SOCIETY OF INDUS. ENGRS.

THE PRACTICAL APPLICATION OF THE PRINCIPLES OF INDUSTRIAL ENGINEERING

The Practical Application of the Principles of Industrial Engineering

COMPLETE REPORT OF THE PROCEEDINGS OF THE SPRING NATIONAL CONVENTION

HELD UNDER THE AUSPICES OF

THE SOCIETY OF INDUSTRIAL ENGINEERS

Philadelphia

MARCH 24, 25 and 26, 1920

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For their contributions of material for this exhibition The Society of Industrial Engineers is indebted to the firms named below and desires to acknowledge its sincere appreciation for their cooperation.

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OPENING SESSION

WEDNESDAY AFTERNOON

March 24, 1920

Chairman: L. W. WALLACE
President, The Society of Industrial Engineers

THE CHAIRMAN: I will ask you to stand while the Reverend Arthur C. Baldwin of the Chestnut Street Baptist Church delivers the invocation.

. . . Invocation . . .

THE CHAIRMAN: I am sure that we are honored in having a representative of the Mayor of the City of Philadelphia and also of the Philadelphia Chamber of Commerce here to extend to us a word of welcome. I take pleasure in introducing to you Mr. Edward James Cattell of Philadelphia. (Applause)

MR. CATTELL: Mr. President and members of this association—two tasks of that size is a pretty big job for a man of my size physically, but my joy in meeting you ought to help me to put heart into my words and make you realize that in welcoming you in behalf of Mayor Moore and in behalf of the Chamber of Commerce, which I believe, has the largest membership in the world, approximately eight thousand members, we welcome you cordially to this old city of the Mother Republic.

We have been accused of not bragging. You don't often hear a mother say that she is the best mother in the world—she prefers to speak of her children, and Philadelphia prefers to speak of the achievements of her children and let the children say something about the old mother city. At the same time, we do resent a little of the idea that we are slow and asleep. As I said the other night in a meeting, when somebody introduced me as "Mr. Cattell of old, sleepy Philadelphia of America"—"If we're alseep, Lord help the others because it sure is a restless sleep." Every second we make ten pairs of stockings; every second we make a new saw; every two seconds we make a hat; every three seconds we make a pair of lace curtains; we build a trolley car every hour, a locomotive every two hours, a new home every twenty minutes, and in normal times, a baby every thirteen seconds. (Laughter) It seems to me that if we are asleep, we sure do work while we sleep.

Another thing—two and one-half million little children are alive at this moment, not one of whom would have been alive if we hadn't made a serum that helped doctors to overcome diptheria; over three million men are now alive who would not have been alive if we hadn't discovered a serum to fight lockjaw.

Out here about a mile from where we are now gathered, you will see what I am pleased to call the greatest philanthropy in the world, $40,000,000 left by Stephen Girard, fifteen hundred orphans taken care of all the time, money spent on their education. One of them is now the chief engineer of a great city; one hundred of them are at the head of great financial institutions, all doing credit to the Alma Mater of that institution because of the kindness of a man who came here poor—who, a man of foreign birth, has blasted the idea that people from overseas cannot become good Americans.

As the statistician of this city, you may be interested in the fact that I made a very careful estimate of the city, taking the great sums of money we have made in leading in great movements such as the transfer of horse railways to electrical railways; in electrical work; the building of the Northern Pacific and the opening of the northwest—I worked with J. Cook up until the time of the failure of that and people laughed at us—in opening the southwest, the Texan Pacific, and my estimate is that we have a per capita wealth of over three thousand dollars, which is twice as much as the per capita wealth of the United States. In one of our savings banks you will find two hundred and ninety-eight thousand separate laborers' accounts, all serving the city and inter-locking capital and labor without paralyzing the world.

I am glad to welcome you here and proud because you stand in a movement that must prosper if the nation is to continue. (Applause) I don't know whether you realize that our enormous national wealth is equal to only six years' wealth in production. That means that we waste from eighty to eighty-five percent, or spend from eighty to eighty-five percent of all we create of new buying power in a given year. Now you see what was our salvation in the war—war economies coupled with excess war production under necessity, produced a maximum of over twenty-four billions, leaving us actually richer in wealth at the end of the war than when we entered into the war. But there is a tremendous waste; there is a tremendous and foolish prodigality of spending and if we can systematize our operations and individual habits of life along scientific lines, we can reduce our expenditure every year certainly below sixty percent of what we produce. I made a little calculation, taking this leap year, and the estimate of wealth to be produced works out about twelve hundred sixty dollars every tick of the clock.

When you meet a pessimist, just remind him of that fact. It's important because the pessimistic lines lead to paralysis, and paralysis, death. I hate a pessimist—he is nothing more than a blind man in a dark room looking for a black cat that isn't there. (Laughter) He will lick his children for growing; he has no perspective. Let me illustrate what I mean by that. I was left in charge of a young nephew of mine one night and I was very much interested in my paper and wanted to read. This boy asked about ninety questions a minute and I offered to give him a dollar if he worked out a problem—a well twelve feet deep, every time the cat jumps up three feet, he falls down six feet; how long will it take the cat to get to the top of the well? He covered both sides of two sheets of paper and said, "Uncle Ned, will you give me another sheet of paper?" "Why, you little fool, you should work that out in your head—a well twelve feet deep, every time the cat jumps up three feet, he falls down six feet." "Yes, I understand it perfectly, but if you give me another sheet of paper and five minutes more time, I'll have that cat in hell." (Laughter)

That seems very foolish and nonsensical, the foolish remark of a foolish boy, and yet that was duplicated in New York when the papers came out with glaring headlines and said, "Congress appropriates $42,000,000 for war—we can't stand it another month." Why didn't they say that Congress appropriated $42,000,000 to save the life of the nation and that the American people created $100,000,000 new spending power and that the $42,000,000 was only the expenditure of 42% of the new spending power created in the same period of time.

It's utter nonsense for a man to be a pessismistic in these days. It's against the proper development. Let's find a way to do it! The French say that if a thing is possible, it's done; if impossible, we'll do it. You find a common meeting ground where you can all agree and then differ on non-essentials.

A young friend of mine was sent over to France on a mission during the war and he met a man who had been over there a long time and he said, "au revoir." "What's that?" "Good bye in French." The young man came back here and said, "Carbolic acid." "What's that?" "Good bye to everybody." (Laughter) We can find that common word in every language—let's find it and get rid of our pessimism.

During the dark days of 1914 I was talking to a Western banker saturated with ink and gloom and I said, "How far can a dog run into the woods?" "Cattell, don't try to be funny, things are too serious." "Answer my question and then I will answer yours." "Why a dog can run in the woods as far as he wants." "No, he can't, for after he gets half way in, he is running out on the other side." Foolish, yes, but when you get to five minutes to midnight, you are only at the end of a day but you are near the beginning of another day.

I like that saying that "He who wrestles will be strengthened," and, "My enemy is my helper," and, "The more the marble wastes the more the statute grows," and I think they are considerably applicable to America. We have got to learn to think in terms of continents rather than countries. We have got to grip that idea of Emerson's that we are strong by our relativeness, each saving to the other and out of the general saving of that which was waste produce another power to buy. We must solve some of the problems which make for economy.

I got about the best lesson in philosophy about one hundred years ago when I was dancing with a young lady. I thought I was dancing particularly well, thoroughly enjoying myself, and I said, "What a remarkable floor to dance on," and she said, "Why don't you dance on it and keep off my feet?" (Laughter) That's the idea! If I had thought more of that girl's good time and less of my own, I would have had a good time and she would have had a better time. That's the idea! It's to so increase the productivity of this old earth from its natural resources to lessen the cost of those raw materials, making them of service to mankind that the economies of new wealth will bring the new wealth and production to solve some of these difficulties.

As for labor, I am not a bit afraid. I was in New England last week and I found a general feeling that we had passed the peak of those troubles. In the south I found the same thing and out through the west, Detroit, Cleveland, Cincinnati and St. Louis, and among those that do not scare quickly and who have faith in themselves and this America of ours, I find that they have a feeling that we have turned the peak and we turned that peak when that man in Massachusetts took the police in hand. (Applause)

This America of ours is going to live. I have seen it grow; I have seen the homes of this city multiply from 80,000 to 300,000. Take one prosaic detail—when I was young, you had to pay a rental of $150 a month to get a house with a good bath in it, and at the present time we have 340,000 bathrooms in this one city—more than other city in the world, and 140,000 of our small houses have permanent laundries built in them. That may seem trivial, but in the first place, it saves us ten percent of our expenditure of water; in the second place, it brings a good rental, and in the third place, it is equivalent to five thousand dollars each year paid to laborers. It saves doctor's expense, where the wives run risk of strain pumping the water, slipping on the ice, and so on. I figured at one time that the introduction of that little thing resulted, in addition to our revenue as a city, in a saving of over twenty millions a year—the preventable death in Philadelphia represented an actual wealth greater than the cost of building our traffic system, actual, as well as potential wealth, in preventable death.

Now those are the things to do and if you can eliminate friction and do that, and will do that to bring America to the point where she utilizes her raw materials which are available at the least possible expense, you are doing God's work as well as the work of statesmen; you are lifting your profession to the highest level, and I do bid you Godspeed.

I love this dear old city. Many times I have come to the top of this hotel when I was almost breaking under the strain and I looked out over this city, the city which I have praised and spoken of to seventeen million people within the last twenty years, and during the war I lifted my soul to the living God. From this very balcony here I asked Him to protect those homes and protect this America that I love, and it seemed to me I had the vision of Elijah and I could see in all those little homes the mothers asking Him to "Give us this day our daily bread" and I saw behind the clouds those large reinforcements that always come to the rescue. Don't be afraid of the future because the principles for which old glory stand are God-given.

You are very welcome to this old mother city of Philadelphia and may I ask each one to reckon in the gravity of the hour the fact that the world is leaning on America for help, material and spiritual; that each one of you, as you go home, visit that old Liberty Bell and renew your oath of allegiance to the Highest and to those principles of government which make very man a sovereign and every woman a sovereign of divine right. May God bless you and bring out of your deliberations those things that will help this city that I love, this state that I love, and this country that I love, in our present need. (Applause)

THE CHAIRMAN: Mr. Cattell, I wish to express to you our appreciation for this instructive and valuable word of welcome and I am quite sure that all agree with me that Philadelphia is not asleep, and because we realized that is the reason that we are here. (Applause)

The program committee saw fit to have your President open this conference by presenting a paper which is to outline the objective of this conference, and will also indicate to you something of the scope and activities of The Society of Industrial Engineers. The committee assigned to me a a rather large task, one which I have labored over a good deal and now you must suffer as a result of that labor.

"WHAT THE PRINCIPLES OF INDUSTRIAL ENGINEERING ACTUALLY ACCOMPLISH WHEN APPLIED BY THE FOUR CLASSES OF INDUSTRIAL ENGINEERS"

1—Managing Executives—including Directors of Employment, Safety, Welfare and Medical Departments.
2—Professional Industrial Engineers—Consultant and Resident.
3—Technical and Accounting Engineers—Consultant and Resident.
4—Specialists in Industrial Economics—including Teachers, Psychologists, Professional Labor Mediators, Publicists, etc.

L. W. WALLACE

President, The Society of Industrial Engineers

The general topic for discussion at this conference is "The Practical Application of the Principles of Industrial Engineering." In planning the conference, it was urged upon all speakers that they speak in practical terms; that each show by a concrete example how the principles of Industrial Engineering have been applied and with what results.

As there appears to be some confusion in the minds of many as to the real function of the Industrial Engineer, and indeed, as to what is an Industrial Engineer it is advisable to begin the conference by defining the term Industrial Engineering and to indicate briefly the principles that must guide the work of the Industrial Engineer.

In one of the current periodicals there has been a discussion of Industrial Engineering. This discussion has taken the form of answering five questions as formulated by Mr. Berndt, a vice president of the Society. The questions being asked are:—

First. Is Industrial Engineering an art, a science, or a profession, or a part of all three?

Second. What is its scope?

Third. How does it effect the other recognized engineering professions?

Fourth. Who are Industrial Engineers?

Fifth. What is the position of the Industrial Engineer in Industry?

A discussion of the questions raised will be helpful in many ways and will enable all to participate in the conference with a more unified thought as to the fundamental subject of Industrial Engineering.

At the risk of appearing academic, some of the terms to be discussed will be defined. No apology is to be made, however, as it is only by tracing a subject from its source that a true conception can be obtained of it.

Engineer.

The basic word is engineering. We find that the root for the word engineer traces through old English and medieval Latin, to the Roman verb, **genere,** meaning, to beget, to create.

In the purest sense, therefore, an engineer is a creator. Unfortunately many who are accepted as engineers are not creators, but all should aspire to be. Mr. Henry R. Towne once said that:—

"The engineer is one who, in the world of physics and applied sciences, begets new things or adapts old ones to new and better usages; above all one who, in that field, attains new results in the best way and at the lowest cost."

It is evident that if one is an engineer in deed and in truth, that he must be creative, be productive; that he must be familiar with the laws of physics and of science and so apply them as to obtain useful results at the lowest cost.

In a recent statement of the Honorable Franklin K. Lane as published in "Industrial Management," he said, "By an Engineer, I mean the man who can apply imagination to facts—the planner, the one who sees his way through, the one who deals with realities in the light of possibilities."

"The pioneer in all enterprise is the man who plans, the thinker who sees the opportunity for development of a resource and the supplying of a need. He studies the difficulties, gets his levels finds his sources of supply, discovers the demand that must be met, and plans the methods by which these can be brought together, such a man, states Mr. Lane is known by a dozen different names, the most dignified of which, perhaps, is engineer. . .

And more and more we will find use for the man who thinks ahead with the sure back ground of facts. This is statesmanship; this is engineering." said Mr. Lane.

We concur in Mr. Lane's conception of an engineer and we hold that it conforms with the best definition of the term. An engineer is a creator; he is one who thinks ahead with the sure background of facts.

But engineering is broad in scope. It touches in some way every phase of human life. The artist would have been unable to execute his master-piece; the musician would not have played his harp; the surgeon would not have performed his marvelous operation; the dentist would not have reformed the mouth; the scientist would not have unearthed the mysteries of nature, if the principles of engineering had been non-existent, or if they had not been applied by "the man who thinks ahead with the sure back ground of facts."

Since engineering covers such a wide scope, it has become increasingly necessary to divide it into special branches. Formerly there were only two classes of engineers, the military and the civil. The military engineer was concerned with all the engineering problems of the army and navy. In later years the functions of the military engineer have greatly increased and specialization has become a necessity. Formerly a civil engineer meant a man in civil life who did engineering work of whatever character outside of a purely military realm. But this activity became so vast that the engineer in civil life or "Civil Engineer" had to specialize. Hence there have arisen branches of engineers known as Civil, Mining, Electrical, Mechanical, Industrial and many others. Indeed there are many sub-divisions of each of these.

Industrial Engineer

Our particular concern at the present moment is with the Industrial Engineer. What is an Industrial Engineer, we ask? We have indicated that the engineer is a creator, a planner. Then what does the Industrial Engineer or Industrial Creator or Industrial Planner, create or plan? Again we turn to the definition of terms and find that, "Industrial, means that which relates to industry, or to labor as an economic factor." Another meaning, and the one that is most applicable to our discussion is, by "industrial is meant that derived from human toil, rather than from natural advantages or resources on the one hand, and mere pecuniary profit on the other." In the light of the definition of an engineer and of the word industrial, we can say that, the Industrial Engineer is the creator of plans that relate to human toil, for productive purposes; or, the Industrial Engineer is one "who deals with realities in the light of possibilities," as they relate to human toil for productive purposes.

The productive purposes for which the human toil may be used may be the manufacture of a knitting needle; an automobile; an aeroplane, or it may be applied to determining the best method for finding the cost of a locomotive, the sale of a pin, or the checking of a pay roll. And again, it may be used for establishing standard practice; in scheduling the work through a factory; in routing a salesman over a given territory; or a workman through an employment office or a course of training.

Indeed the Industrial Engineer, as the creator of plans, may apply his skill to the best way of accomplishing any task, or to the establishment of standards for any procedure. His scope is unlimited, hence the confusion. As ordinarily and narrowly used, the Industrial Engineer is considered as one having to do with the productive methods of a factory. This, of course, is a very restricted and a very narrow view.

Mr. Henry R. Towne, in an address in 1905, defined the Industrial Engineer as "The man who combines with an extended scope of technical knowledge, good administrative powers; who can select the right man for the various positions to be filled; who can inspire them with ambition and the right spirit in their work; who can coordinate their work so as to produce the best final result, and who, throughout can understand and direct the technical operations; who can appreciate quickly and surely whether they are properly performed; and who combines in one personality the two functions of technical knowledge and executive ability."

We grant you there are few who can measure up to the standard set by Mr. Towne, yet he has established an ideal which all Industrial Engineers should endeavor to reach.

Our friend Mr. Harrington Emerson defined the Industrial Engineer by outlining his function. Said Mr. Emerson in his address to this Society last March:

"It is the function of the Industrial Engineer to discover industrial standards, to make them known, to emulate them and teach how to realize them." Mr. Emerson's outline of the functions of an Industrial Engineer might be re-stated in this way; The Industrial Engineer is a creator of industrial standards, a planner through which standards become known and applied and realized.

To summarize, the Industrial Engineer is a creator of plans and standards to govern the use of human labor for productive purposes.

We have answered the question, "Who are Industrial Engineers?" We have indicated that the scope of the Industrial Engineer is unlimited. He may, and does create plans to govern human labor in every activity of human life. This is the broad interpretation. That it is possible of attainment is evidenced by the fact that the services of the Industrial Engineer have been utilized in industrial plants, hospitals, transportation systems, educational institutions, banking houses, commercial enterprises, military activities, both on land and on sea, insurance offices, and many other enterprises. One of the most interesting applications came to my attention within recent days. Upon entering the office of the Medical Advisor of a large Insurance enterprise, we were immediately impressed by a set of large charts upon the wall. After a few minutes conversation with the Medical Adivsor, he turned to his desk and picked up other charts and some tabulated data. In the course of that interview, it became evident that the work of that medical division was being planned, scheduled, routed and checked up in as systematic a way as would have been done in the production office of any factory. That Medical Advisor was an Industrial Engineer, but he did not realize it. It was a pleasure to talk with him because his entire concept was that of an Industrial Engineer. Unquestionably, it may be said, that the scope of Industrial Engineering is universal.

Art, Science, Profession

We now wish to discuss the question, "Is Industrial Engineering an Art, a Science, or a Profession, or a part or all of them?"

Art is defined as (1) "Skill in applying knowledge or ability to accomplish a concrete purpose;" (2) "Facility resulting from practice, dexterity, hence power;" (3) "An organized body of men in some trade or profession."

If an Industrial Engineer is worthy of the name, then he certainly must have skill in applying knowledge; he must have ability to acomplish concrete results. He is then an artist in so far as it relates to the application of fundamental knowledge to the problems of industry. If it is true that the Industrial Engineer, when applying fundamental knowledge to the problems of industry for the purpose of accomplishing concrete results, is an artisan, then it naturally follows that Industrial Engineering, as such, is an Art.

"Is Industrial Engineering a Science?" We find Science to be defined as; (1) "Any department of knowledge in which the results have been worked out and systematized; an exact and systematic statement of knowledge concerning some subject or group of subjects". . . (2) "Knowledge obtained individually by study of facts, principles, causes. . . " (3) "Expertness or ability to do, resulting from knowledge. . . ."

It is unquestionably true that in a number of distinct lines of Industrial Engineering that results have been worked out and systematized and that a large amount of knowledge has been acquired through the individual study of facts, principles and causes. For instance, "The Art of Cutting Metals," and, "The Principles of Scientific Management," by Mr. Taylor; "Wage Payment Plans," by Mr. Emerson, Mr. Gantt, and others; the "Control Boards" by Mr. Knoeppel, Mr. Babcock and others; the elaborate "Motion and Fatigue Studies" made by Mr. Gilbreth; these and many other such studies have been made and applied in solving industrial problems. Hence, there is a science of Industrial Engineering and there is an art of Industrial Engineering because there is an accumulation of knowledge, systematized and available pertaining to industrial problems, and there is a large group of men skilled in the interpretation of application of such systematized knowledge.

Someone has correctly said, "**Art always relates to something to be done, Science to something to be known.**" "Science does not make production its direct aim, yet its possible productive application in the arts is a constant stimulus to scientific investigation. Science is urged on to higher development by the demands of Art, while the Art is perfected by the demands of Science." This we believe to be true in the realm of Industrial Engineering as well as in many other activities.

To repeat, both Art and Science have a place in Industrial Engineering, and the Industrial Engineer, as an artisan, must constantly apply scientific principles if he is to do worth while things.

Profession

All of the proceeding discussion can lead to no other conclusion than that Industrial Engineering is a profession. Because, to be worthy of the name of an Industrial Engineer is to have acquired special knowledge and to have developed sufficient skill to instruct, to guide, or to advise others in the use of the special knowledge. One competent of rendering such service, is, in the strictest and purest sense of the meaning of professional, entitled to be considered a professional man. The reverse is therefore true, namely, if those who are competent to practice in the field of Industrial Engineering are professional men, then Industrial Engineering is a profession. It is unfortunately true that there are some who profess to be Industrial Engineers, who are not, in any sense, professionally qualified—but this should not detract from the credit and the economic value of a large number of competent men in the profession of Industrial Engineering—men who live up to and who would meet the most rigid ethical requirements—men who would gladly subscribe to and live by such ethical ideals as Mr. Emerson mentioned in his paper before this society last March.

Ethical Code.

It is well to recall these, and in so doing, we hope that others will formulate other ideals, so that, in the course of time, we may have a well developed, appreciated and observed ethical code. To quote:

"No Industrial Engineer can set up unreasonable or distinctive standards to favor the employer as against the employee. He must not countenance anything that is unfair to either. He must be as fair as is the commercial chemist with his analysis, or as is the mint when it buys gold."

"To be obeyed industrially, the Industrial Engineer must set up unassailable standards, and he cannot for any compensation or reward betray either side."

"The Industrial Engineer, although accepting a fee, cannot prostitute the standards for the gain of either class."

