Barth, the expert mathematician, can condone such procedure, when more precise methods and devices are available today.

40. In paragraphs 20-22, the comparison to a telescope and microscope is meant to be complimentary, but the feature of *permanence* of record which is so important in micromotion study is neglected. The "guess work" advocated simply shows how different one's views of one's own field and that of others are, for Mr. Barth scorns guess work in respeeding of machines. In Mr. Barth's comparison with the telescope, which we think quite irrelevant, we would call to his attention that even here the best work was not done until the astronomer used photography.

41. In paragraph 23 Mr. Barth chides us for calling attention to the secret time study of the stop-watch advocates. We persist in saying that the stop-watch is still used today in many places in the manner he disclaims. It is to the credit of the Philadelphia Section of the Taylor Society that they passed, after hearing his objection, a resolution against secret time study after our paper was discussed. The reason that stop-watch time study men are prone to use secret time study is because they do not know when the observed man is working at the proper pace, and have no way of knowing, whether or not he really is expert. They have no method for judging exhibition and demonstration speed, as compared with economic speed, because they have no fundamental correct data or norms with which to compare his records. Neither have they their records in such form that they could compare them, if they did possess such norms. Therefore, the secret time study men are continually prone to resort to "peeking thru a knothole," as it has sometimes been truthfully described with facetious intent, and to class such secret observations under "production studies," with the idea of making them more justifiable. For Mr. Barth to say that secret time study "has not been done since I became associated with Mr. Tayor," must be construed as meaning that it has not been done by him, or that he has not been in close touch with stop-watch time study practice.

42. In paragraph 24 Mr. Barth has opened a large subject when he states that the micromotion method does not necessarily imply "the consent and full co-operation of the worker." We must repeat that we always observe *the best man obtainable only*, which gives us an entirely different procedure and result from Mr. Barth's practice of not observing the "extraordinarily expert worker," which he specially warns against. The worker who does not thoroly cooperate is, therefore, of no use to us. Micromotion records are so perfect that we can instantly detect him by his variation from established norms, should we, by mistake, record a man who is not cooperating fully. This fact stands out clearly in the Simultaneous Motion Cycle Chart, which we make from the film. Regardless of what he may desire, the worker who does not cooperate cannot hide that fact from us. Obviously, the observer might photograph a worker who did not consent and who did not desire to cooperate, but neither one would be a party to it, if he could help it, for the record, when completed, would be worthless from the standpoint of finding the One Best Way to do work.

43. In the final three paragraphs of his discussion Mr. Barth criticises us for believing that efficient planning is based only on standards derived from accurate data. Apparently he fears that superstandardization will lead to rigidity. As a matter of fact, it leads to the standardization of such minute elements that we have a flexible equipment to meet the emergency, which is always expected and prepared for. It is axiomatic that the more accurate the data on which the planning is based the easier it is to keep to schedule. It is a law of statistics that the accuracy of a whole is no greater than the accuracy of its components. For further proof of the correctness of the theory we have the experience of our practice. We may say that even the blank forms used in planning and control, and the old methods of their making and their use, have invariably been found inefficient and out of date, as a result of recording and analysing the old methods accepted by management engineers, without question, before our micromotion studies of them.

44. Mr. Barth has not discussed the relative values of the two methods for purposes of teaching. He has acknowledged the superiority of our devices from the accuracy standpoint. His criticism of our methods is from the cost standpoint only, and here he has been shown to be mistaken. It need only be said here that the micromotion method does not always imply the use of film for recording immaterial happenings. The camera has two shafts for the handles, one of which takes only one picture per revolution, and such a picture can be taken as often or as seldom as desired. Besides, the multifilm pro-

vides for taking such a large number of pictures on a foot of film that the cost is negligible. Its greatest immediate merit is that it pays in actual savings. Most important of all, even to those who misunderstand, ignore or oppose it, the work has come to stand for precision, for fairness and for permanence.

REPLY TO MR. MERRICK

45. The discussion of our friend Mr. Merrick shows his usual fair spirit. In his second paragraph he sums up briefly and accurately our claims for the micromotion method, and the relative importance of motion and time records.

46. In paragraphs 3 and 4, he gives the real reason why both he and Mr. Barth underestimate the importance of the newer methods and believe the stop-watch gets results on "time data" that are "close enough." If "time data" is all that is wanted, a stop-watch probably is close enough. It certainly is close enough for those who are interested in the work only temporarily. Because Mr. Merrick and Mr. Barth have had occasion to study machine time perhaps oftener than they have handling time is not sufficient reason for their not having accurate observations showing *all* conditions, as often as they would snap a stop-watch. In answer to his argument, it is to be said that where it is desired to take observations at long intervals, such as where the handling time is but a small per cent of the total time, only enough pictures need be taken during machine time to record the conditions as they actually are, slates being photographed along with the operation, as we have already explained.

47. It must be remembered that those who know about the possibilities of savings by motion study and also those who want permanent data regarding the surrounding conditions are not looking for mere handling time data and machine time data only. Therefore, even on the rare and unusual jobs to be found only on the heaviest machine work,—and our organization has been and is working with "repeat order" satisfaction on that kind also,—there is no commercial or scientific argument for not getting better and more permanent records.

48. During the handling time the full possibilities of the micromotion method are available and ready instantly to record the combinations of motions used and the method in detail. There seems to be no excuse for substituting the stop watch on a hypothetical ninety-five per cent of the observation, as the micromotion equipment is acknowledged superior even on the hypothetical five per cent, and can furnish a continuous or intermittent, homogeneous, permanent record of the entire work process. We have jobs running today such as Mr. Merrick describes, and can furnish indisputable correct time and motion records, such as never have been and never can be furnished on any work that has been studied by the stop watch only.

49. The amount of percentage of the handling time to that of the task is irrelevant to this discussion, in any case. The argument here is on the accuracy of times, *together with indisputable records of attending conditions* at the time that the times were taken, and on the relative cost of the two methods of obtaining these. The micromotion method has been proved, in the original paper, unsurpassed in these respects, as mentioned.

50. In paragraphs 5 and 6, Mr. Merrick outlines and concedes the need for the micromotion method on highly repetitive hand work. It is true, as he states, that recording times on such work with the stop watch requires "intense application." It is to be added that such application does not insure accuracy of times and it precludes the possibility of also recording conditions, thus no method study or skill study can possibly run concurrently. The reason that stop-watch time study men have done so little Fatigue Study, comparatively, is because they have no complete records of the fatigue-causing factors which they can study leisurely. The micromotion method records rapidly performed small cycles with the same ease that it records slow work, and, after the apparatus has been set up, the observer is free and ready without distraction to study or coach the worker under observation. As we said in 1915 in a paper "Motion Study and Time Study Instruments of Precision,"[1] "No specially gifted observer, combined with the most willing and efficient recorder, can compete with it for observing and recording facts."

51. It should be remembered that more than ten million American workers have life work that consists principally of a comparatively small number of cycles of less than ten seconds each. Practically all of the skill-requiring motions of the textile trades consist of a very few cycles of less than five seconds each. In such cases, the ordinary speed of the motion picture camera is entirely inadequate

[1] "Applied Motion Study"—Chapter IV.

to record with sufficient speed the skill of the super-expert. In some such cases, we have been obliged to devise special cameras that operate as high as 115 pictures a second and then for a second time, an entirely new motion world was opened to us. A moment's consideration of any unbiased critic will result in admitting that any record of say, five to ten cycles, less than ten seconds long, that represent a life work of craft skill achieved, is warranted.

52. Moreover, we have found that micromotion and cyclegraph records may be made of mental as well as physical work,[1] which makes them essential to recording the work of a far larger per cent of workers.

53. Mr. Merrick has made no mention of, or excuse for, the reams of time study data which he has made and has not used in his book. He has made no attempt to answer our indictment sentence by sentence, paragraph by paragraph, or subject by subject.

54. We have indicated stop watch time study in general, and his methods, as representing the best of that inaccurate practice, in particular. Mr. Merrick replies to our indictment by saying he is "thoroly convinced that for ordinary practical purposes the stop watch will continue to be the most convenient time measuring device."

55. If *convenience of device* is all that one demands of records of workers, then it is perhaps quite natural to feel satisfied with inaccurate equipment, and inaccurate temporary results.

56. We have invited Mr. Merrick many times to visit us and to become familiar with our methods, and he has not as yet availed himself of the opportunity. We have enjoyed an uninterrupted friendship with him for fourteen years, have advised him as to cameras,—which he did not buy,—sent him a copy of our latest book, and indicted his methods in this paper, and we do not know what more we can do for him.

REPLY TO MR. KENT

57. Mr. Kent was, as he states in paragraph 1, the first person outside of our own family, organization and patent attorney, to be told about the micromotion process. He worked with it with us after the devices were perfected, and was, we believe, the first to appreciate the benefits of the process. He wrote, in 1912,[2] "Micromotion study is the most powerful tool ever offered the engineer to measure the efficiency of the worker." "Time study is the basis of all modern management. The provision of a machine to make time study should be as revolutionary in the art of time study as was the invention of the power loom in the art of weaving. Among other things, it absolutely eliminates the human equation. It provides a method in which there is not only no possibility of error in measurement, but which furnishes at once a true statement of the time elapsed in the performance of any operation and a record and instruction card of the best method of doing a job." And again, "Micro-motion study revealed the deficiencies of previous methods and permitted the development of the final accepted methods in a small fraction of the time and expense which would have been necessary under conditions existing before its invention."

58. Now let us analyze what he now says after nine years reflection. He states that he has "had no litle part in the preparation of Mr. Merrick's book[3]," and is "in a position to speak with some measure of authority upon both phases of the subject." In paragraph 2, he states that he has been an "ardent advocate of Mr. Gilbreth's methods of time and motion study for certain classes of work." The entire paragraph suits us to the letter, and it ends with the phrase "in a class by itself." Still he limits his advocacy by the phrase "for certain classes of work." We see in the two remaining paragraphs what classes he refers to,—namely, certain classes of *time study*.

59. Mr. Kent knows that our time study and motion study data can be used when they are "cold" just as efficiently as when they are new. We would suggest that he compare them in this respect with any stop watch time study data.

60. We would like to have him describe the various conferences where the accumulated stop-watch time study data which was collected by Dr. Taylor's "direct disciples" was reviewed by Dr. Taylor and Mr. Kent and others in 1914 and 1915, with the object of including it in a book on time study which later became Mr. Merrick's book "Time Study for Rate Setting." We should like to have him explain why voluminous time study data, such as that of the Link Belt Company and the

[1]"Motion Study For the Handicapped," Pages 93, 94, Pages 7 and 8.

[2]Transactions of the A.S.M.E. Pages 1187-1189.

[3]See "Time Study for Rate Setting." Page XIV.

Tabor Manufacturing Company, is so scantily represented—in fact is conspicuous by its absence—in this book. This is not for our benefit, for we already know in detail exactly what happened and why, but we believe that if he will state fully just why it was necessary to do much time study all over again, it will be a worthy contribution to the subject of time study, a most pertinent addendum to this paper, and a most valuable document for the young engineers entering our profession.

61. Mr. Kent will probably answer that it is neither his duty nor his place to tell this, but we feel that it is only just to micromotion study that such a fair, friendly, well informed judge as is Mr. Kent should thus open the way for impartial critics to compare and evaluate the two types of data from the standpoint of recording the surrounding conditions and the possibilities of using such data from the standpoint of permanence.

62. We will state that we have never had reason to change our original methods of recording all the surrounding conditions in the greatest detail that attend any time-study and motion-study observations, as practiced in the beginning of our motion picture experience, when Mr. Kent had his most intimate knowledge of our work. Not one micromotion study that ever has been taken is any less clear, complete and understandable today than it was in the days when it was first developed. Furthermore, these studies permit re-grouping the subdivisions of the operation in any desired manner or sequence, and give results that are fully as efficient as new studies for recording the phenomena of behavior.

63. In paragraph 3, Mr. Kent says "There is time study and time study." Now let us remember the accepted time honored definitions of time study, namely, "time study is for rate setting;"—"Time study is the art of determining how much work a man can do in a day;"—and the confirmations of these definitions in the first paragraph of Mr. Barth's discussion. We will now again call attention to the fact that the purpose of micromotion study is finding the One Best Way to do work; and that the errorless time observations are a free by-product; therefore, the balance of Mr. Kent's discussion,—all that is contained in his paragraphs 3 and 4,—must be read with the full appreciation that he is here talking only of accuracy of times, without mentioning the features of motion study and transference of skill, which he compliments so highly in his paragraphs numbers 1 and 2.

64. He is perhaps unaware of the fact that we now have various sized cameras, some of which are very small, and that we can take as few records as are desired. Some photograph on film, others on plates, and for those who desire lowest cost, we can now photograph a negative or positive direct upon the paper. Surely, in the light of his experience with voluminous quantities of stop-watch time study records, where the surrounding conditions were not recorded, and were found unusable when old, Mr. Kent is not serious in even suggesting not taking a snap shot with the micromotion apparatus as often as he would press a stop watch. Perhaps he will still say that he does not know how to develop the pictures after he snaps them. If this is the case, we will agree, as a matter of long friendship, to have our organization in our laboratory develop them at cost or, as a matter of business, we will furnish him the entire apparatus for taking, film and developing and printing complete, to make time studies, for what it costs him to do it with a stop watch.

65. As for paragraph 4, we accept what Mr. Kent says about the two-foot rule and the piece of wood, but his comparison is irrelevant because for cutting only one piece of wood, under the conditions which he describes, there would be no need to record the surrounding conditions. Furthermore, because one has a machinist's scale is no reason for cutting a piece of wood to the sixty-fourth of an inch, when the tolerance is plus or minus a quarter of an inch. He has met our views exactly, however, in his last sentence. By all means let us use "the tool best suited for the job in hand." Therefore, for temporary and guess work, where it is desired to have no data of tools used or motions, or any record of surrounding condition, we recommend the stop watch. For work where accuracy and permanence of complete records are essential, we recommend the micromotion method, it being always remembered also that we recommend taking micromotion records *of the best man obtainable only*. The skill of the super-expert is too valuable, for further use in the present and the future, to be missed. We thus secure by-products of the records, that alone more than pay for the price of the entire micromotion procedure.

REPLY TO MR. COOKE

66. Mr. Cooke labels his discussion of our Indictment "Make Time Study Open and Above Board," but he is not fully consistent. He lays stress upon Dr. Taylor's "Being absolutely opposed to secrecy in time study when the results of such study were to affect in any way the wages to be paid to the individual on whom the observations were to be made," but does not state that it is not ethical to take secret time study on any man, whether it will affect his wages or the wages of his colleagues or not. Whether it is ethical or not, the workers consider it unethical, and even the advocates of secret time study admit that it hinders hearty co-operation "when the workers find it out."

67. We know of no case where taking secret time studies is justified, whether or not it affects the group of men on which it is taken, and what is more, such time study data are quite valueless from any standpoint.

68. We are glad that Mr. Cooke agrees with us that there is no excuse whatever for secret time study under any circumstances. We are opposed to it on principle. We have never practiced it, and any instance that can show any excuse for it simply shows the inadequateness of the previous time study that it is supposed to check.

69. The existence of a vestige of desire for secret time study of any kind simply shows a complete ignorance and disregard of the possibilities of hearty cooperation of the worker combined with micromotion time study that records *all* of the details. This was one of the subjects of our first meeting and conference with Dr. Taylor, and we have continued holding our same views ever since.

70. We regret exceedingly that Mr. Cooke does not take this occasion to declare himself on the subject of the desirability of accuracy of timing and recording in such permanent form that the workers can see for themselves and understand all of the motions and surrounding conditions of these errorless times from which tasks are set for mutual benefits.

71. We are greatly disappointed that he does not express himself on the desirability of having these records in such physical shape that they can be shown to the workers, that they may receive the benefits of "education thru the eye" which they so sorely need, of the new world of knowledge regarding their crafts and skill. It can hardly be said that Mr. Cooke has not had time to make up his mind, because he saw our micromotion data nine years ago.

72. We believe that the management engineering profession ought to hear what methods are used by Mr. Cooke in solving problems of skill in millions of possible combinations and permutations of therbligs or cycle subdivisions of the five-second cycles of the garment industry. Does he attempt to find the scheme of perfection of motion of this most highly repetitive industry by means of Mr. Barth's algebraic method recommended by Dr. Taylor in 1903 in spite of its complications, and based on erroneous original times, with no accurate data on the tools used and surrounding conditions existing? Or would he consent to recommend five feet of film for study, with every subdivision recorded automatically as to tools, surrounding conditions and times obtained by merely turning the handle of the camera?

73. He apparently stands for "less mystery." There is *no mystery whatever* regarding times and methods derived photographically.

74. Mr. Cooke's discussion would lend weight if he had expressed his views on Prof. Spaeth's statement that "the stop watch is already far too accurate," and it would have been particularly fortunate if he had stated that, other things being equal, the greater the accuracy of all fundamental data, the better. We wish he had stated his position regarding the statement of Mr. Barth, who says that he does not take Dr. Taylor's statement seriously, and whether he agrees with Mr. Barth or with us that Dr. Taylor was right when he stressed the importance of "unit times" as quoted in the opening paragraph of our paper. We also wish that he had expressed himself concerning the fact that there is practically no machine work in the garment industry that has not handling time that runs concurrently with the machine time, as emphatically as Mr. Barth and Mr. Merrick emphasized the absence of high percentages of handling times in certain branches of work in an arsenal.

75. Regarding Mr. Cooke's invention of a barking stop watch, we note with much interest that his stop watch neither barked nor wagged its tail at the principal topics of discussion of our Indictment.

76. We thank Mr. Cooke for his discussion of the reference to secret time study in our paper. May we assume that he accepts all of the other parts of our indictment of stop-watch time study, since he in no wise objects to it?

REPLY TO MR. MITCHELL

77. Mr. Mitchell has shown a greater appreciation of micromotion study than have any of the other discussors. He brings out in paragraph 1 its usefulness for comparing and testing methods, a use implied in our emphasis on the importance of deriving the One Best Way.

78. We are not sure what he means in the latter part of the paragraph. If he implies that the micromotion method may be used to evaluate stop-watch data, he is quite right. It has been so used, with startling results. He must surely realize, however, the wastefulness of such a process, since the "standard time," if desired, can be derived from the accurate record of the micromotion method, thus making absolutely unnecessary the "mass of varying readings" of the stop-watches.

79. He has brought out admirably, in paragraph 2, the vital defect of stop-watch time study. As he says, the methods vary, the data are not interchangeable. "They cannot all be best." We have confined ourselves in our paper to Mr. Merrick's method, as we consider Mr. Thompson's in detail in a forthcoming paper, and as we understand our friend Mr. Knoepple no longer emphasizes stop-watch time study.

80. Of course Mr. Mitchell cannot imply that micromotion study should be only a judge of the correctness of conflicting "times."

81. In paragraph 3 he speaks of "different readings for the same element," as being a "common experience." We should say rather, *universal* experience. He emphasizes well the variety and number of possible, no, practically unavoidable, errors. As he says in the first part of paragraph 4, these errors are "concealed" from the stop-watch observer. He does not overlook them, he cannot see them, while attempting to take accurate times with the "running watch." He states our views absolutely when he advocates taking records simultaneously with all the available devices, and comparing the data. The H. H. Williams time study machine is practically the same as one we invented and discarded in 1907.

82. We have micromotioned not only the observed man at work but also highly expert advocates of the stop-watch, timing the said worker simultaneously on many operations, and demonstrated that in the matter of times alone—a small part of the micromotion record, but all that compete the stop-watch records—the resulting records have invariably made all of the stop-watch data ridiculous and pathetic.

83. If any other stop-watch experts feel that they have anything further to offer, we ask nothing better than for some member of our organization to have a chance to complete with the master of each stop-watch method.

84. As Mr. Mitchell suggests, in paragraph 5, the micromotion method is ideal for recording "before and after,"—a real measure of both behavior and results.

85. We agree with him in paragraph 6, where he says "there are comparatively few classes of work elements." In fact, we believe that there are but sixteen sub-divisions of a cycle of motions. They are called therbligs. They are as follows:[1]

1. Search, 2. Find, 3. Select, 4. Grasp, 5. Transport loaded, 6. Position, 7. Assemble, 8. Use, 9. Disassemble, 10. Inspect, 11. Pre-position for next operation, 12. Release load, 13. Transport, empty, 14. Rest for overcoming fatigue, 15. Other forms of unavoidable delay, 16. Avoidable delay.

86. Mr. Mitchell seems to be remotely groping for these in his "pick up," "put down," "drop," etc. He is quite right in saying that "these cannot be timed directly by the running decimal watch." Also he is right beyond the slightest doubt in believing that the study of them will lead to really scientific job analysis, instruction cards, times and standards.

87. We had the honor of explaining this to Prof. Mitchell at our house more than four years ago, and we regret that he still emphasizes the value of the feature of errorless timing more than the possibilities of recording the method with such perfection that it can be used for any purpose of re-examination that may come up later, including, of course, synthesizing the One Best Way to do Work.

REPLY TO PROFESSOR SPAETH

88. Professor Spaeth's discussion stands in a very different class from the others. He has none of the advantages or the disadvantages of knowledge of the history and theory of Scientific Management. He has no experience in the practice of Scientific Management. His discussion is, therefore, of importance not as an opinion as to the values of the stop-watch method and the micromotion method, but as reflecting the "state of information" or lack of information today of the highly trained physiologist and psychologist, as to

[1]These therbligs were first disclosed in the pioneer paper in any language on reeducation of the crippled soldier. See "Motion Study for the Crippled Soldier." Journal American Society of Mechanical Engineers, 1915.

the problems of modern management and their solution.

89. It must be remembered that Professor Spaeth is an expert in physiological hygiene, but not in time study, motion study, or skill study, therefore, in accordance with the time honored practice for courts of law, his opinion is to be accepted as *testimony* and not as *evidence*, and, as in all cases where one is not an expert in the subject under discussion, he must prove each statement that he makes in order to give it weight.[1] His testimony will not have weight merely because he is a recognized expert in other professions, or even because he has rendered valuable service to industry by contributions to Fatigue Study, thru the Committee of the Society of Industrial Engineers, and otherwise.

90. We must, therefore, consider Professor Spaeth's discussion on its merits as determined by measurement.

91. In paragraph 2 Professor Spaeth states that he believes that we have "lost sight of the fact that the problem of time study is not one involving extraordinary accuracy in measuring time." To which we reply that "time study" is but a small portion of the subject of our paper. Until it is realized that time study is one thing and motion study another and entirely different, it will not be appreciated that what we are discussing is a much greater problem than mere time recording. We have stated repeatedly and emphatically that *deriving the One Best Way is the chief aim of our methods*. We have stated that this One Best Way known is offered as an ideal of achievement to the learner, and used as a base line from which the improvements suggested by the workers may be measured and rewarded. We are obliged to assume that Professor Spaeth is completely unaware of the existence and uses of our Simultaneous Motion Cycle Charts,[2] which are made from data on the film, or he would not think for a moment that we place much emphasis on time records as compared with motion records.

92. Nevertheless, in such problems as that of determining in advance which of many will be eventually the One Best Way To Do Work, we must have accurate times, otherwise it is impossible to distinguish between *merit of method and, state of dexterity and automaticity* of the observed demonstrator of the proposed method, or method under consideration.

93. To illustrate, let us consider a proposed method for doing a piece of work at which the demonstrator has little or almost no practice, as compared with an existing method at which he has had much practice. The former may and often does take three to ten times as long to perform as the latter, when the proposed method is first demonstrated. A proposed method must be analyzed by the micromotion process into its therbligs.

94. In no other way can the ultimate achievable times of a new method be accurately prophesied, and the method undertaken and carried with confidence thru the learning period, until skill is achieved.

95. For definite and simple examples of this one should try writing one's name; 1—upside down; 2—backwards; 3—mirrorwise; 4—various combinations of 1—2—3. To do this simple experiment will require approximately from three to ten times the length of time which one requires to write it in the customary manner, yet the only change is the effect upon one's automaticity, due merely to the simple change of the variable, *direction of motions*.[3] A study of the times of the worker under the same condition of automaticity at work at which he is skilled, will give information as to his ability at similar and at dissimilar work. Therbligs must be synthesized from their fatigue standpoint, not their time standpoint unless under similar conditions of automaticity for all methods being tried. Therefore the stop-watch is out of the question on such work.

96. Our standards of times for individual and combinations of therbligs can then be used to furnish the times. If this were not possible we could not select the method that would eventually be the One Best Way until automaticity had been actually achieved in all methods considered. Obviously, a

[1] "The normal function of a witness is merely to state facts within his personal knowledge. An expert witness who can prove his qualification as such by special training and experience in a particular line is permitted to state an opinion or inference drawn by him based on an assumption of the truth of facts proven by other evidence.

"In all cases in which opinion evidence is admitted in a court of law it is essential that the witness should be possessed of adequate special experience and knowledge of the (precise) subject matter to which his testimony relates.

"Chateaugay Etc. v. Blake 144 U. S. 476.
American Car etc. Co. v. Thornton 183 Fed 114.
Parsons v. Syracuse etc. R. R. 133 N. Y. App. Div. 461.
Burroughs v. N. J. Gas Co. 88 N. J. L. 634,
and that the witness is specially qualified to draw a correct inference.
Feuchtwanger v. Manitoc Co. 187 Fed. 713.
Samuels v. U. S. 232 Fed. 536."

[2] See "Applied Motion Study" Pages 138-9. "Motion Study for the Handicapped" Pages 30-31.

[3] For list of variables of motions see "Motion Study," Pages 6 and 7.

hopeless task! It is the failure to recognize this point which makes re-examination of methods derived by stop-watch time study such a fertile field for possible savings. We have now hundreds of thousands of timed therbligs transferable to any kind of work where human motions and decisions are made. The achievement of books of errorless time study, transferable and interchangeable on all kinds of work, is now assured.

97. Professor Spaeth, as a psychologist, ought also to appreciate that *speed is an important variable in automaticity,* and that when a worker operates at more than a certain amount below the speed of his automaticity, his manual process is transferred from his unconscious mind to the conscious mind. Therefore, the greater the accuracy of the records of the times, and the relative times of the therbligs, the greater the value of the original data, from the *Skill Study Standpoint.*

98. It is a law of motion study that fast motion and slow motions do not and cannot occupy the same paths in space. This fact we have used as a working theory since 1885, but it was not until we had perfected the apparatus of micromotion study and the stereochronocyclegraph methods that we were able to record the amount of variation from paths of the economic speeds, the amount and effect of muscle rebound, the conscious interference of automaticity, and the phenomena of behavior in general. These data proved by exact records of practice the correctness of our general theory and practice, that one of the greatest hindrances to progress in learning the trades is the usual and customary practice of teaching the learner to begin his learning at *demonstration speed,* and then, after having acquired the ability to produce an acceptable quality together with the automaticity of such demonstration motion, expecting him to learn a different set of combinations of motions of different paths, with a resulting habit interference for the rest of his life. For example, to the observer's eye, it may appear that both hands and eyes arrive at certain locations simultaneously, and he will so record. Then, perhaps, his ear will note the sound of the motions or the use of tools, which show that the motions were not precisely simultaneous. The errorless micromotion process records the facts, and shows that if motions are ever performed exactly simultaneously it is so rarely as to be negligible. In other words, there is no such thing in motion study as simultaneity of performance of two anatomical members of the body. For practical work, variations of less than 1/4000 of a minute are considered as simultaneous. However, records can be made with any degree of accuracy desirable without extra effort and the results can be regrouped as desired.

99. The "five per cent error" that Professor Spaeth expects is enough to make data on this subject useless for finding laws for methods of least waste in learning processes for acquiring the super skill of the One Best Way. All such errors are, of course, eliminated by the micromotion process.

100. The lateness of the hands which follow in or near the paths made up of the sequence of locations of points of focus thru which the eyes have already passed is an indication of the degree of automaticity, skill, distraction and habit interference at the particular method recorded. Conversely, the lateness of the eyes, if they follow the sequence of locations of the hands, is evidence of subnormality. The quantity of time late is too small to measure with a stop-watch, and of course the relative locations of the eyes and hands cannot be determined or recorded by the stop-watch method.

101. The greater the amount of automaticity, the greater the amount of space, the greater the amount of time and the greater the number of therbligs that the hands are late, or behind time, in following the eyes, in each cycle of the operation. In fact, it might be said regarding the motions of the hands and eyes, that the amount of variation from simultaneity is an index of one's automaticity. Regarding the motions of the two hands, the percentage of therbligs begun simultaneously is an index of skill. The greater the percentage of therbligs begun simultaneously with both hands, the greater the skill.

102. We had the honor of co-operating on a problem of lateness of the lips, as compared with eyes, in reading tests made on young children of various ages. This last subject, however, can be explained best by Professor Courtis, an engineer in education, author of the Courtis Tests of Educational Methods, who believes that correct fundamental records of actual performance are the basis of all progress in education. Professor Courtis is to be congratulated on the pioneer work which he did long before his remarkable theories and practice were appreciated. Many similar problems can be cited; for example; the effects of variables on constructive imagination; the likeness of the motions of epileptics in seizures to automaticity of the skilled worker, etc.

103. These are a few typical studies that require accuracy of paths of motion in three dimensions and accuracy of timing.

104. It must always be remembered that our records of *the best man obtainable* become the norms for all such scientific investigation. Such records, taken primarily for scientific purposes, have invariably helped us to find and use the laws of motion study, absolutely necessary for teaching the One Best Way to do work to organizations on a large scale.

105. All of these facts are shown beyond argument or doubt in the Simultaneous Motion Cycle Charts. When the result is unsatisfactory the place and the cause can be located on the chart and corrected. Therefore, the determination of fundamental laws for synthesizing methods of least waste for the skilled, as well as the learning process of all manual education, demands data regarding Skill Study, which at the present time is a subject unrecognized in any college curriculum, and is not given the slightest consideration by Professor Spaeth at the time that he criticises the micromotion method. This subject must be recognized, and will be, to compensate for the trend of modern industry in specialization and standardization of the workman, and in the division of labor. This is absolutely necessary, that the underlying principles regarding the skill of super-specialized workers may be most efficiently transferred, and that the underlying principles of methods of least waste and greatest productivity may be taught a worker regardless of how small a subdivision of the whole his particular division or specialty represents.

106. In paragraph 3 we are astounded to find that Professor Spaeth says, "In my opinion the stop-watch, instead of being inaccurate, is already far too accurate." Compare this with what Mr. Barth says in his paragraph 5: "Of course, it would be preposterous to maintain that, even with a somewhat uncertain final quantity to be measured, it would not always be desirable to employ the most refined measuring device obtainable." Professor Spaeth's paper deals only with time study, not motion study. Therefore, he has missed everything that has to do with complete recording of all behavior of the super-expert to find the scheme of perfection of method of work, or perfection of method of teaching perfected method of work. If he recognized the possibilities based upon actual accomplishments of the micromotion method together with the fact that errorless times are a free by-product, it would seem possible that perhaps he could learn to use our errorless times as a base, afterward changing each of them to such degree of inaccuracy as he desires.

107. Professor Spaeth points out, in paragraph 3, what he considers the errors of stop-watch time study, and implies that the micromotion method shares in these. In our paper we endeavored to confine our principal criticism to the statistical standpoint leaving other criticism for later papers, as we there stated. That our statistical arguments do apply to micromotion study data is proved by the practice which enables us to determine from accurate data whether or not the observed worker is of the highest order, for purposes of demonstration and for permanent data. We shall not endeavor to defend the stop-watch method from his attack, but shall here discuss simply the application of his remarks to our method. It must be said, however, at the start, that by his last sentence in this paragraph Professor Spaeth shows that he does not appreciate Dr. Taylor's great invention of timing the work period and the rest period separately. This seemingly unimportant invention of Dr. Taylor's is seldom appreciated, but those who really understand the Taylor System as well as the Taylor methods are in complete agreement with Dr. Taylor's belief that this separation of the timing of work from the timing of rest is imperative for best results.

108. Delays are of two kinds, avoidable and unavoidable. They must be accurately recorded and classified. Unless they are accurately recorded and classified, it is impossible to plan for the utilization of both the periods of "avoidable delay," (therblig 15), and "unavoidable delay" (therblig 16), for the purpose of "rest for overcoming fatigue," (therblig 14). As a result the amount of fatigue allowance that can run concurrently cannot be deducted from the total amount of allowance of rest for overcoming fatigue, and consequently the correct amount of time to add to the net time of an operation cannot be determined.

109. The amount of fatigue allowance is best estimated as a percentage of the synthesized time of the work cycle. The more inaccurate the time of the work cycle, the more this inaccuracy is compounded. Nothing could be more ridiculous, statistically, than "fatigue curves" based upon inaccurately observed stop-watch time study, averaged to the fourth decimal and with no data whatever regarding the fatigue causing factors,—no statement whether the observed worker had chair, nail keg or tote box to sit on, etc. This one point alone, handled and covered to perfection by the micromotion method, should be considered

when reading Professor Spaeth's remarks on uncertainty of fatigue data.

110. The question of incentives, as introduced by Professor Spaeth, involves supplementing a study of how much a man *can* do, by a study of how much he *will* do, but the former is an essential element in the latter. Four steps are involved:

a. Find the One Best Way to do Work;

b. Identify the method so that there will be no misunderstandings as to what is to be taught or what is to be learned;

c. Determine how long it takes to do the work in accordance with the clearly defined and identified method;

d. Consider the incentives that will induce the worker to do as much as he can, and thrive, and improve in his health simultaneously.

These four steps make a dependent sequence not to be tampered with by anyone.

111. The "variability of individuals" and the suitability of jobs and men we shall consider a little later, where Professor Spaeth again refers to them. It is well to mention here that because of the fact that we observe only the super-expert or super-experts, we do not need to be reminded that it is "not exceptional experts with whom we are forced to work in practice." We observe the best there is that we may learn and that their priceless information may be put at the disposal and the use of workers of the present and the future generations. It goes without saying that the "given man[1]" will be the best obtainable of a kind that will be permanently satisfied with the job itself, or with the job as a stepping stone toward a more desirable one. He will vary as to quality according to a great many factors outside the scope of this paper. Of course he will not be expected to do as much work, or as good quality, as the best man obtainable, and a due allowance must be made accordingly.

112. We may say here, however, that while it is desirable to have each grade of work done by workers as nearly alike as possible, this is not practicable, and it is not essential, because those who are still superior to the others will earn more money, which they should. It is neither necessary nor desirable to herd workers into classes, but each should be helped and lifted as far as possible, and each should be paid for his results. If the method of least waste is taught and becomes the method at which one has automaticity, the resulting inequalities in possible performance of two workers who vary greatly in the other respects which Professor Spaeth emphasizes, simply affect the quantities of their pay. The *method* is determined by the recording of the behavior and motions of the super-experts and the task by the capabilities of the least efficient workers who are to work at that work permanently.

113. There is nothing new about this practice but it completely answers and eliminates all of Professor Spaeth's objections in his parable of the chemist. Surely no thinking man would prevent a worker from learning all possible regarding the most accurately acquired data from the super-expert, simply because workmen differ as to the amount of fatigue they acquire,—or the difference in their strenuosity, brawn and brain, or the difference in effectiveness of the same incentive. These are handled as problems of obtaining utmost skill and greatest productivity according to ability, natural aptitudes, and attainments, and utmost money according to fitness and perseverence. Because these differ greatly is no reason for confusing with them the problem of the accuracy of the One Best Way to do work.

114. Regarding the problem of incentives for workers for maximum economic effort we would call Professor Spaeth's attention to the fact that the worker's pay is a matter of definite percentages above the wages to be obtained elsewhere, on similar kind of work where the workers can take it easy. Of the amount of this percentage which ranges from thirty to one hundred per cent, Dr. Taylor says[2]: "The exact percentage by which the wages must be increased in order to make them work to their maximum is not a subject to be theorized over, settled by boards of directors sitting in solemn conclave, nor voted upon by trade unions."

115. After basic wages for work have been determined by general or local industries, the motion and time study men determine the relation of the method and quantity of output to the time and additional compensation.

116. As for the remainder of paragraph 4, in criticising "the final result" he forgets that what we are stressing is the accuracy of the micromotion method, and the accuracy of the results as obtained by the method. We did not explain this method and the cyclegraph method in our paper, both because we have explained them elsewhere, and because the paper confined itself, as far as possible, to an indictment of the stop-watch. We submitted our methods simply

[1]See "Psychology of Management," Page 152.

[2]See "Shop Management," Paragraph 32, Harper Edition, Page 25.

to show that an alternative was available that could do the work better.

117. With our method we can record skill, and we can measure degree and causes of skill. We can determine the One Best Way, and determine and measure the variation from the One Best Way. We can determine commonest pitfalls of method that handicap a worker for life. We can transfer skill from one subject to another. We do not combine unlabeled facts with unlabeled guesses into a "final result," and then claim that we have a scientific achievement. Professor Spaeth knows that any chemist of repute would scorn to make a combination such as he suggests and pretend to call his mixture accurately determined. Why should he imagine that any engineer of long experience would be less particular?

118. In paragraph 5 Professor Spaeth hints that our work is of little value in practice, where it is necessary to deal with "average" men. Perhaps the best answer to this is that we have applied it successfully for years to all kinds of men in all kinds of work. As for the benefits to the same "average workman" from studying the film, the fact that Professor Spaeth is "skeptical," only shows that he has made no intensive study of the possibilities of visual education, in general, and the actual effects of our micromotion study on the training of the worker, in particular. We must say frankly that we have no trouble convincing the workers, compared with that of convincing those who theorize about him. Besides, there is no reason to limit the worker merely to five feet of film and a magnifying glass. Five feet of a film of a super-expert, together with a magnifying glass will open the door of knowledge to anyone. The possible results are not to be doubted; they are actual. The material is at his disposal.

119. Professor Spaeth apparently is not aware of the advantages that come to the worker himself and to his associates and employer, as a result of teaching him to *think in terms of elements of motions.*

120. In paragraph 6, Professor Spaeth concedes the value of our work "as a research method and as a permanent record of the best way to do work." This is all we need. If he acknowlerges that, all that we claim for it follows, as we shall show. As for attempting "to control some of the larger errors" before increasing our refinements in one direction, it is thru these very refinements that we get the knowledge and facts to control that he advocates. This is the heart of the whole argument. The attending fatigue causing or eliminating conditions, already referred to, furnish a typical instance of the case in point. The effect on the workers from their control of analysis and synthesis not only makes all work less monotonous and more interesting, but is also educational. Education of the workers has too often and too generally been neglected. Actual practice shows that the micromotion method has done more to cause the workers to think logically and to utilize to advantage their entire fund of craft knowledge than any other one thing.

121. In paragraph 7, the importance of standardization of the *material* element is outlined,—a matter upon which we all agree. The importance of standardizing the *human* element is demanding universal attention also. By such standardization Mr. Spaeth certainly has no thought of limiting the worker's opportunity, but of studying the worker as well as his work to discover "fitness" and insure better placement.

122. The three phases of such standardization are listed in paragraph 8. The account of Dr. Martin's work in paragraph 9 is very interesting and well serves to illustrate much similar work being done in this line abroad, as well as in many parts of this country, including our own laboratory. So do the physiological tests referred to in paragraphs 10 and 11, and the psychological tests referred to in paragraphs 12 and 13. All management men are not unacquainted with such tests, as Professor Spaeth seems to think. Our testing of such psychological tests as those for the selection of candidates for training in world championship contests of typewriting, were carried out in great detail five years ago, and others as far back as 1912. The elaborate paraphernalia of such minute investigations as those being made in their laboratories by Professor Schlesinger, Professor Moede and Doctor Piorkowski,—all of which we have had the honor of inspecting at their invitations,—and their results and applications to and implications in industry, have been carefully investigated by several industrial engineers, at least, who have travelled abroad for years, as well as thru the laboratories of this country, seeking closer affiliation with investigations in the field of physiology, psychology and psychiatry.

123. In paragraph 14 is discussed the illusive character of fatigue and the power of suggestion. It is scarcely necessary to mention that such experiments would not and could not be tolerated in the industries. We agree with Professor Spaeth that the will must be studied and the importance of motivation appreciated. both in its effects on the conscious and the uncon-

scious mind. We realize the importance of investigating inhibitions, and of "releasing" co-operation. We also second most heartily his suggestion that all who study the human element co-operate, as voiced in his final paragraph. This, however, can by no possible stretch of the imagination be called an "untouched field."

124. Professor Spaeth has been exposed to the doctrine of Behaviorism so long that it is astounding that he does not recognize that both changes in manual processes and in mental processes and attitudes manifest themselves in behavior, in action. Mental processes and the resulting behavior can now be photographed. For such purposes we have used for seven years with most satisfactory success sterescopic motion pictures examined and charted at leisure, descriptions of which will be given in one of our forthcoming books. Photographing of mental processes as indicated by behavior is the special work of the micromotion and the cyclegraph methods. They were specially devised for this work, they have been developed and supplemented so that now we can obtain records that completely satisfy not only our needs in the industries, but such psychiatrists as the late Dr. E. E. Southard, with whom we co-operated for many years, and such expert psychologists and educators as Professor S. S. Colvin, whose "Learning Process" serves as a guide book in the industries as well as the schools and colleges. The epileptic specialists, such as Drs. L. D. Damon, G. Kirby Collier, W. T. Shanahan, and Dr. Arthur L. Shaw have used our records in studying the epilepsies and the National Safety Council under the leadership of Mr. Louis Resnick and Mr. S. J. Williams have used our conclusions to reduce the "irreducible minimum" in accident prevention.

125. Human standardization, if that means understanding the human element and classifying work and men so that the human element can develop, *is* the great work of today and tomorrow. But it can only take place when accuracy of devices and records is insisted upon *absolutely,* with no exceptions.

126. Human standardization is desirable only when it raises the standard; when it raises each human being to the standards above. To raise them we must first find the One Best Way and then survey their differences as to method and education. The other differences will, of course, be reflected in the payroll, as they should, and will permit the most efficient to earn the most wages. There can be no logical objection to that.

127. It may not be advisable for mechanical engineers or industrial engineers to carry this psychological discussion further. We therefore will leave Professor Spaeth in the hands of his brother psychologists one of whom, Dr. Henry C. Link, has recently written a most inspiring paper on "The Application of Psychology to Industry."[1] We quote from the opening paragraph:

128. "Psychology as applied to industry is today on the defensive, partly because industry has expected quick, concrete returns, whereas psychology could offer only piecemeal, tentative conclusions; partly because psychologists have approached industrial problems with an assurance which they were unable to realize in actual practice. On the part of business men there has been a failure to appreciate the necessary refinements of the psychological methods. On the part of the psychologists there has been a failure to understand the intricacies of industries."

129. There may still be some question whether the most desirable training consists of ***preparation in engineering supplemented by training in applied psychology*** or ***training in psychology and education supplemented by training in engineering and practical work in industry.*** Certainly we agree absolutely with Dr. Link that training in both lines is necessary. In the meantime, industry is justified in questioning the advice of those who neither understand her theory, her needs, nor her practice.

SUMMARY

130. To summarize;—the managers and stop-watch time study experts who have discussed our paper have in no wise strengthened the arguments in favor of stop-watch time study as embodied in Mr. Merrick's book, neither have they brought any criticism against the micromotion method except its alleged greater cost.

131. Professor Spaeth also has in no wise justified stop-watch time study, even from the stop-watch man's standpoint, for while they all contend that it is accurate enough, he says it is too accurate. We are glad that no engineer ever made this statement, but we regret exceedingly that every member of the Philadelphia Section of the Taylor Society let his statement go unchallenged and without dispute.

[1]Phychological Bulletin, Volume 19, No. 10, October 10, 1920.

132. We would ask here, why have these gentlemen confined their discussions to two minor points? Why has no one disputed the principal points of our paper, such as the following:—

a. That stop-watch time study is unethical in so far as it does not define clearly, and in as much detail as possible, the subject matter of the contract between the employer and the employee on which the money paid for achievement and productivity is based;

b. That stop-watch observations lack permanent value;

c. That the stop-watch does not record surrounding conditions;

d. That stop-watch time study is useless from the standpoint of Skill Study;

e. That stop-watch time study does not record anything regarding the priceless methods of the super-skilled expert, or best demonstrator obtainable;

f. That the accepted methods of the stop-watch enthusiasts for handling stop-watch data are wrong from the statistical standpoint;

g. That there is no attempt under the stop-watch method to instruct the worker regarding the details of those methods which excel his;

h. That there is no standardized procedure for synthesizing better methods under the stop-watch method;

i. That to find the One Best Way to do work under the stop-watch method is impossible;

j. That there is no realization of similarity of the practice of the stop-watch method to the "rule of thumb" practice of the old fashioned manager;

k. That with the stop-watch method there cannot be obtained any records of the "single small elements" that Dr. Taylor demanded;

l. That the laws of habit formation and automaticity, that underlie an efficient learning process and least waste in future practice, are not discovered or utilized?

133. These and many other claims regarding the deficiencies of stop-watch time study and the superiority of micromotion study have not only remained undisputed, but undiscussed. Why?

134. Perhaps we should have described the micromotion method more fully in our original paper, in order to demonstrate not only that the stop-watch method is inaccurate, but also that its use is absolutely inexcusable, because the micromotion method can do the work of the stop watch better than the stop watch can, and can also supply all the lacks in the stop-watch method. There is not space enough to discuss our methods at length here. They have been fully described.[1] The methods and the films themselves have been offered for observation and for use to our fellow managers, to the engineering profession, to education, in fact to all to whom they can be useful.

135. We have mentioned but a small fraction of the uses for complete and correct data. Such data will in the next few years more completely revolutionize methods of industrial teaching and of production than did knowledge of machine design change machinery.

136. If we have seemed to repeat ourselves unnecessarily in mentioning certain features of the micromotion method in this closure, it was because it was necessary to answer the discussors paragraph by paragraph and point by point.