Mr. Schwedtman in an address before this Society at the New York Conference said, "Industrial Engineering as a profession means that the Industrial Engineer detaches himself from the mere purpose of individual gain and associates himself with a broader purpose of general advancement."

It is conceivably the function of The Society of Industrial Engineers to stimulate the activities of the profession; to enrich its ideals; to further its usefulness; and to encourage its adherents to render the largest possible public service in the most unselfish manner. If the Society attains unto these things, then it has a reason for existence, otherwise, it has not.

Industrial Engineers—Classified.

It has been mentioned that the scope of Industrial Engineering is unlimited, that it does and may touch many phases of human activity. So pronounced is this true, that within the field of Industrial Engineering, as such, there are many special branches and many specialties. The founders of The Society of Industrial Engineers recognized this, and therefore established four principal classes of membership, viz:—

1. Managing executives, including directors of employment, safety, welfare and medical departments.
2. Professional Industrial Engineers.
3. Technical and accounting engineers.
4. Specialists in industrial economics, including teachers, psychologists, professional labor mediators, publicists and other allied activities.

We wish to make a brief reference to the work and accomplishments of each of these classes.

Employment Adviser

The Employment Adviser has come to be recognized as one of the prime factors in any organization, be it purely commercial, industrial or educational; for after all, what are the Deans of Men in our large Universities but the chief employment executives. It is not necessary to relate facts to show what the Employment Adviser has been able to produce. His has been one of the outstanding accomplishments of the past five years.

There are, however, many serious problems confronting the Employment Adviser which will require the application of the most fundamental knowledge and the greatest skill and the most humane viewpoint, if they are to be solved for the best interests of mankind.

To name a few of the problems: shortage of labor, both skilled and unskilled; readjustments of wage rates; length of the work day and week; the training of the workers,—how shall it be done; the utility of the handicapped man. It is our strong conviction that industry has no right to place the responsibility of the future of the handicapped man upon his family, or upon society. Plans must be developed, whereby the handicapped man may be speedily restored to a position of economic independence and self respect. Compensation insurance, while helpful, is not the correct solution. It is expected that the manner in which some of these problems have been solved will be expained to us during this conference.

Safety Adviser.

One of the best pieces of work that has been accomplished in recent years, has been done by the Safety Advisers. The Safety Movement has saved untold millions of dollars and thousands of human lives. It is one of the outstanding examples of what a systematic organization can accomplish. The way in which standard practice has been established is indeed remarkable. It is not our desire to discuss this movement at length, but we do wish to remind you of some striking results.

On the Eastern Lines of a large railroad system, the number of accidents to employees for the year ending December 31st, 1914 as compared with the year ending June 30th, 1914 with the same number of employees was reduced from 29.5 to 22.8 per one hundred employees, and there was a decrease of sixteen thousand in the number of days lost by disabled men.

On this same road it has been shown that 23% of those injured had been in the service twelve months or less. Another reason for reducing labor turnover.

A large steel mill, through the work of its Safety Adivser has accomplished the following:—

	Average daily employment of men first quarter	Number of accidents per 100 men employed
1917	2405	6.8
1918	2586	1.00
1919	1800	.77

The two illustrations are only indicative of what has been accomplished. It is known that thousands of plants have realized equally large results through the work of the Safety Adviser. There is yet a large work to be done, however, so no one need fear that the Safety Adviser has outlived his days of usefulness.

Welfare Adviser.

Many have been the discussions as to the functions and the value of the Welfare Adviser. Personally, I consider the term unfortunate—there has become associated with it many false ideas, not to say practices. We were associated with an organization for some time wherein was coined the term "Mutual Service," which is better than Welfare because there is not the stigmatization attached to it. And again, Mutual Service implies more. It implies that the employees and the employer are cooperating for the benefit of each other.

However welfare work may have been exploited, however badly handled, however disliked, yet all those who are conversant with this subject must admit that an untold amount of good has been accomplished through such efforts. There is unquestionably still a need and a place for it in American Industrial and Commercial life. To accomplish the most lasting and the most wholesome results, it must be administered in a different manner and from an absolutely changed point of view than previously. As a sop it is a failure; as a substitute for wages justly due it is pernicious; as paternalism, it is dangerous. If administered as supplementary to fair and full wages,—if conceived as giving that justly due,—if guided by the sincerest motives, and if participated in through the spirit of human kindness and cordiality, it will be a benediction.

Medical Adviser.

The Industrial Medical Adviser is an absolute essential in this day of intensive and mass production. The value of his work was summarized by an editorial in "Industrial Management" some months ago. To quote:—

"When we realize that the average industrial worker is not normal physically, and when we are told that only one industrial worker in five calls a physician when needed, we begin to realize the possible economic value of the service of industrial physicians. When we read of the work that they perform in gaining the confidence of employees, in coaching them in better ways of living and harmonizing them with their shop and community surroundings, we gain an idea of the social and industrial value of the Industrial Physician's work."

Dr. Otto P. Geier, of Cincinnati, has further called our attention to the need of, and value of, the work of the Industrial Physician through a number of important addresses. Said he,

"The practice of Industrial Physicians in rebuilding the health of the working force has long since passed beyond the experimental or laboratory stage, and in a number of representative plants has reached a firm footing of recorded results and established principles from which the service can be evaluated. . . ."

"Any discussion of employees' service must carefully consider the position, work and results of the socially minded physician in industry. . . . The human effectiveness of the nation is needed today at its maximum, for the country cannot afford the usual labor shrinkage due to accident, disease, fatigue, and poisoning. . . ."

"Investigators tell us that only one industrial worker out of five in need of a physician calls on one. What is the connection between these two facts and the lost time in the plant? There must be some relation between the physical condition of workers and industrial accidents; between the deterioration of physical health and labor turnover; between facts noted above and the impressive number of chronic invalids; between the great number of persons who are only casually employed and the unemployables. . . . "

The loss in wages to the employee must be very large and the loss to the employer much larger when it is remembered that bad health plays a large part in inefficiency; in irregularity in attendance; which results in a lower standard of living; in the shifting from job to job, which reduces stability of character.

It is these considerations that have led a large and a growing number of factory managers to add to their staff the industrial physician, who should be a social-minded physician as Dr. Geier very wisely suggests.

That his work has been very valuable is unquestionably true as many know. We are told that in one plant where the health conditions were properly supervised that the absence from work in the plant was only approximately three percent, whereas the average for other shops in the same vicinity, where preventive work was not done, the absence was ten percent.

In a published statement, the Norton Company of Worcester, Mass., says, that a seventy-five percent reduction in loss of time on account of illness has been obtained since the establishment of their medical department.

In the March issue of "Factory," Dr. G. L. Howe presents some interesting and valuable information with reference to the work of the Industrial Physician. We wish to quote some of the more striking statements:

"Each industrial worker in the United States loses on an average of nine days per year because of sickness. . . This statement is based upon official figurers of the U. S. Commission on Industrial Relations and covers one million cases. . . . It coincides with the experience of England and Germany, which were based on twenty-six million cases."

As a result of a careful analysis made of data submitted by seventeen industrial physicians and surgeons, Dr. Howe gives the following data:

Number of days lost per employee per year in industrial work because of illness:

1. Average number based on English, American and German experience, 9.0

2. Estimated days lost by group working under exceptionally good conditions: 7.5

3. Days lost by selected group (after elimination of physically unfit) 5.5

4. Two days saved per year per employee through physical examination.

5. Days lost by soldiers in U. S. army in time of peace 2.85

The data given is indeed significant and indicates the great possibilities to be obtained through the Medical Department.

Dr. Howe also gave this very interesting summary:—

"In a typical plant of one thousand employees, suppose the value to the employer of each employee-day, above wages paid, is two dollars:

1. A conservative calculation places the:

Saving from lessened illness due to medical examination of applicants	$ 683.00
Saving due to prevention of infection at	$2442.00
Saving in workmen's compensation insurance premiums	$1105.00
Total	$4230.00

A careful investigation in 95 representative plants places the

Cost of medical supervision at	$2.21	
per employee per year, or for this plant of 1,000 employees		$2210.00
Balance saved		$2020.00

And besides this there are many intangible savings due to such causes as lessened illness through dissemination of health literature, and through prompt treatment at the beginning; greater output though increasing vigor; and increased good will on the part of the employees."

We are confident that the paper of Dr. Quinby, to be delivered this evening, will give us further information as to the valuable work of the social minded Industrial Physician.

Professional Industrial Engineers.

The Directors of Employment, of Safety, of Welfare and of Industrial Medical Departments are specialists within the realm of Industrial Engineering. They are important factors that contribute to the rounding out of the profession. They are an integral part of the profession. They differ from the professional (professional being used in the sense of the general practitioner—the coordinator—either resident or consultant) Industrial Engineer, as such, in that they are highly specialized, where the professional Industrial Engineer, as such, covers more phases of the subject. A parallel suggests itself in the medical profession—all are doctors but the general practitioner is concerned with many phases, whereas the eye man only treats the eye; the surgeon only performs surgical operations and so on. But the general practitioner is the coördinator, the diagnostician, the one who directs that special attention should be given to a particular part of the body.

In like manner, the professional Industrial Engineer, either resident or consultant, is the chief coordinator, the chief diagnostician, the chief planner. He studies the industry as a whole and assigns to the specialist certain tasks. He indeed may be, and often is, a specialist along one or more lines. To his aid he brings other special and expert advice as the occasion demands. The real Professional Industrial Engineer does not profess to know all that is to be known about all phases of industry. But he does know how to make a correct diagnosis, and on the basis of such, to be competent to direct that certain things need to be given special attention by an Employment, a Medical, or a Safety, or a Time and Motion study specialist. And further to plan the execution of each task so that the work of each specialist will be properly coordinated with that of every other and with the whole.

The professional Industrial Engineer, as such, may be either resident or consultant, or both. If resident, he may be the Managing Executive, and in fact, usually is. In fact, should be because in the last analysis the Managing Executive should be, and if he is properly functioning is, the chief planner; the planner through which standards become known, applied and realized.

All Managing Executives that function as they should and do not permit themselves to become too entangled or engrossed with the routine of mere execution, are professional Industrial Engineers, as was pointed out in the case of the Chief Medical Adviser of a large insurance enterprise.

The resident Professional Industrial Engineer has on his staff his specialists—men who direct certain phases of the work.

The achievements of the resident Industrial Engineer, as broadly interpreted, are many and widely known. The city of Philadelphia has produced many such—Mr. Taylor as a Managing Executive of the Midvale Steel, Mr. Hathaway of the Link Belt Company, Mr. Morris Cook, as Director of the Department of Public Works, of the City of Philadelphia, all have demonstrated in a marked degree the value of the work of the resident Industrial Engineer. Mr. George Babcock, formerly with the H. H. Franklin Company, Mr. J. E. Otterson, Winchester Repeating Arms Co., Mr. Edwin C. Shaw, of the Goodrich Rubber Co., Mr. E. W. Hulet, of the White Motor Car Co., and many others that might be mentioned as illustrations, have fully proven the value of the resident Industrial Engineer. It is unfortunate that a much larger percent of the industrial and commercial organizations of this country have not men of such quality directing their activities. We are indeed fortunate to have with us this afternoon a resident executive—who is to tell us of the work of the industrial executive.

Notwithstanding the importance and the achievements of the resident professional Industrial Engineer—there has been, and will continue to be, a large need for the consulting professional Industrial Engineer. This has been, and will be, true because it matters not how near perfection an organization may become—certain important matters will be overlooked entirely or else neglected through the pressure of other work. And again, a stranger coming in, sees things in an entirely different light. He applies a different standard of measurement. He evaluates upon a different basis. All of which is helpful, and many, many times discloses most serious conditions. The Consultant, therefore, has a value even in the best organized and manned institutions.

The Consultant fills a great need in those organizations that cannot permanently support an expert staff; those organizations that cannot regularly employ specialists, and in fact, would not require such services continuously. The hospital requires a physician in constant attendance, the small family, only occasionally. Likewise, large organizations require professional services of a special character constantly—whereas small enterprises only occasionally. But as the hospital must turn to the consultant in an emergency, likewise the large industry should do so.

The work of the consulting professional Industrial Engineer is growing in importance each day. His services are being appreciated as never before because his accomplishments have been so marked. It is unfortunate that much of his work is of such character that the results cannot be given to the public. But notwithstanding this, a sufficient amount of data is available to prove to any reasonable person that the accomplishments of the consulting Industrial Engineer have been eminently worth while.

The testimony before the Interstate Commerce Commission on the Rate Case, as edited by Judge Brandeis disclosed many instances of large savings through the work of the consultant. It is to be remembered that the information was given under oath, hence must be authentic.

A few specific examples of the good results obtained through the work of the consultant Industrial Engineer were recited in Brick and Clay record some time ago. The data was supplied by our friend Dwight T. Farnham. These are merely indicative of the scope and possibilities, and in no sense relate the full story. It is to be expected that other concrete data will be given at this Conference.

Steam Pipe Factory—Labor cost reduced 20%
Output increased 50%
Automobile Accessory Plant—Economics effected over
$200,000 per year.
Steel Mill—Cost of guiding switches reduced from
$.21 to $.037
Cost of forging braces from
$.612 to $.258 per hundred pieces.

Miscellaneous Steel work, steel castings, cost of labor in good ton reduced from

$7.50 to $4.80 in seven months.

Number of pounds of good castings per molder increased from 1050 to 1700

Such examples of accomplishment could be multiplied many fold. It is hoped that many of you will give expression to your experience as to the savings made through the work of the resident and the consulting Industrial Engineer.

It is readily granted that there have been some losses occasioned by the work of the Industrial Engineer. Some of these have been due to the mistakes and bad judgment of the really qualified consultant. Some have been due to the attitude and action of the management. Some have been due to the poorly qualified Industrial Engineer. Some have been due to the man who posed as an Industrial Engineer, but who had no more justification in claiming to be an Industrial Engineer than has the hole in a doughnut to claim that it is the doughnut. It is the responsibility of The Society of Industrial Engineers, through an organized effort, to make it impossible for the unqualified and the imposter to long exist.

Cost Engineer

One of the outstanding developments in Industrial Management in the last ten years has been the recognition of the very great importance of the work of the Cost Engineer or accountant. No competent executive will today speak disparagingly of the Cost Engineer—the man who gives to the manager a record of costs while it is yet time to remedy conditions that may cause serious loss. It is as dangerous to operate a plant without the right sort of cost system, as it is to operate a ship without a pilot. The ship without a pilot is likely to be wrecked at any moment, upon unseen shoals. The industry that is being operated without proper and correct cost figures will never reach a safe harbor—but instead will be wrecked in some unsuspected moment through some unknown cause.

Is it not ignorance of the actual elements of cost and of their respective significance that accounts for a large share of labor trouble, of unfair competition, of failures, of profiteering? It is our conviction that it is. The employer, not knowing the correct relationship between the cost of labor, or material and of management, concludes, when profits decrease, that he has been paying too much. A reduction in wages takes place—a labor fight ensues.

A manufacturer, ignorant of actual costs, or through a faulty system, arrives at an erroneous cost of a unit of production, or of a piece of construction. One of two things happen, either his price or his bid is too high—consequently he does not sell or obtain the contract. This repeated a few times a bankrupt business results. Either this, or he bids too low. He sells his product or obtains the contract. Loses money—eventually the same result as before—bankruptcy. In either instance the man who knows his costs suffers, and it is only a question as to which has the most capital as to which one will fail first. But it is unfair and dangerous competition.

Correct cost accounting is a matter of public concern and interest. The public suffers through labor troubles, through unfair competition, through profiteering, brought about through an ignorance of the elements of costs and their relative importance. It being true that labor, that capital and that the public are vitally affected by incorrect costs, it then becomes evident that the function of the cost engineer is one of very great importance and that he, in a peculiarly significant sense, may render a large public service. Therefore, to the cost engineer, because of the extreme importance and far reaching effects of his work—we should give much deference.

The Society of Industrial Engineers recognizes the value of correct costs; definitely analyzed and timely presented. The Society realizes that the cost accountant, either resident or consultant, or both, is essential to effective production. It is gratifying that we shall have a paper on "How the Cost Sytem Assists the Management in the Reduction of Operating Costs," by Mr. Ferguson. We anticipate a full discussion of this important paper, and we bespeak for it a sympathetic hearing.

Specialist in Industrial Economics

It is our conception that the present industrial situation as it relates to labor cannot be remedied over night. We now see the result of the accumulation through the ages of the evils of the industrial system. It will require patience and perseverance to counter act the cancerous growth, and to re-establish that bond of fellowship and esteem, that once existed between employer and employee. It is to be a long process of evolution and education.

It is the teacher of broad vision and keen perception that we must turn to in this treacherous hour. It is the teacher who must be used to eliminate the gross ignorance that accounts for a large amount of the present trouble. This ignorance permeates every human element connected with, or affected by, a disturbance of industrial tranquility. The employer does not know any more, if as much, about the real economic situation as does the employee. The employee does not have the correct perception of the cost of production hence is easily persuaded to believe that the employer is making enormous profits. As a result of ignorance on the part of both parties, grievous mistakes are made; rank injustice results; estranged relationships become a fact, employer, employee and the public suffer mentally, physically and financially.

The only remedy that is apparent is education. An education of the masses, of the employees, of the employers.

Our engineering schools should see to it that their graduates who expect to become Industrial Engineers and managers are thoroughly conversant with fundamentals of industrial economics; that they are acquainted with the elements of the labor question; that they are familiar with the importance of shop hygiene, of the principles of first aid, of the value of correct food, and of the basic principles of psychology, or mental hygiene. These things are far more important and basic than the mere mechanics of industry.

The education programme must not end in the college—it must be carried to the vocational, the high and the public schools. Indeed it must go into the shop, the office and into the labor hall. Education is the great need, and it is the intelligent, the broadminded, the properly trained, and the splendidly paid teacher that must do the work. If the teacher has the qualifications suggested, and if he is supported as he should be, the results of his labors will be of inestimable value and unlimited in area of influence.

We are hopeful of a New Day because we see evidence of an awakening in matters of education. Almost every issue of every trade and professional paper contains some account of some executives, formen's or workmen's classes.

Our optimism is further stimulated by the records of splendid accomplishment.

The Packard Motor Car Co. sent its executives to school. Important executives did the teaching. The text book evolved is one of the best texts to be had upon factory management. Many of our universities should use it as the basis for a part of the course in Industrial Engineering. Mr. Stanbrough and Mr. Beall have told us of some of the splendid results that were obtained. One foreman has been quoted as saying, "These classes are the best thing that ever happened. I have learned more about the Packard System in these weeks than in the six and one-half years I have been here."

Mr. Beall in a recent article in "Factory" said, that through the educational work done in the Packard plant, there has been a reduction in scrap and corrective labor; some waste in stock in process had been sqeezed out; there had been a saving in cost of repairs and replacements and the production had kept close to schedule. "But", said he, "the most important result was the acquaintance and confidence that the classes brought about between the executives in the plant and the officials in the front office."

Many such examples could be cited—all subscribe to the value of such educational plans, which leads us to say, more power—more prestige—more pay to the able teacher, because his work is the hope of the hour. To his support and to his assistance, this Society must go.

Editor—Publisher

In the great campaign of education that must be conducted, if industrial peace is to become a reality, the twin brother of the teacher, the industrial economist, the editor, must perform his valued function. The Society of Industrial Engineers welcomes such men into its membership, because it realized that they were indispensible adjuncts to the profession. Indeed the profession and industry could not long thrive without the mediums of exchange of thought and of experience, afforded by the activity of the editor, the publisher. It is unnecessary to undertake to show the value of the work done by the editors and the publishers in the field of Industrial Engineering, for it has been too long evident.

Psychology or Mental Hygiene

We have recently read with much interest and profit an article entitled, "The Mental Hygiene of Industry" by Dr. E. E. Southard, who has been conducting a limited study of abnormal persons in industry through the support of the Engineering Foundation. This article was published in a recent issue of "Industrial Management." It is worthy of your careful study.

Dr. Southard suggests the term "Mental Hygiene" for a rapidly growing group of ideas suggested by such phases as—

". . . the human element, personal factors, individualism, values, workman's standpoint, workman's ambition, creative impulse, instinct of workmanship, role of habit, fatigue and efficiency, anti-social behavior, wasteful emotions, unemployment and personality, the psychopathic employee, civilian shell-shock analogues, neurasthenia, a disease in engineers. All these expressions, and many like them have been found in recent literature, to which an increasing number of articles are being contributed, both by managers, who have grown up in the work, and by specialists from many fields. The term has become familiar because of the excellent results obtained in various fields in war and peace by the National Committee for Mental Hygiene, founded in 1909, and has the special advantage of not assigning the human element to any one particular science, or art, such as psychology, psychiatry or social work."

"When we use the term "Mental Hygiene" of industry, we intend, therefore, very definitely to suggest that something practical in the shape of a new art has been found, looking toward betterment in industry."

"But the personal work of the psychologists in the American army, and the elimination, by neuropsychiatrists supported by psychologists, of the feeble-minded from the army have settled for all time the question of the applicability of skillfully and specially devised mental tests to groups of men as well as to individual men. We do not need to grant one-half of the claims made for this work to concede that this kind of mental measurement, psychology has come to stay. Even if we limited consideration to the personnel work of the Secretary of War's office alone, or to the work of the Nervous and Mental division of the Surgeon General's office alone, we should be able to demonstrate the value of these methods. Of course it will be a long time before the full story of these efforts and results can be properly told by the experts engaged."

"It takes but half an eye to see that many of the methods and some of the conclusions of military psychology can be carried over with due modifications into industry. And in point of fact, some of the army psychologists are now entering the industrial field."

"The keynote of this systematic attack on industrial personnel problems by means of mental hygienic data and methods is the pooling and cooperative combination of expert engineering interests and expert medical and psychological and sociological interests; in brief, the invoking by the expert in industrial personnel of the aid of all available experts in personality, to the study of which the whole personnel problem must reduce."

We fully agree with the statement of Dr. Southard and we hold that we must give more consideration to the various aspects of the Mental Hygiene of Industry, than ever before.

Conclusion

In conclusion, permit me to say that it has been the purpose of this paper to briefly sketch the broad activities which The Society of Industrial Engineers stands sponser for and is endeavoring to foster in every legitimate way. We hold that it is the function of the Society to coordinate and to guide all of those activities of industry and of commerce that have to do with human toil for productive purposes.