137. It is not our function to judge finally between the merits of the methods, having presented ours and pointed out the differences. Neither is it our place to pronounce judgment upon the calibre of the opposition that we have received. We commend Professor Spaeth and his attitude toward accuracy to his brother psychologists. We recommend the Philadelphia Section of the Taylor Society itself for decision as to whether the Society backs up or repudiates the representatives of the Section who confirm or assume the superiority of, or justification for, the inaccurate non-method-recording stop-watch time study, and who remained seated and permitted such statements as were made at this meeting of the Philadelphia Section of the Taylor Society to go unchallenged.

138. Finally, in accordance with the decision that the Taylor Society makes on this matter, we commend the Taylor Society to the Engineering Profession, as having lived up to, or failed to live up to the second article of its own "Management Engineers Creed," which states: "The sublimest duty of the engineer is to keep the faith"—to—"remain true to his science."

[1]"Applied Motion Study," "One Best Way," "Fatigue Study," "Motion Study for Handicapped."

Professor Bob Emiliani

Please visit bobemiliani.com

GREAT article from 1925! “Executives hesitate a long while before they will actually scrap any system. A manager will not hesitate a minute to replace expensive machinery once his engineers prove to him that it is necessary; nor will he hesitate to scrap a piece of obsolete equipment, or sell an inactive machine for any price he can obtain for it; but scrap a perfectly good system -- never! He often looks upon it as a mysterious sort of possession. Why, it has been in use for years! Think of the money which has been spent to maintain it; why throw all this away? Perhaps he feels that he is competent to rule on the big questions of finance and of general policy; but system, a matter of infinite detail, the very word sends chills up and down his spine!” If we were aware of such profound wisdom 33 years ago at the dawn of Lean, would we have listened? Would we have done anything different? Or would we have ignored it, figuring "that was then, this is now"?

Why Systems Fail[1]

Ready-Made Systems and Systems Which Just Grow Up Are Seldom Efficient—An Efficient System Must Have Purpose and Unity

By ROBERT JULIUS ANDERSEN
Bowen Products Corporation, Auburn, N. Y.

EXPERIENCE has proved that if a thing is to be done efficiently it must be done systematically. Yet if there are two words which have been a curse to industry, they are *efficiency* and *system*. Some of those "engineers" who have exploited American industry have employed these words as though they mean the same thing. They have conceived efficiency as the certain result of a system, and have conceived system as red tape. Efficiency means the securing of results in the best possible way—in the least time and with the least expenditure of effort. A system may contribute to this end or it may not—too frequently it does not.

Our plants are loaded with production, accounting, cost, statistical and other systems, and many of them, at least large parts of most of them, are useless. A general manager would receive a rude shock were he to ask the operatives concerned a number of leading questions such as the following:

1. Do you believe this is a good system? A necessary one?
2. Do you think you could devise a better one?
3. What use is made of the output of your unit of the system?
4. Do all the people concerned with the system understand what they are doing and why they are doing it?

The principal reason for the failure of a system is that it does not reflect a definite purpose and a comprehensive plan. Most systems just grow up. A man starts in any kind of business. For a time he is general, captain, sergeant, private—the whole force. The business grows and he finds it necessary to secure assistants and to put on record things that should be generally done and things that should be generally understood. Not one time in a thousand does he do this with any general plan in mind—he simply jots down things as they occur to him. Before long an analysis would show that many essential things have been omitted, and many things included are unnecessary and unprofitable.

Another reason why these planless and unprofitable systems develop is because department and other unit heads are left to devise their own unit systems. These units eventually become united into a whole which operates with much working to cross purposes, duplication and waste. Generally speaking, no department head has his eye on the same goal precisely as the general manager or as other department managers. The general manager is interested in net results—in net profits. The department manager may be interested in department net profits—or he may not; he may, for instance, be interested in system for its own sake, which usually means a complicated and costly system.

Another kind of system that is likely to prove inefficient and costly is the ready-made, installed system, even though it may originally have expressed a general plan and have possessed unity—in another place. There is no idea possessing managers which retards progress more than the idea, "my business is different"; yet there are local conditions in every plant which cannot be disregarded with respect to their bearing on details of a system. The plastered-on system seldom fits, or if it at first seems to fit, it is because local conditions have been temporarily modified to fit the system. Gradually these local conditions return to their normal and it is discovered that the system doesn't work. A young tree may be shaped by tying to a stake, and sometimes such shaping is permanent; but generally after the stake is removed the tree will shape itself according to its basic characteristics modified by local conditions of soil, winds, shade and light. A tree is a living, growing thing, with dominant characteristics influenced by environment. So also is a live business.

There are four good tests of a system.

[1]Abstract of an address at a meeting of the New York Southern Tier Section of the Taylor Society, at Elmira, N. Y., April 13, 1925.

1. Does it represent a definite purpose—work towards a definite net result? Therefore does it have unity?

2. Does each element of the system play a definite part in accomplishing the net whole?

3. Is there duplication of the parts played by the various elements of the system?

4. Is there lacking any element necessary to the accomplishment of the net whole?

A simple searching test with which to begin the appraisal of a system is expressed in the questions, with respect to each element of the system, Is the action which the system requires essential and worth its cost? Is the information being compiled used and is its use worth its cost?

Executives hesitate a long while before they will actually scrap any system. A manager will not hesitate a minute to replace expensive machinery once his engineers prove to him that it is necessary; nor will he hesitate to scrap a piece of obsolete equipment, or sell an inactive machine for any price he can obtain for it; but scrap a perfectly good system—never! He often looks upon it as a mysterious sort of possession. Why, it has been in use for years! Think of the money which has been spent to maintain it; why throw all this away? Perhaps he feels that he is competent to rule on the big questions of finance and of general policy; but system, a matter of infinite detail, the very word sends chills up and down his spine!

Systems of all kinds group themselves under several distinct heads:

1. Ready-made systems installed by an outside consultant. These systems are based upon some common plan and are sometimes adapted to the needs of the organization. Usually they are either production control systems, cost control systems, accounting systems, or a system to cover all these branches. These systems must be approached with care. There are very few places where an outsider can install successfully a ready-made system. Generally the system works while it is being governed by its progenitor but as soon as it is turned over to its adopted parent, trouble begins. There are exceptions, but for every success there are countless failures. Another bad feature of this method, and one of the chief reasons for so many failures, is the fact that the management often thinks its job is done when the decision is made to have the system installed. The managers wash their hands of the whole affair and instead of giving the outside consultant the full benefit of their years of experience, they leave him to find it out the best way he can. The installation of a comprehensive system should not be a matter merely of high pressure salesmanship. Unless the management and the administrators feel that the very success of the business depends upon it, nothing should be attempted. Better to guide the ship by avoiding the known rocks than to hang up a chart and think you can read it without the aid of a compass.

Business has grown so large in some cases that the management is too far away from the scene of activity to be able to render just decisions on these matters. You cannot umpire a ball game from the grand stand; neither can you sit in an office in one city and decide the destinies of an industry miles away in another city. It has been done, is being done, and as long as it continues to be done, systems will fail. This idea of having men in charge of big jobs so restricted that they cannot act upon an original idea if it costs money without having it approved by some distant manager may sound all right, but it simply makes managers high priced clerks. A manager should manage and not simply carry out instructions. If he cannot manage, replace him; but he should manage.

2. Systems built by the organization itself as part of a complete plan properly to develop, control and execute all of the various details connected with the task of management. Systems in this category depend entirely upon the ability of those responsible for their development. If those concerned are well trained and have a good background of experience, with a knowledge of what is being done elsewhere, success will often crown their efforts. The main trouble here is that too often the organization is handicapped by a lack of regard of executives for one another. Each executive thinks the other one is "getting away with something." They are apt to underrate one another's ability, especially when it comes to decisions affecting their several departments.

At times it seems as if we suffer from the woes of specialization. Executives are highly trained in their particular phases of the business, but they are unable to think in general terms because of a decided lack of knowledge of the general principles of conduct governing all business. This lack of knowledge tends to make each think that his function is more important than any other function and this causes friction between departments. No system which is woven into many departments can survive a mass attack from the heads of all departments. Unless all believe that the system is necessary, and that it is, in part, of their creation, it will not stand up under the stress and strain of the daily onslaught. If any system is continually being picked apart by antagonistic executives it cannot fulfill its mission. All concerned should plan and create together, and someone should pass on the thing as a whole before it is started. Once started, all must work together. Each must concede something to the other. Each must be willing to pocket departmental pride for group pride. Unless the management in its entirety is a compact working unit, no system will succeed.

3. Systems built by the organization itself with advice from an outside consultant. Most systems are so developed. If a management is wise in its choice of a consultant this is an ideal arrangement. It is better if the initiative comes from the inside, better to call upon the consultant than to have him call upon you. Every profession but business seems perfectly willing to call upon outside counsel when needed. Medicine, surgery, law, art, music—all except the profession of managing—seem to sense the need for expert advice in the matter of special and difficult problems. Perhaps this lack is due to the fact that business has yet to formulate a set of laws applicable to all business. At any rate, when an organization feels the need for a closer control over some or all of its functions, that is the time to call for help. A surgeon friend of mine once asked one of the leading surgeons of America when should a patient be operated on for appendicitis. This learned man of medicine made an illuminating, terse reply: "The time to operate is when your diagnosis shows that the patient has appendicitis."

The time to call for outside counsel is when the management is satisfied that the answer to their particular problem lies partly or wholly in the hands of one who will bring a fresh viewpoint and a varied experience, one whose training and very experience enable him to do what he is required to do—act as a counsellor.

If a management contemplates a large expenditure of money for a piece of production equipment, it searches the country over for the best. I have in mind a corporation whose production manager brought to light the need for a piece of production machinery which cost approximately $75,000. This company left no stone unturned to obtain the best. They not only had bids from many companies but engineers spent several months at a cost of several thousand dollars visiting plants all over the United States. When they were ready to act, the engineering department drew up a brief setting forth every fact and figure connected with the proposition. After this, and before the order was placed, they submitted this brief to a competent consulting engineer. He visited the plant, studied the job, made certain suggestions and they placed the order. The consultant's suggestions added about $10,000 more to the cost of the machinery, but he was the means of making a considerable reduction in their production costs.

Yet many a management will install a system without any more consideration than if they were buying a bunch of letterheads—and then wonder why it fails.

4. Systems developed by department heads to handle various tasks connected with their respective departments. Such systems are rarely part of a general plan. They are devised for carrying out the various functions of individual departments. Yet even the smallest of them directly or indirectly affect some other function, some other department.

How often a department head starts some system in his department on the impulse of the moment. He finds that he is without certain information or certain facts, so he starts a system. "Get out some forms," says he. Forms are the roadbed of the railroad represented by system. On this roadbed must be laid the rails of orderly and organized procedure and over these rails passes the train of information or facts. Too often some clerk or tracer in the drafting room "gets out the forms." If every department head would spend an average of one day each month studying the systems of his department, noting how they work, whether they meet the need they were built to meet, whether the information is supplied in the proper manner, in the proper place, and at the proper time, he would learn a great deal. As long as department heads operate their branches of the business as if there were no other branches, just so long shall we have these ill-begotten systems.

5. Self-contained system units sold by organizations to buyers for limited, specific purposes, such as bookkeeping systems, visible indexes, filing systems, and so on.

This last group of systems seem at times to give us the most trouble. They are systems sold as such, to be installed intact, and very often by a salesman. With the manufacturers of these things we should have no quarrel. They are meeting a certain need and they are providing a satisfactory service where that particular kind of service is needed. But we are going too far. Some places of business look like the convention grounds of a group of equipment makers. Who is to blame for this? The seller of the system? No, the buyer. Why should any business have any particular system just because some other business has it? Why should every stores record be a visible record just because some of them are visible? Why should all time cards or job cards be of a certain kind? Why should every sales department have the same kind of maps? And so on ad infinitum. No reason whatever.

We are suffering from too much standardization in certain quarters. Companies seem to pride themselves that they have but one kind of typewriter, one kind of calculator, one kind of job ticket, one kind of stores record, one kind of control board. Just as if business had reached the point where all one needed to do would be to pick out what appeared to be the best set of systems for a business and go to it.

Too often these systems are bought without any consideration whatever being given to their maintenance cost. Too often a smooth salesman makes an executive believe that anybody can maintain them. He brings in a ponderous looking set of records or a mysterious looking machine and he proceeds to prove to us that his system is very simple.

Rarely are these systems made part of any general plan. The business that houses a statistical department where all data pertaining to every branch of the business are compiled, analyzed, and developed into real reports is generally free from this curse of all systems, but a business without such centralized departments exhibits a conglomeration of well-advertised brands of systems. Some day we shall buy the tools of management the same way as we buy production tools, and when we do, purveyors of systems are going to have a hard time. Then we shall not have selling us accounting systems salesmen who cannot do simple double entry bookkeeping; neither shall we have to listen to an army of salesmen who lack fundamental training in the particular fields in which they are trying to sell some of the tools necessary to obtain managerial results.

No system is a substitute for executive ability. No system can replace the brain power needed to man a business. No system can be a panacea for the ills of an incompetent management. Systems are nothing more than a means of giving expression to the ideas of those who manage. When any business attempts to solve its problems with systems instead of with knowledge and experience, its doom is sealed. Executive ability without system means chaos and inefficiency, but system without executive ability means disaster.

The Apprenticeship System in a Large Paris Department Store

By Julia Lesser[1] 658. 871

IN THESE days of elaborate departments of training and carefully worked out plans for the training of new employees in our large department stores, it is interesting to note that the old apprenticeship system still prevails, though slightly modified, in the large continental department stores.

At the largest department store in Paris, employing a personnel of well over 5000, and doing a business easily comparable to that of our largest New York stores, the following is the system of training new employees.

The young woman, who must be at least 16 years old, makes her application to the employment department giving information about her education and previous experience if any, the number of languages she speaks, whether she lives at home with her parents, her parents' business, etc. She must wait a minimum of two weeks, usually more, after entering this application before receiving any answer as to whether or not she will be engaged. During this time, an investigation is made of the truth of the statements on her application and an inspector is sent to observe her home and family conditions.

When she enters the store's employ, she is given a medical examination to make sure that she is strong enough for her work, and then a brief interview with the director who acts as personnel manager, in order that he may make her acquaintance. She is then placed as apprentice (the word used is "debitrice," which means literally "debtor") in a selling department. The head of the department to which she is assigned and his assistants are entirely responsible for her instruction in the ways of the store. She is assigned minor jobs in the department at first, such as

[1]Planning Department, R. H. Macy & Co., New York, now abroad studying European department stores.

Professor Bob Emiliani

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"Waste serves no good purpose; and management must learn to respect science, since, in the long run, the impact of the new method will be most severely felt on the side of management." That has not happened yet. Arbitrary management remains prevalent.

Arbitrary Management on the Defensive

What Science in Management Means to the Worker[1]

TRADITIONAL, rule-of-thumb management in industry made a fatal slip, back in 1881 or 1882, when the authorities of the Midvale steel plant, Philadelphia, permitted a young gang boss to organize his responsibilities after a fashion of his own. When Frederick W. Taylor was permitted to substitute his early beginnings in scientific analysis and organization for the older rule-of-thumb processes, industry all over the country, all over the world, indeed, should have seen that this was the beginning of the end for arbitrary rule everywhere. There was, after that—there is, now, no permanent stopping place for the scientific analyst until every item of every process in industry is understood and approved by the most adequate intelligence that humanity can produce. And arbitrary, rule-of-thumb management, wherever it persists, waits, on the defensive, the coming of the scientist.

Workers long believed that the whole incidence of the Taylor System was directed to the increase of the employer's profits. For this reason they opposed the system in many places. They should have understood—they have since found out—that traditional methods, attitudes and relationships have never specifically favored the worker.

It may even be that industrial management was first induced to accept the Taylor idea because it seemed to promise increased profits, at small additional outlay. If so, here is another proof that business men sometimes buy either more or less than they agree to pay for. Management should have been forewarned that science is not likely to give up, at any arbitrary wish or command, an unfinished task.

Those early analyses had to do with physical factors involved in specific operations. Management relished this and the workers did not—for the most part. But in those days science had no technique with which to probe any of the other processes involved in industrial operations. And, anyhow, the establishment of the scientific ideal with respect to objective factors and in the elimination of obvious wastes was not an undesirable first step. Waste serves no good purpose; and management must learn to respect science, since, in the long run, the impact of the new method will be most severely felt on the side of management.

[1]An editorial by Joseph K. Hart reprinted by permission from *Survey-Graphic*, January 1, 1925. The caption is ours.

The intervening years have provided a new technique. Analysis is now rapidly passing over from the consideration of the old physical processes to the uncovering of those many intimate moral and emotional factors which under all conditions of industry implicate the worker in his work and which help to determine, not alone his present effectiveness in his present work, but also his wider relationships to his whole environment and, therefore, his ultimate effectiveness in the industrial order and his human significance in and to the community which supports and is supported by industry. This new technique is that extension of the psychiatric approach which is coming to be called industrial psychology.

At the December, 1924, meetings of the Taylor Society, in New York City, the significance of this wider analysis was set forth by Dr. Elton Mayo, in an address on The Basis of Industrial Psychology. It is impossible to summarize that address here. It appears in full in the December number of the Taylor Society Bulletin. The spirit of it—its promise for the future of the workers and the standpoint of the emotional release of the workers and the humanization of the whole industrial complex—may be found in the following single quotation:

"Taylor confined his attention, upon the whole, to the problem of irrelevant synthesis or mistaken coordination in our muscular apparatus; there is urgent need to extend this inquiry to discover what irrelevant syntheses of emotions and ideas are imposed upon workers by indifferent education and unsuitable conditions of work. I use the term 'worker' here to include proprietors and managers as well as machine operators."

The address was characterized by one of the hearers who took part in the discussion as "the most important message ever delivered to industry in America." As applied to the content of this particular address, the statement may be an exaggeration; but as applied to its import, it was but a simple statement of fact. Arbitrary, rule-of-thumb industrial management is more and more on the defensive. When the management engineer and the industrial psychiatrist have finished their work, every rule-of-thumb cranny in the industrial world will have been cleaned and swept; every traditional and arbitrary management will have been discharged; and industry will have become, under the direction of intelligence and good will, the effective and human means by which the community provides for its inclusive economic needs and desires.

Professor Bob Emiliani

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Mary Van Kleeck was a prominent American social scientist, labor movement leader, and proponent of scientific management. "...my interest in the Taylor Society is not directed toward challenging the technical engineer to give attention to problems of human relations. I am not worried about that, because if he is a good engineer he cannot fail to contribute to human relations. I am concerned rather with the other end of the story... [to] realize how the art of management in the shop can fundamentally change those social conditions in the community. The Taylor Society can thus interpret management to the group who are seeking to construct a better community."

the individual workman of the necessary incentive to increase production. Both capital and labor are injuring themselves by squabbling over distribution instead of joining in production. The distribution struggle in Russia has ended in Bolshevism, which has reduced production as startlingly as Taylor's scientific management would increase it.

The Social Meaning of Good Management[1]

I SHALL limit my remarks to an attempt to show the significance of the Taylor Society in my own experience. This I do, not as a means of enlightening any of you, but in the hope of stimulating each of you to evaluate once more the meaning of the Society.

I was keenly interested in the discussion at the morning session in which, as in previous meetings, several speakers talked about "the new recognition" of "the human element in industry." They seemed to think that this was lacking in the first formulation of the principles of scientific management.

I should like to turn the subject completely around. My own experience began with what is called the human element in industry, and I saw it at first outside the shop in the community. In the lives of wage-earners, particularly women in industry, I saw the effects of long hours of work, unemployment, and low wages. In the search for remedies, I was led back into the causes of these conditions in the shop itself, and nowhere did I find so many questions in process of being answered as in the Taylor Society. Not the final answer but the process of discovering the answers was for me the big contribution of this group.

Those answers did not relate merely to what is called the human element in industry, conceived as a separate problem in a different compartment of the manager's desk. My interest in the contribution of scientific management to the social problems in the lives of wage earners was not solely in its emphasis upon personnel relations, but in the technical organization of industry as it affects wage earners. The constructive imagination which can spend seventeen years studying the art of cutting metals is the imagination which can make industry and all its results in human lives harmonize with our ideals for the community. That kind of constructive imagination, though it may deal with one technical problem, will not fail to envisage the whole significance of industrial management. Nor will it be content merely to increase profits. The philosophy and the procedure which it represents will ultimately build a shop whose influence in the community will be social in the best sense, because the shop and all its human relations are built on sound principles.

Therefore, my interest in the Taylor Society is not directed toward challenging the technical engineer to give attention to problems of human relations. I am not worried about that, because if he is a good engineer he cannot fail to contribute to human relations. I am concerned rather with the other end of the story. I am eager to have those people who see in the community the present disastrous results of industrial organization realize how the art of management in the shop can fundamentally change those social conditions in the community. The Taylor Society can thus interpret management to the group who are seeking to construct a better community. Membership in the Taylor Society means an opportunity to share in that interpretation.

I can illustrate in another way what membership in the Taylor Society means. I have in my mind a picture of the Taylor Society in session. A valiant member rises with tilted spear to advance upon the rest of us. He has discovered a new idea which was lacking in Mr. Taylor's formulation of principles. He hurls his challenge. I see members of the old guard sitting on the front row, and I observe over the collar the tip of a smile. The smile means: "If this young man will think a little more deeply, he will find his idea already formulated in scientific management, but we won't tell him so." For this is what the Taylor Society is for. It makes just one claim upon its members—the claim to understanding by each member for himself. To the man who asks, "What shall I get out of membership in the Taylor Society?" the answer is simply "a challenge to think for yourself and to test your thinking in actual practice." Membership in the Taylor Society does not mean simply paying dues in order to receive a bulletin and to share in other attractive perquisites of an ordinary society. It means a readiness to accept a challenge presented in the discovery and formulation of principles of management which have a lasting value because they stimulate the conflict of ideas.

[1]Abstract of remarks by Mary Van Kleeck, of the Russell Sage Foundation, at the dinner of the annual business meeting of the Taylor Society, December 4, 1924.

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EXCELLENT and INSIGHTFUL critique by Prof. Henry Hallowell Farquhar (1924). The parallels to today are remarkable. “It is folly to delude ourselves into believing that the message which we have been preaching for thirty years has reached the average or even the high grade manager. Undoubtedly also our message has not been more fully absorbed because, as Taylor himself has pointed out, the easy way is usually more attractive to the average manager. Short-cuts are particularly tempting. It is due also to the fact that we have been talking calculus much of the time when the manager is still struggling with elementary algebra. Primarily, however, I believe it is a case of psychology. Mr. Taylor himself was not noted for his tact and appreciation of the psychological elements in human affairs, and I am afraid that we have tended to forget certain principles of mass as well as of individual psychology. I am afraid that we have too often given the impression to the manager that nothing which he has or does is worth much, that we have asked him as well as his workmen to 'lose face' by expecting that he 'hack up' on matters which he cannot do without losing status, as well as by failing to give credit for good work and good suggestions where credit is due... Is it not possible for us to get our message across so that administration can distinguish the sound from the superficial?”

A Critical Analysis of Scientific Management[1]

Its Accomplishments, Shortcomings, and Future Obligations

By H. H. FARQUHAR

Assistant Professor of Industrial Management, Harvard Graduate School of Business Administration

IN PRESENTING this paper I find myself in the accustomed position of being "between the devil and the deep sea." I am peculiarly fortunate in that I am constantly being admonished as regards the Taylor philosophy of management by two groups—by one for being too "liberal," by the other for being too "orthodox"! I hope that the friendly protests I constantly receive from these groups have at least resulted in a balanced viewpoint. The following discussion is offered not primarily as a representative of any group, but as the personal observations of one who, in preparing this paper, desires to be neither modernist nor fundamentalist.

I. Some Prevalent Misunderstandings of Scientific Management

It is a little curious in view of the very considerable literature on the subject that the movement that we are discussing continues to be so persistently misunderstood. I believe we cannot do better than turn back occasionally to the fundamentals as expressed in the writings of Taylor in an effort to clear up not only what Scientific Management is *not,* but also to see what is the real essence of its philosophy. Mr. Taylor has constantly emphasized, for instance, that it is *not* any "system" or efficiency device or a new scheme of paying men, or time study, or functional foremanship;[2] that "the mechanism . . . must not be mistaken for the true essence or underlying philosophy" because "precisely the same mechanism will in one case produce disastrous results and in another the most beneficient;"[3] that "Scientific Management is *not* a theory" but that "it is the practical result of a long evolution."[4] He constantly combatted the serious and persistent misunderstanding that Scientific Management may be bought, or copied, and installed in a business in much the same fashion that a new process for making steel may be—a misunderstanding for which, as will be discussed later, I am afraid some of our own practices have been partially to blame. Mr. Taylor says: "The essence of Scientific Management consists in the application of certain broad, general principles, and the particular way in which these prin-

[1] Paper presented at a meeting of the Taylor Society, New York, January 24, 1924.

[2] Hearings before Special Committee of the House of Representatives to Investigate the Taylor and Other Systems of Shop Management, H. R. 90, F. W. Taylor's Testimony, January and February, 1912, page 1387. "Scientific management is not any efficiency device . . . nor is it any bunch or group of efficiency devices. It is not a new system of figuring costs; it is not a new scheme of paying them; . . . it is not holding a stop watch on a man and writing things down about him; . . . it is not the printing and ruling and unloading of a ton or two of blanks on a set of men and saying, 'Here's your system, go to it.' It is not divided or functional foremanship; it is not any of the devices which the average man calls to mind when scientific management is spoken of . . . I am not sneering at cost-keeping systems, at time study, at functional foremanship, nor at any new and improved scheme of paying men, nor at any efficiency devices, if they are really devices that make for efficiency. I believe in them; but what I am emphasizing is that these devices in whole or in part are not scientific management; they are useful adjuncts to scientific management, so are they also useful adjuncts to other systems of management."

[3] "Principles of Scientific Management," page 128: "The mechanism of scientific management must not be mistaken for its essence or underlying philosophy. Precisely the same mechanism will in one case produce disastrous results and in another the most beneficient. The same mechanism which will produce the finest results when made to serve the underlying principles of scientific management will lead to failure and disaster if accompanied by the wrong spirit in those who are using it." Ibid, page 28: "Most of the readers of these (earlier papers) have mistaken the mechanism for the true essence. Scientific management fundamentally consists of certain broad general principles, a certain philosophy, which can be applied in many ways, and a description of what any one man or men may believe to be the best mechanism for applying these general principles would in no way be confused with the principles themselves."

[4] Taylor says, Cleveland Advertising Club, March, 1915 (Copley I, page 348): "Scientific Management at every step has been an evolution, not a theory. In all cases the practice has preceded the theory, not succeeded it . . . . Every new element has had to fight its way against the elements that preceded it, and prove itself better." And again, (Hearings, page 1415-16): "Far from being a theory . . . the theory of Scientific Management has only come to be a matter of interest and of investigation during the past few years, whereas this type of management itself has been in process of evolution during a period of about thirty years." . . . . it is the practical result of a long evolution."

ciples are applied is a matter of entirely subordinate detail."[5]

Another fallacious idea for which no one in particular seems to be to blame (unless it be what Sheldon has called Scientific Management's "profligate pursuer, 'efficiency' ")[6] is that all one needs do to have Scientific Management is to introduce some sort of incentive payment scheme. Taylor's followers, largely without avail, have constantly reiterated his position on this point, as for instance, when he says: "Under Scientific Management the particular pay system adopted is of minor consequence, and in many of our establishments we have six different pay systems all going on at the same time . . . ."[7] He furthermore emphasized the "paramount importance" of standardization as a basis of incentive payment.[8]

So much very briefly for some of the things which Scientific Management is *not*. Although Mr. Taylor emphasized the fact that the theory and philosophy was given almost no attention until long after its development in numerous industries, it is rather significant that of all who have attempted to tell of what this movement really consists, we still turn back to Mr. Taylor for the most complete and convincing description of its theory and principles. It is important to note that his very first effort was to harmonize the interests of the workmen and the management; he gives this as the first object he had in mind when he was made foreman at Midvale.[9]

The importance in which he held the matter of mutuality of interest is made clear when he says: "Scientific Management has for its very foundation the firm conviction that the true interests of the two (employee and employer) are one and the same; that prosperity for the employee cannot exist through a long term of years unless it is accompanied by prosperity for the employer, and vice versa."[10]

As against these quotations from Mr. Taylor it is interesting to see what organized labor has to say in this connection: "It is not the mission of industrial groups to clash and struggle against each other . . . . Industry must organize for service . . . for justice to all who participate."[11]

In its essence, then, Taylor conceived the movement which he started to involve a "complete mental revolution on the part of the working man . . . and on the part of those on the management's side . . . both as to their duty to cooperate in producing the largest

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[5]"Shop Management," paragraph 290: "The principles and details which are admirable in one type of management have no place whatever in another."

In a letter to Holden A. Evans, Taylor wrote December 2, 1919 (Copley II, page 309): "The essence of modern scientific management consists in the application of certain broad general principles, and the particular way in which these principles are applied is a matter of entirely subordinate detail . . . . . As you know, I personally believe that certain methods of applying these general principles are better than others . . . . this, however, I look upon as entirely subordinate to the general principles and among those who have succeeded me in the business of introducing Scientific Management, there is not one who uses the same methods in any two successive establishments. The methods must in all cases be, to a considerable extent, modified to suit the special conditions and needs of each establishment."

Taylor at Cleveland Advertising Club, November 3, 1915 (Copley I, page 348): "All the men that I know of who are connected with Scientific Management are ready to abandon any schemes, any theory, in favor of anything else that can be found that is better. There is nothing in Scientific Management that is fixed."

[6]*Bulletin of the Taylor Society*, December 1923, Vol. 8, No. 6, p. 209.

[7]Taylor says (Harvard Business School Lecture): ". . . the average manager quite firmly believes that the whole art of managing men practically consists in the adoption of one or the other of these pay systems. Under Scientific Management, however, the particular pay system adopted is of minor consequence, and in many of our establishments we have six different pay systems all going on at the same time, each one having its especial advantages under certain conditions and at certain stages in the development . . . ."

Furthermore in the "Principles of Scientific Management," page 34, Taylor writes: "Under Scientific Management . . . . the particular pay system which is adopted is merely one of the subordinate elements."

And in "A Piece Rate System," paragraph 53, we find: "Whether cooperation, the differential plan, or some other form (of incentive payment) be chosen . . . . there are certain fundamental facts and principles which must be recognized and incorporated in any system of management, before true and lasting success can be attained, and most of these facts and principles will be found to be not far removed from what the strictest moralists would call justice."

[8]"Piece Rate System," paragraph 54: ". . . . not the least of the benefits of elementary rate-fixing are the indirect results."

And in paragraph 76: ". . . the rate-fixing department has shown the necessity of carefully systematizing all of the small details in the running of each shop . . . . These details which are usually regarded as of comparatively small importance, are of paramount importance in obtaining the maximum output, and . . . . require the most careful and systematic study and attention in order to insure uniformity and fair and equal chance for each workman."

[9]"Principles of Scientific Management," page 52-53: "Soon after being made foreman . . . he (F. W. Taylor) decided to make a determined effort to in some way change the system of management so that the interests of the workmen and the management should become the same, instead of antagonistic."

This attitude is further reflected in the opening sentence of the same book: "The principle object of management should be to secure the maximum prosperity for the employer, coupled with the maximum prosperity for each employee."

[10]"The Principles of Scientific Management," p. 10.

[11]Resolutions adopted at the October, 1923, meeting of the American Federation of Labor, held at Portland, Oregon.

possible surplus and as to the necessity of substituting exact scientific knowledge for opinion . . ."[12]

He summarized the duties of the management in his four well-known "Principles": (1) the development of a science, (2) the scientific selection and development of the workmen, (3) the hearty cooperation with the men, and (4) the division of work and of responsibility between the management and the men.[13]

As a result of Mr. Taylor's vision expressed in these excerpts, and in the light of the best development of these principles in practice today, I believe that we can briefly summarize some of the significant viewpoints which distinguish this movement. I believe there is coming to be a better understanding that Scientific Management rests upon the viewpoints:

1. That business is organic, no part of which can function to best advantage until all parts function to good advantage;

2. That thorough standardization and scientific methods throughout the whole business are necessary for organic control, that management must be based so far as possible on facts, and that ignorance leads to more harm than does malice;

3. That the interests of the employer and employee are mutual; that, as Mr. Taylor says, the principal object of management should be to secure the maximum prosperity for employer and employee; that this viewpoint requires a change in mental attitude and a belief that employees cannot be tricked or driven into working efficiently, but that they must be carefully selected, trained in their jobs and fitted to the highest class of work of which they are capable, and that they be promoted on merit;

4. That the management must take the lead in bringing about proper conditions and mutual helpfulness;

5. That lasting development must come from within the organization; that Scientific Management cannot be "installed" from without; that outside assistance is often desirable, but that any outsider can do absolutely nothing unless the heart of the management is in the work, because the success rests absolutely on the management; that Scientific Management cannot remove the need of big men, but can make a little manager bigger and add permanence to the business.

6. That development must be democratic; that the road to opportunity must be kept open; that promotion must rest on proved ability backed by adequate records; and that sound methods will bring pressure to bear upon the management for the proper exercise of its functions;

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[12]"Hearings," pages 1387-89: "Now in its essence, Scientific Management involves a complete mental revolution on the part of the workingman engaged in any particular establishment or industry . . . a complete mental revolution on the part of these men as to their duties toward their work, toward their fellow men, and toward their employers. And it involves the equally complete mental revolution on the part of those on the management's side—the foreman, the superintendent, the owner of the business, the board of directors—a complete mental revolution on their part as to their duties toward their fellow workers in the management, toward their workmen and toward all of their daily problems. And without this complete mental revolution on both sides Scientific Management does not exist. That is the essence of Scientific Management, this great mental revolution."

Continuing, he says: "The great revolution that takes place in the mental attitude of the two parties under Scientific Management is that both sides take their eyes off of the division of the surplus as the all-important matter, and together turn their attention toward increasing the size of the surplus . . . They both realize that when they substitute friendly cooperation and mutual helpfulness for antagonism and strife they are together able to make this surplus so enormously greater than it was in the past that there is ample room for a large increase in wages for the workmen and an equally great increase in wages for the manufacturer. . . . . It is along this line . . . . . . of the substitution of peace for war; the substitution of hearty brotherly cooperation for contention and strife; of both pulling hard in the same direction instead of pulling apart; of replacing suspicious watchfulness with mutual confidence; of becoming friends instead of enemies; it is along this line, I say, that Scientific Management must be developed.

"This change in the mental attitude of both sides toward the "surplus" is only a part of the great mental revolution which occurs under Scientific Management. I will later point out other elements of this mental revolution. There is, however, one more change in viewpoint which is absolutely essential to the existence of Scientific Management. Both sides must recognize as essential the substitution of exact investigation and knowledge for the old individual judgment or opinion . . . .

"These are the two absolutely essential elements of Scientific Management."

[13]"Hearings," page 1393: "These new burdens and new duties assumed by those on the management's side are so unusual and so great that they are to the men used to managing under the old school almost inconceivable. These duties and burdens voluntarily assumed under Scientific Management by those on the management's side, have been divided and classified into four different groups and these four types of new duties assumed by the management have (rightly or wrongly) been called the 'Principles of Scientific Management.' "

These principles, or duties, he states as ("Principles of Scientific Management," page 35): "*First;* They develop a science for each element of a man's work, which replaces the old rule-of-thumb method. *Second;* They scientifically select and then train, teach, and develop the workman, whereas in the past he chose his own work and trained himself as best he could. *Third;* They heartily cooperate with the men so as to insure all of the work being done in accordance with the principles of the science which has been developed. *Fourth;* There is an almost equal division of the work and the responsibility between the management and the workmen. The management take over all work for which they are better fitted than the workmen, while in the past almost all of the work and the greater part of the responsibility were thrown upon the men."

7. That development must be based on principles, consciously, continuously and consistently enforced through *sound methods*.

Scientific Management is not "simply common sense"; neither is it simply the scientific method applied to the management of industry. Both of these definitions leave out of account the "mental revolution" and the mutuality of interest so constantly stressed by the founder of the movement. I believe "Scientific Management" at its best comes pretty close to being the golden rule made operative in industry through the scientific method.

II. Positive Contributions of Scientific Management

In setting down as impartially as I can what I believe to be the principal contributions of Scientific Management at the present time, it would, of course, be folly to claim any monopoly of effort along constructive lines for the movement as a whole or for any business operating under its principles. These cases are simply illustrations of what may be accomplished along so many lines, by a policy of conscious and continuous taking thought of the numerous economic and social factors which make for permanent success, and of coordinating these elements into a rounded, balanced management.

A. Original Contributions

The outstanding accomplishments of Mr. Taylor and his associates are well known and require only a reference. His revolutionary invention of high speed steel has had a profound effect on all metal-cutting establishments; as a result of long investigation we have the standard shapes of tools which are in everyday use in all well-run shops today, the marvelous slide rules devised by Mr. Barth, and the modern automatic tool grinder. As part of his early work also came the standardization of belting care and maintenance which constitutes best practice up to the present time. The present sharp line which well-run plants draw between planning and performance is a direct outgrowth of his later work. His instructional or functional form of organization, found in such wide use today, is a direct heritage from his early insistence on making the work of the management more effective. Over thirty years ago he devised a cost system which, with slight modifications, has not suffered in comparison with the best along this line that we have at the present.

Some of the significant contributions, as outlined in a paper by the present writer in 1919,[14] will be briefly summarized, but reference must be made to that paper for a more extended discussion of each of these contributions than is possible here.

1. The Mechanical or Impersonal Aspects

a. Increased Production

By far the most striking single fact as regards the results of Scientific Management is the very considerable increase in production it has effected with the same equipment and personnel. And this result has not been always secured, as might be assumed, from plants that were near the lower level of efficiency before the development took place.[15]

Of the various means by which Scientific Management increases production and decreases cost, some—such as the selection, fitting and training of the workers, the reducing of labor turnover, absences, lates, etc., the determining and securing of a proper day's work and the paying of a correspondingly increased wage—are distinct economic gains in themselves. These will be indicated under the human factors. Others, however, only indirectly related to questions of personnel relationship, merit mention here. Among the most important of these are:

(1). The *more effective utilization of equipment*, a use greatly stimulated by Mr. Gantt's admirable idleness charts showing as accurately as may be the cost of each different kind of idleness;

(2) The *more effective use of labor* through scientific man and job analysis and the devising of better methods of work;

(3) The *strict regulation of materials* through simplification and standardization, and through methods of control of material activities;

(4) More accurate *routing*, including both the physical layout and the administrative control of work in process; and finally,

(5) The *regulation of industry*. Perhaps nowhere

[14] *Quarterly Journal of Economics*, May, 1919, reprinted in *Bulletin of Taylor Society*, October, 1919, Vol. 4, No. 5.

[15] Besides the desire for increased production there has also been the determination to establish a more scientific and therefore more lasting basis for the management of industry, and to bring about better industrial relations. When speaking of increases in production, it must be remembered that a simple increase in production with accompanying decrease in a cost which was hitherto higher than it should reasonably have been, is not entirely satisfactory—it is only erasing the negative and getting back to par, as it were, but failing to add a plus. Where the increase in production and the decrease in already reasonable cost go hand in hand, however, as is characteristic of plants run under Taylor principles, the gain is direct and indisputable.

better than in the elimination of seasonal production and its attendant evils is the fact illustrated that what is of permanent benefit to the management also benefits the workmen, and vice versa. That seasonal variation in many cases is not an unpreventable waste has been amply proved by those industries which have attacked and eliminated the evil.

b. Improvement in or Maintenance of Quality

Scientific Management has pretty conclusively shown that as between speed and quality there is not only no intrinsic irreconcilability, but indeed that with intelligent handling an improvement in quality has usually accompanied increased speed. Just why this is so may be left largely to the psychologists—we are dealing simply with the abundantly proved fact.

c. Speedy Production and Accurate Delivery

The firm which can accurately predict and rigidly maintain delivery dates is not only in an enviable position from the buyer's standpoint, but may claim a distinct contribution to itself, to the buying public, and to the community at large. This control, characteristic of the properly managed plants, constitutes a decided antidote to the tendency for ever-increasing costs of living.

d. The Power and Stimulus of Knowledge

As a final consideration under the industrial or non-human aspects comes the confidence, the sense of security, the power and stimulus which spring from the knowledge that we have real control of our business through the ordered regulation of its activities according to adequate knowledge and best practice.

2. The Human Factor

Important though it be for the country at large that we have high production and low costs, that we establish a strong industrial basis, it is of greater importance that while we are making *things* we do not forget that our first and infinitely more important duty is the making of *men*—making good citizens.

a. Industrial Peace

The fact seems to be that in scientifically managed plants there has been remarkable freedom from the turbulent and distressing manifestations of industrial maladjustments characteristic of the last few years. This absence of labor trouble is due undoubtedly to a combination of causes; to a spirit of cooperation—the "mental revolution" which is such a vital part of Scientific Management; to fair dealing; to a proper work environment; to a spirit of democracy; to increased individual production; to high wages unaccompanied by over-exertion; and to a feeling on the part of the employee that his best interest is being and will be looked after. It is due indeed to all these factors; it is inclusive of them all.

This fact is of pre-eminent importance at the present time. The bringing about of industrial peace in its establishments is unquestionably *the greatest* contribution of Scientific Management.

b. High Wages

Increases in the earnings of operatives working under Scientific Management are too common and well known to need repetition.

c. Proper Working Hours

Mr. Taylor was one of the first to recognize and to prove the fact that overlong working hours are not conducive to high output, and that in very many cases hours of work may be sharply decreased up to a certain point and output increased simultaneously.

d. Conditions of Work as Related to the Health and Well-Being of the Worker

Looked at from the entirely personal, selfish, financial aspect, there can be no question that the very best condition of the employee is the very best condition for the owner of the business. That the owners and managers of plants under Scientific Management primarily and continuously have the best interests of their people at heart—not from any ulterior motives, however, but because they are "that sort of person"—I believe can be doubted by no one who will take the trouble to visit them and their employees.

There is another phase of this question, however, which is of much greater importance in that it affects the workman during his entire life as a productive member of society. This is the determination, through time study and allowances for rest and necessary delays, of "the best day's work that a man could do, year in and year out and still thrive under." It is significant that the first "fatigue study" ever conducted in a really scientific manner, so far as the writer's records show, was performed over thirty years ago by Mr. Taylor as a part of his determination of a proper day's work.

In closing the discussion of this particular topic, it may be stated that, in spite of the oft-expressed fears that the so-called "speeding-up" would result to the immediate or ultimate detriment of the worker, no authentic case of anything but beneficial results of high individual production has been brought to light.

e. Selection, Fitting and Training

It would be difficult to overestimate the advantage both to the individual and to the nation of a condition where each person could be engaged, under conditions satisfactory to him, upon work for which he is naturally best fitted.

In plants run under Scientific Management, committed as they are from early days to a policy of "scientifically selecting, training, teaching and developing the workman," it is the customary thing to find operatives who are now doing excellent work on their third, fourth, or even fifth trial after having previously been unsuccessful at work for which even they originally thought they were best fitted. We naturally expect to find, and do actually find, numerous cases of promotion from the ranks.[16]

f. Free Scope for Individual Initiative and Opportunity for Advancement.

The criticism has been made that in working under the highly standardized conditions and detailed instructions that Scientific Management insists upon, there can be little chance for the exercise of one's individuality. This accusation is true in that we do not let a novice tamper with a new and delicately built mechanism until he proves that he has mastered it.[17]

It is not individuality and initiative run wild which is really constructive; it is intelligently applied individuality, and prerequisite to this is an understanding of things as they are and how they have come to be what they are.

So far from killing the right kind of initiative, Scientific Management plants are promoting individual initiative in the truest and highest sense—the intiative of the enlightened type of workman. The oft-quoted criticism that under Scientific Management the worker's job is monotonous, overlooks the fact that monotony is due not so much to the unvarying repetition of recurrent operations, as to the accompanying feeling that the work holds no future possibilities. The consistent policy of promotion from the ranks has done much to make every workman feel that he has a marshal's baton in his knapsack. Instructional (or functional) foremanship opens up avenues for advancement to others than the exceptionally gifted workman.

g. Reduction of Labor Turnover

Much of the restlessness in industry is curable. It is caused by the existence of unsatisfactory conditions in just those features of management discussed in the preceding topics—too low wages, long hours, poor working conditions, lack of proper selection, fitting and training, and to a conviction on the part of the employee that for him his present job in his present place offers no future. Naturally, therefore, with the removal of the causes in any particular place the evil itself largely disappears. This has been the experience in numberless plants which have adopted advanced measures more or less completely.

h. Spirit of Cooperation and Confidence and Feeling of Security

As a result of all of the positive products of advanced management enumerated above come the last and most important of them all. Indeed, so important are the spirit of cooperation and confidence and the feeling of security on the part of the whole personnel that nothing should be allowed to undermine them; for without them, although a certain *efficiency* may be obtained, *true Scientific Management* is impossible.

Cooperation may be obtained only by securing the *confidence* of those with whom we deal, and this confidence in turn results only when each man feels *secure* in the belief that he is in the best possible place for him and that he need have no fear for the future so long as he fully plays his own part. Only when the management really assumes its full share of the work and the responsibility may his confidence be secured. And only through making this security and this confidence an actual fact has Scientific Management been able to produce what it so highly prized and what it has so remarkably obtained—true cooperation.

B. Refinements in Technique

There are some significant advances which have been made during the last few years which can be referred to only briefly. Since progress has been rapid and widespread, the following list of accomplishments must necessarily be incomplete.

1. Cost Methods

Mr. Taylor's early work set up admirable means for the collection of costs and the distribution of overhead

[16]Starting with the original instructional foreman inappropriately called the "Disciplinarian," now developed into the modern functionalized Employee's Department (known variously also as the Personnel Department, the Labor Department, the Employment Department, etc.), there is set up not only a means for bringing to pass such conditions as those described above, but also the means to establish and maintain a more intimate personal touch between management and men, and to sit in judgment over the employee on the one hand and the management on the other—acting as buffer, as it were, between the two. The very recent widespread adoption of this safety valve is a decided step in the right direction.