The Society is not concerned with promoting the theories of any one man or group of men, but it is endeavoring to coordinate the best thought of the nation on all matters pertaining to productive methods.

The Society of Industrial Engineers is committed to furthering and to developing the profession of Industrial Engineering as such. And we have endeavored to show by this paper the various aspects of the profession. The papers that are to follow will give a clearer insight into the activities of the profession and will show what results have been accomplished by the application of the principles of Industrial Engineering. It is our earnest hope that, because of this Conference, that the efficiency, the prosperity and the tranquility of American industry will be enhanced.

THE CHAIRMAN: We have one disappointment for you this afternoon. We had a telegram from Mr. Scott this morning, saying that it would be impossible for him to be with us but that he had mailed his paper to us. His paper has not yet arrived but will be included in the printed report of the proceedings.

"THE WORK OF THE INDUSTRIAL EXECUTIVE"

FRANK A. SCOTT
Vice President, The Warner & Swasey Co., Cleveland, Ohio.

It is well, in discussing any subject, to begin with definitions. Some of you will remember a school-book which began by defining "axiom" as a self-evident fact. Now a self-evident fact has no need of definition. But unfortunately we are too prone to assume that glittering generalities are axioms, and to fall into phrase-making as a substitute for clear thinking. I shall try to avoid that fault, and to start, at least, with both feet on the ground, hence, in discussing the subject assigned me, "The Work of the Industrial Executive," I shall begin by defining the industrial executive of whom I shall speak as the man in whose office the real control of an industrial concern centers. Moreover, the executive I shall discuss is presumed to be operating a going business. It is clear that the establishment of a new business would involve many other and different problems.

The work of the modern industrial executive is as different from that of the general manager of twenty years ago as that of the corps commander from the man at arms. Knowledge of the work in hand, courage, the practical head, the strong will—these have always been necessary. But conditions have changed very radically. Business has expanded, methods have advanced, and to the old pre-requisite qualifications must now be added, to a larger degree than ever before, faith to believe in and trust others; quickness of apprehension; constructive vision; capacity for bearing great responsibility; and a patience that is akin to the infinite. The modern executive must be a list of seeming contradictions; a dynamo and a shock absorber; a long distance telescope and a microscope; a lavish spender and a miser; a heart free to praise, and a tongue that can cut like a knife; an eye as quick as light and as blind as a bat.

I have said that one necessary qualification always has been knowledge of the work in hand. But the knowledge that sufficed twenty years ago must now be infinitely greater and broader. The conduct of the typical modern industrial business is no longer a one-man job. Authority must be delegated to subordinates, and this calls for faith to believe in and trust others. But the controlling executive must have knowledge of men, to enable him to select capable and loyal subordinates; knowledge of methods, that he may measure the efficiency of his subordinates, spur on the laggards, curb the over-zealous; knowledge of conditions and their consequences, that he may have the far-seeing vision which goes beyond the need of the hour and builds for the future at the same time that it takes care of the present. Concretely, he must have a broad knowledge of production, advertising, sales, finance, accounting, commercial and tax laws, labor relations, welfare work, and organization. It is true that in a well organized business each of these operations will be under the charge of a specialist; but specialization, while it makes for efficiency, tends also to narrowness. Each specialist is prone to believe that his work is the one vital part of the business. The executive must coordinate the work of his subordinates; and to do this rightly he must know the basic principles, at least.

You will notice that I place production at the head of the list which the industrial executive must know. I have done this designedly. In this time of world shortage of necessities, production has come to be the key to the world's future. The industrial executive is the keeper of the key. Suddenly the world has had to turn to him—first, for the production of the fighting-materials necessary to protect mankind against spoliation; second, for the necessities wherewith to feed, house, cloth and transport the entire population of the earth. The transition from a period of over-production in many lines to one of almost universal under-production has been effected without shock. The world is now experiencing the throes of readjustment; and the cry is "produce, produce, produce!" The executive who has vision enough to see and produce economically that which the world needs, rather than that which he thinks it wants, is a world benefactor; and to produce economically he must work whole-heartedly for quantity production and for the development of new materials and improved methods.

Next after production come sales and their pioneer, advertising; for production of that which the world needs does not accomplish its mission until it is translated into possession of the thing needed by those who need it. It is not the order on our books, but what we put onto the other fellow's books, that counts. While it is true that with today's under-production, we have a seller's market, and sales are made with less than the normal resistance, this condition cannot and will not last. We must be ready to meet changing conditions, taking advantage of the present to build for the future. The industrial executive must be a strategist, planning his campaigns in advance, considering not only all known factors, but also the changes that might be necessitated by any possible new combination of conditions. For him, as for the nation, there can no longer be a policy of magnificent isolation. He must consider world trade and its opportunities. He must have knowledge of tariffs and foreign exchange; of transportation and trade-routes; and these things are no more the same that they were a half-dozen years ago than day is like night.

Given production with economy, and sales at an adequate profit, and almost any industrial business can "muddle along." That's what most industrial concerns did twenty years ago. Nowadays more is expected, and more is necessary if a business is to keep its place in the ranks.

The modern executive must be a financier. The old problem of acquiring and maintaining sufficient capital and credit to carry the business has been very greatly complicated. The increased cost of materials and labor alone has strained the resources of many a business in the interval between the initation of production and the receipt of the sale-price. Then, too, the tremendous expansion of facilities which was brought about to meet war-needs now finds us with larger factories whose operation must be financed, and this calls for large increases in capital. It is the modern executive's task to find out how to get that capital, and how to pay for it—for capital must have its price—to determine which of the various available methods will secure the necesary capital with the least future burden.

Though the modern executive need not be an accountant, he must know enough of the principles of accounting to determine what records will be pertinent and useful, and to make correct deductions from the facts adduced by the records. He must know his plant like an open book—its average production, its maximum capacity under present conditions, its possibilities of expansion in one or another department; he must know his costs down to the last element; and to know these things he must have complete and accurate records. He must therefore determine beforehand the nature and extent of the records to be kept, in order, upon the one hand, to assure an adequate supply of pertinent information, and upon the other hand to avoid the waste of amassing needless and irrelevant records.

In days not so very remote, the only time an industrial executive needed legal knowledge was when he was about to sue or be sued, or when a contract was to be drawn up, and then he consulted counsel. Nowadays, with a mass of legislation affecting industries and commerce, and with the State and National governments calling for reports, statistics and returns of one sort or another, he himself must be familiar with certain phases of the law—not for the purpose of evasion, but to be in a position to "render unto Caesar that which is Caesar's", and, if it should be necessary to invoke the law, that he may come into court with clean hands.

Today, more than ever before, an industrial executive must give wise consideration to labor relations and to the effect of such relations upon the business which he guides. The day has gone by—and forever, I hope—when the man who has the right to hire and fire could assume the position of an autocrat from whose dictum there was no appeal. We now recognize that the two prime factors in production are capital and labor and that in a very real sense their interests are identical. Until the time shall come when out of the present chaos there shall have been evolved a clear and equitable definition of the respective rights and privileges of capital and labor, of employer and employed, it is necessary for the industrial executive to steer his course through troubled waters beset with many an uncharted rock and shoal. It is not enough that, if he have a hand of steel, it should be encased in velvet. He must cultivate the understanding, sympathy and square dealing that will make every one of his employes recognize and repect him as a "regular fellow."

There is no more marked and obvious indication of the tremendous changes brought about by modern requirements than in sanitary conditions and welfare work. We all remember when the workman hung his coat upon a nail, ate his luncheon out of a tin pail, and washed—if he washed at all—out of a bucket. Perhaps we thought that was good enough for him; or perhaps he expected no better. Today he hangs his coat in a steel locker which costs real money for its construction and for the space which it occupies. He eats his luncheon—hot, wholesome and well cooked—at the factory restaurant or cafeteria. He washes in a porcelain-lined washstand in which the water begins to flow at a stated hour. He has, perhaps, his club and reading-room, maintained at company expense; and his hospital, where he receives the best of care if injured. Conveniences which were undreamed-of luxuries two decades ago are now expected, and their absence leads to invidious comparisons. The modern executive must see not only that they are provided, so far as may be practicable, but also that they are administered wisely and sympathetically.

It is said that poets are born, not made. I believe the executive I have been discussing must be both born and made. He must have been born with those qualities of mind and heart which fit him for his work; and he must cultivate those qualities to the utmost, in order to be equal to his task. His training must be both subjective and objective. And if he is to live up to all his opportunities and requirements, he must provide within his organization the means of self-perpetuation in personnel as well as in capital, equipment and good will. In other words, he must have subordinates who are capable of performing the duties of the next higher job, and must have in training one or more successors to himself. To attain this end, specialization in subordinate executive work must not be carried to extremes; for, as I have already stated, specialization means a one-sided, one-idead development which leads to restricted vision and a narrowed horizon.

To my mind the executive bears the same relation to his organization that a master musician does to a stringed instrument. He must keep it in condition and keep it in tune; and when so kept it responds to his every touch. Occasionally a lax-fibred string will need tuning up; and it will sometimes be necesary to change a string. These things are incidents not affecting the quality of the instrument, which, if well designed and well made, improves with age and right use. But if it should become necessary to remake the instrument, that is positive evidence of a mistake upon the part of the maker, or a mishandling by the musician. Let us, who have these powerful yet delicate instruments, so handle them that they will be kept in condition and in tune.

In the first analysis it is the duty of the industrial executive to make money. If we do not make money we are failures; but if all we can do is make money, then I say we are also failures. We must build into our organizations something which is eternal; something which makes men better; which contributes to the progress of the race; which lifts forever some of the burden of suffering.

We must cultivate the spiritual side of our organizations. That is an element which it is impossible fully to comprehend; which is incapable of accurate measurement, and not bound by man-made laws; but susceptible of the greatest degree of training, and capable of attaining the impossible. We must remember that when material has reached its limit, when the lessons of experience no longer apply, when all that is reasonable and well-known has been applied to a situation and something greater is still needed, than the spirit of our organization may generate the power to carry us through. Witness the response of our country to the call of war, when industrial plants turned from the arts of peace and performed miracles, almost, in the production of arms, munitions, and equipment. That, in many instances, was attributable wholly to the spirit with which the seemingly impossible was attacked and attained.

"The first man is of the earth, earthy. The second man is the Lord from Heaven."

Woe to the business whose executive cannot believe this. As surely as David slew Goliath, he will go down before his competitor who believes in the spiritual power of his organization.

The next paper on the program is the "Executive Direction of Industrial Relations." The paper has been prepared by Mr. Dudley R. Kennedy of Philadelphia. Unfortunately, Mr. Kennedy is ill, but he has sent his associate, Mr. R. M. Neustadt, who will present his paper.

MR. R. M. NEUSTADT: Mr. Kennedy asked me to express his regret at not being able to be with you. He has tonsilitus pretty bad and I am afraid will not be able to attend any meetings during this conference. If you will bear with me, I will try to bring out the salient points of his paper.

"EXECUTIVE DIRECTION OF INDUSTRIAL RELATIONS"

DUDLEY R. KENNEDY
Industrial Counsellor, Philadelphia

What do we mean by Industrial Relations? The art of synchronizing men with production. This definition may seem to broaden the conception of Industrial Relations which has generally obtained. I sincerely trust that it may.

What subjects are included in the art of Industrial Relations? A few of these are Hours, Wages and Salaries; Light, Heat, Ventilation and General Conditions of employment; Safety and Service; Workmen's Compensation; Vacations; Cafeterias; Cooperative Stores; Collective bargaining; Housing; Transportation; Group, Health or Life Insurance, Annuities or Pensions; Mutual Aid Organizations; Bonus, Premiums and Profit Sharing; Training and Education, elementary and technical; Physical Examination, Remedial and Preventative Medicine, Sanitation and Hygiene. This is but a hasty survey of the field and does not include some of the other phases of the work of Industrial Relations.

How many chief executives of even the larger companies are competent to pass authoritatively upon even the majority of these questions? From a technical standpoint, comparatively few. It is no longer a question as to whether or not an industrial executive wishes to interest himself in these matters, because many of them have been the subject of legislation during the last ten years, especially in those states which have much manufacturing activity, and the problem of keeping abreast of current legislation is getting to be a more and more serious one, necessitating an increasing degree of attention from industrial executives, whose businesses are, of course, directly affected thereby.

During the years 1910 to 1914 we received into this country, through immigration, nearly five million new workers. With the declaration of war in Europe in 1914 this immigration naturally came to an end, and we have had practically none since that time. If immigration had continued at no greater rate we should have received between 1914 and the present time seven to eight million additional workers. Assuming that our demands for production today are only in proportion as with 1914, we would be woefully short in man power, but the best authorities agree that, by and large, per capita production has fallen off 25 to 30% from a standard as of 1914.

This statement of conditions, of course, brings nothing new to this audience, but we are interested in being of constructive help to industry and the country.

The reduction in the workers per capita output is attributed by most people under the blanket indictment labelled "Industrial Unrest." The causes of this industrial unrest are matters of continuous controversy at the present time and are too many to be by me here enumerated. It is my own conviction that these reasons are largely of economic origin, going far beyond the fault of any particular group of individuals and considerably back of the World War. I have said many times that the present situation would have arisen in this country even though we had had no World War, and that war and war conditions have only served to accenuate and antedate a foregone economic conclusion.

While the interest in 1920 in Industrial Relations would lead one to think that it is an entirely new subject, such is not at all a fact. A comparatively few far-seeing manufacturers and economists have been experimenting and groping for the answer for a number of years. In many quarters this experimentation and groping has taken on too much of the guise of philanthropy, humanitarianism, or welfare. Too often the actuating impulse has been from the heart and not from the head, and this has resulted in much work, which while potentially good, was being wasted by improper or illogical application.

I wish that I had the time to trace the history of Industrial Relations through its present era, which covers only the last ten or twelve years. It is very fresh in my mind because it has been my life work during all of this period. As many of you remember, it started with the rise of the Safety movement and continued into the health side of industry, more or less naturally as a result of the fine constructive work done in the field of Accident Prevention. Pursuance of the Safety and Health program led naturally into Service, or, as it was more popularly known, Welfare work, which was taken up from an entirely praise-worthy standpoint of bettering the lot of the workers and assisting them in difficulties which had been brought to light through these earlier campaigns.

The next development in this period was the rise of the employment department. The real interest in this phase of Industrial Relations came with the war and the cessation of immigration. Suddenly jobs became more plentiful than men, and hence men were at a premium. They were not slow to seek the advantages which this situation pointed out to them, by demanding or asking for increases in wages and other demands which they had long secretly cherished.

We got through the war production largely because of skillfully aroused and maintained patriotic zeal and fervor. With the end of the war came the real reaction and the real problems of re-construction and rehabilitation of industry. While a great many people were prophesying depression, under-employment, an over supply of labor and other dire events, a very few persons saw the real truth; to wit, that the demands upon this country for industrial production must necessarily exceed anything which we had heretofore been called upon to do, not only to provide the deficit which had resulted from our attention to war needs, but also to provide for the needs of the war-torn countries where the grim struggle had created a tremendous lack of the necessities of life and had at the same time seriously impaired the means of supplying them.

I personally feel that great harm was done by setting up for the country such highly idealistic slogans as "Making the World Safe for Democracy." Most people soberly appreciate that this was not the issue, but that we were in fact fighting to save our own bacon. Through clever propaganda and publicity the great rank and file of the American people were literally pulled off the ground and injected into a rarified atmosphere of idealism, only to be very rudely pushed back to earth with the signing of the Armistice. The shock of this transition had much to do with precipitating industrial unrest.

A rather unlovely illustration of the merits or demerits of collective bargaining, as exemplified in Washington over the Peace Treaty, has not helped matters materially. We are, therefore, today faced by a situation—not by a theory. It would be unfair and unkind to belittle the pioneering experiments in Industrial Relations, up until the present time, just as it would be unfair to condemn capital or labor, or both, for their failure to anticipate the present situation. We cannot think these things through, however, without coming to the conclusion that Management has fallen down on its job. The bluntness of this statement might well antagonize some, at first blush, but I am afraid that it is the cold blooded truth. Management certainly did not look into the future. Management has been so obsessed with the technique of its business that it has apparently forgotten that it must have the loyal and willing cooperation of the workers. Even at this late date there are many executives in industry who do not understand why their subordinates cannot drive the work out of the men as they used to.

It is a temptation hard to overcome to discuss at some length the economic and psychological reasons for the present state of mind of the workers. They are exploiting their economic advantage and a great many of them feel that they are "getting even" with employers for what they conceive to be the wrongs of past years. Now when their own particular job holds no charm for them; now when they can procure a job somewhere else if they are too hard pressed in their present employment, they cannot help but glory in their independence. They have entirely overlooked some of the most fundamental axioms of life. Perhaps it would be more truthful to say that those fundamental axioms have never been explained to them.

The old time workman fully understood his obligation to the purchaser of his product (and hence to society) because he himself wrought the product from its raw state to its finished form. He himself very often negotiated the sale and placed behind the article the guarantee of his reputation as a workman.

Too often today the workman does not know even the purpose of the particular specialty which he grinds out by the thousands day after day, and the tendency has become more and more for him to demand a maximum number of dollars for a minimum number of hours. If he has any attitude at all toward the public as a party to his relationship with society, it is hazy at best. His careless thought is apt to be that if the public howls too strongly against the cost of the product which he is making, his boss and employer will have to reduce the price and take the loss out of the tremendous profits which all employers generally are assumed to make.

To summarize the great mistake of management I would say that when it has thought of the human side of business at all, it has done too much **for** the workman and not enough **with** the workman. There can never be any real cooperation between employer and employee until both understand the problems and responsibilities of the other. Management has assumed a superior intelligence, and too often believes that it knows better than the worker what the worker wants and should have; now the worker is seizing his economic opportunity of proving to Management that it had the wrong dope. Management has expected cooperation from labor but has been willing to extend little or none itself. Management has done almost no broad educational work with its workers. Management has issued orders that 10,000 pieces of a certain thing were to be finished on a certain date. It has given no explanation as to why they were necessary, as to what they cost in the shape of raw materials, as to what percentage of their finished cost the direct labor bore or the factory executive or sales overhead bore. Not only have they impersonalized the job to the ultimate degree, but they have in the large factories even taken a man's name away from him, substituting therefor a check number.

When labor become scarce it is the habit of many managements to attempt to fill their labor quota by raising rates a few cents per hour, thus hoping to attract new workers to their industry. They know full well that the workers attracted usually come from their competitors or neighbors, and if they had the sense that they are usually credited with they would certainly appreciate that the aforesaid competitor or neighbor would be forced to meet their increase and might very well go them one better in retaliation by raising over their price.

Management, by and large, has had no labor policy as such in the sense that they have had a sales policy, or a production policy, or a financial policy. Their labor policy has been one of expediency. It has been necessarily impossible to pass the policy down through the supervisory organization so that the subordinates might know what to do in case of emergency, because the management itself did not know what its labor policy might be under given circumstances. We often see a large corporation with a number of subsidiary companies having as many labor policies as it has subsidiary companies, moulding the policy to the exigencies of the occasion and the modes and customs of the district where situated. Management, by and large, has wasted our labor resources and is now too much engaged in crying over spilled milk.

The most important single factor in the great question of production today is the element of man power. Many managers are sitting by bemoaning their situation and vainly wishing for something to happen. In the present political viewpoint toward immigration little help can be expected from that source for quite some time to come. It has been conclusively proven that no real gain in production is being made by raising individual wages, and it is beginning also to dawn upon most people that you cannot increase the total number of men in a community from which the company must draw its supply by raising the wages of individuals. It would seem, therefore, to the thinking person that the answer must be very patent. We must get out our production requirements with the tools at our disposal. This is the task of management. This is what it is paid for. The man who stands by and wrings his hands in despair accomplishes little.

The wiser managements in this country are meeting the situation squarely and unflinchingly. They are accepting a large share of the blame for conditions as they are, and are meeting the situation in the only way which holds any hope of solution. They are deliberately creating a new cabinet position called the Department of Industrial Relations. They are placing at the head of this department the biggest, broadest and best equipped man in their own organization qualified to handle this job, or they are very often going outside to find the man they want. In such organizations the head of this department is being given the title of Vice President or Assistant to the President, not to please his vanity but because the management is at this late date by inference confessing its former mistakes and deliberately attempting to set up a department at least as important in the organization as any other.

Such management has analyzed the problem. Such management has come to the only logical conclusion, which is that it has done everything on the mechanical and technical side of its business to improve the quality and quantity of its product and has not only not been successful but has in fact slipped back. It now turns to the long over-looked power factor from which can come the only solution of the problem.

Where Industrial Relations Departments have been created on such a scale as indicated they are not attacking this problem with the idea that it will be solved within a few weeks or a few months. They are not installing any set of forms or ready-to-wear plans of any particular expert, but they are rather starting in to educate the whole organization, from the President down, in the basic and fundamental truths of business, life and economics. They have started upon the tremendous task of synchronizing men with production. Men are today out of mesh with management. They are out of sympathy with management. Management will have to regain their good will and their confidence before added production can be expected or obtained. They will have to convince the workers that added production is necessary from a different standpoint than that of purely increased dividends to stockholders.

I have been rather frankly grilling management and I am perfectly aware that many of the members of this organization are engaged in selling advice on management problems. Those of us who have been practicing along the mistaken lines, for which I have indicted management, must in all honesty submit ourselves to the same indictment.

Just the other day I addressed a meeting of industrial executives, endeavoring there as here to point out as the great necessity of our future production program a frank and comprehensive policy of education in the fundamentals of economics among management and men alike. At the conclusion of the evening one of the group came to me and quizzically offered me this criticism,—"The trouble is, young man, most of us employers need that education ourselves."

He is right. It is folly—or worse—to talk of education in fundamentals that starts and stops with the workers or with their immediate supervisors, the foremen. Our policy must be broad enough—our facts must be sound enough— and our pedagogical methods must be keen enough—to interest and develop every member of the industrial organization from the president to that rarest of things—common labor.

Where are we to find the teachers? Right here, I trust. I modestly submit that it is the essence of industrial engineering to teach economically sound industrial principles to our clients and to the general public. Is it not primarily the function of the industrial engineer to teach executives how to execute, management how to manage, and, through them, workers how to work? Must we not also be able to reach the "why" as well as the "how"? Are we not the guardians of the right spirit in industry?

I wonder whether the experience of those consultants and engineers who have preceded me in this profession agrees with my own. As I go into plant after plant I find that the root of the trouble lies not in the technique of routing, pay systems, or graphic control, and not in the technique of employment, or safety, or service, so much as in the lack of spirit of mutual confidence in which the work is planned and administered. A real spirit must be based on a knowledge of sound economics and supported by a respect for that element common to us all—human nature. Is this experience not universal among all industrial engineers and all others who are privileged to observe and study the present industrial situation?

If I am wrong, then industrial engineering—like production management—becomes a field for the development of technique—of forms, statistics, graphs and schemes—without the time, the ability or the vision to lift its eyes from the mechanics of the work to its purpose. Is this true? It has too often been tried. Far too often both the engineers and the executives have been concernd over the detailed operation of the Taylor System, and have forgotten the clear vision and spirit of that great man who himself recognized any system as only a faulty tool for the accomplishment of a great purpose. Scientific Management has come into disfavor because its science was felt to be too cold and without interest in the human element. On top of this management endeavored to save the day by introducing welfare work for the employees! You can't blow hot and cold at the same time and the American worker naturally distrusts the perspiry warmth of paternalism as he does the scientific coldness of "efficiency."

If we are to synchronize men with production we must make production a fascinating mentally interesting, as well as a physically fatiguing endeavor. We must develop the cooperative spirit by inspiring mutual confidence, and by instilling the truths of that great human study—economics. We must increase output by increasing the desire of men to put out production. This is not so much a problem of developing financial incentives; it is not solely a question of reorganizing our mechanical processes so that they appeal and stimulate creative instinct, although it includes both of these. But more fundamental than both and more immediately critical it is a task of reinstilling industry with the spirit of the square deal and of rekindling in all who work together a faith in the essential worth of their fellow man and in the social justice of the principles of economics that bind them together in united productive effort.

How is this spirit to be reinstilled and this faith rekindled? Through a progressive development of industrial relations; through a technique that will become recognized by employer, employee and citizen alike as fair and sound; by mechanics that will meet the approval of common sense when, through education, common interests have been revealed by common knowledge; and by an honesty of effort and sincerity of purpose among all concerned. This is not to be solved by social service workers, in or out of industry. The Safety Engineer or the Employment Manager cannot accomplish the result. It can be attempted seriously only by a consistent policy of industrial relations directed by an executive in each industry. It is primarily the responsibility of management. Only through the executive direction of industrial relations, conceived and administered by men who know men as well as mechanics, can we get the synchronization of men with machinery. Only thus can we answer the challenge, and establish effective industrial organization for efficient production for social use.

I trust that we all can serve industry and our country by holding aloft the torch and pioneering the path toward a universal acceptance of the truth of these principles.

THE CHAIRMAN: I take pleasure in introducing to you Mr. Mark M. Jones, who will discuss Mr. Kennedy's paper. (Applause)

MR. MARK M. JONES: Two things struck me rather forcibly when I saw this program. The first one was with respect to the paper of "Dud" Kennedy. I thought it was all right for him to talk on that question but I wondered who would write his speech, and then when I found Mr. Neustadt was to present it, I thought the right man presented it because he probably wrote it any way. (Laughter)

Another thing that struck me was that I thought the subject of "Executive Direction of Industrial Relations" was a very interesting subject. It occurred to me that it would be a fine thing if we did have a little of it. (Applause) Little, in two ways—in some cases we have entirely too much executive direction; in other cases, we don't have any at all, so we are not in balance.

The reason we want executive direction of industrial relations, as I understand it, is to put the machinery of industry in balance; to cause personnel plus process to make production. That is what I understand is the reason for advocating executive direction of industrial relations to be.

I have heard a great many very interesting definitions of a pessimist and I can subscribe to Mr. Cattell's definition. The personnel men, however, have one of their own—probably many of you have heard it. When

I say I think there should be a little executive direction of industrial relations, I don't want you to think I am a pessimist. While I am at times I am not all time. Among the personnel men we have adopted a very clever definition, we think, viz., that a pessimist is not the man who can go home at night and concoct a delicious drink out of the lemons that have been handed him during the day. (Laughter)

It strikes me that the fact that we are discussing this subject of executive direction in industrial relations today emphasizes that we are slowly proceeding from a state of mind comparable to the days of witchcraft when the reasons for things were not known; where arts and sciences were vague things, to a clearer atmosphere and a better and more exact basis of procedure.

We want balance of all things. The hardest man in the world to find is the man who knows how far to go and stop, or the man who does not know when to stop when he hadn't ought to stop. In other words, balance in men and in organization is perhaps one of the outstanding things that is needed from my viewpoint, and I see the successes and failures of a great many men in our organization right along. There is a continual procession just as there is in all other businesses, and it's exceedingly interesting to see the procession and to sit back and think what should have been done that wasn't done to prevent a certain failure. It strikes me that one thing that should be done is, of course, more executive direction of industrial relations.

I want to emphasize the remarks of Mr. Kennedy by Mr. Neustadt on the point that the present situation in industry would have come without the war. I think it certainly would. The war accentuated and accelerated the coming of the present industrial situation, but it would have come. We were overlooking one phase of production, one factor in production—not in every case but in more than fifty-one percent of the cases, and therefore, the present situation has developed.

It seems to me that if I tell you some of my ideas as to what problems the industrial relations men or executives directing industrial relations must work out in the future, they would emphasize the need for executive direction of industrial relations. The first problem is that of discovering and developing leadership, real, genuine leadership—the kind that really gets out the production with good will and that doesn't simply drive it out. Very, very few industrial managers, executives or others, really understand leadership. We have got to get more managers out in front of the working force—too many of them sit back in the office and expect somebody else to do the firing line work. Its all right to have an organization and delegate things to other men, but you have got to have some one spark plug that touches off the physic forces, and the manager or the executive, the head of the line organization has got to be drawn out of his shell a great deal more by the industrial relations man and made a more vital factor in the life of the average industry. Too many of them are bashful and backward and are willing to sit back and let the organization do the work on the theory that you shouldn't do something yourself that you can get someone else to do. Possibly that's right, and I think it is up to a certain point, but the one job of personal leadership is to recognize that there is no one who is going to take the place of the man at the head of the line organization, and the industrial relations man has to draw him out of the shell and build him up as a strong force in the life of each and every worker. Soldiers who see the Commanding General occasionally are usually inspired by such contacts and the industrial leader must make it more of his business to go among the rank and file of workers and make himself a more realistic thing to them.

That's a very important task, in my opinion. We have also to work out ways and means of changing labor policies so that there is less repression and more expression. At the present time there is a tremendous repression. The old time executive often operates that way—if a man asks a question he tells him it's none of his business—simply get that work out and get it out in a hurry. He embellishes that with a few adjectives, so that the policy of repression has not been entirely discarded and while you see large attendance at meetings like this, and you see a few managers of industry out in touch with people who are thinking along industrial lines, don't fool yourself and don't think that rapid progress is being made in this direction because it isn't being made as rapidly as you think. There is a whole lot to be done and it emphasizes the very great need for more executive direction of industrial relations.

Repression versus expression, therefore, is another one of our questions. We have to help men get what they want—not simply say that you are crazy for bothering with an idea like that, but giving the individual who has something on his mind that he wishes to achieve a fair hearing, and think of ways and means to assist him to achieve that desire. It may be impossible, of course—many of them are—but they are not to be discarded, no matter how impossible they are, without a reasonable hearing, and we have to sell the men the idea that we are wrong just as much as we have to sell the new policies we may advocate to the management.

Another immediate problem is going to be (these are all, of course, linked up closely together) overcoming the disadvantage of absentee management. Every day you hear of new consolidations—industries being linked up with some holding corporation, the head office of the holding corporation being, in most cases far remote from the operating units that support it. There is a great disadvantage in absentee management, unless it is very high class management, which there is as yet in very few cases. How to establish a transmission system that will radiate the program policies of the administrative offices to the executive offices of line units and get the highest possible degree of effectiveness at the point of contact with a worker is a very real problem. You have that job—the one of overcoming the disadvantages of absentee management, because absentee mangement is certainly going to stay with us, and we must accept it and meet the problem and the industrial relations man has got to figure out in some way to solve these questions so that the personal policies of the Board will mean something to the men in the factories far away from the offices where they never see the president of the company and don't know what he looks like.

We also have to meet the question of sickness insurance. We hear a lot of talk of compulsory sickness insurance. I think there is greater danger of that than we realize. Compulsory sickness insurance is something that you all want to study and be informed upon, in my opinion. I am not thoroughly informed on it and can't tell you about it, but I am satisfied that there are possibilities of our having compulsory insurance rammed down our throats in a great many states in this country today and we have all got to be on the alert, and all you gentlemen who stand for leadership want to get on the job and thoroughly inform yourselves and decide what is the right thing to do in that direction.

Another problem of industrial relations at this time is that of education —education of not only the supervisory force but the workers as well—linking up the workers with the finished product; putting the reputation of the worker behind the goods as Mr. Neustadt brought out. How many men represent the fellow who is covered by the story of the man who applied for a job and he was asked what he was. He said that he was a machinist. "Where did you work?" "At the Ford plant." "What did you do?" "I put on nut forty-seven." He didn't know what relation his work was to the other work, and yet he was a machinist. (Laughter) There are too many men running around that put on nut forty-seven. The schools can help, but in the final analysis, the schools will never reach the goal unless management is on the job and it is the schools plus management.

We have to impress more people with the fact that when you acquire rights you also acquire obligation. That is another important problem from the standpoint of education. Rights generally carry with them obligation and that must be applied not only to economic questions but to all questions that arise in the management of an ordinary business.

The development of individual responsibility, that thing which we are all told has contributed more to the tremendous leadership of the United

States than any other one thing, must be studied, and the industrial relations men must get it over as a problem to their managers and there must be more executive direction of those agencies that will develop and promote a greater feeling of individual responsibility.

There is still another point, I think, that in some way overshadows all of these others with respect to the need of executive direction of industrial relations, and that is the growing interest of the public in questions of industrial relations. The interest of the public is expressed in a great many ways through legislation, through attempts to secure legislation, etc. It strikes me that unless management takes this question seriously and does something about it, they will, before long, be in the same position that the railroads got into in 1903, 1904, 1905 and 1906 before the cloud of regulatory legislation was rained down upon them. We don't want any more governmental direction of industrial relations than we absolutely have to have, but unless management exercises that leadership which is its right, and at the same time its obligation, we will certainly have more of it. I think the public is entitled to more consideration than it is getting and I think they will get it and it's up to the management to recognize that fact and give it to them before they come around and say we must give it to them.

In working out these questions of industrial relations, I think we also have got to look out and not get to the point where we have too much centralization. It's fine to have executive direction of industrial relations, and we want just as much centralization of that direction as possible, without too much. Don't tamper with the line organization any more than is necessary to immediately correct a bad situation. The line organization must be strengthened and must be brought to the point where it can spread more and more over the field and really function in a balanced way. That is one of the very critical problems and one of the things that we are apt to overlook in our organization in providing for executive direction of industrial relations. We are apt to sheer the line organization of that feeling of individual responsibility they must have and that individual responsibility must be maintained among the men who make up management in the minor executive fields just as much as it must be developed in the workers, so we should be exceedingly careful in working out this question of executive direction of industrial relations to avoid weakening the line organization. The staff and line organization I presume is understood by most of you. By line organization I mean the men who take the plans and try to make them work (notice I said "try" for that is generally the case—sometimes they make them work) but we must be careful not to upset or weaken the line organization.

I hope that a very free discussion will be provoked along that line.

There are two things that I want to say that do not refer to this discussion. I am going to give you folks an opportunity to render some assistance to me. I have calls for two men. If any of you know of an industrial physician, I think I know of someone who would be very glad to get in touch with him. Have him get in touch with me at Orange, New Jersey.

Another proposition is that a bank has informed me that they wish to secure a personnel man. I don't know a man at this moment who would be interested in considering such a position. It would probably pay between five and six thousand dollars a year. If you know of such a man, have him write to me at Orange, New Jersey. I can assure you that they will not lose their present jobs because of my calling their employers up. (Applause)

THE CHAIRMAN: I was interested in Mr. Jones' last remarks. The fact that two different firms wanted men, one an industrial physician and the other an experienced personnel man, supports some of the things that I said in my paper about the value of their work.

I also want to say that Mr. Kennedy cannot accuse me of plagarizing although certain things I said paralleled some of his satements because I had not read his paper.

It is my thought that in this matter of industrial relations there are two paramount things. Our laboring people are seeking a means of self-expression. Our present factory system of dealing with labor does not permit of that. I believe we ought to evolve some system, some means whereby they may have self-expression.

The other thing is this—that we have taken all of the play and fun out of the job and an industrial relations program should be provided whereby there may be pleasure in the work.

The meeting is now open for discussion. We would be glad to have anyone, whether a member or not, give any contributions on this subject that they may have, or ask any questions.

MR. MARK M. JONES: I want to question that first point of yours about the present type of industrial organization not providing the opportunity for expression. In other words, you indicate that possibly we might need something additional, or something new, and I want to ask whether or not its exactly that or whether the present type of organization does not function properly because it does not provide that opportunity.

THE CHAIRMAN: That is a splendid question.

MR. G. T. TRUNDLE, JR., Cleveland: It is my opinion that the executive direction of industrial relations is being worked to death. We have a system of our foremen of line or staff, properly educated so that it will allow the workmen an opportunity to express themselves and get their suggestions through to the management.

Here's the failure of industrial relations, in my opinion—in every case it belittles the foremen. A workman who has an opportunity to consult a superintendent over the foreman's head, immediately takes the position that he is not responsible to the foreman any more. When the foreman loses control of his men, he loses his grip on the organization, and the sooner you dispose of him, the better.

Our industrial relations men that have been installed are usually men taken from the office. An advertising man who has been put in that position, having no knowledge whatever of the working conditions in that plant, cannot look at this problem through the eyes of the workingman; he cannot look at the problem in the way it should be looked at. I should like to hear some discussion along that line. I believe an industrial relations man must be a man with shop experience, a man that can look at that job from a workingman's standpoint—the workingman does not have the same ideas that the office man has.

MR. MARK M. JONES: I want to suggest that you don't overlook in that question the fact that the practical man very often is looking out to fill the job where he will function along the lines of executive direction. That's one of the weaknesses, the lack in that capacity to advertise, develop leadership, to marshal facts and to build policies and plans from them that are so necessary, and then the other man is weak on the practical experience so that you are up against a balancing problem right there too. You can't overlook the fact that your problem is that of balancing and I would like to point out that you can't go too far in that problem of balancing. The foreman has a lot to answer for and he has produced a lot of good—I don't wish to belittle him in any way, but he still has overlooked a great many things.

MR. LOWMAN, (Shepard Electric Crane & Hoist Co.): Which do you think is the worse condition in a plant—Mr. Trundle's plant in Cleveland where the workingman has not the courage to speak to the foreman because he is afraid of a poor answer and no encouragment, or the plant where that workingman knows that if he does speak to the foreman and doesn't get a courteous answer, he can go above his head without having his head cut off?

I think you will find that there are a great many industries today where the workingman is allowed to go as high as the president of the concern, when he thinks he has a just cause, and you will find that there is harmony and loyalty there and where you find that you are getting the heart of the man in the product as well as getting the production out of that man.

I think you must give the man opportunity for self-expression, but you can't do it if you put him down under the iron heel of the old line foreman. I think the day of the old line foreman has passed; in this day you have to have a broader, bigger man and the greatest effort today that has to be put forth by the industrial engineers of this country is to get the workingman to express himself. We find that our greatest difficulty—we cannot get them to express themselves. When you go before them and ask them to express themselves, they are reticent—they have been ground down so long that they will not talk, they fear to express themselves. We find ourselves trying to find out what we want them to say, If we find out what we want them to say, they will talk, otherwise you know they won't. Our biggest job is to get them to talk. If they do talk, you know where you stand and where they stand and you can help them; if they say nothing and their hearts are full, you can't help them.

MR. RUSSELL A. PETTINGILL (Chicago): Isn't the solution, after all, the organization to which any employee having a grievance can go through a committee if that grievance has any justice? I might say that in certain government institutions with which I have been connected, we have used that plan with men working in uniform and in the civil service and also men employed under ordinary conditions, and we found it very successful. We found that our great difficulty was in getting the men to speak. We placed suggestion boxes all around, sent out cards, asking people to give us ideas, but we found, in the past, that a man will go before a committee with some grievance and the next day be given his pay envelope with some excuse of being late, and so on, but my opinion is that the workmen are afraid because they are in among the foremen.

I am interested in knowing whether this particular plan has been tried elsewhere and whether it was successful.

MR. NEUSTADT: I would like to answer Mr. Jones' question at the same time. The gentlemen brought up the question of employee representation, of which we hear so much. We hear it in all languages. It isn't anything new at all and it would be folly of the worst kind to say that employee representation of one thing or the other is the panacea. On the other hand, there is unquestionably certain conditions in certain plants where the basis of confidence between management and men is already established so that you can develop employee representation for the elimination of the causes of grievances and construct improvements on the whole production policy.

Too many of our plans, shop committee plans, are merely talkative affairs. Too many of them are camouflage, and you can't fool the workman and you are a bigger fool than he is if you think you can, because they see that so quickly that you are hurting your cause.

Your industrial relations man, whoever he may be, or your number of industrial relations men, if they are staff men or line men, are not striking at the foremen—they are backing the foremen up, educating them to use their power properly. You men buy a personnel man or an employment man, one who can step in and be something of a scare, and you are making the situation worse, but if you can find someone who can study the thing and bring it to the attention of the proper executive, what better remedy can be adopted to enthuse the spirit to work those things together? You will get somewhere. That's the difference between line and staff, as I see it.

The industrial engineer or the advertising man or the salesman is just as much the staff man as the industrial relations man.

As to shop committees, some shop committees have been extremely successful and a great many have failed. You read of them in the papers by the score but even the papers don't always tell the truth. The trouble is that we are "kidding" ourselves that if we put in a shop committee it will offset other forms of collective bargaining, without realizing that by developing a shop committee we are encouraging that and are willing to encourage that, and we are just simply committing suicide.

You can't have collective bargaining unless you bargain collectively. Mr. Kennedy spoke of the unfortunate collective bargaining in this country. You can't have collective bargaining by pounding your fists on the table and demanding something—that's collective scrapping and doesn't do any more than individual scrapping would do, and the whole word is bad—it surely isn't a bargain. Unfortunately, it is! But an employer who is trying to buy his labor by the good old Essex Street method of selling goods, the employee bargaining in much the same spirit, is the kind of bargaining that doesn't go through unions or shop committees. If you mean collective action, collective interest, then you talk of co-operation or something that extends far beyond the present situation and very far in the future situation, and if you are talking about that and don't apply any one medicine to every situation, then you are all right. There are a great many plants in this country where the relationship between the individual employer and employee is such than no further machinery is necessary. There are many more plants where additional machinery is necessary for the good of both. It depends entirely upon the situation of the personnel.

Does that answer your question, Mr. Jones?

MR. MARK M. JONES: Well, you're asking me a question now. The point I wanted to get at was whether in the opinion of the people present here shop committees, collective bargaining or trade unions or the systems the Chairman referred to, are necessary if we have a real management. Do we have to have some additional machinery to provide the opportunity for expression? I am not convinced that we do have to have it. I am not convinced that we don't have to have it, either, but I am convinced that there's a reason and that is why I questioned the statement of the Chairman.

Systems can be made very useful. Some other system, I presume, possibly included committees in that connection, but if you get back to proper organization and you have the right kind of management, is there any substitute for good management?

THE CHAIRMAN: I did not mean to imply that any additional machinery was necessary. If you read the paper that I presented a few months ago before the Western Efficiency Society, Chicago, you would clearly understand my position on the question of additional machinery. I said in that paper that there was no panacea for industrial relations problems and it did not make any difference whether you used collective bargaining, shop committees, or whatnot, if back of it there was not sincerity of purpose, an earnest desire to be fair and just, you would have trouble. No kind of machinery is going to carry you through if you have not that sincerity of purpose to be fair and square. On the other hand, if in your organization you are prepared to put across a fair, just and sincere deal, you do not need to create a new piece of machinery. It's not a question of machinery, it's a question of a fair deal. (Applause)

MR. DALE WOLF (Philadelphia:) I would like to ask Mr. Jones if a good management could not include in it the question of shop committees. I believe that in this group no one would doubt that some years ago we didn't have industrial engineers but today industrial engineers are a part and are of the whole of good management. If the industrial engineer can be a part of good management or can be good management, so the shop committee can be good management, not a piece of machinery.

MR. D. C. PETERSEN (Dayton, Ohio): I do not know whether we on the floor are permitted to disagree with authorities like Mr. Kennedy, but I didn't like Mr. Kennedy's method of speaking of welfare work. On the other hand, I regret very much that it's necessary to talk to an organization of this kind which knows so well what welfare work really means. I do not think there is any question but that we, who are consulting engineers, know what welfare work really means.

Down our way we are pleased to state that we have welfare work, and that welfare is the working together of capital and labor. I don't know whether you will be able to find a better definition, and if you can, we would certainly be glad to adopt it.

We adopted welfare work years ago in the National Cash Register Company, away back in the infancy of the business, in 1884, and we adopted that definition of industrial welfare and we have broadened out on it and to our minds it's only a heart action and we describe it as such and illustrate it as such, using the big heart, the working together of employer and employee.

At one time a circus came to town and we saw the methods under which the circus unloaded and so forth, and it was the organization, the getting together of units for common purpose, that we called welfare work.

Mr. Pettingill raised the question of suggestions. That is something we have fostered for years and we think so much of it that we have been giving cash prizes for years. That worked out very successfully and it increases the general good will of the employees to the management. It gives them a voice. We thought so much of our suggestion system that just recently we increased our cash prize contributions, made every six months. We have just doubled that and added to it, we gave five ten-day educational trips to various sections of the country in which the prize winner might be particularly interested in the work. We also have a four-day free trip to any city that they might be interested in. Just last Monday evening we made a distribution of the prizes for the December contest, and the first prize-winner was a three-time winner, and he has not only promoted himself to foreman of his department but he has won a first prize three times in succession. We thought so much of that record that the management gave to him a ten-day educational trip. I don't think there is an question at all in our minds as to whether or not the system pays.