[17]As Alexander Meiklejohn says ("College and the Common Life," *Harper's*, November, 1923): "Let it be understood among us that no man has a right to any opinion on any subject unless it rests upon the best thinking which we have upon that subject."

expenses.[18] Mr. Gantt emphasized strongly the desirability of ascertaining that part of expense of operation which was due to idleness of various causes. The result has been that in the last few years much attention has been given to the establishment of "standard costs" or standard rates for overhead distribution. In fact, I question whether the pendulum has not swung too far in this direction in that the actual cost is too often disregarded by simply taking the difference between actual and standard directly to Profit and Loss. I feel that Mr. Taylor himself would have heartily approved of setting up a normal or standard overhead rate, but that he would have most emphatically condemned our using the resulting theoretical cost figures alone without being able to compare them with the facts—the actual cost of the product, including all expense of turning that product out.

2. Organization

What seems to me to be one of the really significant developments is that made by the Joseph & Feiss Company in functional organization. Among other valuable features, this organization is tied absolutely to the cost classification so that the expense of performing each function is definitely tied to the man responsible for that function. It is hoped that this matter will be the subject of a future paper before the Society.

3. Fatigue

The publication in 1917 of Merrick's articles on "Time Study for Rate Setting" (followed later in book form), with the fatigue allowances presented, can by no means be overlooked as a distinct addition and extension of Mr. Taylor's pioneer work in the study of rest and delay allowances.

4. Executive Reports

Much remains to be done in the field of executive reports, both as to subject matter, form, and period of time covered. There are two noteworthy developments which must be mentioned here: one, the admirable administrative guide called the "Progress Chart," devised by Mr. Gantt; the other, the advanced thinking presented in a paper entitled "A Technique for the Chief Executive" presented to the Society in 1921 by John Williams.[19]

[18]This distribution was such as to load all expenses of running the business during a given period on all products made during that period, the variations from period to period being ascertained and watched by means of shop and general expense rates worked out currently.

[19]Printed in *Bulletin of Taylor Society*, April, 1922, Vol. 7, No. 2.

5. Control

We are familiar, of course, with the refinements of control worked out by Mr. Barth and Mr. Babcock at the H. H. Franklin Manufacturing Company. I am not sure that the latter gentleman has not at the Holt Manufacturing Company out-Babcocked himself in securing a degree of control that seems to come pretty close to the ultimate goal. With Mr. Babcock's permission I quote from a statement on this subject which he gave me under date of December 29, 1923:

> A significant fact which should be noted in connection with the results of scientific management at this plant is the absolute control and regularity with which our product is produced. For a period of 496 working days, starting with March 13, 1922, up to the present time, our shops have not failed in one instance to bring through exactly the number of units of product which were scheduled to be finished on each of the 496 working days.

6. Adaptation of Methods

As is pointed out later, one of the most serious shortcomings of which we as a group are guilty is an over-readiness to accept as suitable, under a wide diversity of conditions, methods which have proved satisfactory in one or more instances. I am glad, however, to record the fact that a distinct advance has been made in the last two or three years; first, in analyzing the particular situation in hand, and second, in devising methods to meet that situation.

C. Application to Broader Fields

This record would be incomplete without referring even very briefly to the significant extension of Taylor principles to fields outside of production proper. Probably as fine an example of Scientific Management as we have today is to be found in the non-selling departments of the Jordan Marsh Company of Boston, Mass. Should the members of this Society have an opportunity to investigate that development I am sure that they would be struck with the extent to which the principles, and even the detailed methods, with which they are familiar in a factory, have been applied to a department store. The work which has reached such a high plane in this firm is being extended in several other similar establishments. Similarly, the managements of general offices in manufacturing plants, and banks, etc., particularly as regards layout and office procedure, are being reorganized in several instances in accordance with the principles found so effective in the factory.

It would be impossible in the space available to give due praise to the splendid development of the principles and methods which such firms as the Dennison Manufacturing Company, and the Joseph & Feiss Company have made in the selling ends of the business. I believe the leadership which a few of these firms is showing in the field of distribution is destined to have a profound affect on American industry.

A significant line of development also is experienced in the maintenance department of a large eastern mill. Gratifying savings in cost of actual repairs as well as freedom from breakdowns have been made through careful inspection, through standardization and advanced planning of all maintenance work so far as it can be foreseen, through elementary time study, and through the payment of bonus.

Reference should here be made to the widespread adoption of budgets and quotas as simply an extension of the general principle laid down in "Shop Management" of setting up standards and of measuring actual performance (whatever form it may take) against such standards.

Reference has been made to the early efforts of Scientific Management plants to regularize production. It is gratifying to note that these attempts have been followed up and extended to cover the span of the business cycle.

Following the extension of the principles of Scientific Management to the selling end of several businesses, has come the effort, as yet scarcely under way but destined to receive increasing attention, to raise the level one stage higher by extending the same principles to the control of the total activities of the business. This attempt to coordinate sales, production and finance, coming to be known as "master planning for balanced management," is occupying much attention today in progressive firms.

D. General Influence on Industry

Mr. Taylor as early as 1895 said:

> This system of management will be adopted by but few establishments, in the near future at least, since its really successful application . . . . involves such thorough organization that . . . . but few manufacturers will care to go to this trouble until they are forced to . . . .[20]

Although this prophesy regarding the number of establishments has been borne out, nevertheless the influence of Taylor philosophy on industry has been tremendous. Many organizations which would be very loath to admit it, show unmistakably the influence of this movement. The growth in numbers of really scientifically managed plants has been slow, but what is of much more importance, there has been a growth, and this growth has been entirely healthy and permanent.

1. Although some other "philosophies" of management can claim many more original converts, nevertheless the plants which have really achieved true Scientific Management almost without exception are running along as merrily today as they were five, ten, or twenty years ago, while the examples of these other systems existing today are exceedingly rare. The object lesson of this permanence resting upon thorough conversion has not been without its effect on industry generally.

2. This permanence is particularly striking in view of the readjustment period since the war. The present writer raised the question just prior to the depression as to whether the methods or even the principles of Scientific Management would not have to be very closely scrutinized and possibly materially modified during the coming years of a declining market. Rather extensive investigation, both personally and through correspondence, has revealed the gratifying fact that these principles have in no way been found wanting, and that in most cases not only the principles but the methods used have stood up together with altogether healthy refinements and modifications made to adapt them to changed business conditions.

3. Scientific Management has affected industry generally by pointing out the only known method of attempting even a partially satisfactory solution of wage problems, that is, by making a sharp distinction between the *amount of work* and the *amount of pay* for that work. Only through a determination of a standard output may industry be assured against a disproportionate increase in the cost of living due to possible decreased production with increased wages.

4. Another significant influence has been the lesson pointed out so forcibly that it is the little things which produce profits. Seldom can dividends be paid out of revolutionary inventions — they must ordinarily come through constant attention to what someone has called the "tremendous trifles."

5. Possibly the greatest effect, although as yet not very widespread, is the emphasis which Scientific Management has placed on the responsibilities of the management as against those of the workman. It has been shown conclusively, I believe, that it is the *management's duty* to bring about thorough standardization and accurate planning and control before asking the

[20] "A Piece Rate System," paragraph 89.

workman through an incentive method of payment to exert himself toward increased production.

6. Finally, the general acceptance on the part of the average manager of the desirability and place of the scientific method in the management of business has been particularly noticeable during the last few years. It is true that many managers still shy at the word "science," and it is true that we have as yet barely scratched the surface in the application of the scientific method to industry, particularly as regards departments other than the shop; but the entering wedge has been driven, and as Professor Sederholm of Finland has said:[21]

> . . . . Industry . . . . has not yet advanced beyond the Mesozoic stage, but the time will soon come when people will regard shops without a planning department of sufficient size, shops where hundreds of laborers are managed by half a dozen of engineers and foremen, with the same wonder as is felt by us when we look at the skeleton of a *Diplodocus Carnegie* with its gigantic body and almost microscopical brain.

III. Neglected Opportunities

It has previously been stated that it would be improper to claim for the Scientific Management movement any monopoly of effort and accomplishment along many of the various lines indicated previously, although this movement has always been at the front of new developments. In considering what seem to me to be some of our neglected opportunities, I wish also to state that Scientific Management as such must not be blamed because it has not completely solved partially unsolvable problems. It must be remembered that many of the unsatisfactory conditions under which we work today are heritages of an age long past. The problems and ills of the individual due to the massing of workers, the economic dependence of the employee on the employer, the specialization of process and the minute subdivision of labor have not, as is sometimes intimated, been brought on *by* Scientific Management. They are inherited problems and abuses with which, in common with other agencies, Scientific Management must deal. The following queries are therefore raised, as to whether Scientific Management has made as aggressive an attack on these bigger problems as it might have. The attempt will be made to deal only with those features which we can remedy or at least strongly ameliorate, and which, therefore, will be of concern to any group interested in the future of the movement.

A. The Art as Distinct from the Science of Management

Oliver Sheldon has forcibly brought out[22] the distinction between "operative sciences," which embody standards of procedure with respect to different kinds of processing, the "managerial sciences" or the sciences of putting these standards into operation, and the general administration of an enterprise. He further brings out very clearly the fact that while there may be a considerable managerial science, there is without question much in management that must remain an *art*. There must still be required the skilful exercise of human faculty, since there can be no science, for instance, of cooperation—cooperation rests not on scientific but on ethical principles. I believe Sheldon has done a real service in putting this viewpoint before the Society and that because we have not sufficiently recognized these distinctions in practice, we have fallen into a number of serious errors.

I wonder whether we have given sufficient weight to the question of personality in management; I wonder whether we have not tended a little too strongly to establish scientific methods, to tie these together into a logical "system," and to rely on this oftentimes beautifully designed machine to accomplish our objects, forgetting that such a system, just as is the case with any other system or mechanism, requires human direction and control?

I wonder if we have sufficiently realized that, in order to live up to Mr. Taylor's ideals, the need of real leadership is even more necessary than under the older types of management; I wonder whether on the contrary there has not been a tendency to employ too cheap clerks at certain strategic positions in the organization, trusting that the carefully outlined procedure would make up for their lack of leadership and personality?

I wonder whether, with our admirably proper insistence on considering each individual as an individual, we have not obscured the possibility of making that individual and his fellows more productive and more contented through recognizing the psychological benefits to be gained through group dealings?

I wonder whether we have considered the question of fatigue from a too coolly scientific viewpoint?

B. Labor

Many of us feel that it is unfortunate that Mr. Taylor expressed himself so frequently and so forcibly

[21]Copley, II, page 126.

[22]*Bulletin of Taylor Society*, December, 1923, page 210.

on the question of soldiering, and that he emphasized the profit motive on the part of the workman almost to the exclusion of other instincts and motives in life in which at heart he knew every workman is interested. This attitude on the part of the leader I fear has been too largely inherited by his followers. I believe it is true that the average American workman is not inherently lazy, but on the contrary is delighted to put forth his best efforts in production and in cooperation where he can be even reasonably assured that the management is doing its own part and that it really has his best interests at heart. Have we had the dollar so firmly fixed before our own eyes that we have assumed that the workman is similarly constituted, overlooking the workman's pride in workmanship, his logical desire to retain what he considers to be his own tools of livelihood . . . his trade secrets . . . and his desire to be a regular fellow in his own group? I wonder if we have sufficiently remembered Mr. Taylor's admonition:

> The principles of Scientific Management must rest upon justice to both sides, and it is not Scientific Management until both sides are satisfied and happy.
>
> Now if the mechanism . . . of Scientific Management . . . is used by unscrupulous people, it is not then used under Scientific Management; it may do a durned lot of harm.[23]

Can we honestly say with Mr. Taylor:

> . . . if the results of my work were merely to increase the dividends of the manufacturing companies, I certainly should not devote my time to this object. Scientific Management is for me, then, primarily a means of bettering the condition of the working people.[24]

I wonder whether we have sufficiently realized that to get real cooperation on the part of all of our people it is desirable to give them the psychological appeal of at least some stock ownership in the enterprise? Experience has proved that stock ownership by the employee has a tremendously beneficial effect upon the management. Incidentally, I wonder whether we have considered also our obligation to the public at large, whether Mr. Taylor's comment given below does not apply with considerable force even today:

> Most of us see only two parties to the transaction, the workmen and their employers. We overlook the third great party, the whole people, the consumers, who buy the product of the first two and who ultimately pay both the wages of the workmen and the profits of the employers.[25]
>
> The rights of the people are . . . greater than those of either employer or employee.[26]

C. Organized Labor

Scientific Management has to date neglected its opportunities and obligations to organized labor. There are many indications that organized labor's attitude and cooperation with managers in the application of the principles of Scientific Management have changed for the better. We should, however, show more readiness to meet organized labor half-way in a constructive program, and also aid by combating in a helpful non-antagonistic spirit the uneconomic practices on the part of some labor leaders. I believe there are great possibilities for cooperation, but they imply a prime obligation on our part of absolute straightforwardness and friendly instruction in the high principles for which we stand. It also places upon organized labor a prime obligation of recognizing that all men are not created mentally, mechanically or productively equal, and of allowing individual liberty to produce up to individual ability.

Mr. Taylor's attitude towards organized labor has been misunderstood by most people. For his views we can turn to his own writings:

> . . . in many establishments under the ordinary system, collective bargaining has become and is in my judgment an absolute necessity.[27]
>
> . . . there is no reason on earth why there should not be collective bargaining, under Scientific Management just as under the older type, if the men want it.[27]
>
> . . . I have not the slightest objection, and never had had, to collective bargaining, but I merely say that under the principles of Scientific Management that necessity has never come before me.[28]

D. Lack of Adequate Analysis

What I shall have to say under this topic will be largely destructive criticism. It is offered merely as having possible value for future analysis.

It seems rather an anomaly to charge against engineers and scientific managers, above all things a lack of analysis, yet I feel that this is one of the most serious criticisms to be leveled against most of us who attempt to follow the technique of Mr. Taylor. I believe it is partially due to the fact that we are so intent upon following him that we do not always stop to realize that he himself would undoubtedly have disapproved under present conditions numerous things which we have done and have left undone in his name.

Our most serious failure is neglecting sufficiently to analyze the particular sales, production and finan-

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[23] "Hearings," pp. 1459, 1462.

[24] Copley, II, page 236.

[25] In a letter written in 1911, Copley I, page 13.

[26] "Principles of Scientific Management," page 136.

[27] "Hearings," page 1444.

[28] "Hearings," page 1458.

cial problems of the particular business before attempting to apply methods for more effective management. The fact that practically all groups particularly interested in industrial management have done likewise does not by any means excuse us who have the reputation for possessing a scientific, analytical method of attack. I refer specifically to an analysis of the general type of industry (assembly or continuous); to the present size of the business; to the competitive state of the business; to the character of the personnel as regards the skill required on the part of the management and the workmen, and the general "intelligence level" of this personnel; to the traditions and type of management, i. e. whether autocratic or democratic, its policy as regards promotion from the ranks, and the mental and spiritual development and coordination of personnel; to the degree of quality required in the various operations and in the finished product; to the existing degree of departmentalization, and the possibility of modifying present arrangements in this respect.

All of these factors and many more, I submit, must be carefully analyzed before even the general type, much less the details of production control most suitable to the particular circumstances, can be determined. I believe we should not have quite so much argument as to whether centralized or decentralized management is better if we confined our arguments to a particular plant of a particular size, because the question of the proper degree of centralized as against decentralized control is very considerably one of size and departmental arrangement. Similarly, the types of organization, the questions of degree of functionalization, are scarcely things to be scrapped over in general but only as regards a particular situation. We have had too much of a tendency to impose our pet mechanisms promiscuously on plants of widely different character, just as was so long ago the custom with certain persons to sell family medicines good for all diseases. As a result, individual businesses have had to cast off these unsuitable mechanisms (mechanisms perfectly good in themselves when used under the right conditions) with the result that in more than one case I have in mind not only the mechanisms but even the principles for which we stand have become discredited.

Is it not still true that as Robert G. Valentine said[29] in 1915:

A great deal of the Scientific Management in use at the present day, whether in sales, finance, production or personnel, is similar to the situation in which a great deal of money might be spent in curing of flat foot a person who had some disease of the bone which might lead to amputation. This lack of coordination is an excellent illustration of one of the basic inefficiencies which permeates the world today.

It becomes so easy to let good enough alone, to use outworn mechanisms and to hold to outgrown notions. As Alexander Meiklejohn says:[30]

. . . The bane of a democracy is the man of easy solutions . . . such a man is a pest when there is thinking to be done. He does not need to think; he knows. He does not need to experiment; he has already found out. His father has told him, or his party, or his common sense, or his church.

It is a pleasure to quote Carl G. Barth:[31]

. . . the fact so often laid stress upon by Mr. Taylor himself . . . that while the principles of his system of management were essential, yes even perhaps as immutable as the laws of nature, the detail mechanisms he had to date developed for the attainment of the results aimed at, were necessarily subject to continual, if not continuous, growth and change. He laid such stress on this as to express the opinion that not a single one of his details, either paper forms or mechanical contrivances, would be in use ten years after he handed them over to myself and my co-workers.

Because Mr. Taylor invariably insisted upon the use of such forms and contrivances as had been developed . . . up to a certain time, until the members of a new organization should have become thoroughly familiar with these, his "system" undeservedly got the reputation of being an uncompromising and rigid code . . . .

. . . Whenever a workman had learned to obtain results known to be possible by an implicit following of . . . instructions, Mr. Taylor even insisted on a special reward being given him for any suggestion that would lead to improved instructions and better results.

Mr. Taylor's whole spirit was that of continued progress, *but by evolution only and not by revolution* . . . . .

It is in this spirit that progress must be made.

E. Our Failure to Get Our Message Accepted

It is folly to delude ourselves into believing that the message which we have been preaching for thirty years has reached the average or even the high-grade manager. The apparent salability of various "efficiency systems" and incentive payment plans, dressed up in new and attractive clothes but as a matter of fact violating the very basic principles of sound management which we have been proclaiming, would seem to testify to our failure to impress the average manager of industry.

[29]*Bulletin of Taylor Society*, Vol. 8, No. 6, Dec., 1923.

[30]"College and the Common Life," *Harper's*, November, 1923.

[31]*Bulletin of Taylor Society*, December, 1921.

Believing as firmly as we do in the fundamentals of the industrial philosophy initiated by Mr. Taylor, why have our mechanisms and methods received so much attention at the expense of the basic principles? Why have we failed to make management and men realize the mutuality of interest existing between employer and employee; to bring the management to a realization of its own responsibility as against that of the workman;[32] to make the manager know that before he is justified in an appeal to the workman through incentive payment or any other measures to give forth the best he has, he, the manager, must first do his full share in standardization, planning and the providing of proper working conditions?[33] Is this condition due partly to complacency, or to a lack of aggressiveness or persuasive powers on our part?

To be sure, it is sometimes difficult to get some managements to assume their just share of the work and the responsibility, and Taylor himself had his share of this difficulty.[34] That the development of his principles of management would necessarily be slow, was foreseen by Mr. Taylor as early as 1895, and he emphasized the very necessity of slow development.[35] Yet I find most managers are willing to do their share when it is made clear to them of what their share really consists. I wonder how much of our failure to impress the manager and to secure the progress we desire is because we have given more thought to training the workman than we have to training the management?[36]

Much of the disregard of what I believe to be fundamentally sound principles of industrial relation-

[32]"Hearings," page 1393: "By far the greater gain under Scientific Management comes from the new, the very great, and the extraordinary burdens and duties which are voluntarily assumed by those on the management's side."

[33]Taylor certainly emphasized as hard as he could the part that standardization must play in good management. For instance, ("Shop Management," paragraph 284): "It would seem almost unnecessary to dwell upon the desirability of standardizing, not only all of the tools, appliances and implements throughout the works and office, but also the methods to be used in the multitude of small operations which are repeated day after day . . . . . In the type of management advocated by the writer, this complete standardization of all details and methods is not only desirable but absolutely indispensable as a preliminary to specifying the time in which each operation shall be done and then insisting that it shall be done within the time allowed."

Again (in paragraph 285) he says: "Neglecting to take the time and trouble to thoroughly standardize all of such methods and details is one of the chief causes for setbacks and failure in introducing this system . . . . It is uniformity that is required. Better have them uniformly second class than mainly first with some second and some third class thrown in at random . . . . In fact, however, it is not a matter involving any great expense or time to select in each case standard implements which shall be nearly the best or the best of their kinds. The writer never has failed to make enormous gains in the economy of running by the adoption of standards."

Again ("Shop Management," paragraphs 297-8) in listing steps in developing Scientific Management he puts at the very top of the list: (1) The introduction of standards throughout the works and office.

The necessity of standardization as a fundamental prerequisite was again emphasized in paragraph 269.

[34]"Hearings," page 1445: ". . . I wish to repeat and emphasize, that nine-tenths of the trouble comes from those on the management side in taking up and operating a new device, and only one-tenth on the workman's side. Any difficulties are almost entirely with the management." This is constantly emphasized (see pages 1401, 1465).

An inkling of what some of these duties of the management are is given when he says (Hearings, page 397): ". . . . I can say, without the slightest hesitation, that the science of handling pig iron is so great that the man who is to handle pig iron as his daily work cannot possibly understand that science . . . . . the man who is fit to work at any particular trade is unable to understand the science of that trade without the kindly help and cooperation of men of a totally different type of education . . . . . ."

[35]"Hearings," page 1437: ". . . even in the most elementary work, to make this great change (to Scientific Management) is a question, not of a month, not of a year, but two or three years, even in the most elementary work, and that in an intricate establishment it is a matter of not less than five years before a great increase in the output per man can be made."

"A Piece Rate System," paragraph 89: "From what the writer has said he is afraid that many readers may gain the impression that he regards elementary rate-fixing and the differential rate as a sort of panacea for all human ills. This is, however, far from the case. While he regards the possibilities of these methods as great, he is of the opinion on the contrary, that this system of management will be adopted by but few establishments, in the near future at least, since its really successful application not only involves thorough organization, but requires the machinery and tools through the place to be kept in such good repair that it will be possible for the workmen each day to produce their maximum output. But few manufacturers will care to go to this trouble until they are forced to."

"A Piece Rate System," paragraph 90: "It is his opinion that the most successful manufacturers, those who are always ready to adopt the best machinery and methods when they see them, will gradually avail themselves of the benefits of scientific rate-fixing; and that competition will compel the others to follow slowly in the same direction."

[36]In this connection a word of emphasis is justified on the value of the task idea, particularly when preceded by rigid standardization and coupled with incentive payment as in Mr. Gantt's task and bonus method of payment. The task when thoroughly operative furnishes a tremendously democratic pressure from below in forcing the management to continuously hold up its end of the bargain. Taylor says ("Principles of Scientific Management," page 39): "Perhaps the most prominent single element in modern Scientific Management is the task idea . . . . The task is always so regulated that the man who is well suited to his job will thrive while working at this rate during a long term of years and grow happy and more prosperous, instead of being overworked."