With regard to the particular way in which a thing is operated, you at a distance cannot quite see it, but I would be glad to go into details with anybody who is particularly interested.

MR. NEUSTADT: I want to point the difference in viewpoints. That isn't welfare work—you give those cash prizes because the men deserve them and you ought to give them. If you don't give them to the men, you cheat them. While this ten-day vacation is very pleasant, I prophecy that some day you will give everybody a two-weeks' vacation with pay. (Applause)

MR. H. A. HOPF (New York): Speaking strictly to the subject of executive direction of industrial relations, it seems to me that one or two definitions might not be out of order. In the first place, I take it that the personnel manager or the operating head of the personnel department is an administrative officer and as such is charged with the responsibility of carrying out the policies which have been laid down as the guidance for his work. In the second place, I take it that the executives are those who are responsible for the formation of policies, and as such, set them up for the guidance of the personnel men as well as all others in the organization. That puts, then, the emphasis in the matter of executive direction where it belongs and it places it upon those who occupy the highest position in the organization.

What is the picture of the average executive? He is usually a man of the old school who has graduated from the ranks and to whom modern personnel relations and the underlying philosophy come, when he becomes acquainted with them, as a distinct surprise. He has worked his way up through the ranks and he is concerned with just his work and above that he cannot think his problems and he is only too often inclined to leave not only the administrative direction of personnel affairs alone, but also the shaping of policies for the personnel men who are staff specialists and as such are not possessed of executive authority.

It seems to me that the problem, then, is to interest the executives in the executive direction of industrial relations. How can that be done? Most of you here are in common relation to the other—we do not have initiative action. If we could get our executives into this group and have them attend these meetings, they would undoubtedly learn enough and would retain enough to move them to the formation of some definite policy of management. Executives must see the whole sphere of productive life in industry and they must understand that it's just as important to set up standards of production as it is to set up standards of training and incentives both financially and otherwise, and they must also study productive life and develop a just and not harsh method of supervision, and I have yet to see such attention being given to that end of productive life.

If we can get our executives to understand that in addition to marketing a product there is a great big division of human relations and if they will give enough time and not act by delegation in the matter of formulation of policies, they will have collective thinking on the subject, and ultimately they will realize that whether they can act or not, the problem is always there and must be met by a sane, intelligent and well-balanced application of their attention units to the subject. They have just so many and usually the attention units are exhausted before the personnel manager can secure some of them.

The personnel manager, in other words, has got to be a salesman. He has also got to keep this great big philosophy before the eyes of the executives. He has got to be practical and he has to show them the relation of one phase of the problem to the other, and where it hits him first as an organization problem and second as an administrative problem.

I wish I had time to develop that thought, but I want to say that there is one of the most difficult things, as I have found in my own experience—getting the attention of the executives in the interest of scientific accuracy.

May I comment on the definition of a pessimist? I think, as I remember it, the statement was made that a pessimist was not one who at the end of a business day was able to concoct a delicious drink out of the lemons that had been handed him during the day. An optimist is a man who since July 1st has been carrying a corkscrew in his pocket. (Laughter)

MR. FRANK B. GILBRETH: The Society of Industrial Engineers has always shown a very liberal spirit in asking people in other fields to co-operate with us. The speech of our President today brings out in fine shape the possibilities of the full co-operation of the plant physician, the economist and others, and I wish to take this time to call attention to a very sad fact that has happened to two men in our profession, who did not happen to be members of this Society, and in accordance with the broad spirit we have always shown, I think we should have official recognition of those men, because it's obvious that a man does not have to be a member of this Society in order to be a first-rater. That question is entirely out of the question at the present time. The men are Henry L. Gantt and Ernest E. Southard—two of the greatest men that we have ever known in our profession died recently.

Aside from the loss to our Society and to fellow members, I am going to speak purely of personal relations with those two men. I have recently moved to Montclair, and one of the reasons that I moved to Montclair, of the many choices I could have had, was that I might be near my friend Gantt. His family and my family have been very intimate for a long time and I have learned a great deal from that man and that man was an economist and his name will go down in history with Adam Smith. We do not appreciate those who live in our time. They have to be dead a certain length of time before we wake up to the fact that they were great, and it's one of the greatest, saddest things of our established government that such a man as Gantt could not be captured and taken out of his profession, recognized and paid to devote his entire attention to furthering our aims and plans. Something is wrong with our type of government. Under an autocracy that man Gantt would have been grabbed and put where he belonged.

While we were waiting for the freight cars to come to our house with our household furnishings, Gantt came over to see me two Sundays. A few things had come by truck so he sat on packing cases in our house and he was the same Gantt as he would have been if he had sat on a throne. Those two successive Sundays Gantt was there and the next Sunday I was going to return the call (of course, it wasn't returning the call—I simply wanted to see Gantt and his family) but I heard that he was sick, and the next Sunday I heard that he was not well and we decided to go over in the evening. It seems that the telephone in Gantt's house was in his bed-room and when my wife called up, consequently Mrs. Gantt said all encouraging things and we had no idea that he was so ill. The nurse telephoned that Gantt was no longer alive just as we were putting on our hats to go over to see him. You can imagine the personal shock that we had, but everybody that knew him experienced the same personal shock. It's impossible for me to express what I should for Gantt at this time, and consequently somebody must do it, and I am going to ask our President to take the matter in hand and see that this Society goes on record as recognizing the great work of Gantt and sending word to his family to that effect.

The same thing might be said of Southard. I think perhaps fewer of us knew Southard as we knew Gantt. Southard was a member of the faculty of the Harvard Medical School. He was at the head of the psychopathic hospital. Possibly a week or eight days before he died, my wife and I were over in Boston, co-operating with him as we had been for some four years, and we had the pleasure of attending one of his lectures. After the lecture he came over to our hotel and we went to the movies and when we left him at night, he said, "Don't let the flu get you," and I think I said, "Same to you," or some other expression that had no seriousness in it whatever. I came back to New York, got the flu, and when I sat up in bed I read the paper and saw that he was dead.

It's impossible to do justice to Southard but this Society must recognize his work. One of his friends told me that he had fifteen pages of titles of papers and books that he intended to write before he died, and he already had a number of co-operators who were working with him on various books on the subject of feeble-mindedness and promotion and personnel work in general, from the medical end of it, and the scientific end as well, what we would call the personnel end.

I had the pleasure of attending a sort of a clinic in which Southard took charge in the hospital in Boston for possibly two or three years during the war, and during that time the newspapers came out in Boston with a full account of a dangerous bomber who had been captured by the police and he was slated to spend the rest of his life in the Charlestown prison. There happens to be a law there which gives the man another chance—a a chance to go the psychopathic hospital, and I was there with Southard in this court-martial clinic. He just had a little meeting—the most informal thing, and instead of having that man behind the bars, where most any man would not be fit to talk to if he was behind the bars for the first time, he put this man in a room, and incidently, they took his clothes away from him, and they told him they thought he was sick.

This man's crime was the fact that he was found with several bombs in his possession, three, I think, and the newspapers were full of it. Southard sat down with this man, much the same as our personnel men sit down with our men with some trouble, and said, "Well, well, you're here without your clothes and only a bathrobe. I understand you have a scheme to put the Germans out of business—tell me all about it." If he saw that the question was at all of the sort that made the man uneasy, and if he saw the answer coming, he immediately went on to the next question before the man answered. What he was after was facts.

It developed that this man was a sort of feeble-minded altruist who had discovered the fact that in hitting a match on the head it would blow up. He decided that if he could get enough of those piles of matches (and you always can get matches) and put them in a milk bottle together with a couple of rusty nails, they could throw these things over Germany and kill Germans galore, and this man was simply doing his bit in his mistaken way for his country, and instead of sending him over to prison, Southard rescued this man and told him that his job was being a painter (he had been a painter before) and he explained to him that he shouldn't monkey with such things as that because he might get in trouble, and that man went back happy to his wife and children, and if that isn't the finest sample of personnel work, I want to know where you will find it.

Southard has been co-operating with us since 1913. His papers have been printed and will be printed, and I think this Society should recognize that his death is a tremendous loss to us and send such word to his family.

I want to say that those are the kind of people we must get into our work—not necessarily in our Society. A man doesn't have to be a member of this Society in order to do business here. We want those men—men like that—to come into our Society and become members, because it will only be a short time before we are going to have a word to say about legislation in matters pertaining to personnel management. The reduction of the cost of living and those things will all go back to education—education back to fundamentals, and the sooner we get in and have our work criticised so that we may get on the right track and so that we may co-operate with such men, when we do that, the better it will be for this country, and the better it will be for all, and consequently, I am very glad to have this opportunity to call attention to the wonderful work of my personal friends, Gantt and Southard, and I hope that this Society will take action to express our great loss that I myself feel entirely unable to express today. (Applause)

THE CHAIRMAN: Your remark is very timely. I shall have action taken before the close of the convention.

ADJOURNMENT.

The President requested Mr. L. P. Alford, Editor of Industrial Management, to draft resolutions recognizing the great work performed by Mr. H. L. Gantt and Dr. E. E. Southard, as suggested by Mr. Frank B. Gilbreth.

The following resolutions were sent to Mrs. Gantt and Mrs. Southard respectively.

IN APPRECIATION

Henry Laurence Gantt stood among us as a great leader in engineering, doing his active work at a time when industrial conditions were in a state of rapid change. He gave the strength of his personality and constructive thought to those things which stood for progress and permanency. To him more than to any other engineer belongs the inestimable credit of insisting upon humanity and democracy in the relationships of industry. The influence of his leadership in this particular is bearing most worthy fruit.

Through his death on November 23, 1919, we have lost our personal contact with him and the inspiration of his personality. But his leadership through the enduring principles that he taught and insisted upon can never be lost, but will continue to govern men's actions, not only for the physical well-being but likewise for the moral upbuilding of productivity of all who participate in or are influenced by the agencies of productivity. Therefore, be it,

Resolved: that The Society of Industrial Engineers in convention assembled expresses its deep appreciation of the great engineering attainments of Henry L. Gantt as a most imperfect token of sympathy.

IN APPRECIATION

Whereas through the death of Dr. E. E. Southard on February 8, 1920, one of the great leaders and advisors of engineers has been taken away, Be it,

Resolved: that The Society of Industrial Engineers in convention assembled pays tribute to the great contributions made by Dr. E. E. Southard to the knowledge and literature of mental hygiene in industry and through this resolution to express to Mrs. E. E. Southard its sympathy in her great bereavement.

SECOND SESSION

Wednesday Evening, March 24, 1920

Chairman: E. S. COWDRICK

Assistant to President, The Colorado Fuel and Iron Co., Denver

MR. WALLACE: We have been gratified with the beginning of the conference. We feel that it has been profitable and encouraging, and we wish to extend to all a very cordial invitation to attend all of the sessions, if possible.

We have heard a great deal about the work of that western organization which has set the pace in matters relating to industrial relations and we are indeed fortunate to have with us as Chairman of our meeting this evening, a representative of that company, the assistant to the President of the Colorado Fuel & Iron Co., Denver, Col., who will tell us a few things about their experience in handling the strike situation there—previous to his introducing the first speaker of the evening. I wish to say that the Chairman will make these remarks as he has been requested to do so by several that are interested.

I take great pleasure in introducing Mr. E. S. Cowdrick, Chairman of the evening. (Applause)

THE CHAIRMAN: I believe my friend Mr. Dent has me about as far away from home as he can get me. Last summer he invited me to come to Chicago and I thought I was making a pretty long trip from Denver to Chicago; now he has invited me to Philadelphia and I came. I have gotten in a very bad habit of accepting invitations, but it seems to me that if I get much farther away from home, the next meeting will have to be held out of the country. I thought I was the man who had come the greatest distance, but a fellow blew in here this morning from Texas and he claims he has come farther than I have.

THE COLORADO FUEL & IRON COMPANY'S INDUSTRIAL REPRESENTATION PLAN

E. S. COWDRICK

Assistant to the President, The Colorado Fuel & Iron Co., Denver

The works council system of industrial organization has for some five years been under the critical observation of industrial engineers, economists and business men. Looked upon at first as a fascinating theory—an adventure in industrial knight-errantry—it soon attained a significance that made it an object of earnest and hopeful study. We who to a greater or less extent have been in touch with its development have compared theories and swapped experiences. You easterners have gone west, and we westerners have come east, in search of facts which might make more easy the equitable adjustment of the relations between employer and employee.

Friends of the works council must now admit in all fairness that its period of probation is over; that it is no longer a theory, but a fact, and that the industrial world has the right to judge it by its results. When the mechancial engineer has installed a piece of machinery, he observes its performance in comparison with that of the best device invented by his competitors. By this standard he judges his product. If it meets the test, it is retained; if it shows imperfections, it is improved; if it is hopelessly inefficient, it is scrapped, to make room for a more successful machine.

The industrial engineer should be no less impartial. He should examine the principle of workmen's representation, as every other principle connected with his profession, or to determine whether or not it measures up to the requirements of justice and practicability imposed by labor, by business, and by the public.

It is because the Industrial Representation Plan of The Colorado Fuel and Iron Company has been in force since 1915, during which period it has been tested in normal and abnormal conditions and under most diverse circumstances, that I venture to point to the experience of that company as furnishing a reasonably accurate indication of what may be expected of workmen's representation at its present stage of development.

The Colorado industrial plan belongs to that general class in which elected representatives of the workmen deal directly with company officials, largely through joint conferences and joint committees. During five years it has functioned with increasing satisfaction to the management and with growing understanding and appreciation on the part of the workmen. It has paid dividends in bettered working and living conditions and in increased good will and co-operation between employer and employee.

One agreement written into the Industrial Representation Plan is that "there shall be no discrimination by the Company or by any of its employees on account of membership or non-membership in any society, fraternity or union In its scrupulous observance of this regulation, the management has interposed no objection to the workmen joining the unions of their various crafts, while at the same time it has rejected demands for union recognition and the closed shop.

For months before the outbreak of the steel and coal strikes in 1919, union organizers had been particularly active among the employees of The Colorado Fuel and Iron Company, and a considerable proportion—although probably a minority—of the company's workmen had become identified with labor organizations.

In Colorado the steel and coal strikes were in no sense local contests nor based upon local issues. They were a part of a national movement, the history of which is now well enough known to prove beyond question that the purpose of its leaders was to force the closed shop upon the steel industry, to extend it to every coal field, and to strangle the rapidly growing method of collective bargaining through works councils. Behind this purpose there apparently lurked, in the minds of some leaders at least, a design to overthrow existing systems of industry and government.

The nation-wide contest was inevitable; it would have been unreasonable to expect that any form of organization, however faithfully administered, would make the employees of one corporation immune to infection. In future years, with increasing intelligence among workmen and a longer record of co-operation between employer and employee, it is not too much to hope that systems of works councils will stand as impregnable ramparts against unjust strikes, but in 1919 that time had not yet come. There still is need for much education on the side of the workman and much patience on the side of the employer.

Granted, the steel strike was effective for a time at the works of The Colorado Fuel and Iron Company and at those of some other corporations having plans of employees' representation; granted, further, that the coal strike for a few days reduced production at C. F. & I. Co. fuel mines—is workmen's representation therefore to be condemned as ineffective?

Each day's newspapers record railroad accidents; do we on that account discard block signals and scrap air brakes? Scientists have toiled for centuries to prevent and mitigate disease; a year one epidemic swept away more American lives than were lost on Europe's battlefields, yet we do not brand medical science as a failure. Human society during thousands of years has devised laws for the government of its members; murder and robbery have not vanished from the earth, nevertheless most of us still believe a government of law effective and necessary.

The principle of employees' representation is entitled to be judged by the same standards.

Let us, then, consider just what the Industrial Representation Plan of The Colorado Fuel and Iron Company actually did accomplish when assailed by the nation-wide and revolutionary strikes of steel workers and coal miners.

On September 17, 1919, representatives of the Minnequa workers met with company officials in one of the regular joint conferences provided for in the Industrial Representation Plan. The meeting was entirely typical of its kind. The usual number and variety of subjects were brought up by the workmen's delegates, and either settled or referred to the appropriate committees for investigation. There was no intimation that a strike was impending.

The next day a local committee of five union men received the strike order from William Z. Foster, secretary of the National Committee for Organizing Iron and Steel Workers. The demands formulated in the east were served upon the manager of the steel works with the ultimatum of the National Committee. The president of the company immediately returned to Pueblo, and another conference between employees' representatives and company officers was held. The representatives stated unhesitatingly that working conditions were satisfactory and that with the exception of union contracts and the closed shop, practically all the conditions demanded by the national strike committee already were in effect at Minnequa. Some of the representatives who were members of labor organizations said they had no option in the matter of a strike, because of the obligations they assumed when they joined the unions.

Following the conference with representatives, the president and other company officers met with the local strike committee and urged the discussion of such demands as did not involve discontinuance of the Industrial Representation Plan and the signing of union contracts. This the strike committee refused to do, declaring that the principle, if not the sole, issue was union recognition and the closed shop.

There is little room for doubt that the majority of the workmen were opposed to the strike. The average steel worker who obeyed the order of the national committee, did so reluctantly and seemingly somewhat in the spirit of the proverbial farmer, who said he was "going down town to get drunk—and, Gosh, how I dread it!"

In spite of this sentiment, and for causes which require no explanation in a company of men familiar with labor disturbances, the greater number ot Minnequa steel workers failed to report at the mills on the morning of September 22. In the lack of sufficient forces to operate the various departments, the plant was shut down, the management believing that this was the wiser course to pursue until the men had had time more clearly to understand the situation.

There followed a few days of peaceful idleness; then the manager of the steel works was approached by former employees, who said they had formed a Back-to-Work Organization of men who wanted the company to re-open the plant on the old terms and under the old conditions. The membership of this Back-to-Work Organization grew by leaps and bounds, and it would have been possible to re-open the steel works in October except for the then impending strike of bituminous coal miners. During the coal strike fuel from Colorado mines was diverted to districts in the middle west, and the company was unable to use its own output for the steel works. When the diversion orders were withdrawn on December 15, the steel plant re-opened, peacefully and as a matter of course.

In the meantime the nation-wide coal strike had become effective November 1. The purpose of this strike, so far as Colorado was concerned, is sufficiently indicated by statements of an organizer for the United Mine Workers of America, quoted in the press as follows:

"We are going to organize every coal mine in the country, and if the Rockefeller interests do not come through it will be a warm time through 1919 and into 1920."

"We will not give up until The Colorado Fuel and Iron Company gives us a closed shop."

At mines of The Colorado Fuel and Iron Company the effect of this strike was not seriously felt. Most of the properties continued without interruption, or resumed them within two or three days. Before the strike was officially called off on November 11, nearly all the mines were operating practically at capacity. The relatively small number of men who were still out returned to work immediately upon publication of the information that the strike order had been revoked.

For the relative unimportance of the coal strike in Colorado Fuel and Iron Company properties, much credit undoubtedly is due to the Industrial Representation Plan and the sentiments of co-operation and confidence built up under its administration. One series of incidents is illustrative of this feeling. A few days before the strike began, employees' representatives from some of the largest mines of the company voluntarily held a meeting and drew up resolutions which later were adopted at mass meetings held at various mines. These resolutions read in part:

Whereas, A nation-wide strike of the United Mine Workers of America has been called for November 1, 1919 and

Whereas, The votes of the employees taken at the meetings recently held have shown a large majority of the employees opposed to the strike; and,

Whereas, It is our opinion that the demands on which the strike is being called are unfair, and the strike will work a tremendous hardship on the American people; and,

Whereas, The persons agitating in favor of the strike are almost without exception single men and non-citizens; and,

Whereas, We believe there are many members of the United Mine Workers of America organization who are opposed to the strike and in favor of continuing at work.

We believe that an organization should be formed for the purpose of uniting the loyal employees who wish to work.

Therefore, be it resolved, that we form an organization to be known as "The Employees' Representation Protective Association of Huerfano County"; and,

Be it further resolved, that we do hereby pledge our support and assistance to the county officers in the preservation of peace and order; and,

Be it further resolved, that the employees at each camp be advised to select a committee of twenty-five or more to assist in preserving peace and harmony by preventing inflammatory speeches, criticisms of the President, the Governor or any others in authority, or in any manner attempting to destroy American ideals and principles; and,

Be it further resolved, that all loyal American employees and all those who love and respect American ideals and principles, be asked to sign copies of these resolutions.

Both strikes were almost wholly without violence. The continuing amicable relations between officials and those of the workmen who elected to quit their tasks, and the lack of bitterness at the end of the contests, form a chapter in industrial history differing markedly from the typical labor disturbances of the past.

In January, 1920, were held the annual elections of employees' representatives at the mines and the steel works, followed by the usual conferences between representatives and company officials. At these conferences the representatives, in the most matter-of-fact way conceivable, took up the work of the Industrial Representation Plan, entering heartily into the proceedings and joining in plans for the future development of even closer relations between the management and the working forces. Their actions, and in some cases their words, indicated that they had no other thought than that of continuing to regulate their relations with their employer under the terms of the Industrial Representation Plan.

During the closing months of 1919 the Industrial Plan of The Colorado Fuel and Iron Company, like the similar organizations of many other business enterprises, underwent a crucial test. The principle of employees' representation was assailed in what was avowedly an effort to tear its roots from the soil of American industry. It is the belief of The Colorado Fuel and Iron Company that the events of those trying months demonstrated the essential fair dealing of the Industrial Representation Plan and its practical usefulness in adjusting the mutual relations of labor, capital and the public.

THE CHAIRMAN: It is very encouraging that during the recent unpleasantness, Uncle Sam found use for industrial engineers. We have with us this evening, as the first speaker, a man who was one of the original directors of The Society of Industrial Engineers, and who since then has been in the service of Uncle Sam, who still declines to release him—Major Harry Franklin Porter of Camp Zachary Taylor, Louisville. He will address us on the subject of "Application of Principles of Industrial Management to Army Construction."

MAJOR PORTER: After I had been in the Service a short time, some one of my friends asked me if I was happy. I told him that I was enjoying myself, feeling that I was applying my knowledge of industrial engineering to good account in the army, and I want to say that I have been in it nearly three years now and it has been a very happy and busy and interesting period of my life. I have seen a lot to criticize in detail, speaking broadly, and looking at fundamentals, but I have been at all times pleased and gratified at the evidence of forethought and scientific approach to the handling of the most gigantic problem that the government has ever faced.

Of course, I can only speak with detailed knowledge of my own department—the construction division. When the army picked me for the service they drove back into my experience and slated me for construction. I had gotten away from it somewhat but it wasn't long before I found that even in construction there were plenty of opportunities to apply industrial engineering principles. I felt somewhat like the golf enthusiast who, when he got to St. Peter, asked if there was golf up there. "No, no place for golf in this place, if you want golf you have to go to the other place." "Well, good bye, I'm going where there is golf," and he turned around and at the other place was met by a little imp. "Do you have golf here" "Yes!" "Let me see your links." The little imp took him to the links and they were the finest links he had ever laid eyes on. "Let me see your clubs." And they, too, were the finest clubs he had ever seen and they quite matched his ideal. "Let me see your caddies," and there again he was completely satisfied. "Well, I guess I'll have a game now—where are your balls?" The imp, without a smile on his face and a look of blank astonishment said, "Balls—we have no balls—that's the hell of it." (Laughter) And I want to assure you that there has been plenty of it in the army during the war—that's the reason I have been happy there. It's been a "heluva time," its true, in some respects.

APPLICATION OF PRINCIPLES OF INDUSTRIAL MANAGEMENT TO ARMY CONSTRUCTION

MAJOR HARRY FRANKLIN PORTER, U. S. A.

Mr. Chairman; Members of the Conference:

At the very outset I wish to amplify the title of my paper to include also **Army-Camp Operation and Repair,** for although I have been closely identified with the army construction program throughout the war period, as a Utilities Officer for more than two years, it is with the operation and maintenance of our Army "cities" that I am most familiar.

First, however, I shall deal with the construction side.

It was a gigantic problem that faced the war department—to create in sixty to ninety days thirty-two cities complete in every detail, even to laundries and ice plants, for the housing and training of thirty to forty thousand men each. This problem could only be solved by the most skilful planning and careful coordination of effort—in short, by the application of the tried and tested principles of Industrial Management.

In one respect the problem was simplier than that which ordinarily confronts the manager of an industry. I refer to the financial factor. There was no stinting of funds. Time being the all-important element, the abiding and ruling consideration, whenever obstacles imposed that threatened to delay the program, they were quickly swept aside by sheer weight of resources. If spending two dollars where one dollar under normal conditions would be considered a proper cost, the two dollars was spent without hesitation if it would appreciably hasten the date of completion. I don't mean to infer that money was deliberately wasted. On the contrary, expenditures were, on the whole, controlled with remarkable judiciousness, and no effort was spared to secure the maximum return for each dollar, provided so doing introduced no element of delay.

The question of finance being settled, through the liberality and **prompt** liberality of Congress, the next problem was organization. At the time this country entered the great war, the only agency for handling army construction—aside from fortifications and river and harbor work, which is the province of the Corps of Engineers—was a relatively insignificant bureau of the Quartermaster General's Office, known as the Construction and Repair Division. Two or three officers, an advisory architect and maybe a dozen clerks comprised the entire force. Realizing that the Quartermaster General had his hands full in expanding his organization to handle the titan task of feeding, clothing and otherwise supplying an army of four million men, the Secretary of War at an early date authorized the Construction and Repair to function virtually independent of the Quartermaster General's Office, under the name of the **Cantonment Division.** Subsequently the separation was made complete and the name changed to the **Construction Division of the Army**, under a chief reporting through the Director of Operation (Assistant Chief of Staff) directly to the Assistant Secretary of War, Benedict Crowell.

The way having been cleared for action by the application of a sound principle of management, the next and perhaps the biggest task was the quick assembling from all parts of the country of the engineering talent, business skill and construction genius necessary to make plans and translate them quickly into structures to house and supply the soon-to-gather army that, two years later, was to bring the proud Kaiser to his knees.

Men came gladly—big men, brainy men, men of wealth and men of far-flung fame in engineering and contracting circles. It was their opportunity to serve—to do their bit. As fast as the necessary formalities could be executed, those who could best function in the regalia of the military service were comissioned. Some entered as civilians and so remained till the end. In the space of a few weeks a mighty construction machine was fashioned, complete in all its parts. It embraced engineers and builders, accountants and architects, material men and real estate experts, lawyers and business men—and each man a specialist in his particular line. And at no time did this mightiest of all construction organization include in its members more than three regular army officers. Theirs was the task of, first, building the machine and then, from their vantage ground of long familiarity with army practices, to guide and steer the machine clear of the pitfalls of cumbersome statutory limitations and restrictive army regulations.

This organization, in the space of a year and a half, put through the mightiest construction program in the history of man. Beside it, the Panama Canal accomplishment, great though it was, pales into insignificance. It embraced not only great military cities for the housing and training of our citizen army, but huge storage and terminal projects, manufacturing plants of divers descriptions, hospitals, wharfs, and in fact every conceivable variety of construction such as was needed in connection with the training, arming, equipping and supplying the greatest and finest army ever gotten together in the history of the world. Cantonments, in point of fact, comprised only fifty percent of the total.

To give some idea of the unprecedented proportions of the army construction program—and this does not include the program on the other side which, with some few exceptions, was handled by the Corps of Engineers, and which, while not nearly so large, was no less note-worthy in degree—the following selection of salient statistics, taken from General Marshall, Chief of the Construction Division's testimony before the Senate Military Committee, is offered:

Total Authorized Expenditures	$1,000,000,000
Men Engaged (Maximum)	427,000
Total number of Projects	458
Lumber used (1000 Board feet)	2,647,000
Cement used (Barrels)	6,200,000
Miles of R. R. Track Constructed	987
Total number of Buildings Erected	54,000
Total Hospital Capacity provided	186,500
Total Storage Space (Acres)	898
New Roads Constructed (Miles)	1,031
Water Main (Miles)	800
Sewer Main (Miles)	1,000
Electric Light & Power Lines (Miles)	3,000

Some description of the organization that put this truly stupendous and unprecedented program over, some notion of how the talent assembled was classified and grouped so as to function smoothly and effectively, cannot fail to be of interest to industrialists. While the Construction Division experienced several stages of development and refinement, it operated throughout the war period with practically the following major sub-divisions:

A. **Engineering Dept.**—Charged with the development of plans and estimates, the selection of sites, layout and technical supervision. It was also the agency through which the final authorization of a project, carrying the approval of the Secretary of War, emanated, releasing action all along the line. And no authorization was released until the plans were fully matured and the stage set for quick execution.

B. **Building Dept.**—Charged with the execution of the plans of the Engineering Dept. Consisting of general supervisors or "controllers" stationed in the Washington Office, and constructing officers with auxiliary engineering and auditing staffs in the field, liason being maintained through traveling supervisors and auditors and by the liberal use of the telegraph and long distance phone. For the guidance of the officer on the job, it caused to be prepared a book of instructions, known as the "Manual for Constructing Quartermaster's" which, taken in conjunction with the "Field Auditor's Mannual" to be mentioned later, outlined in detail the procedure and methods to be followed and insured uniformity. A Construction Officer with these two volumes of "written standard practice" in hand could scarcely go wrong.

C. **Materials, or Procurement Dept.**—Charged primarily with the task of allocating and mobilizing the necessary materials on call of the Supervising Constructing Officer; also with task of expediting delivery of materials to the project. The work of this department was greatly facilitated by the cooperation of the War Industries Board and allied counsel of National Defense. Its buyers dealt, not with individual vendors, but with entire industries, the latter in turn distributing the business to the various members of the industry in accordance with their ability to furnish the material in the quantity and at the time wanted. The question of price was fixed through the same cooperative agencies. No time, therefore, was lost in advertising for bids or negotiation as to price. From the War Industries Board delivery priorities also were obtained, in view of the relative urgency of the project and the requirements of the completion schedule.

D. **Contracts Dept.**—Charged with the task of selecting through the agency of the Emergency Contract Committee of the Council of National Defense, a suitably qualified contractor for the project and of setting up the proper contractual relations with him. Charged also with the lease and purchase of sites, (Subsequently the function of Real Estate Procurement was turned over to a section of the Purchase, Storage and Traffic Division of the General Staff, but this allocation was disregarded by the Secretary of War when the acquisition of the cantonment sites was determined upon, for the task was delegated to the Contracts Department of the Construction Division and it is probable that this function will eventually revert to the Construction Division, where it undoubtedly belongs.)

E. **Accounting Dept.**—Charged with the task of accounting for funds allotted as spent, in accordance with Army Regulations. This department ramified into the field as did the Building Department, extending supervision over the accountants on the staff of the Constructing Officer. For the guidance of its traveling and field men, it caused to be compiled a book of instructions, known as the "Mannual for Field Auditors," which is a model. By this means it insured uniform accounting methods on all projects,—methods that basically conformed to the requirements of army regulations and yet compared favorably with the latest and most approved commercial practice.

F. **Administrative Dept.**—Charged with the task, as its name implies of coordinating the activities of other departments. This included, among other items, the recruiting of the necessary personnel, officer and civilians, for all departments, the collection and safekeeping of the personnel records, the handling of the mail and the issuance of travel orders for the movement of personnel. It also embraced a section for the handling of wage disputes such as might and did arise on various projects from time to time. The chief of the section represented the Construction Division on Secretary Baker's Industrial Service Counsel, upon which the Ordnance Department and other branches of the War Department employing labor in large numbers were represented.

In the field, the Construction Division operated through a Constructing Quartermaster, as previously indicated. Men for this position were as a rule selected because of their previous training and experience as construction engineers. Theirs was the task of supervising the operations of the selected contractor:—in some cases with the actual management of field operations, when the work was done by direct purchase and hire; and with making all disbursements in payment for materials bought and services rendered.

On the earlier projects these officers had for their guidance only the Manual of the Quartermaster Corps, that ancient and honorable prototype of written standard practice instruction, excellent in its way but collated with peace time conditions in mind and thus not entirely adequate as a guide under emergency conditions. This was supplemented and in part supplanted by the two Manuals previously described, the full development of which took several months.

As aids and counsellors the Construction Quartermaster was provided with two principal assistants; a **supervising engineer** and a **field auditor,** either one or both, in many cases, receiving a greater compensation than he.

It was the function of the supervising engineer to make the necessary surveys, stake out buildings and other structures, give grades, develop detailed working plans based on the standard general plans sent out from Washington, to check over the work of the contractor, to formulate progress reports for the information of the Construction Quartermaster and the Washington office, and in general to advise and aid the Construction Officer on all engineering questions.

It was the function of the field auditor to supervise all fiscal transactions. This included reimbursing payments to the contractor for material as well as labor. To insure that all materials received were applied, and that the labor reported as carried on the pay rolls actually put in the time claimed, the Auditor operated a more or less extensive force of material checkers and inspectors, and time checkers. On large projects such as cantonments, the time checkers were mounted on horseback and in addition to checking the men in and out at the various checking stations, checked their presence on the job several times each day.

On the larger projects, particularly those that involved complicated water and sewer problems, the Construction Quartermaster also had the aid either of resident or visiting consulting engineers, as conditions demanded.

Attention is invited to the conformity of the organization described to the well established principles of **staff** and **line** and **competent counsel.**

On the larger projects, too, the Constructing Quartermaster's staff usually included one or more officer assistants who were chosen for their special knowledge along some line. If only one, he became usually the "Property Officer," taking over accountability for all property and thus freeing the Constructing Quartermaster from one of the greatest bugbears of army administration routing.

A word of explanation may not be out of order as to what is meant by "Property Accountability." In the Army property of whatever description must be carried, and fully accounted for at all times on paper. An officer accountable for property clears himself of the responsibility therefor in one of four ways:

(a) By dropping it on an issue ticket, if expendible, or certificate of installation, if non-expendible.

Note: **Expendible,** in the army vernacular, means an applied material, such as lumber, oil, etc., a **non-expendible** is a tool or fixture, what in industrial parlance is classed as a capital asset. Thus a motor truck is non-expendible, but repair parts thereof and the supplies used thereby are expendible.

(b) By "loaning" it (if non-expendible) to another authorized to "borrow" it for use, on a **Loan Card.**

(c) By having the property officially condemned by an **authorized** Inspector as unserviceable and dropping it on an **Inspected** and **Inventoried Report.**

(d) By "surveying" the property, if lost, stolen or damaged by accident or carelessness.

Note: Surveys are made by a disinterested officer appointed by higher administrative authority. He investigates the statements and affidavits concerning the property presented for survey and on the basis thereof recommends that the responsible officer be cleared in whole or in part. This recommendation is subject to the approval of the appointing authority and in some cases requires the approval of the Secretary of War. If the officer is not cleared of any item, he must then dig down in his jeans and pay for it, or suffer a stoppage against his pay. The "survey" is peculiar to the army, but it handles a difficult problem in a practicable way and might well be applied in principle, to industrial practice.

But to return to the description of the working organization of the Constructing Quartermaster. His "staff" has been depicted. His production or manufacturing department was his selected contractor's organization, supplemented and reinforced by such special skill and talent as conditions required. This was headed by a General Superintendent, corresponding to your factory manager and one or more assistants with a superintendent at the head of each main department of construction; for instance, Superintendent of Carpentry, Superintendent of Plumbing, Superintendent of Waters and Sewers, Superintendent of Roads and Drainage, etc. Under the department superintendent, in turn, were the various section, gang and special foremen.

The Contractor's organization usually included also a Commisary department, in charge of an experienced caterer, as it was necessary in most cases to lodge and feed a great many of the workmen. On most projects with which I am familiar, this important detail was handled in admirable fashion, it being realized that a comfortably housed and well-fed working force was a prime essential to uninterrupted progress of the work. I personally subsisted at a contractor's mess for several months and never knew a bad meal. The methods used in preparing and serving the food would have done credit to the largest and best managed hostelries and cafeterias.

The comfort and well-being of the men housed on the project were considerably looked after in other ways, too. Systematic laundry service was arranged for at the start, as well as places provided where those who preferred could do their own washing. Bodily cleanliness was made easy by the early construction of temporary bath houses.

First-aid station and dispensaries, with doctors and attendants, were also provided sufficient unto the needs, while sanitary squads under the supervision, usually, of an army sanitarian tended to the satisfactory disposition of waste, warred on stagnant pools and underbrush and exercised a close vigilance over kitchens and latrines. Mosquitoes, flies and disease-breeding conditions of every kind and description found our army projects a very unhealthy locality for their nefarious activities, I am sure. All this helped progress by reducing the toll of sickness.

Undoing of steps already taken by that other great enemy of the handiwork of man—fire—was prevented by equally thorough methods of preventive inspections and organized protection. One of the first duties prescribed for the Constructing Quartermaster was to organize a fire department. For apparatus, water barrels, chemical extinguishers and hose reels were provided and, later, modern motor-driven pumps. The pesonnel for his fire department was usually recruited from the neighboring cities. The strictest rules were promulgated and enforced vigorously against dangerous practices. Rubbish was required to be picked up and removed to designated dumps daily; smoking, except in completed buildings, was totally prohibited. In order to have a sufficiency of water for fire protection, as well as for working and drinking purposes, almost the first,—if not the first—task undertaken was the laying of temporary water lines of screw-joint iron pipe, placed on top of the ground, fed from elevated tanks of wood, filled from a nearby stream or lake by pumps. The fire department operated directly under the Construction Quartermaster or one of his officer assistants and he was guided and aided in its establishment by a fire prevention specialist detailed for that purpose by the Washington office.

The contractor's organization also included the following departments, counter-parted in all modern industrial organizations:

(a) Employment
(b) Timekeeping & Payroll (subject to supervision of Field Auditor)
(c) Purchasing
(d) Stores
(e) Traffic
(f) Scheduling and Routing
(g) Transportation (Motor)
(h) Transportation (Animal)
(i) Equipment, Control & Repair

A few words about purchasing. It will be remembered that the Materials Department of the Washington Office allocated materials and arranged for delivery in accordance with directions from the Supervising Constructing Officer. Confirming purchase orders were, however, required to be immediately placed by the contractor, bearing the approval of the Constructing Quartermaster. The Quartermaster was also given large powers to authorize local purchase of materials, not only to enable him to overcome the handicaps of delayed deliveries but also to relieve the load on the railroads. Material offset by local purchases was then diverted to other projects. Undoubtedly much time was saved by this arrangement. While the Washington office undertook in a general way to expedite material deliveries, the actual responsibility for tracing through shipments was centered on the contractor. His traffic department was, therefore, a very important element of the organization.

To control the sequence of the elements of the work, carefully calculated schedules were prepared at the very start. These schedules were plotted and actual progress recorded daily by a parallel graph. If the schedule was not being met, on any item, a thorough search was immediately made for the cause. If it was belated delivery of material, tracers were dispatched and the local market canvassed for all available supplies of the kind needed. If a shortage of labor, the shifts were lengthened, additional labor immediately sought and sometimes continuous operation instituted. In relatively few cases did the means taken fail to produce the desired effect, altho at times on certain classes of work, particularly towards the close of the project, no amount of stimulation or increase in the labor supply seemed to avail.

In other words, the workman, fearsome of the approaching finale, deliberately "stalled". Malingency was most flagrantly emphasized during the normal hours of work, for which the men received only the regular scale. They were playing, in short, for all the overtime and Sunday time possible. Everyone was "wise" to their game, but there was nothing to do but submit. It was an example of shameless and unpatriotic profiteering on the part of certain elements of labor. On the project with which the author was connected, when early in autumn the days became too short for effective work ten hours of the day with eleven hours pay, and the length of the working day had to be reduced to nine hours, with pay for nine and a half, practically all crafts showed an ugly spirit and it was with the greatest difficulty that a general walk-out was averted. Up till then, I had always been open-minded on the subject of the eight hour day, with so called "punitive overtime," but the most zealous labor propagandist would now have the greatest difficulty in convincing me that age-old-greed for gain rather than any genuine altruistic consideration is not the prime actuating motive back of the drive for "shorter" hours. If scales had not been generously advanced in the beginning stages, from twenty to fifty percent, there might have been some justification for manouvering to increase the amount of extra-scale pay. As it was, there was absolutely no justification for the attitude displayed. It was not only sordidly selfish, but down-right traitorous—in view of the fact that the country was at war and it behooved every man to do his bit cheerfully without thought of recompense. In my judgment, the man-power with which to build our war structures, no less than to fight our battles, should have been recruited through the selective draft. There is something horribly incongruous in the fact that men to face the shot shell of the enemy were paid thirty to eighty dollars a month, plus upkeep, while those who fashioned the instruments with which they were trained and equipped received from $100 to $300 with free lodging and board at cost to boot in many instances. The former gave much and risked all; the latter risked little and gave only so much as they were obliged to give.

But to return to the main theme. There was nothing scientific about the handling of the wage question during the emergency construction period, but it was beyond the power of the Construction Division to proceed otherwise. It was a plain case of consciously and deliberately sacrificing economy and efficiency for expediency. Time was the all-important element. Organized labor must not be antagonized. Schedules were, therefore, fulfilled not by scientific handling of labor, but by "paying the price" necessary to keep labor satisfied—and a big price it was. And the end of the "paying" is not yet. In this connection the accompanying chart tracing the rise in wage scale from 1907 to 1919 maybe of interest. (See page 88.) The rise is gradual until the beginning of the war period, then it jumps upward with leaps and bounds.

Another good, sound principle of industrial management exemplified in the management of field operations, particularly on the major projects such as cantonments, was the holding of frequent conferences among the chief directing heads, both staff and line. These were held at least twice weekly and constituted the means whereby the effort was coordinated and stimulated at the top.

With regard to the application of principles of industrial management to actual construction operations, aside from the general scheme of organization and control already outlined, the following two principles were applied to a considerable degree and with remarkable success:

(a) **Labor-Saving Devices.** Nothing was attempted manually which could be performed by machine. This was not done so much to lower costs as to save time—the all-important element. But it made for marked economy as well. The Constructing Quartermaster had a large, almost unlimited scope in this respect, as he not only had power to call into use the entire available and serviceable plant and equipment of the selected contractor, but he could authorize him to acquire such additional equipment as was required either by purchase or rental. All equipment, it should be noted, was paid for by the government on a rental basis, according to a uniform scale of rental, fixed by the Construction Division, the agreement providing that when the value of the equipment was overcome in rentals, the title automatically passed to the government. The agreement further provided that the government, after fifty percent of the appraised value had been paid for in rentals, could, at its option, by paying the balance, acquire possession. In this manner, virtually all the equipment needed to operate, maintain and develop the project after the original program was complete, was acquired, greatly simplifying the labors of those who come after. It was an extremely wise provision.

(b) **Sub-Division of Labor.** Not in the great Ford factories are the working operations more finely sub-divided than they were on cantonment construction. For example, carpenter work; one crew specialized on foundations, another on floor-laying, another on door hanging, another on flue openings, another on roof laying, etc. By this means it was possible to produce finished buildings almost as rapidly as Henry Ford produces automobiles. It was a common occurrence for a large two story barrack building to rise from a pile of lumber in the morning to a finished structure by night-fall. I don't know what is the record, but Mr. A. J. Bently, who constructed both Camp Sherman and Camp Joseph E. Johnson, told us that he repeatedly turned out completed buildings, except for some finishing touches—installation of stoves, lighting fixtures, etc., in as little as four hours. All the necessary materials were of course delivered to the site at least a day beforehand and no crews were scheduled for any job on which it was not known that the wherewith was already at hand. Millwork was delivered ready to install; lumber for joists, studding, etc., first coursed through a sawmill to be cut accurately to dimension and to be marked. By this method the number of structures that could be completed in a given space of time was measured almost wholly by the quantity of material and labor that could be assembled.

The installation of the utilities progressed more slowly, of course, because the character of the work in most instances did not lend itself so readily to a correspondingly fine sub-division of labor, but sheer inability to obtain delivery of materials—boilers, pumps, motors, transformers, radiators, pipe and fixtures—from the manufacturers was the principal reason for any important delays that occurred.