Again, on page 122: "The task and bonus are especially important from the fact that they are, as it were, a climax, demanding before they can be used almost all of the other elements of the mechanism, such as a planning department, accurate time study, standardization of methods and implements, a routing system, the training of functional foremen or teachers . . . etc."

ship as laid down by Mr. Taylor has been due to a lingering prejudice against the name "Taylor" and to a reaction of scepticism connected in the linking of the terms "scientific" and "management."

Undoubtedly also our message has not been more fully absorbed because, as Taylor himself has pointed out, the easy way is usually more attractive to the average manager. Short-cuts are particularly tempting. It is due also to the fact that we have been talking calculus much of the time when the manager is still struggling with elementary algebra.

Primarily, however, I believe it is a case of psychology. Mr. Taylor himself was not noted for his tact and appreciation of the psychological elements in human affairs, and I am afraid that we have tended to forget certain principles of mass as well as of individual psychology. I am afraid that we have too often given the impression to the manager that nothing which he has or does is worth much, that we have asked him as well as his workmen to "lose face" by expecting that he "back up" on matters which he cannot do without losing status, as well as by failing to give credit for good work and good suggestions where credit is due.

We must admit that some who are least sound in their principles and least scientific in their work have been better missionaries than we have. Impossible programs are proposed in the name of Scientific Management, and when these superficial substitutes are sold it adds to the doubt and distrust of intelligent management as regards the whole movement.

On the whole, however, as has been intimated before, I have found recently a very deep interest in really scientific methods of management and a much more open-minded and receptive attitude generally in any effort to really take advantage of what Mr. Taylor has given the world. For this we very largely have to thank the splendid constructive work of this Society under exceptionally able leadership. I am not preaching pessimism and discouragement therefore, but exactly the reverse, for I believe we are on the threshold of a development along lines which we believe will far surpass anything in the past. But the extent to which we can take pride in this growth and its permanency, and the extent to which we will be relieved of the present necessity of denying responsibility for attempted short-cuts, which have no part in our philosophy but which nevertheless reflect back upon us, will depend upon the extent to which we first formulate and then secure the acceptance of the fundamental and underlying principles of this whole movement—the mutuality of interest of all parties, standardization as a basis of good management, the primary duty of the management to assume its full share of the work and responsibility; realizing that unless we ourselves emphasize these fundamentals we must not be surprised if others mistake the mechanisms for the essence. We are very directly the custodians of an industrial philosophy which is distinctly a "quality product"; upon us devolves the obligation of keeping faith with and proclaiming the ideals of its founder. Is it not possible for us to get our message across so that administration can distinguish the sound from the superficial?

IV. Obligations and Future Problems

Some of the outstanding problems which must occupy our attention in the future will be outlined very briefly.

A. Production

One of the biggest problems ahead I believe is that of securing suitable foremen. Under the rapidly increasing complexity of modern business, in spite of the unquestioned advantages in attempting to meet problems of organization through instructional foremanship, there is going to be increasing difficulty in securing and training the right type of foreman. Not only the mechanical and managerial duties of securing maximum production at minimum cost, but also the increasing realization of the importance of the foreman from the industrial relations standpoint, is constantly emphasizing the necessity of training high grade men for these key positions.

I believe that with restriction of immigration the question of the better utilization of such unskilled labor as we can secure, and particularly the devising of labor-saving equipment and methods to make up for an inadequate supply of common labor, deserves intensive study.

I feel that the question of fatigue must be given additional attention for the proper determination of rest and delay allowances. There is needed here the combined efforts of the production man, the industrial physician and the practical psychologist.

As regards mechanisms, the period of competition which we are entering will force the development of effective and more expeditious means of control, and new mechanisms of real value will undoubtedly continue to be devised. Simply to mention one such apparatus, we find need today of more adequate methods of determining the order of work and thereby securing a better machine and departmental balance, in plants doing a miscellaneous jobbing or made-to-order business. Closely related to this is the need of further intensive study of lot sizes.

B. Distribution

The importance of cutting down as far as possible the extremely high expenses of selling must not fail to receive more intensive study than is generally given it today. There are to be sure a few pioneer firms which are making real headway, but any one firm or group of firms can have but limited effect except by way of example on this truly national problem.

In a report of the Joint Committee on the Agricultural Industry, [37] it is shown that of each $1.00 spent for many articles in the United States in 1921, less than $.50 in many cases represents the cost of the finished product ready to sell. The conclusion of the Commission is that we have outgrown our whole distribution system. The insistence of immediate service in every case where it is at all practicable has made manufacturing to order practically a thing of the past. The problem confronts us as to the means by which the increasing cost of production and warehousing pending the customer's demand is to be met, and to what extent field assembly plants can relieve the situation.

C. Finance and General Administration

A further standardization and simplification of materials, and of varieties and finish of product, needs the detailed attention of factory executives.

Questions of seasonal industry, continuity of employment, unemployment insurance, service bonus and pension systems, and the general coralling of the business cycle, must continue to be studied in a scientific manner.

Industrial relations problems must continue to be investigated in a sympathetic manner. Since these problems probably cannot be permanently solved, it is therefore incumbent upon us to devise more adequate means for adjusting differences currently as they occur.

Our relations with organized labor, which has shown a very much more open-minded attitude toward the Scientific Management movement during the last few years, must be fostered. I believe one of our great duties is to minimize those seemingly irreconcilable points of differences which may remain, and to cooperate in the solution of common problems. We have an excellent opportunity to help in persuading organized labor that it is its duty to allow and persuade the individual to produce up to his individual ability. In order to secure that organized labor must have confidence in our motives as respects both the group and the individual.

The following striking excerpts from the Resolutions of the American Federation of Labor have the ring of sincerity:[38]

"Industry must organize to govern itself . . . . It must bring order to itself constructively or it will have an order thrust upon it . . . .

"It is not the mission of industrial groups to clash and struggle against each other.

"Facts must take the place of opinion and selfish interest.

"Labor stands ready for participation in this tremendous development."

Are we willing to help them?

We as a Society have not, I feel, utilized as we might the many educational institutions which are giving courses on management. I believe that in a few years the profession of management will be generally recognized, and that our future managers will be expected to have had training in this, as in other professions. It is our obligation to see that the part which the schools of business play in this training is based on thorough understanding of what really constitutes sound management.

A prime educational duty before us is to foster the increasing readiness on the part of the banker to look beyond the balance sheet. It is only through a wider dissemination of truly scientific and broadminded methods of industrial management that we may hope to secure united action in bringing about more enlightened administration of national and international affairs.

Related to this subject is that of the measurement of management. We have yet barely scratched the surface in this respect, and although the measurement of the *art* part of the management can never be exact, yet that part which is scientific has not yet had applied to it satisfactory yardsticks. In this connection the general question of executive reports needs further study.

[37] Reviewed in *Scientific American*, December, 1923.

[38] *American Federationist*, November, 1923.

One of the really big questions we must face in the future is that of getting back more nearly, not to the one-man organization itself, but to the essence of it so far as coordination, control and personal touch go. The manager in one-man organizations has many advantages in these respects over the manager of large plants. As soon as a manager is forced to sub-divide his duties and departmentalize his plant, he loses much in control which he formerly held. Recognizing that this specialization is necessary in large establishments, it then becomes a matter of prime importance to set up some means by which this unified control and personal touch may be restored.

Finally, as regards our responsibilities as managers, I wish to quote the manager of one large establishment—an establishment to which we commonly refer as being one of the very finest examples of the application of Taylor principles and methods of management. In reply to my question as to the probable future trend of developments in his plant, he writes:

> The most important development in our management methods in the near future will probably be improvement in management itself. We have an idea that in general the efficiency of the management is less at the present time than the efficiency of labor.

Business Meeting

THE annual business meeting of the Taylor Society was held in the Engineering Societies Building, New York, January 24, 1924. The first order of business was a report of the letter ballot for officers for the year 1923-1924. The balloting resulted as follows:

President—	Richard A. Feiss	420
	Scattering	5
Vice-President—	Percy S. Brown	416
	Scattering	6
Treasurer—	Edward W. Clark, 3d	423
Directors—	Mary VanKleeck	412
	Wm. B. Ricketts	411
	Scattering	10

Then followed an informal report by the Managing Director concerning the affairs of the Society; after which the Treasurer's report was presented and explained. It was voted that the Treasurer's report be accepted and placed on file. This financial report will later be printed and sent to members. The last order of regular business was the election from the floor of the Nominating Committee for the coming year. The following were elected: Richard H. Lansburgh, Philadelphia, Chairman; Wm. H. Leffingwell, New York City; Henry H. Farquhar, Cambridge, Mass.; Robert J. Andersen, Auburn, N. Y.; Howard G. Benedict, Hornell, N. Y.

The remainder of the business session was devoted to a general discussion of the affairs of the Society, the problem of membership promotion receiving especial attention. No motions were presented.

MORE and more it is becoming necessary (in buying an industrial security or participating in the refinancing or reorganizing of an industrial) to examine into the labor situation; the supply of labor and the quality available, living conditions and cost of living, the history of existing labor difficulties, whether the business operates under the open shop or closed shop plan, the method of payment for labor, the average earnings of the labor in comparison with past records and with the average earnings of similar labor in the vicinity, and the relations between the management and the working force. (F. G. Coburn, *Financial Investigation of Industrials,* in Harvard Business Review, January, 1924.)

THE day of the so-called "desk-hand" is passing, as his work becomes more specialized and even professional. The Costing and Planning clerks are clearly engaged in occupations calling for more than routine ability. With the development of the Facilitative functions, clerical work is rapidly becoming the stepping-stone to positions in the management —not the management of manufacturing departments, but of the functional activities supplementary to manufacturing. Modern developments indeed indicate that, at a guess, some 50 per cent of the managerial positions in the industry of the future will need to be filled by men trained and qualified in various branches—statistical, analytical, investigational, and coordinative —of clerical work. This tendency places clerical work in a new light. (Oliver Sheldon, *The Philosophy of Management*, p. 276.)

Professor Bob Emiliani
Please visit bobemiliani.com

An interesting, but predictable, counterargument to Scientific Management (or any form of fact-based management such as TPS or Lean): Managers must reserve the right to ignore facts. Indeed they do reserve that right. We constantly see facts ignored, especially in the world of classical management. However, ignoring facts increases risk in decision-making -- think of the Boeing 737 Max disasters, Wells Fargo fraud, GM Ignition Switch failure, BP Gulf oil spill, etc. And when things go wrong it is other people, not leaders, who pay the price when leaders ignore facts. Classical management refuses to accept the idea of management (and associated leadership) as a science (e.g., cause-and-effect, never-ending revision as new facts are discovered, etc.) in order to preserve their leaders' rights and privileges.

Management as an Executive Function[1]

Emphasizing Modern Biology and Psychology as Essential to the Development of a Science of Management

By JOHN H. WILLIAMS
Consulting Engineer, New York

THE meaning of the term Scientific Management is still in the making. It was coined by Taylor in the early stages of the public announcement of his application of the scientific procedure to management. It met a popular need to express the idea back of the beginning of a new era in management, and was broadly used by people with little or no knowledge of its meaning in the mind of the originator.

In the light of Taylor's own words, it seems to me to represent a personal expression of what he regarded as necessary to correct the deficiencies of the then existing social and economic status of industry. It is comparable in nature, though not in kind, to the present use of the terms liberalism and radicalism with relation to society at large, and is subject to as many different interpretations.

Taylor says, "Scientific Management . . . . . fundamentally consists of . . . . . *a certain philosophy which can be applied in many ways*[2], and a description of what any man or men may believe to be the best mechanisms for applying these general principles should in no way be confused with the principles themselves." He also says, "I want to tell you as briefly as I can what Scientific Management is. It certainly is not what most people think it to be. It is not a lot of efficiency expedients. It is not the printing and ruling of a lot of pieces of blank paper, and spreading them by the ton about the country. It is not any particular system of paying men. It is none of the ordinary devices which, unfortunately are going by the name of Scientific Management. It may in its essence be said in the present state of industry *to involve a complete mental revolution,* both on the part of the management and the men."

I have always felt that Taylor's selection of the term Scientific Management was unfortunate, because of its inevitable confusion, on the one hand with the science of management and on the other with the function of management, although neither of these latter terms expresses what he most often stressed in what he said and wrote. The absence of accepted terminology which sharply distinguishes these concepts is like a cross roads without sign posts, and has done much to befog an understanding of Taylor's work. Everything he did is clearly definable as either science of management or the function of management and these should be distinguished from his philosophy or state of mind, however much they affected his art and science. His selection of the term Scientific Management is not surprising, however, in that the development of his principles (a science of management) and of himself as an executive managing man (the art of management) had to go hand in hand, and against tremendous odds and misunderstanding, of which none but those who have attempted to pattern their work after his can have any appreciation. It was not unnatural that he coined a term which combined these distinct things as though they had been brought together. With the idealism of a revolutionist he hoped for the merging of the art and science of management, and was impatient of their mutual evolutionary development.

Mr. Oliver Sheldon, in an article in the December, 1923 *Bulletin of the Taylor Society,* refers to "the science of management of which we are beginning to hear so much," but denies the present validity of the term. He speaks of the existence possibly of a "science of bricklaying or a science of chocolate covering, but not a science of management," and goes on to say, "It is the science, the knowledge, the truth, the standards which the bricklayer has to learn. To achieve a science of management therefore, we have to apply the scientific method to the tasks of management, as distinct from the tasks of those whom the management controls. It is fundamental, I suggest, to draw a distinction between operative science (which management, of course, uses) and managerial science, where management itself is the operative"

[1]Paper reproducing an address presented at a meeting of the Taylor Society, New York, Jan. 25, 1924.

[2]The italics are Mr. Williams'.

I believe that it is possible to define certain fundamental principles and rules which will ultimately be entitled to be called a science of management, and even to compile a handbook of standard mechanisms and means consistent with these principles. Taylor in his four principles and in the mechanisms and devices which he originated, went far in this direction, but I do not believe that we know as yet, (and I question whether we ever will) sufficient about man's emotional and intuitive faculties to define laws and principles adequate to constitute a "managerial science, where management itself is the operative."

Mr. Kendall last evening referred to his having spoken, in his earlier paper at the Tuck School Conference, of systematic management and scientific management as representing two different types of management. As I recall this talk, he gave an illuminating description of the distinguishing characteristics of each, but made no reference to the science of management as distinguished from Scientific Management.

The science of management, as I see it, has to do with the determination of the facts concerning the design, selection and operation of means to a given end—in other words, the facts bearing upon a problem of management; whereas management—whether systematic or scientific, whether of a manufacturing or merchandising business, whether of an institution or a government—if it is *management,* and not *the science of management,* is primarily concerned with expediency and leadership, however much it may be tempered by science or system. While every manager should seek to increase the element of fact in the basis of his judgments, the word management does not necessarily imply even a knowledge of the facts concerning the thing managed, and is without regard to effectiveness. It is often spoken of as an art and used synonomously with the executive function of administration. It is preferably used in connection with the direction and manipulation of units of activity, where there are a limited number of opposing objectives, as in a small or simple business or a department of a larger business.

The term administration as a policy determining function is usually exercised by a committee or board of directors, in which case it means something very different from management. Administration as an executive function, however, is very like management and connotes something very different from a science. It is preferably used in connection with the supervision and manipulation of opposing objectives existing in the management of several smaller businesses, or the various departments of a larger business. There is no legitimate difference between it and management except in degree and scope. Either or both may be characterized as systematic, scientific, humanitarian, ruthless or any other of a score of types.

Production is usually considered to constitute one branch of management and selling another, and the adjusting of the opposing elements in these and other branches of a business as still a third. The word management could properly be used to describe the function performed by a person charged with responsibility for production or sales or any other department of a business, or for all of the departments of a business where the business is small enough for them to be handled by one person. But when a business is so large that production, sales, purchasing, finance and other functions are each headed by separate executives, the function of the person charged with responsibility for supervising and manipulating these personalities and coordinating their responsibilities can best be described as administration.

The science of management, or management as a branch of engineering, which I believe to be a more desirable term, should be used by both managers and administrators to determine the facts upon which their policies and decisions are based, but its function as such should stop where the determination of facts ends and expediency begins. However far management as a science may encroach upon management or administration as an executive function through the development of facts bearing progressively upon problems as they arise, there will always be a plane on which the final determination must include things other than facts. If management as a science or branch of engineering hopes for recognition as such, this must always be the place where it stops and management or administration as an executive function begins.

In its present stage of development, management as a science or branch of engineering has hardly gone further than to deal with the mechanics of management, and it is not to be wondered that executives with broad and varied experience in management and administration, in their larger aspects of policies and personalities, resent the sometimes all-embracing counsels of those whose experience is largely confined to the mechanisms of management.

I think it is fair to say that Taylor was the first to collect and formulate the existing knowledge with reference to management into a comprehensive and logical body of principles and practice in any way entitled to be called a science, and for this he is entitled to be called the father of the science of management, although not of management as an executive function. The term Scientific Management implies a certain condescension toward the then existing stage of the art of management which I do not believe was intended by Taylor. His criticism was principally directed at the absence of scientifically determined facts as a basis for management.

When we speak of Darwin as the father of evolution, of Pasteur as the father of modern bacteriology, of Fulton as the father of steam navigation, or of Newton as the father of the law of gravity, we do not imply that they were the first to conceive of these discoveries, or that the last word was said by them. But we do give them credit for being the first to deal with these subjects in a manner sufficiently comprehensive, logical and practical to bring them to the attention of the world. This is the least that can be said of Taylor. In proof of this, I shall cite his "four principles" and show that, although they were developed largely with reference to production, they are fundamental to management in its larger aspects, as is proven by their having been generally adopted by industry at large.

Before referring specifically to the principles, it should be observed that Taylor not only formulated definite principles, but he developed a technique and actually drew all of the necessary forms and standardized the paper work required for their application. More than this, he gave an actual demonstration of all that he advocated in a going, competitive business. Had he done less than this, he would not have received either the recognition or the criticism which has been lavished upon him. The recognition is, I believe, due to the effectiveness of his principles and formulae, and the criticism to an assumption, unwarranted by the facts, that he considered them to constitute the sum and substance of management.

Taylor's first principle was the gathering together of all of the traditional knowledge which in the past has been possessed by the workers, and the classifying, tabulating and reducing of this knowledge to rules, laws and formulae. With reference to production this included roughly: 1, standardization and classification of stores; 2, maximum and minimum requirements of stores; 3, standardization and classification of tools and machinery; 4, product specifications; 5, job analysis and standard route charts; 6, worked material classifications; 7, forms and records.

This, as with all of his principles, is clearly limited to the facts of management and not the executive function. Its soundness is testified to by its counterpart presented by the services performed by the research and statistical department, now quite general in all phases of management.

A second step in his first principle was the development of a science for each phase of man's work, to take the place of the traditional rule-of-thumb method. With reference to production, this included roughly: 1, time study of unit operations; 2, standardization of operations; 3, operation instructions; 4, balance of stores. This has its counterpart in the statistical charts and formulae now almost universally used as an aid to executive judgments.

His second principle was the scientific selection, teaching, development and training of employees. With reference to production, this includes roughly: 1, standards for selection of employees; 2, schools for instruction; 3, standards and records for judging qualifications and efforts; 4, training of foremen, gang bosses, instructors and inspectors. While no reliable tests for the selection of executives have as yet been developed, there is hardly any university of standing that does not include a school of business administration in which it undertakes to prepare young men for the executive function. Is not this a general recognition of his principle with respect to the higher executive function?

His third principle was the cooperation with employees so as to insure all of the work being done in accordance with the principles of the science developed. Notice the use of the words, "the science developed." With reference to production, this includes roughly: 1, informing and educating owner, manager, foremen and employees with reference to plans and methods; 2, central planning and control; 3, comparison of work performed and time consumed with standard, and a bonus reward for satisfactory results achieved. The general application of this principle to the administrative function is easily recognized in the growing use of budgets and accounting methods to see that budgets are conformed to.

His fourth principle was the equal division of work and responsibility between management and labor. With reference to production, this includes roughly: 1, assumption by the management of full authority and responsibility for ways, means and records; 2, relieving workers of all clerical work; 3, determination of sequence and routing of work; 4, supplying workers with proper stores; 5, supplying them with proper tools. This is the forecast of the elaborate organization plans and charts and schedules defining duties and responsibilities, now generally in use in large concerns.

In his application of the scientific procedure to problems of management, Taylor not only gave us a practical beginning but he blazed the way for much that is to come. In this connection I do not feel that any discussion of the evolution and present state of management can be complete without reference to what I believe to be the next step—the inclusion in both the science and the art of management of the use of what has been recently developed in the closely related science of psychology. I do not mean by this what is commonly known by the word psychology, in the sense of the static process of introspection that was taught when most of us went to school, but rather, the fundamental principles of what is sometimes called "the new psychology," with principal reference to what it has to teach us regarding man, the principal factor in both the executive function and the science of management.

Mechanical engineering reached its present high state of development largely through intensive investigation of the materials with which it deals. It did not hesitate to use physics, metallurgy, and other sciences for this purpose. The management engineer has attempted to go forward on the information accumulated by the mechanical engineers, seemingly overlooking the fact that his principal material is man himself, concerning whom he has almost no knowledge.

Can you imagine a mechanical engineer working without a knowledge of physics? With all of his mechanisms, he would be in a pretty plight without a knowledge of the laws of the physical world with which he deals. Why then should we expect more of the management engineer with all of his methods, systems and controls, until he acquires a knowledge of the laws governing the behavior of man, the principal material with which he deals?

The hopeful tendency of today for management as an executive function, and the new and ever increasing opportunity for management as a science to be practiced by those adequately informed and trained for their task is, as I see it, in the rapid development of psychology as a science, and the beginning of its recognition by executives as a controlling factor in management. The growing tendency to consider man's probable behavior on the basis of experience, in place of reasoning according to prescribed rules for behavior, the increasing tendency toward the decentralization of authority, the substitution of clearly defined responsibilities for duties, the keeping of accounts in terms of cost and revenue growing out of responsibilities in place of arbitrary accounting terms—these are all evidences of progress in the right direction.

Whereas we formerly railed at what we chose to call unreasonableness and inconsistency in others, we are now coming to recognize, all unwittingly, but through a better understanding of the dynamics of man, that this unreasonableness and inconsistency is a natural result of differences in nature, environment, and opportunity, and can be adjusted only through changes in environment, opportunity and our own attitude, and that it cannot be adjusted through reasoning or punishment.

Most of us were brought up under the theological traditions of man's essential goodness or badness—the idea that, freed from external influences, man would be good or bad as the case may be. It was thought that he could be reasoned into gratitude, generosity or honesty, even in the face of all opposing influences, and great stress was laid upon the effectiveness of the spoken word. This tradition has done much to befog our understanding of his probable reaction to any given set of circumstances. In our dealings with each other, we have depended upon *reason*, very much as though it were a *law* controlling human action.

Modern biology and psychology teach that man is primarily emotional, that he is descended from primitive forms of life, and that his reactions are still influenced and modified by primitive emotions, such as fear, rage, hunger, and desire for comfort. They argue that because he was in a primitive state for millions of years, and has been a reasoning being for only a few thousand years, the first and most powerful influence upon him must necessarily be the old habit reaction of quick emotional response to the primitive fear, rage or love which each situation however subtly may suggest. Only secondarily and after control of his emotional reaction does he become subject to reason and the spoken word.

While these views regarding man's origin and his present state are by no means generally accepted as yet, they have shaken the foundations of the earlier beliefs. Executives are unconsciously beginning to study the probable reactions of those they direct, regardless of the reasonableness of such reaction. Whereas executives used to spend days over the reasonableness of their proposals, and what explanation they might make to justify their actions, they now try to forecast the probable reaction of those they direct, and to adjust things to meet these reactions. Strangely enough, the very men who yesterday flatly denied the theory of man's evolutionary heritage today use its standards in considering the probable reaction to their proposals.

An eminent student of the human mind is quoted by Walter Dill Scott in his "Influencing Men in Business" as saying that most persons never perform an act of pure reasoning, but all their acts are the result of imitation, habit, suggestion or some related form of thinking, which is distinctly below that which could be called reasoning.

Mr. Scott continues: "Our most important acts are performed and our most sacred conceptions reached by means of merest suggestion. Great commanders of men are not those who are best skilled in reasoning with their subordinates or most logical in presenting their truths. In moving and inspiring men, suggestion is to be considered in every way the equal of logical reasoning." And I may add that their unconscious ego and defense trends have now come to be recognized as even more important influences.

James Drever in "The Psychology of Industry" says: "From very early times, speculative philosophy has been greatly interested in that very group of phenomena which constitutes the social province of the science of psychology as we understand it. Thoughts, feelings, desires, emotions were looked upon as manifestations of the mind or soul, a substance quite distinct from the matter of which external bodies consisted. Many of the deepest and most momentous problems were raised by the relations of this mind and this matter to one another. Hence, one of the chief interests of philosophers came to be to interpret both in such a way as to satisfy the demands of the human reason on the one hand, and the needs of the human spirit on the other.

"Thus was created the atmosphere in which the 'old psychology' came into being. It was characteristic of this 'old psychology' that it was either deduced from the supposed nature of the mind or soul, or it was formed by the observation and selection of those facts of experience and consciousness which seemed to support a certain view of the mind or soul, or it was reached partly in the one way, partly in the other. In any case, the old psychology could not in strictness be described as a science. It was the battleground of contending philosophical systems. The truths generally accepted as established principles were submerged in the vast mass of controversial matter in regard to which some held one opinion, some another, according to the philosophical views which required to be supported. As a result, interminable disputes obscured the very real advances in psychological knowledge which were made. Such was without exaggeration, the position of psychology from the time of Plato or Aristotle, or even earlier, until the 18th or 19th centuries.

"It is the application of the method of science in the field of mental phenomena that has given us the modern science of psychology, the so-called 'new' psychology. The 'old' definition of psychology was 'the science of the mind or soul,' or 'the science of mental or conscious processes.' The 'new' definition of psychology is 'the science of the facts of human nature and behavior, or the science of human behavior in its relation to, and dependence upon mental process." There is, indeed, a strong body of opinion among present day psychologists in favor of defining psychology simply in terms of behavior. The new psychologist rightly holds that to define his science in terms of mind or soul is to define it in terms not of facts, but of an inference from facts which might be challenged, and is therefore, entirely illegitimate.

"This new psychology really made a serious start with the application of experimental methods some fifty years ago. A quarter of a century later, when experimental psychology had already made substantial progress, systematic efforts were begun to develop applied psychology in various fields. In all respects therefore, the history of the science of psychology has been that of the other sciences from the time when it first took shape as a definite science."

In his inaugural address to the first meeting of the Industrial Section of the British Psychological Society, in April, 1919, Charles S. Myers said: ". . . . recently another stage in the evolution of psychology has been reached by the systematic study of unconscious processes and of their relation to consciousness. Whereas the earlier philosophical psychology and the experimental school which arose from it, had been mainly intellectualistic, giving undue prominence to the play of reason, this later stage has been characterized by the emphasis it lays on the importance of instinct and the emotions, and by its devotion to the study of unconscious processes.

"As in the case of biology, the results obtained from experimental psychological methods, and indeed, those methods themselves, have begun to be applied to practical purposes—first to Education, next to Medicine, and most recently to Industry, thus creating three applied sciences, those of Educational, Medical and Industrial Psychology; and the British Psychological Society is now instituting three special sections of the Society which are to be respectively devoted thereto.

"Under the application of psychology to management, I include the consideration of the psychological causes of industrial discontent and restricted output, the psychological advantages of different methods of payment and supervision, and other conditions which affect the efficiency and happiness of the workers. During the last few years a flood of light has been thrown on the importance of the emotions and on the changes which they effect and to which they are subject. We now recognize how prone we are to rationalize, i.e., to give an intellectual reason for actions which are really prompted by emotional states, or by subtler influences which are unknown to us or which for good reasons dare not be faced. We now recognize that in order to avoid causing excessive self-depreciation, an emotion may undergo a process of 'projection.' Thus instead of reproaching ourselves, we may attribute the reproach to others; hence arise delusions of suspicion and even persecution. Or, for the same purpose, an emotion may be 'inverted,' e.g., shyness becoming concealed by an affected boisterousness, the desire for a person of the opposite sex by aversion, submissiveness by defiance. We understand now more fully the psychological basis of worry and anxiety, the importance of their early treatment, and the psychotherapy of the functional nervous disorders to which, if unresolved, they may give rise. The application of such new advances to the problems of industrial unrest is sufficiently obvious."

I feel that this modern view of man strikes definitely at the barrier which has stood in the way of the development of management as a science. The tendency, whether conscious or unconscious, which I see among executives, to accept the findings of modern biology and psychology as a basis for dealing with man, is the most hopeful sign of the day, not alone for the future of management and administration but for the whole social order.

AMID the waters, blown stormy by the blast of all these forces, management stands at the helm of industry. Labor may bring about a change in its composition and relations; Science in its methods and materials, but neither can change its functions. The man at the wheel may be replaced, may be put under a new authority, may be regarded differently by the crew, and may work with different instruments in a different way, but the functions performed remain constant, essential under every conceivable circumstance. It is important, therefore, that we should devise a philosophy of management, a code of principles, scientifically determined and generally accepted, to act as a guide, by reason of its foundation upon ultimate things, for the daily practice of the profession. The adoption of this or that principle in this or that plant will avail but little. Management must link up all its practitioners into one body, pursuing a common end, conscious of a common purpose, actuated by a common motive, adhering to a corporate creed, governed by common laws of practice, sharing a common fund of knowledge. Without this not only have we no guarantee of efficiency, no hope of concerted effort, but also no assurance of stability. (Oliver Sheldon, *The Philosophy of Management*, p. 284).

BOTH for training and for the movement of personnel, the existence at the head of the educational system of the factory of an enlightened and far-seeing administrator, who realizes the extent to which his system of training can affect the whole management of the business in the future, is an invaluable asset. Next to the training of foremen, the training of clerks of the new order will be his most important task. The training of the clerk, indeed, so that he may take his legitimate position in the ranks of the highly developed system of management which is growing before our eyes, is a necessary and practical recognition of tendencies in industry which promise to make a highly trained and broadly educated staff indispensable to efficient administration. (Oliver Sheldon, *The Philosophy of Management*, p. 279.)

Professor Bob Emiliani

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The paragraph below will surely sound familiar to you. Those who disrespect our forebears by saying Scientific Management and Lean are completely unrelated don't know what they are talking about. They have zero credibility on the matter. 🤐

From the 1924 paper

"Industrial Psychology: A Layman Considers Its Status and Problems"

by H. S. Person,

Managing Director, Taylor Society, New York, NY

VII.

Ten or a dozen years ago I was inspecting the development of new management methods at a New England factory, as a guest of the general manager and the consulting engineer. My interest in a machinist who was working in accordance with new, standardized methods having been noted, I was informed that the machinist had been with the firm some sixteen or eighteen years, and that in all the time prior to the beginning of the development of new methods he had not changed his chance-acquired methods in any noticeable particular and had not made a suggestion relating to improvement of machine, conditions or methods; but that within the year since the new standard methods worked out by the consulting engineer had been explained to him and practiced by him, he had made a dozen suggestions worthy of adoption—the first within an hour after he had started to work in the new standard way. That incident made a profound impression on me, for it was one of my first plant inspections, and my attitude towards scientific management had up to that time been susceptible to *a priori* arguments of academic friends to the effect that standardization of operations destroys initiative and weakens intelligence. Since that time I have observed it to be generally the fact that where scientific management with its standardization, planning, scheduling, instruction cards, progress records and other mechanism has been introduced, people generally show more interest, originality, initiative, and intellectual self-expression than they had done before the development of the standards, and more than is characteristic of other people engaged in similar work in conventionally managed plants.

What is the psychological inference to be drawn from these observed facts? The answer to this question was suggested by the Gilbreths ten years ago[15]

[15]Lillian M. Gilbreth, "The Psychology of Management," Sturgis & Walton Company, 1914; pp. 178, 179, 218, 235, 236, 240, 312, 313. Frank B. and Lillian M. Gilbreth, "Fatigue Study," The Macmillan Company, 1919; pp. 140, 146 and *passim*.

Professor Bob Emiliani

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A wonderful accounting of Scientific Management world-wide. A paragraph that resonated with me: “The increased interest in developments since Taylor's day demands that progress in the science of management be outlined and evaluated by trained writers like Drury, who really devote themselves whole heartedly and in a non-partisan and constructive spirit to finding and presenting the facts. Such work demands background, intensive training, capacity, fair-mindedness and both writing and teaching ability. A hard standard to reach!” Indeed it is.

Scientific Management in Other Countries Than the United States[1]

By FRANK B. GILBRETH and LILLIAN M. GILBRETH
Consulting Engineers, Montclair, N. J.

ADVANCES in scientific management in other countries than the United States have a deep significance to this country, especially to management engineers. They have an historical significance, not only in the amount and rate of advancement but as comparable to similar advances in this country during the same length of time. They have a geographical significance, not only as they refer to likenesses or differences in geographical conditions in the different countries, but as they refer to nearness or remoteness from the United States. They have a statistical interest, in that we shall in time be able to compare results and trace causes. They have an important economic significance, in their relation to the prosperity of the various countries involved. They have a sociological significance, as referred to the other factors that make up the status of the people of the various lands. The psychological significance can scarcely be overestimated, for a close study of the advances and the retardations furnishes information as to behavior that will furnish studies for generations of psychologists. But for the Taylor Society, nothing in this advance can be so important as its educational aspect.

This Society, as advocating and as sponsoring scientific management, is obligated to all the nations of the world. It must learn from a study of the advances in other countries two things—first, possible improvements that it can make in its own practice, and second, possible assistance in the development of scientific management it can offer these other countries, whether this consists of removing obstacles to its advance, of furthering activities already prospering, or of cooperating in finding new units, methods and devices of measurement that can be used. It is the aim of this paper to present conditions abroad with these thoughts in mind; to make clear the duties of this Society during the decade to follow if the Society is to be a true exponent of its stated beliefs and is to assist this country in maintaining its leadership in the field of scientific management which is at present deserved and universally acknowledged.

Data on which this Paper is Based

This paper is based on a mass of foreign literature in our files; observations made during conferences with visitors from abroad; correspondence extending over the past fourteen years, and in some cases longer, with correspondents in many countries; and data collected during more than a dozen trips abroad which consisted largely of conferences with those interested in scientific management and of installation work since 1900 in the plants of foreign clients. We desire to acknowledge cooperation from all our past and present clients and from those whom we have interviewed or with whom we have corresponded, especially our pupils in management abroad, many of whom were at the same time our teachers.

Every statement made in this paper is based upon carefully selected and verified information, which is at hand and can be examined by anyone at any time if the authorization of the one furnishing it can be secured. We should have been glad to mention the names of all those who have given us information, as well as of plants where advances in management have been made, but many have requested that this be not done. Because of the necessity of a brief presentation, an enormous amount of information valuable in itself and as an indication of the amount of interest in the subject, has had to be omitted; but we feel that not only our appreciation but that of the Taylor Society goes to all those who have cared enough to further the cause of scientific management to make this information available.

A first glance over the data collected brings before one a host of interesting personalities, for those who are advancing the cause of scientific management in other lands are not only splendid types of the nation they represent but fine specimens of human beings.

[1]A paper presented at a meeting of the Taylor Society, New York, January 26, 1924.

Many are approaching the problem of scientific management with the missionary spirit of service, and with the belief that maximum waste elimination is for the interest of all. We quote a Danish professor who writes "Having now attained the age of 70, I am going to give up my chair in the University, but I hope to get sufficient strength to work for scientific management—as far as I can see, one of the most important social problems at present." And there is a professor of engineering in England who is doing the same splendid thing. It may surprise you to know that in the past the largest group interested in scientific management abroad has consisted of professors of psychology, physiology and psycho-technic. There are also engineers, economists, statisticians and men whom we might class as educators, altho whatever their fields of activity, educated men abroad are almost always also technical men. There are an enormous number of scientists, especially research men, and of writers interested in scientific subjects. There are comparatively few manufacturers, altho there are some exceptions. We have a list of "brilliant examples" of satisfactory installations in many countries—some made by American consulting engineers, some by local consulting engineers, some by engineers attached to the plant. Each represents one or more interested manufacturers. This list, unfortunately, is not available for publication. There are some few labor leaders interested, fewer workers and still fewer government officials. Those who are doing the most writing abroad are, or have been, teachers in universities or technical schools. Perhaps this is only natural, as while scientific management spread in this country from the plant and actual practice, there it is spreading from the colleges and other educational institutions.

You are doubtless all acquainted with many of the types of persons who are furthering the cause of scientific management abroad: A Japanese psychologist who has read much, written in many languages, and corresponded with many leaders; who comes to this country to get in touch with latest findings and carry them back to develop in the educational institutions and in the industries of his country. An Icelandic psychologist who comes to study refinements of measurement and to apply the most intensive scientific investigations of the One Best Way to Do Work to the industries of his country. A young Dutch engineer who brings knowledge of the advanced standardization methods of Holland and comes to get actual experience in American industries, and to compare methods with theirs. A young English university man who, paralyzed from an accident while swimming, turns to research not only as a relaxation but as a panacea, and does much to awaken his countrymen to interest in scientific management before his short life is ended.[2] A distinguished French scientist, a master of his own branch and a leader among his countrymen, who comes to cooperate with our leaders in thought and to develop an international method of attack. A brilliant young German with the ability to think equally well in several languages and many subjects, capable of comparing methods and results and indicating trends. A Spanish psychologist who thinks in terms of vocational guidance for all youths of his country, and assists in getting together groups of men from all nations interested in such subjects and spreading their findings before the world. A young Canadian Government official with a passion for better methods, and not only a thirst for information but a desire to apply everything he learns in order to get a personal reaction. Army and navy men—Swedish, Belgian, French, Japanese, etc.—it is such types as these who are stimulating interest abroad, and all of these mentioned and many others are of the type who desire to cooperate, who wish to make scientific management not a secret of the few, not something belonging to the informed and lettered, but a working practice for the entire industrial world, that lower unit costs of work and higher wages simultaneously may go far to solve the problems of lower costs of living everywhere.

Sources of Scientific Management Information Available to Other Countries

We have mentioned visitors to this country, and the number of such visitors is increasing, as is also the diversity of types. Even in the early days of scientific management it was customary for young men to come from abroad and enter the industrial plants of this country as learners, apprentices or workers, just as similar young men came and took courses in the colleges and universities. The number of these is increasing. Practically every day brings news of such young men coming to this country, and almost every steamer has one or more of these among its passengers. The number of such young men more or less adequately trained who return and are

[2]See *Science*, August, 1922, and *The Spectator*, July 15, 1922.

working in their own countries is increasing also, and the next ten years will show an enormous increase in this group, and we may look for noteworthy results. Visits to this country of research men and of teachers are also increasing, though it is to be noted as of extreme importance that these are often of too short a duration to prove as profitable as we would desire to make them. A mistake of Taylor's, being repeated by a majority of our foreign visitors and also by many in our own country, is to underrate the great value in the education of a manager of actual experience with the old fashioned methods of management. It was exactly that contact which developed Taylor, who, we all know, was not naturally adapted to be a manager. It was his actual contact with problems under the old type of management that brought out the Taylor system of management. Taylor was a great scientist, philosopher, economist and engineer, but he was not a psychologist nor was he naturally a manager. Yet thru his experience with the old he became great with the new methods of management.

It would enable engineers and managers on this side to do much more for visitors if they were to have had previously actual experience with the problems of management and also a thorough acquaintance with the literature of scientific management, and knew exactly what they desired to find out, whom they desired to meet, how much time they could allow to each branch of their investigations, and the amount of information they could reasonably expect to acquire in a given time. We have personally met many young men from Europe who have had a comparatively short experience in one or two American plants, and have returned to Europe with the firm conviction that they had learned scientific management. The editors of our management papers should correct this impression and should disseminate the distinction between application of the principles of scientific management in any one shop and the knowledge of the underlying principles of measured functional management for enforcing the conditions for obtaining the One Best Way to Do Work. Perhaps no one thing has injured the reputation of American management methods so much as has the return to Europe of young men who have spent time in one or two shops in America, and have seen the application but have not been taught the underlying universal philosophy of scientific management.

Besides accounts of visits made to this country, there is at the disposal of the foreign reader the literature written here, but too often the writers of such literature do not have the foreign reader in mind. It is, perhaps, too much to expect that highly technical literature shall be expanded with the aim of making it more comprehensible to foreign readers. There is much room in this country for less technical treatment of the fundamentals of scientific management and this will be useful not only to foreigners but to beginners in this country. There is also much room for interpretations of scientific management from the psychological, economic and other viewpoints presented in simple form, yet with a background, a degree of indusputable accuracy and an amount of reference material that will lead the reader to have confidence in what he learns and to continue in his learning.

The number of those acquainted with scientific management traveling through foreign countries is increasing, and this is a source of information there. Unfortunately, however, many who have done much of the talking and some of the installations abroad are not adequately informed or trained and have done much more harm than good. We may perhaps look forward to exchange professorships which would bring us much profit, in that we would learn much of foreign opinion and feeling and be able to orient ourselves in the foreign fields. No one who has visited in foreign countries can fail to have noted the hearty welcome extended, the enormous desire to profit by any information offered, and, in many cases, the masterly manner in which all such information is extracted from the willing or reluctant visitor. When one of the writers had the pleasure of accepting an invitation to visit Czechoslovakia recently, he was met at the frontier by an official with an official program covering practically every moment of the day and night, and left after a short but most stimulating visit, mentally enriched thru contacts and experiences that will remain a treasure of a lifetime.

Foreigners have also at their disposal, as a source of information, translations of the classics of scientific management, but only one who has suffered from a typical translation can speak from the heart as to their value. Many foreign translations of American books on management have had the sense completely changed, because the translator preferred to rewrite in words that he himself could understand, regardless of the meaning of the result. It is interesting to note the volume of translations now existing.

We are told that twenty thousand copies of Taylor's "Principles of Scientific Management" have been sold in France alone, and we know that translations of this and other classics have been made into most of the languages of Europe and several of Asia as well.

Another source of information most valuable to foreigners is that which comes through American firms having affiliations or branch offices in foreign countries. Where these American firms are properly systematized, the results must be, in time, far reaching. However, few of our large industries with branches in many countries stand at present as exponents of any complete installation of scientific management, as we understand the term.

Expression of Reactions to Scientific Management In Other Countries

As for the reactions to information received, we get in touch with these partly through the lectures that our visitors deliver when they return to their countries, and through the translations made. We must not forget that to most foreigners a translation means something very different than it does to us. An American translating a foreign book has in mind *conveying the ideas* of the writer as clearly as possible and in the most nearly correct English possible. A foreigner translating an American book too often has the idea of *interpreting* the thought to his countrymen in the best language possible. He hesitates not at all, usually, to change the form of expression or arrangement, and all too often changes the thought as well. This is not only acknowledged but defended by the average translator and his countrymen. This does not apply alone to translations into foreign languages. It applies to American books printed in England. Often, even the title of books have been changed "to make them sell," and the entire meaning of the title is not only changed but lost.

While there are many fine translations, it certainly would be of value if the Taylor Society would make it its business to go over carefully every translation of any of Taylor's works and ultimately of any of the recognized standard books on scientific management to evaluate them as translations, for much has been done to discredit scientific management abroad through translations that are not worthy of the name. If such books were published as interpretations or reviews of the Taylor System it would be one thing, but they have no right to stand as translations or as presenting the principles and practice.

Further vehicles of expression are papers and books which usually come to us soon after they are written and which often cause us to turn to the material upon which they are based, questioning the adequacy of our own American thought and expression. There is also the teaching, the effects of which we see in the young men who come to us for instruction or positions. Their viewpoints again often lead us to consider the adequacy of the American literature. A most striking outcome of the reaction to scientific management is the amount of testing being done abroad, both in the schools and in industries. This is taking place in England, France, Germany, Iceland, Belgium, Holland, Czechoslovakia, Japan, and in many other countries. Finally, there are rapidly being formed abroad societies or institutions most of which, so far, take up either vocational guidance, applied psychology or some such ally to scientific management. The conventions and proceedings of such societies or institutes form a most valuable source of information. It must be remembered that while scientific management cannot claim credit for —does not even antedate—psychology, vocational guidance, etc., it has done much to foster the growth of applied psychology, of "psycho-technic" and of the making of actual tests in the industries themselves. The library of the Taylor Society would be much enriched through the proceedings of the meetings and conventions of such societies, which, while they are not always closely affiliated with scientific management, not only are much influenced by it, but will certainly influence its future developments.

Objections Advanced and Obstacles Encountered

In our review of progress during the last ten years abroad, we must pay special attention to objections advanced and to obstacles encountered. Personal observations abroad and much of our recent correspondence make this clear. In France we find that advances in scientific management have been retarded by a feeling that knowledge of what is happening must be confined to those in the industry itself, and in most instances in the particular plant. We know that this feeling still exists to some extent in this country. It must be overcome. No real progress can be looked for while such a feeling exists. Mistakes are repeated, advances retarded and thorough cooperation is impossible. This feeling that advances should be kept secret exists to some extent also in Germany and Switzerland, but in Germany the feeling is being broken down by the efforts of standardization advocates who are pointing out common problems and common solutions. In France there is advocacy of installations through corporate groups and unions which would do much to break down the desire for secrecy.

We hear much, as an obstacle to advancement, of the lack of technical societies in scientific management. This is to be noted in Mr. Sheldon's excellent paper for the Taylor Society.[3] It is also to be noted in the letters of our French correspondents and in correspondence from Belgium. Another obstacle is the belief that scientific management applies only to repetitive work. This is advanced especially in Belgium, where, because of the nature of the country and of its demands, there is a great diversity of product and many plants turn out only small quantities of any one article. Another obstacle encountered is the opposition of government officials who do not understand and who must be conciliated and informed. There is also in several countries a need to educate and conciliate even the university people, as well as both employers and employees. It would not be wise to mention the name of one country where all of these classes must be conciliated and where in spite of this the brave advocates of scientific management are making distinct progress and look for more progress in the immediate future. The effect of the war and the depression in business are noted in many countries, but seem to be felt especially, perhaps, in Canada, where also there is complaint of lax management because of too plentiful labor supply. In spite of all this, there are, in several countries, government bureaus that are investigating scientific management, or such bureaus are planned for.