What delays were met with, however, did not seriously postpone that date of occupying the camps, because the engineers of the Construction Division had carefully calculated on the available capacity of the various supplying industries and modified the plans accordingly. Because of the known inability of makers of boilers and radiation, for example, to supply these items for all the camps, radiation was wholly eliminated, except for hospital buildings and officers quarters, in all save four of the cantonments and reliance placed on stoves for heating. Again, an example of wise planning and close calculation of garment to suit the cloth available—one of the fundamentals of scientific management.

Before passing to the second phase of my paper—that relating to operation of maintenance, a few words descriptive of the form of contract under which all emergency construction was executed, will not be amiss. Because this, too, was devised with the principle of time-economy ever uppermost. It was realized at the very outset that the requirements of the army training program could not be met if all plans had to be worked out fully in advance and iron-clad specifications prepared, as would be required by adherence to the regulation method of executing public construction—advertising for bids and letting of contracts to lowest responsible bidders. An emergency form of contract was, therefore, drawn up and authorization for use thereof secured which permitted the work to be done on the cost-plus-a-percentage basis. To overcome the disadvantage of this plan—to checkmate the tendency which it embodies to "pack" costs, a sliding scale of profit-percentages was adopted, with a fixed maximum total fee based upon the magnitude of the project. The tendency to "pack" costs was not entirely overcome by this arrangement, as experience proved; for, until the maximum fee had been earned, the incentive to multiply the cost still persisted and operated to a greater or less extent, depending on the calibre of the contractor and the acumen of the construction officer. After the maximum fee has been earned, a curious reversal of incentives was noted. Now the contractor's mind traveled freely with that of the Constructing Officer, his features lost somewhat of that hard, calculating look which characterizes the man who is incessantly driven by a desire for private profit, and a "golden area" of cooperation set in. However, a noticeable slackening in effort after a bit was apparent. It was to the contractor's interest to finish as soon as possible and thus free himself of the overhead expense he was under, but because he was now giving his service "free" ("working for nothing," as I heard one contractor express it,) his supervision seemed to lose something of its effectiveness.

The emergency form of contract possessed advantages however, which in my judgment much more than offset its shortcomings even on the side of economy. It not only permitted construction to proceed before completely detailed plans and specifications were worked out, but it enabled the government to make substitutions of material at will, to add or detract from plans freely and to subtract from the cost of work the transportation charges, all freight being moved on government bills of lading. It also made possible considerable direct buying of items that did not pertain particularly to the activities of the contractor, thus saving his fee. It further placed in the hands of the Constructing Quartermaster a powerful club over the contractor, since if he did not prove equal to the task he could be easily and quickly discharged, another contractor called for or the work finished in part or in whole by the method of direct purchase and hire. If the contractor over-bought and over-equipped, the government was not thereby the loser, as all surplus materials were the property of the government and it only permanently retained such equipment as it needed. Taken all-in-all, the emergency form of contract not only facilitated immensely operations, but it actually saved the government money, in my opinion.

OPERATION & MAINTENANCE—(UTILITIES)

Occupancy followed hard on construction. Almost as fast as buildings were completed, troops or supplies were moved in. Use denotes wear and tear. It also is predicated upon operations of systems. Thus, well before his primal task was out of the way, the Constructing Quartermaster was called upon to operate the utilities and to make repairs.

Usually this important function was turned over to one of his assistants who became the **Acting Utilities Officer.** Later this officer either became nominally the Utilities Officer or gave way to a newly commissioned officer from civilian life, selected because of his experience and ability in the operation and management of public utilities. To assist him, the Utilities Officer had assigned one or more junior officers, likewise selected because of their experience or knowledge along certain lines. To head the Water and Sewer department, for instance, a sanitary engineer or one trained in the operation of water supply and sewerage disposal was chosen; for roads, a highway engineer; for electrical systems, an electrical engineer; etc., etc.

At first the working organization was composed wholly of civilians. These were, however, rapidly replaced by soldiers as soon as the camps filled up and an intelligent selection of personnel through the military personnel section of the command could be made.

As the draft caught in the meshes talent of every conceivable kind and description, it was but necessary to consult the qualification cards in the personnel office to find exactly the man needed for any position. It took a stiff fight and a deal of diplomacy, often, to get the particular men wanted, because the Engineer Corps might also be after him and they, as a combatant organization, usually had first pick. Eventually schools were established calculated to train the special skill required by the Army in the various branches in precisely the numbers analysis showed was needed. These schools had not gotten under way fully before the Armistice, but if the war had lasted another year, they would have kept the army supplied with exactly the skill its highly involved and complicated mechanism required. Great credit is due Col. Walter Dill Scott for his excellent labors in this connection.

All this fine soldier talent was lost to the Utilities early during the demobilization period and it became necessary again to resort to civilians in large numbers. At the present time most Utilities Officers are still re-lying largely, if not wholly, on civilian labor. Soldiers are gradually being recruited for the purpose, but the material is not nearly the equal of that supplied by the selected draft, than which there was none better. The chart showing the changes in composition and size of the Utilities organization at Camp Zachary Taylor, from June 1918 to January 1920 may be of interest in this connection, as graphically portraying the many and varied shifts of personnel under which efficient operation conditions had to be maintained.

Utilities operates under the general direction of the **Operation** and **Repair** branch of the Construction Division. This department was not established until late in the spring of 1918; hence Utilities Officers on those projects turned over the preceding fall, throughout the winter of 1917-18—a particularly trying winter, it will be remembered—were left largely to their own devices without either sufficient funds or authority for personnel, reporting through an officer more concerned, or at least more versed with supply than with camp operation and maintenance, to an in-understanding and un-revitalized bureau of the Quartermaster General's Office. It was one of the kinks in the revamped army machine which was a little slow in straightening out. In June 1918, the Gordian knot was cut, utilities was definitely placed under the Construction Division, the Utilities Officer disassociated from the local Supply Officer (Camp Quartermaster) and made a staff officer of the Camp Commander.

Then for the first time the maintenance organization began to function as it should. The Utilities Officer was given definite, clean-cut instructions to guide him, his authorization for personnel was increased in accordance with intelligent analysis of need and funds were allotted for his use sufficient to the necessities of the project. The instruction issued governing the operation of services (water-works, sewers, lighting systems, etc.) are a model making a fit companion to the two manuals previously described. Monthly report forms were also devised, to bring into the Washington office the information needed for the reports it in turn was required to render higher authority; also to furnish data upon which to judge the relative efficiency of operations at the various posts. Subsequently, late in 1919, a standard form of organization and a standard set of forms for handling the routing of operations and gathering cost data were devised, by and with the aid of officers in the field.

This plan and system, while not exactly scientific, compares on the whole favorably with the average industrial layout. Its short-comings, at any rate, are due rather to limitations imposed from higher up, than to lack of appreciation on part of the Construction Division of what is really needed. In my humble judgment neither the General Staff nor Congress, least of all Congress, has any adequate conception of the size and scope of the problem of operating and maintaining an army city. Until both can be educated to a proper prospective of the problem, Utilities will be greatly hampered in its growth and development along scientific lines—the goal being better, always better service and lower, always lower unit costs (relatively speaking.)

The average man, even the man of engineering training and experience, has, I find, a rather vague conception of the scope of an army utilities organization. Therefore, I trust you will bear with me a few moments, if I appear to digress while I attempt a brief description of the duties and responsibilities of the Utilities Officer.

First, he is charged with the operation and maintenance of the utilities proper—water-works, sewerage systems, electric systems, steam heating plants and refrigeration. He does not operate, altho he maintains the post laundry, post bakery and waste disposal plant. In the beginning he did operate the waste collection and disposal system, but this function was allocated to the Salvage Division of the Quartermaster General's Office, upon the institution of this department. **Salvage** also operates the laundry and shops for repair of shoes, hats, clothing and other soldier equipment. The Bakery operates under the general direction of the Subsistence (Food) branch of the Quartermaster. The Utilities Officer also controls the fire prevention and control system, and as the official head of the Fire Department is **ex-officio** Camp Fire Marshall. He is in general charge of Buildings, Roads, Grounds, Trackage and Drainage and in addition to being responsible for their upkeep, he exercises active jurisdiction over the orderly and neat condition of the post, being **ex-officio** Camp Police Officer, "police" being the army term for "clean-up."

Betterments is another responsibility of the Utilities Officer. These may be minor and authorized by the Commanding Officer from materials on hand and troop or regularly employed civilian labor; or they may be extensive, requiring special authorization and allotment of funds from the War Department. Such projects may be executed by the method of direct purchase and hire or by lump-sum contract. If the volume of new construction is considerable, an officer is usually detailed as the Utilities Officer's assistant, especially to supervise it. The Utilities Officer is then designated "Constructing Quartermaster," in addition to his other duties.

General Marshall, Chief of the Construction Division, in his annual report for 1919 to the Secretary of War, thus sums up the job of the Utilities Officer: "Indeed, he is a composite city manager, city engineer, fire marshall, street and building inspector, manager of municipal waterworks and sewers, electric supply company and cold storage, besides being the general all-round handy man to whom everybody comes to get anything fixed."

As a service organization, it is incumbent upon Utilities, to maintain a duty status twenty-four hours a day, three-hundred-and-sixty-five days a year. Normally the majority of the personnel works the same hours as anyone else. But a "skeleton" organization is habitually maintained on Sundays and holidays, the Service Department is manned regularly night and day, ready to receive and act promptly on any and all "trouble" calls, and a sufficient number of "trouble shooters" are regularly assigned to night duty to cope with any emergency. The cook whose lights go out in in the evening, does not have to get his breakfast in the dark for lack of a new fuse. The man whose single, serviceable commode goes wrong after working hours, does not have to wait until morning for relief. For Utilities, like the eternal sun in the heavens, is always on the job. In order that there be at least one responsible head on duty at all times, to cover fires or other emergencies, each officer and principal civilian takes his turn as "Service Officer." During the absence of the Utilities Officer, there is hence always someone in charge, automatically, with full power to act in his behalf. No officer or important head leaves the confines of the camp, moreover, without registering in a book at the Service Desk his destination and expected time of return.

The activities of the organization are carried out through six main branches:

(a) Administration
(b) Maintenance & Construction
(c) Operation
(d) Property & Supply
(e) Finance & Accounts
(f) Engineering & Service

Each of these in turn is sub-divided into two or more working sections. **Maintenance and Construction**, thus, includes the Building Section, responsible for building repairs, except plumbing, lighting and steam heat, the Shops Section (Stove and Sheet Metal Work, Carpenter Shop, Sign Shop and Blacksmith's Shop,) the Roads and Grounds Section. **Operation** embraces, in addition to the actual operation of the various plants and systems, also the maintenance and repairs incidental thereto. **Engineering and Service** handles all investigations and inspections, prepares plans and estimates, controls the issuance of work orders, operates the cost system, maintains a follow-up on the working branches, dispatches transportation assigned to the organization from the Motor Transport Corps, is the custodian of all technical data and compiles all reports of a technical nature. The **Property Branch** is charged with the responsibility of procuring and keeping on hand the materials and supplies currently needed. It operates a perpetual inventory of stores, verified once monthly by a physical check. Its head, the Property Officer, carries all Property accountability for the organization. **Finance** and **Accounts** prepares the civilian payrolls, keeps the civilian personnel records, and operates the financial books. Its chief is known as the Auditor and Paymaster. As Auditor he vises all requisitions involving expenditures, purchase orders, vouchers and employment applications. In addition to all these, falling into the scheme of organization as a branch, but functioning virtually as an independent organization, is the **Fire Department**, in charge of a **Chief** reporting directly to the Utilities Officer.

Closely interlinked with the Fire Department is another organization wholly independent of the Utilities, but of which the Utilities Officer, as Fire Marshall is the head. This is the organization of **District** and **Zone** Fire Officers. For purposes of fire prevention and control the camps are divided in a number of districts, sub-divided in turn into a greater number of zones. The fire regulations are enforced through these officers. Normally their duties lie wholly on the side of prevention. In time of need they stand by when the emergency is in their area, and lend the fire department all the assistance in their power. They cause the zone hose-reels to be manned on occasion and assume active charge of the work of saving life and salvaging property.

Similarly, the Utilities Officer as Police Officer is at head of yet another organization consisting of the unit and area police officers, the task of this organization being to see that the camp is kept in good "police," or clean and orderly. The Utilities organization itself is responsible for all common thoroughfares and areas not definitely assignable to any military unit. During the summer season, street cleaning and dust-allaying and in the fall, weed cutting occupy a considerable share of the attention of the Superintendent of Roads and Grounds.

So much for organization. Now a few brief remarks on **methods.** The work of Utilities at Camp Taylor is conducted with the aim constantly in view of conserving the time of the craftsman in every way possible. Jobs of a non-emergency nature are saved until there is a sufficient accumulation of them to justify the dispatch of a crew. Workmen sent out specially, on single jobs of relatively brief duration, always phone the office before returning to ascertain if, in the meantime any other calls for similar service in the same vicinity have been received. If they happen to notice some other obvious repair needed, but which has not yet been reported, they proceed to execute it on the authority of their immediate superior, reporting time taken and material expended on an Inspection-Work Report. To a certain extent, the patrol system is operated on all classes of work. A plumber, for instance, is assigned to a unit. His task is to inspect all plumbing fixtures in that area daily and make necessary repairs. He keeps in touch with the office to receive any special orders and also calls regularly at the headquarters of the organization occupying his area. By this means the plumbing is kept in good operating condition at a relatively small expense.

Lack of personnel prevents the carrying out of this same system in all working sections regularly, although it is attempted whenever conditions permit. But usually there are so many special jobs, particularly in the Building and Roads and Grounds Section, that all available men must be called in to handle them.

Another way in which it is aimed to conserve the time of the craftsman is by accurately predetermining the work to be done. No man is sent out to execute an order, if the nature and extent thereof is not plainly potent on the face of it, until analysis of the job has been made by an inspector and a list of the materials and tools required, prepared.

On all new work, or extended repair jobs, a detailed estimate is first prepared. Before work orders are issued, it is then ascertained by reference to the Supply Branch, whether the necessary materials are in stock and available. If not, steps are immediately taken to procure what is lacking. Foremen are checked up closely on the relation of actual and estimated costs and in every case are required to work to a scheduled date. When furnished with no estimate, the time being left to their discretion, as is the case with small repair jobs, the foremen are under instructions to assign no task to a workman without specifying a carefully calculated time-limit.

Owing to the fact that the majority of Utilities men work singly or in small groups under "straw bosses" and only occasionally during the day come under the immediate eye of the supervisor, the problem of supervision is exceedingly difficult. It is all "day" work and the variety of work is such and variables so many, that standards upon which to base piece prices or bonus payments are in general out of the question,—even though incentive methods of wage-payment were permissible which they are not on government work. Reasonable working efficiency must, therefore, be obtained by other devices.

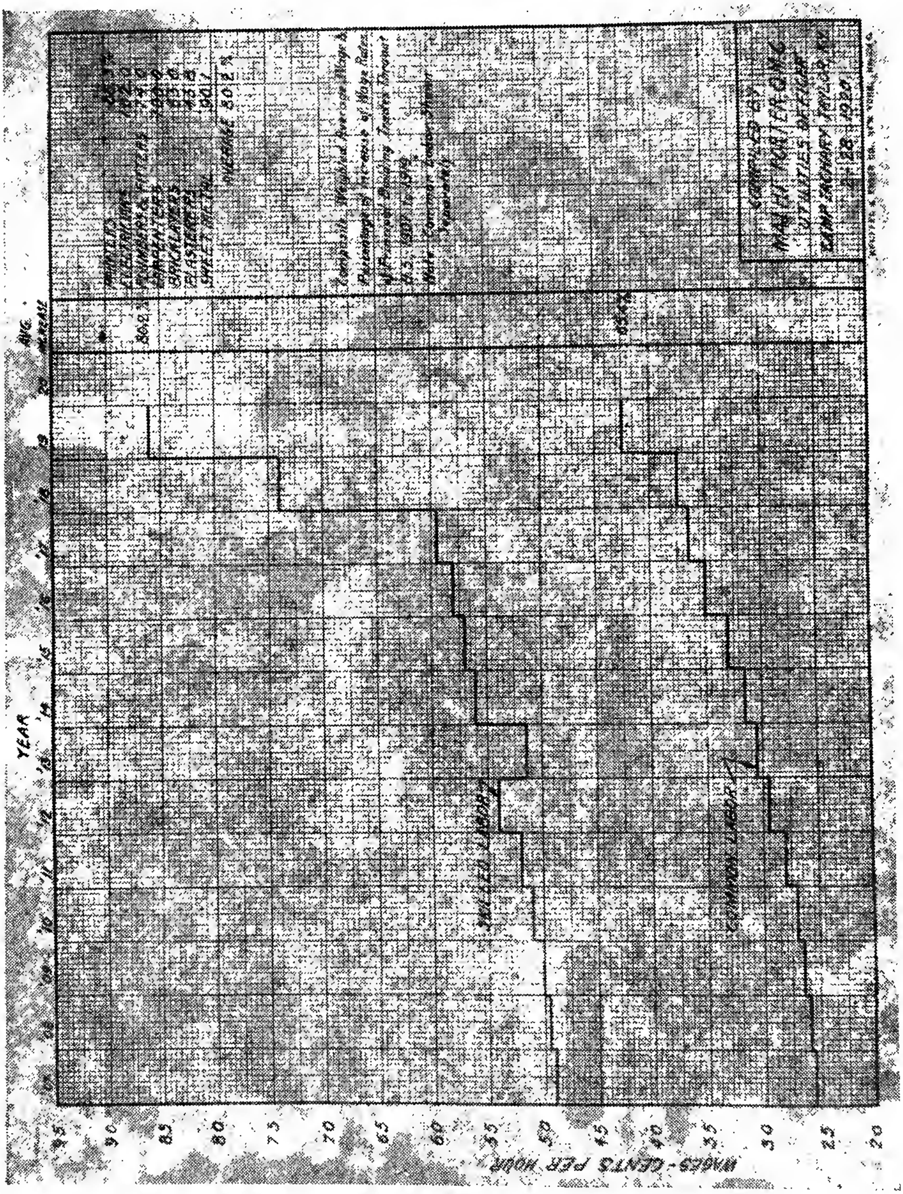
In the first place, men who can be trusted to work by themselves are selected as largely as practicable. The general supervisors are instructed to check the activities of their men at irregular intervals, and any man caught deliberately loafing or "stalling" on the job, is separated from the service without ceremony. This principle is followed by all the executive heads from the Utilities Office on down and is tolerably effective in keeping the organization clean of men who cannot be trusted.

Secondly, the various sections and the individuals composing them, are designedly kept under pressure. That is to say, so many jobs are kept piled up ahead or such stiff tasks set, and so vigorous a follow-up is operated on promises that the strictest attention to duty is necessary to make good. Or, another way of expressing it, the personnel of each working section is so calculated from time to time, in view of the volumn of necessary work, as to require constant hustle on its part to avoid being "snowed under." This is what I term the **hydraulic** principle in management. The device of setting a time limit on all tasks, as previously related, is really an application of this principle. The competitive spirit is also invoked whenever practicable.

A full accounting for each man's time daily, whether he be a soldier-mechanic or a civilian, is required. Credit time is allocated against work-order numbers or against indirect account symbols. A rigid distinction is made between indirect, or pro-rate time that is **effectively** applied and that which is wholly **ineffective**, or non-productive in the true sense. Thus, the time of a supervisor or tool clerk is indirect but effective, while that portion of the time a mechanic spends waiting on orders, tools, materials or transportation is **indirect—ineffective** and is required to be so reported. Sick, holiday and vacation leave with pay constitute another class of ineffective time, to be distributed as an indirect cost, but of course, these do not enter into the question of efficiency. That hinges on the control of **preventible** ineffective time.

Gentlemen, there is much more that could be said on this subject; in fact, I have barely sketched the details and I have not availed myself at all of a wealth of anecdotal material. But I have reached the limit of my own time allowance and must now check in the job as complete before the chairman forcibly separates me from the platform.

THE CHAIRMAN: Out at our steel works we have a safety engineer who during the last year or two has been telling me a good deal about the safety work done at the Youngstown Sheet & Tube Company, and I have an idea that they must have a good man in charge of their safety work. We have that man here with us tonight and we are going to look him over. Mr. James M. Woltz will tell us about "The Dividends Earned by Safety First."


YEAR
WAGES - CENTS PER HOUR
SKILLED LABOR
COMMON LABOR
95
90
85
80
75
70
65
60
55
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"THE DIVIDENDS EARNED BY SAFETY FIRST"

JAS. M. WOLTZ
Youngstown Sheet & Tube Co., Youngstown, Ohio

If you were to enter the office of any plant manager and say to him, "I have a plan to save your company at least 25% of its present waste in material, and all I ask is an opportunity to prove this to your satisfaction," what do you think would be the attitude of that Official? Do you think he would reach for your coat and hat, open a box of his best cigars and tell you to help yourself, and then hold your hand fearful lest you should change your mind and walk out of his office before you had passed on to him your wonderful recipe for the conservation of material, which alas, is to all interests and purposes rapidly getting into a class with the extinct "Dodo"? I'll bet he would! It does appear to the ordinary run of persons engaged in safety work that any operating official in these days would jump at a chance to save even 10% of his labor turn-over, or to cut down by even 5% his absenteeism.

It need not be discussed in this paper how vital to production is the keeping of the old and skillful workmen on the job, and by inference at least we may count it of almost equal importance that the newly hired employee be so surrounded by ordinary working conditions that he too may be spared to give that which he has toward the production of the best and largest quantity of finished material.

If we can place any dependance upon the statistics which have been published from time to time by perfectly reputable business firms, any safety worker would be justified in claiming, and he could prove by the data mentioned, that efficient and consistent safety work will conserve to regular employment considerably more than 25% of those workers whom in the ordinary experience of the plant might be expected to be injured. To quote from a recent article by C. W. Price, General Manager of the National Safety Council:—

> "A prominent Safety Engineer was asked recently: "What is the most significant fact which stands out in the last 10 years experience in accident prevention in industry?" He replied: 'The one outstanding fact is that we have absolutely demonstrated that we can eliminate three-fourths of all accidental deaths and serious injuries in industry.'
>
> The second most significant fact in the history of the safety movement is that accident prevention has offered the first legitimate common ground on which employer and employee can meet with mutual interest and understanding, and with profit to both.
>
> Perhaps ranking third is this fact: That according to the

> experience of hundreds of industrial plants in which accidents have been reduced in amounts varying from 50 to 75%, it has been found that not more than one third of what was accomplished was made possible by any mechanical guard or mechanical equipment—anything which could be made of iron or wood or steel. Two-thirds has been accomplished through organization and educational methods."