In Canada the Honorary Advisory Council for Scientific and Industrial Research recommends that general investigations be superceded by specific investigations. To quote: "It is felt that at this stage the best way for the committee to gain the confidence of industry would be to *conduct some specific piece of research* from which *definite* conclusions could be drawn on some *concrete* problem, however small."[4] This could furnish a text for American management societies! In Germany there is the feeling that there has not been enough stress laid on the *science of management,* and this obstacle they are strenuously trying to overcome. In France there are as yet few or no experts in scientific management working in a consulting capacity, and they seem to feel that they progress very satisfactorily without such experts. England is profiting, she feels, by such experts as have practiced there. So is Germany.

From France comes a very strenuous indictment of American literature. It is felt that there is much confusion in the form of Taylor's books; that in all the literature there is a poverty of example, which Taylor's books illustrate; and that the enormous results there cited suggest "American bluff." There is comment on lack of tact in Taylor's presentation, on certain phrases that offend the worker, on the undesirability of the selection of the strongest and ablest, and on the fact that the increase of the task offends the worker's principles. The belief is elaborated that a complete installation demands too much time, much money and intensive laboratory investigations, too many specialists and too great an effort to secure cooperation. These criticisms all indicate need for supplementing the present presentation of the Taylor system, if it is to make headway. Copley's life of Taylor[5] will do much to explain his work and his books. A life of that great pioneer, philosopher and manager, James M. Dodge, and widespread literal translation of his practice and writings would add invaluable information as to the "human side." The increased interest in developments since Taylor's day demands that progress in the science of management be outlined and evaluated by trained writers like Drury, who really devote themselves whole heartedly and in a non-partisan and constructive spirit to finding and presenting the facts. Such work demands background, intensive training, capacity, fair-mindedness and both writing and teaching ability. A hard standard to reach!

Many foreigners, notably those in Denmark, remark on the conservatism of their workers and their employers and the need for making advance slowly. This calls for advice on methods of presentation and on sequence of installation, planned to effect necessary changes without any jolt to existing organization, by carefully thought out stages, each adjustment to be satisfactory to all concerned.

From England we hear not only of British conservatism, but of the pride of the British in this con-

[3]"The Art of Management from a British Point of View," *Bulletin of the Taylor Society,* Vol. VIII, No. 6, December, 1923.

[4]The italics are ours.

[5]Frank Barkley Copley, "Frederick W. Taylor, Father of Scientific Management," Harper & Brothers, 1923.

servatism, of objections to accepting anything "that has not been fully proven," of objections to a new vocabulary and a desire to keep old terms and functions unchanged. The foreman has always been accepted as the accredited representative of management, with whom the worker feels his contract is made; and in adopting scientific management there, the foreman is made the channel through which all functions must pass. With such adapting comes at times an entire misunderstanding of the uses and value of time study and much overemphasis of cost accounting. This indicates a distinct call for this country to make plain the principles and practices that it advocates; the need for extreme care in changing any part of the mechanism without considering its relation to the whole; the place and value of time study, motion study, and other methods of measurements; the relation of costs to the other parts of scientific management and the place of the cost accountant in management work.

In some countries we find evidences of pirating American books, articles, ideas, methods and mechanisms. Even when due credit is given these are too often adapted to suit some imaginary need and, thus adapted, are entirely unusuable as part of a complete installation. This is not important as affecting those involved on this side who are too busy to be much disturbed and too sure of the necessity of scientific management as a world force to wish to retard its growth through any avenue. It is most important as showing the need of clearer presentation here and of greater publicity as to sources of information and available material.

One of our own countrymen seems to believe that the Taylor system overemphasises the mechanical aspects of work and is "lopsided" because it lacks the technique of human behavior. He finds this viewpoint strongly backed by opinions in Germany, and believes that their great development there in psychotechnic is largely an endeavor to supplement this lack in the Taylor system as they understand it and as they believe we are installing it.

We find, in a Canadian interpretation, a confusion of scientifically studied operations with scientific management, an idea that such management applies only to manufacturing, and a confusion of the teaching of the principles of commercial business, with teaching of scientific management—and these confusions are by no means confined to Canada!

You may doubt the validity of these objections or obstacles as representing any large body of thought or any group of thinkers. If you do, you have only to go over the foreign literature, as it appears in any periodical or as reprinted and revised in this country, to find every statement made here substantiated. Ideas are certainly misinterpreted and misapplied unintentionally, but the fact remains that the most luxurious of foreign growth does require much pruning.

To summarize, it cannot be overemphasized that the underlying causes of these obstacles to advancement abroad or of objections to such advancement lie in faulty practice, teaching or presentation in this country. We must elucidate our belief and our practices so that they cannot be misunderstood, and carefully review European and Asiatics beliefs and practices, in order that these may be corrected and careful recommendations given. In other words, a clearing house is needed.

Methods Advocated and Found Profitable

We turn now to causes of advancement abroad, and summarize first advances in education along lines of scientific management. These are most astounding. In France there is an endowment of one hundred thousand francs a year given by one of the prominent manufacturers, which enables technical students to visit highly organized plants. There is also the start of an organization which meets every month to discuss problems of management which, while it has as yet only a few members, will doubtless grow steadily. In Denmark efforts are being made to introduce efficiency as a subject in the polytechnic schools. In Iceland, the professor of psychology at the University of Reykjavik is the foremost advocate and exponent of scientific management in the country. He has visited America, is doing installation work, and is interesting his students and the entire community in the subject. In Italy there is an institution for special instruction which makes physical and mental tests, provides vocational tests and assists in placement. There, as in many other countries abroad, a start towards education in scientific management is being made through advances in applied psychology and through correlating applied psychology with management. The conferences held at Barcelona in 1921 and at Milan in 1922, while discussing primarily vocational guidance, showed enormous interest in scientific management and invited papers in that field which were presented, enthusiastically discussed, and published in their transactions. In England, university and extension courses already exist everywhere, and while these are criticised as "mostly sociological," they are undoubtedly stimulating interest in the subjects throughout the entire educated community. The Industrial League and Council and similar bodies are also giving courses. These are characterized at present as "inspirational," but will doubtless become more specific as time goes on. In Belgium there are conferences conducted by the universities in industrial centers. In Canada the director of a technical institute states that scientific management is not taught in the schools, but there is every indication that it is being taken up by groups of educated members of the community everywhere.

One correspondent, who is especially interesting—a soldier in the great war and a prisoner in Holland—who kept up his studies in scientific management during that time and undertook the translation of an American book on the subject, informs us that the universities and other institutions are enormously interested in the subject and are spreading information throughout the country. Cornelia Stratton Parker, author and investigator of working conditions in industry, on her recent return from Switzerland and a tour through many countries abroad, tells us of the growing interest in educational as well as other fields. In Japan there is a psychological institute as well as a technical university, and translations of books on efficiency have been made. We have also very recently received the journal of a Society of Chinese and American Engineers in China which includes in one number reprints of two American articles having to do with management, one on an indexing system for Engineering Societies by Mr. Craver, and the other one on applications of motion study. We know also of installations by a Chinese graduate of an American college. The work in the Dutch universities, especially in the University of Delft, is well known and so also is the work of the German universities, where in Berlin, Dresden, Aachen and others centers of thought, not only the principles but the technique of management and psychology are being developed to a high state of perfection.

We have had occasion to judge of the products of the Dutch universities and find them not only instructed in the principles, but able, after a small amount of instruction, to enter profitably into American industry and to make positive contributions not only to production but to technique.

It is not surprising to find that the work of applied psychology is carried on by well established institutions, but it is surprising to find that the work of vocational guidance which is comparatively new has so soon become established as of scientific value, is conducted by institutes, is closely affiliated with both applied psychology and scientific management, and is obtaining excellent results. In Spain the Institut d'Orientacio Professional is adequately supported by the city and province, though it was founded by the initiative of the professors. It tests young men intensively in order to place them congenially in conveniently located places. It has four sections—informational, physical tests, mental tests and statistical. Its tests are exhaustive and the results are correlated with findings in America and in Spanish industry. The institute also conducts tests for the conductors of the Municipal Auto Bus Company and for military aviators. Thus the professors keep in close touch with industry itself. It plans cooperation with engineers and is endeavoring to secure a burden in the department of the Minister of Work at Madrid, which shall investigate scientific management and its application to the entire country.

Similar institutions exist in England, France, Italy, Czechoslovakia and other countries. In Czechoslovakia the Institute of Applied Psychology is a part of the Masaryk Academie of Work, which insures due emphasis on the industrial side. The head is a psychologist who has medical and technical experts affiliated with him. The boys of the country are tested with the latest tests and apparatus of all countries. The results are most noteworthy, and those in charge feel that they "have passed from the period of the speculative swamps into the running waters of empirical research." Their findings are most interesting, for they are not only endeavoring to discover in every case the lowest grade of intelligence that can handle any given type of work, but also to make sure that any types capable of higher work are at once tested for advancement. In fact their findings along some of these lines of work seem pioneer work. In Denmark the advantages of small committees to handle problems of vocational guidance and placement for local communities are advocated. These committees are to write texts for apprentices; a typical committee is to consist of a professor of a psychological laboratory, a professor of economics, a government director, a working man and an employer. It is planned that such a committee in a chief city shall serve as an example for the formation of similar cooperating committees throughout the country.

There is much consideration abroad of the philosophy of management and of the relation between administration and management. This we see in England, and very plainly in the discussions in France. The interest in management seems to have developed along three lines. These are described as Taylorism, Fayolism, and Amarism, according to the findings of our own Taylor, of M. Henri Fayol, a distinguished scientist, and of Prof. Jules Amar, who has for years cooperated with us in investigations concerning the crippled soldier, fatigue, and other lines of activity. The literature concerning Fayolism is of astounding volume and is creating an enormous amount of interest. Prof. Amar's writings are well known in this country as well as abroad and their distinguished significance is universally acknowledged. The distinction between these three branches of activity in France is very plainly drawn and must be thoroughly understood if the situation in France is to be appreciated.

There is little talk as yet abroad of the application of scientific management in selling and finance, although the subject is being considered in Germany. This is not surprising, however, in that in this country also the application in these fields followed the application in the field of production.

One of the most vital questions abroad is that of standardization. Sixteen countries at present handle this through standardizing organizations.[6] In Holland the value of the results from the Dutch standardization office are universally acknowledged. It is assisted in its work by eleven special committees composed of engineers in practice and in scientific institutions. One of our foreign clients is rejoicing that the manufacturers have come to the point where they are actually wording their orders in terms used by the standardization committee. Perhaps these satisfactory results have also assisted in popularizing scientific management, for installations in Holland seem to be singularly successful.

The progress of standardization in Germany is noteworthy as are the results. There is an increase in "vertical" management. This means that the larger works, manufacturing finished products of great value, make sure of the basis of their manufacture by purchasing factories manufacturing products of a lower degree of finish and even mines. Also, the horizontal organization has spread more and more. Works of the same kind associate for purchase or sales purposes and an association of this kind tries in its turn to become a link in the chain of a vertical organization. Throughout the country there is felt a need for more science, for accurate time and motion study, which is closely allied to the emphasis on standardization. The unstable currency has led to "a calculation of values in weight or measures of material used—and in amount of working time." This is so eminently satisfactory that it will probably continue even after the currency becomes more stable. There is also an enormous increase in better tools and in better material, such as stellite.

In Czechoslovakia the leadership in standardization is held by the Masaryk Academie of Labor. This has been functioning along lines allied with scientific management for only a short time. During 1922 and 1923 the work was largely educational. This has been so successful that they are now pressing forward to more intensive standardization. With the approval of President Masaryk and under the direction of an enormous number of scientists of first rank, work processes are intensively studied and the results put at the disposal of the entire community. Around the table gather, with an equal voice in the proceedings, psychologists, physiologists, economists, sociologists, engineers, employers and workers, with the work tools at hand, with the work processes demonstrated —all endeavoring to find the One Best Way for each work process for the individual worker involved with his available tools and material. The wealth, the resources, the brains, the interest, and the cooperation of all Czechoslovakia stands back of this work.

In Russia there is a strong and deep interest in scientific management, and in standardization, as also in applied psychology and vocational guidance. Mr. Walter N. Polakov informs us: "In Russia, the scientific management movement assumed several peculiar characteristics. In the old world its aim was *making profits* in the environment of *free competition.* In the Soviet Republic it was called upon to help in *making goods* on the basis of *cooperation.* It was therefore not limited to a plant, but extended over industry. Another temporal rather than local characteristic was shortage of skilled mechanics after the War, in which more men were lost than by all the Allies together, and especially after interventions, when proletarian regiments formed of skilled workers were wiped out.

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[6] "Progress in Industrial Standardization During 1923," by A. W. Whitney, Chairman, American Engineering Standards Committee.

The third characteristic of the Russian scientific management movement was that it assumed the form of a nation-wide educational campaign embracing farmers, all government employees, and school children. The fourth point of distinction is seen in the large scale laboratory researches, coordinated from the Central Institute of Work at Moscow, with thirty-two branches in various localities all over the country. The fifth characteristic follows from the above large scale undertaking, and reflects the national characteristic as well—namely, the theoretical thoroughness with which even minor details are studied and checked with the aid of higher mathematics. The sixth and last ear-mark is that the entire movement is regarded as a 'workers and peasants' method of rebuilding prosperity and happiness in a Soviet Republic, and not as a means of increasing the exploitation of one class by another.

"To illustrate these six points:

"1. The productivity of industries introducing scientific management in many cases has quadrupled since the start.

"2. The training of industrial workers, based on bio-mechanics, aided by micro-motion studies and supplemented by dietetics and psycho-physiological guidance.

"3. Educational features may be illustrated by the 'trials' publicly conducted by engineering courts, where the defendant may be a boiler showing low efficiency, and the prosecuting engineer accuses it and exposes the reasons; the punishment is, of course, corrective: to install draft gauges and make a gas-analysis, and to keep it on probation until good habits of industry are implanted. In villages, likewise, trials are held over a cow, for instance, accused of low yield of milk and proper diet is imposed as the corrective method.

"4. Research laboratories are in very close cooperation with all scientific societies, medical academies, clinics, psychopathological institutions, etc., as well as with university research and experiment stations and technological colleges. There are over one hundred such cooperating institutions and many demonstrating 'exemplary plants.'

"5. It is interesting that experimental data are always refined and finally reduced to the form of dynamic formulae, chemical reactions, mathematical equations, etc., striving at the fundamental presentation.

"6. Scientific management, being regarded as a matter of the life and pride of the workers' republic, is met everywhere with enthusiastic support. It is introduced also in government institutions such as the Supreme Court to schedule procedure and calendar, eliminate red tape, standardize the forms, train judiciaries in mathematical logic, and banish oratory."

While investigations along lines of fatigue elimination should form a part of all standardization, this is not always the case. In general, we have found, however, more cooperation in fatigue elimination abroad than in this country. There is a large quantity of literature on the subject in Great Britain, although in some of this literature the importance of eliminating unnecessary fatigue is not considered. There is strong emphasis abroad on the physiological side of fatigue and also on the necessity of founding fatigue elimination upon scientific laboratory investigations. While fatigue study was started in this country,[7] if leadership in this field is to be maintained, the efforts of the pioneers must be supported.

The same thing is true for the handicapped. So far as we know, the first paper on the possibility of re-educating the crippled soldier was written in this country,[8] but the work was undertaken so intensively in Germany, in France, in Belgium and in other countries, that this country must devote attention and effort to the problems involved if it hopes to equal the activities on the other side. This work also is closely related to standardization.

As for application of standardization in specific fields, such as in the simplification of spelling, we note abroad a strong desire for simplification and a willingness to cooperate with every nation and every group of thinkers who desire this simplification. Proceedings of foreign countries appear in several languages[9] in order to facilitate understanding, and foreigners both abroad and residing in this country immediately support any plan that will make communication easier and agree that the simplification of spelling is an engineering problem and a necessary department of standardization.[10]

Finally, standardization is closely allied to super-standardization, and to the necessity of intensive

[7]Frank B. Gilbreth and Lillian M. Gilbreth, "Fatigue Study," The Macmillan Co., New York, 1919.

[8]Frank B. Gilbreth and Lillian M. Gilbreth, "Applied Motion Study," Chapter 7, The Macmillan Co., New York, 1919. Frank B. Gilbreth and Lillian M. Gilbreth, "Motion Study for the Handicapped," G. Routledge & Sons, Ltd., London, 1920.

[9]*Annals de l'Institut d'Orientacio Prefessional.*

[10]"Wealth from Standardization," *Society of Industrial Engineers Bulletin,* September, 1923.

investigation in specific fields. In Iceland, the professor of psychology before referred to has made intensive study of the local industries, such as haymaking and fishing, especially the complete handling of herring. This fish, which is extensively packed there, furnishes one of the chief industries of the island. An account of this appeared in a German psychological review, indicating interest in such work. The intensive investigators in psycho-technic in Germany require neither description nor evaluation. It is only a matter of time when every field covered by or allied to scientific management will receive the same intensive investigation with equally valuable results, and this method of attack is spreading throughout Europe and throughout Asia, with headquarters there in Japan. It is only necessary to review laboratory investigations in lines of activity parallel to scientific management in Europe and Asia to realize what must take place during the next decade.

Summary of Present State

To summarize. We see everywhere enormous advances in the promulgation of the principles of scientific management. We find great interest in these advances. We see a growing body of advocates of scientific management—a growing body of teachers and installors. We see a closer affiliation with psychology and economics. We see a development of the technique. We see, in some places, an appreciation of the necessity of the growth of the scientific attitude.

It is important to note that, where the growth is entirely in the spread of the principles and there is a notable lack of growth in the intensive scientific investigation, there is a great variation from the established measured functional management practice, as understood in this country. We have noted this diversity in translations and interpretations. The danger is that unless the scientific side of scientific management is stressed when installations take place, the changes, though apparently slight, will interfere with any complete installation or effective operation of the system. American practice has demonstrated this. We find also that the engineer, under these conditions, is losing his leadership in scientific management—such leadership being undertaken by the psychologist or some allied scientist. Far be it from us to decry the findings or the value of psychology, since we believe that we were the first to call attention to the relationship of psychology to management and to what each could do for the other.[11] But it is obvious that training neither in engineering only, nor in psychology only, fits one adequately to be a manager.

Along with the interest in scientific management developing abroad we find a surprising state of information concerning the subject and a desire to keep pace with the advances. It is doubtful if any prominent European country or progressive country in the Orient can be found as ignorant concerning developments in America as is this country concerning developments abroad—yet it is impossible for engineers in this country to do the best installation without keeping in close touch with advancement abroad. Developments there must form part of the working data of investigators in scientific management and especially of installors, if there are to exist either worth-while research or satisfied clients.

We have noted everywhere the increase of research work abroad, both in the sciences allied to scientific management and in scientific management itself. The only reason why the advances in scientific management are not more noteworthy is because the problems involved are not thoroughly understood.

Recommendations

No reviewers of progress abroad during the last fourteen years have a right to consider their recommendations of enormous or of final value. They can, however, serve as thought detonators.

This country has succeeded in convincing the world that scientific management is a splendid philosophy for industry. No more time or effort is necessary to stress this point. The world is now convinced that management is a science; that it cannot develop adequately unless it is based on careful accurate scientific investigations of the minutest details involved. To stress this is now of paramount importance, but if the countries abroad are to be convinced that management is a science, this country—and especially the engineers of this country—must believe this and support scientific investigations in this field. Half-way measures, opportunism and satisfaction with "good enough" results must be done away with. The necessity of finding the One Best Way to Do Work must be acknowledged. Engineers must, as a body, advocate and undertake intensive investigations in the field of our science, the science of management; in

[11]Lillian M. Gilbreth, "The Psychology of Management," in *"Industrial Management,"* May, 1912, May, 1913; The Macmillan Co., New York, 1914.

the intelligent handling of materials; in the intelligent handling of men; and in the intensive investigation of the One Best Way to do each operation of each process involved in every industry. This emphasis and insistence on scientific management must be preached and followed unceasingly. If it is not, this country will lose leadership in scientific management. If it is, there is at least a chance that such leadership may be maintained here. But only if it is deserved!

News of the Sections

THE New York Southern Tier Section is now holding regular meetings the second Monday of every month. At the May meeting C. E. Killinger, General Manager of the Willys-Morrow Company, presented a very interesting and able discussion of the subject "The Coordination of the Various Divisions of a Manufacturing Organization."

On June 9, Earl G. Brooks of the same company addressed the section on the subject of "Time Study."

The Central New York Section has invited the Southern Tier Section to a joint meeting in Syracuse June 20. Mr. Douglas S. Keogh, Manager of Operations in the Eastern States for Charles E. Bedaux & Co., will speak and the personnel and time study men of member firms will be special guests. This meeting will be the last until fall except for a get-together social afternoon and fish dinner sometime during the summer.

The New York Section, meeting at luncheon May 15 with local sections of the Management Division of the A. S. M. E. and of the S. I. E., was addressed by Dr. Ralph E. Rindfusz on "Interdependence of Production Engineering and Merchandising."

The April meeting of the Cleveland Section was a symposium on "Scientifically Set Sales Quotas." The following executives from some of Cleveland's largest manufacturing companies spoke: Paul Gremb, The American Multigraph Co.; W. R. Sieplein, The Sherwin Williams Company; E. M. Sutherland, The Willard Storage Battery Co.; Joseph Carlton, The White Motor Co.; Harry R. Canfield, The Empire Plow Company; and Loren Morlan, The Joseph & Feiss Co.

William R. Williamson, of Williamson, Tubbs & Co., Chicago, who happened to be in Cleveland that day, contributed to the discussion also and explained his charts for the management of a sales department.

The last meeting of the season for the Cleveland section, May 26, was one of the best both as to attendance and interest. H. S. Person, Managing Director of the Society, talked on "The Potential Growth of a Plant Using Scientific Methods."

"Locating an Office" was the subject of an address before the Chicago Section of the Taylor Society on April 24 at the City Club. The paper was presented by Warren D. Bruner, President, Bruner and Simmons, Inc., and discussed by Lewis B. Ermeling, executive secretary of the National Association of Building Owners and Managers, and by William D. Murphy, office controller of J. Walter Thompson Company, who pointed out how the factors outlined by Mr. Bruner applied to the space selected by his company for its new office in the Wrigley Building.

A special meeting of the section was held at the Old Colony Club, at noon, Saturday, May 19. H. S. Person, Managing Director of the Society, talked on "Recent Developments in Scientific Management" with particular emphasis on the influence on management of present industrial conditions.

The regular meeting, May 15, was addressed by Dr. J. M. Fitzgerald, who for the past thirty-five years has been active in vocational guidance work.

At the special meeting, discussion was opened relative to holding the Spring 1925 national meeting of the Taylor Society in Chicago. The favorable action of this meeting to the plan was ratified at the May 15 meeting and the following promotional committee was appointed: William R. Williamson, Chairman; Warren D. Bruner and Lynn W. Beman.

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