It is not within the scope of this paper to discuss the way and means of safety campaigns, nor will the speaker attempt to point out the manifest importance of having a man with actual experience in such work to do the directing, if best results are to be expected. We have seen some miserable failures made by so-called experts who were quite free in making suggestions and recommendations, that, had they been accepted and placed in operation, would have bankrupted the company, or disrupted the organization to such an extent that bankruptcy would have been acceptable as a refuge from both the angry stockholders and employees. Too often in work, as well as other endeavors, we have the alleged expert proffering for good hard dollars purely experimental theories evolved from the depths of an office chair or from a few days superficial "survey" of a prospect.

Let us at least be honest with ourselves, and so guard the interests entrusted to our keeping that the profession of Industrial Engineering, Safety, Fire, or whatever particular line of endeavor we are engaged in, may not be brought to ridicule.

We have enough isms to contend with now. To have more forced upon the sorely harassed business man by experimentation with his business or tampering with his workmen would be fatal.

Psychology has a most intimate bearing upon Safety, and it is unfortunate that it has only been since the close of the war that we have begun to apply Psychology to the problems this work has presented from the first. In an effort to realize upon the mass of detailed information that has been gathered together upon accidents, their prevention, and kindred activities, it is hoped that we may soon have printed the results of a careful study of this material.

Success in business, as in other matters requires that conflicts be adjusted and difficulties overcome. To quote from that excellent work by Edgar James Swift: "Psychology and the Day's Work."

> "When we ask what determines the selection of the plan or method of meeting difficulties that arise in business or in the professions we come upon this important fact in Human Psychology. The obstacle that confronts us must be overcome and the method employed is commonly the first one that promises to attain the desired result. . . . Now it is significant for efficiency

that the method unconsciously adopted. . . . is not always the best. It is commonly assumed that there is a sharp distinction in this (speaking of reasoning) respect between the actions of animals and man. The one does not reason, it is said, the other does. As a matter of fact, man does not reason as much as he thinks he does. Perhaps this explains why he calls himself a reasoning animal. He reasons so seldom that he likes to call attention to the little he does. Human failure is due largely to the fact that habits get us instead of our getting them."

It is manifestly a hopeless task to attempt anything constructive unless you first lay your ground work carefully. Then it is quite as necessary to plan each successive step in the light of what has gone before and what it is your hope to ultimately achieve.

The quotations from Prof. Swift's work are made to call attention to two things:

First—Man at best is a lazy creature inclined to exert himself as little as possible, and to follow the lines of least resistance. (Hence he acquires the habits of carelessness.)

Second—Man is more often than not, inclined to imagine he has reasoned out his line of action, and the way he does things is the best way, which is far from being true, for as a matter of fact he has not used up his grey matter in thinking over the situation, but is only following an unconsciously acquired habit, (hence the need of safety work, and the educational effort that has proven most beneficial and has actually produced the results sought to be attained.)

Why do we so often see people waste their strength and rack their brains in attempting to accomplish that which is impossible, and made so largely through lack of preparations? It is manifestly hopeless to expect anyone to succeed in an undertaking unless first some definite idea of the problems to be met is secured.

Safety work is no longer experimental. For thirteen years at least it has been going through industry's laboratory. Time after time when put to the test it has proven conclusively that safety was and is a practical, workable business activity, that properly guided, as any other department of a business, it will produce returns in dollars and cents as other well managed departments do. That safety does pay and pay well is capable of demonstration in many ways, and we have only to look about us in daily life to see how strong its hold now is. When buildings are being built or torn down, we find structures erected over sidewalks to protect the pedestrians. Provision is made to protect workers in manholes on the streets; safety belts are required to be worn by window-washers and electrical workers; safety zones are provided at street crossings and for loading and unloading of passengers from street cars.

Strict inspection of all classes of elevators is required in practically all states now. In most cities there are building restrictions that require some degree of fire-proof or fire resistant structures. In fact safety has made such rapid progress that many of things which might be classed strictly as safety measures are so common and recognized as essential, that they no longer attract attention.

The employer and employee have found in safety the first common ground on which they could meet with mutual trust, whereby both can see that their efforts are for the good of all, and in many instances the feeling thus created has resulted in a better understanding of the problems of both.

It has cost the employer hundreds of thousands of dollars to provide the guards and other provisions required to give safe and sanitary work places. Other hundreds of thousands of dollars might well be spent to care for conditions in some plants that have been a scandal to the community wherein they are located, and where the lack of these precautions is a menace to the lives and health of the men and women who work in them.

For every dollar expended along the lines mentioned, there has been a saving of many dollars to the employees who might have been killed or injured. There has been a saving in loss of production and spoilage to the employers, and further saving to the employees' family in reduction of suffering, worry, and in many cases of actual want and the potential horrors that go with these conditions.

You can imagine how difficult it would be to go into a plant where there has been no safety work undertaken, and where the employees find themselves and fellow workers surrounded by hazards that are a constant threat to his life or limb, and try to convince these same employees that the company they are working for cares anything whatsoever about their well being, comfort or health. In the first place there is a lack of ocular proof that this is true. The facts are all against such interest. No matter what may be done by such an organization in the way of so called welfare work, or other activities of a similar nature, we doubt if the employees of such a concern would accept as sincere such approaches.

Efforts looking to the safety and sanitation of his plant is logically the first step that any employer should take when he decides to improve conditions. This is true because protection of life and limb is so simple, fundamental and easily understood by the employee.

It can be stated without fear of successful contradiction that it was largely through the work of Safety Men that Industrial Medicine has reached the high point it occupies today.

Safety investigators found that many accidents were caused by men being employed on jobs they were not fitted for, and because of some physical defect they were injured. It was also found that a serious accident had been caused by neglect of an employee to grasp quickly the meaning of some failure of a machine to function properly, or by reason of poor vision the employee was unable to properly observe conditions that resulted in an accident.

Another important fact that the Safety Man helped to call attention to was that infection, that terror of former conditions of work, could be almost completely eliminated if only ordinary precautions were exercised. Thus it was that the full time, thoroughly equipped medical department has become an essential part of any well organized industrial concern.

By the careful gathering of statistics of accidents it has been possible to discover many interesting things that before were mere guess work, or to prove that some of the former ideas of the causes of accidents had been erroneous. Facts that were hidden under the undigested and unsegregated mass of figures give information where efforts could be best concentrated.

As an illustration of this it has been proven conclusively that a large percentage of fatal accidents and those known as total permanent disability are due to faulty engineering practices, the lack of proper clearances, improper location of machinery, poor lighting, poor heating and ventilating arrangements, lack of aisle and work space, failure to provide protection for stairways, ladders, elevators, hatchways, or inadequate provisions for roadways or passage ways. All of these failures on the part of the Engineer who made the lay out for the plant and machinery have been the source of many serious accidents.

By the proper gathering and classification of accident statistics we can definitely fix the greatest hazards; tell what departments show the highest percentage of accidents, indicate the foremen whose gang has the largest percentage of men injured, what particular hazards present the greatest accident exposure; whether the percentage of accidents is being reduced or increased over any given period, and comparison may be made of plants, departments, or gangs for figured hazards they are exposed to. We can tell what days and what hours of the day the most accidents occur; what month and the time of the month the hazards of the work are indicated; we are also able to settle definitely whether employees who have served long periods in a given employment are injured more frequently than the newer employee; what nationalities show the greatest accident frequency, also whether non-English speaking employees are more liable to be injured than their English speaking fellow workmen.

A close study and analysis of these statistics enables the safety men to overcome the difficulties, and correct the defective methods in vogue.

Experience in Public Safety Work conducted by the National Safety Council has proven without doubt that where a community is thoroughly organized and aroused to the conditions existing within themselves and a properly financed and directed effort made to carry on a public safety campaign, results can be achieved that are truly remarkable. This has been demonstrated in Rochester, N. Y., Detroit, Mich., and St. Louis, Mo., to mention only a few of the outstanding accomplishments along this line.

Perhaps one of the best examples of the accomplishments in safety work is shown in extracts from a communication recently made by the Prudential Insurance Company of America:

> "As a result of the splendid progress in safety and sanitation in the steel industry during the past ten years, a large and conservative Life Insurance Company announces the following remarkable reductions in the extra premium rate charged for insurance on the lives of men in the steel industry on account of the supposedly hazardous character of their occupations. In 1908 nearly all occupations were in the "hazardous" class, the higher of the four extra premium classes; occupations above the hazardous rate are entirely declined. In 1919 all these extra rates have been materially reduced, none of them remaining in the hazardous class, in two cases the extra premium has been entirely removed, insurance for these ocupations being written at the regular rates."

Extra Rating in Principal Occupations of the Iron & Steel Industry—Prudential Insurance Company of America—1909—1919—($1000 Whole Life Policy, Age 35.)

		1908	1919
BLAST FURNACE—	Blower	13.22	Regular
	Keeper	13.22	2.77
	Stove Tenders, Gas Washers, Keepers Helpers, Cinder Snapper, Tayere man	13.22	5.67
BESSEMER PLANT—	Cupola Melter, Liner, Vessel Man, Ladle Man, Stopper Setter	13.22	5.67
OPEN HEARTH PLANT—	Melter, also First, Second and Third Helpers	13.22	5.67
CRUCIBLE STEEL PLANT—	Melter,	13.22	2.77
	Pot Filler, Shaker Pourer, Molder, Lifter	13.22	5.67
ROLLING MILLS—	Roller,	2.96	Regular
	Soaking Pit Heater	5.92	2.77

Here is the direct and conclusive evidence outside of the ranks of safety workers of what can be accomplished by careful, persistent, and energetic accident prevention activities.

Last October, the U. S. Railroad Administration conducted intensive safety work on all of the mileage under its control. Every Operating Official from the lowest to the highest had been impressed with the importance of this particular work. Lectures, illustrated talks, meetings of the employees by Section and Divisions, bulletins, advertisements in newspapers were selected and set at work on all of the various lines to see that the safety message was carried not only to the shop or place of employment, but into the homes of the workers as well. The published result of this campaign was truly astounding.

Much constructive work has been done to have certain changes made in the curiculum of colleges and engineering schools, permitting the incorporation of the teaching of the essentials of safety work in connection with the regular routine. This has proven popular with the students wherever it has been tried, and has given to a class of men who were sorely in need of such instruction the ground work for the practical application of these principles in their future life's work.

Another important educational work has been undertaken recently. To the speaker this is the most significant step yet taken to make this country really safe. I refer to the introduction in the Common Schools of some cities a method of safety instruction that can be combined with the courses now used without material changes. It was worked out in the schools of St. Louis, and the success attained there has resulted in other cities adopting it. A text book has, recently appeared on the market which deals with this method of instruction.

Speaking specifically for the iron and steel industry, and not depending upon a man in that industry for the facts either, permit us to quote from an article by Dr. Lucian W. Chaney, "Pre-War and War Time Accident Rates in the Iron and Steel Industry," printed in the November 1919 issue of the Labor Review of the U. S. Bureau of Labor Statistics. Referring to the years 1910 to 1914 as the Pre-War Years, and the years 1915 to 1918 as the War Time Interval, Dr. Chancy says,—

> "In the Industry considered as a unit, both the frequency and severity of accidents were less in the war time than in the pre-war interval. This means that the exceedingly unfavorable conditions of the war period were not sufficient to overcome the net results of improved physical conditions and the other influences set in operation by the Safety Movement. Frequency declines from 177.7 cases per 1000, 300 day workers, to 129.6 cases. Severity declines from 12.3 days per worker to 10.9 day per worker."

If we are to make our accident prevention work realize its best, the employer must be brought to see that the layout and building of the plant and equipment must be thoroughly checked over by some one familiar with the best safety practices, and must have a thorough knowledge of the various safety codes that are in effect at the present time, while the employee must be educated in safety work to appreciate the need that only by his exercising due caution and by using safety appliances provided can he hope to escape the consequences brought about by neglecting them.

Summing up the dividends of safety we will say that education on the part of the employer is in many cases as important as that of the employee; that it is capable of demonstrating that the work does pay and when properly applied the dividends are quite surprising; that safety work as we commonly understand it includes a vast number of co-related activities, such as, Sanitation, Police, Fire, Compensation, etc. We believe that the real worth of safety work has begun actually to be realized, and that it requires no seer to foretell its rise to a place of prominence in the work of the Industrial Engineer.

MR. WOLTZ: I want to call attention to a few statistics that possibly most of you read in the morning's paper. There is now being organized in Harrisburg a committee having compensation attorneys in attendance. Among the persons who recently spoke there was a Mr. Carroll, connected with the Pennsylvania Railroad System. He stated that in 1911 there was a reduction of 204, or 36%, in the number of employees killed, and a reduction of approximately 5,000, or 14%, of the number of employees injured on those lines.

Another man stated that in his cost accounts he found there had been a 46% improvement in 1919 as compared with 1918. (Applause)

THE CHAIRMAN: The discussion of Mr. Woltz' paper will be lead by Mr. A. L. Rose, Personnel Director of the Kelly-Springfield Tire Company, Akron, Ohio.

MR. ROSE: It is to be regretted that Mr. Woltz' modesty has prevented him from giving us some figures from his own valuable experience in his own plant. Possibly Mr. Woltz preferred to have those figures speak for themselves in their exhibition in the adjoining room in connection with this convention. I think, however, I know why he has refrained. Not being so modest myself, I might tell you of a reduced accident cost of $2.11 to $1.53 per capita in one year, or a pro-rated accident cost to payroll from six tenths to three tenths of one cent, but such accident records are not usually comparable for the reason that there are no standard methods for setting up and keeping accident records for comparison with other plants or industries so that such statements are much like Goldberg's pictures—they don't mean anything.

Notwithstanding Mr. Woltz' reluctance to discuss the methods of conducting safety work, I want to express the opinion that safety work can be more efficiently conducted by safety inspectors than through the medium of shop safety committees composed of workmen. The safety inspector must, of course, be familiar with the duties of the safety inspector, but he should also be tactful and have an attractive personality that will command the confidence of the workmen as he comes in contact with them while pursuing his duties. That is the greatest asset. As his acquaintance with the workmen grows, he will find them giving him valuable assistance in calling his attention to conditions which he may have overlooked. The knowledge that he is in the shop on safety work would make him the logical one to approach on such matters.

If this plan is effectively carried out, it results in every man in the shop becoming a safety committee of one. If the safety work is first being introduced into a plant, the advantage of this plan is that it can be done gradually without having the appearance of an innovation. Such a man could become a valuable medium in ways that may be called welfare work. Safety in industry is so closely related to or is a part of the welfare of the employee that it should be co-ordinated with such activities and under one head.

In advocating the employment of inspectors instead of shop safety committees, I am not condemning the shop committees in the abstract. I appreciate fully the value of group co-operation and I am prepared to say that I approve of committees for the purpose of discussing safety work as well as other shop matters as a medium of contact between the employer and employee. It is purely a question of efficiency. The workmen should be absorbed in their duties of operation or production without time or mind for other things. If a workman is on the safety committee, his time and mind would be diverted, if he does any committee work, to that particular phase and operation or production must suffer. If not, safety work must suffer. It is like the reason for building three, four, five, six or even seven-masted schooners. The good book says that no man can serve two masters. This is assuming that the management is committed to the sincere conduct of safety work.

Management must do its part in providing safeguards, sanitary shop conditions, and in every way set an example. In short, the right spirit must exist or dividends will not accrue.

I realize that I have advanced a rather radical opinion, an opinion that is open to criticism, not in accordance with the popular methods of conducting safety work. I won't deny that I have advanced it for the purpose of inviting argument. I am not like the old lady who was told that she was not open to conviction. "Oh, yes, I'm open to conviction, but I'd like to see the man who can convince me." (Laughter)

Mr. Woltz has very ably told us of the results up to this time but I know he won't have you believe that all has been done that can be done, nor that the lines are even all laid to an efficient accomplishment, for the end is not yet.

As you have been told of dividends earned, I can only cite some reasons why they have not been larger or how they may be increased. Efficiency and safety means increased dividends as well as efficiency in production, accounting, and other lines. There are many things yet to be overcome before efficiency is achieved.

You have been told that competent men must be employed—men with judgment and discretion. I believe you will all agree with this and I believe it is usually done, but the safety engineer is not always given the necessary authority to carry on his work. Too often he has no authority to have executed what he deems wise. He has to plead, reason and argue with the mechanical engineer or others in authority and often has his opinions overruled. This easily leads to discouragement and discredit. I want to appeal to those of you who are managers, who nave this under your control, to give your safety engineers the proper authority to proceed efficiently.

First, gentlemen, get your man and then give him scope in which to work and he will very soon prove or disprove his value.

There are other ways in which this organization may promote safety. First, in the standardization of safety methods. If you are members of organizations that are to be asked by the American Association of Standards to draft costs that may be set up as national standards, remember that this is vital to the future and deserves your best efforts.

Regarding safety inspection of machinery by the manufacturers, it would much better be done by them now than after installation. It is being done by some with varying results. I recall some woodworking machinery recently installed in our plant, supposed to be properly guarded by the manufacturers but arbor ends had been entirely overlooked. Some are not attracted because of the lack of standards or because of the variation of standards of different states. This is something the National Safety Council has been working on for a long time and I know would appreciate any help that any of you can give to that end.

Another means to efficiency and safety to which we can all lend our aid and influence is the very important one of which Mr. Woltz spoke—safety instruction in our schools. A recent bulletin from the United States Department of the Interior dwells on the value of such education in our kindergartens in the Americanization of immigrants. It impressed me that safety could and should be instilled in the minds of the children of the kindergarten age. It is to me something of a paradox that while the law of self-preservation is inherent in the humand mind, yet we are inherently incautious or careless. It seems only natural that we should not cross a street until we look to see if anything is coming—we are trained to look; or a woman should not get off a street car backwards without first looking.

I am glad Mr. Woltz said that it was the tendency of human nature to be careless. It then becomes a matter of training and we have only scratched the surface in teaching the doctrine of safety until we inculcate it in the minds of children; until by evolution, the habit of caution becomes inherent as the law of self-preservation. When our children's children have caution born in them, bred in them, when the human race thinks and lives safety, then and not until then will we have achieved efficiency in safety and reap the largest possible dividends. (Applause)

THE CHAIRMAN: In planning social betterment work for the benefit of the employees, one of the most discouraging things we run up against is the industrial physician, because so often those fellows have thought of our ideas a long time before we did and already put them into effect. We have one of those physicians with us this evening—Dr. R. S. Quinby, Service Manager, Hood Rubber Company, Watertown, Massachusetts, who will tell us "What the Industrial Medical Department Accomplishes."

DR. QUINBY: It was with a great deal of reluctance that I even attempted to try to tell you of the accomplishments of the medical department in industry. An engineer can determine with great accuracy his own accomplishments in industry but I defy you, as industrial engineers to guess what a doctor is going to do. When your Chairman lead you, in his introduction, to believe that I was going to tell you about it, it reminded me of a story I recently heard. One of the British queens was visiting this country for the first time. She was being introduced in New York by a Mrs. Hylan. During the course of this entertainment, she was being driven up and down Fifth Avenue and she responded to the entertainment with due remarks as to the wonderful wide streets, the magnificent buildings, the remarkable shops, and in all, New York was a most magnificent city. Mrs. Hylan had been listening with rather a bored attitude and at the conclusion of her remarks, turned to the queen and said, "Queen, you said a mouth full." (Laughter)

WHAT THE INDUSTRIAL MEDICAL WORLD ACCOMPLISHES

DR. ROBERT S. QUINBY

Service Manager, Hood Rubber Co., Watertown, Mass.

It is with a great deal of reticence that I even attempt to tell you some of the accomplishments of an Industrial Medical Department. An engineer can with great accuracy measure his accomplishments, but I defy even an industrial engineer to guess what a doctor is going to do.

The first and most tangible accomplishment is the fact that the development of industrial medicine has occurred during a period of scarcely ten years.

Most of the early dispensaries were established only to provide first-aid treatment for accident cases. The work of these clinics gradually developed to include more or less medical treatment and supervision of conditions in the factory which might affect the health of the workers. Subsequently further developments such as physical examination, home visiting by nurses, educational work and provisions for treatment of special conditions were instituted.

Legislation, war experiences, different forms of sickness and death insurance and the sound basic fundamentals of health conservation have all given impetus to the development of industrial medicine, until today we see in nearly all of the larger and many of the smaller factories, some form of health supervision.

An adequate program of health supervision divides itself naturally into several main divisions.

First. Physical examination of applicants and of those already employed.

Second. Treatment of sicknesses, accidents and other diseased conditions.

Third. Supervision by factory hygiene and sanitation.

Fourth. Home visiting by nurses.

Fifth. Health education.

Physical examination forms the foundation of any well developed program of health supervision. It is the inventory of health conditions. It is the basis of a preventative and constructive industrial health program.

Before entering into the subject of what may be accomplished by physical examination it may be well, because of the frequent discussions given to this subject, to suggest what appears to be the best method of starting physical examinations in an industrial plant.

Many industrial managers, while passively in accord with the idea of physical examination of their employees are somewhat fearful of putting the work into effect because of possible difficulties which may arise. They frequently have a more more or less indefinite feeling that workers will find physical examination objectionable and will resist the introduction of this plan.

It is of primary importance that physical examination should not be attempted until the management is thoroly in accord with the idea. Once they have agreed to the practicability they should be the first to be examined. Attempt should be made at the time of such examinations to further sell the idea explaining carefully to them their own conditions and what benefits they may expect to derive. Also explain to them the necessity for their co-operation in explaining this matter to their workmen so that they may realize more clearly the reasons for examination.

After the management group has been covered it is well to select from different departments a few employees of longer term service who are familiar with the policies of the Company and are thoroly willing to accede to reasonable requests.

After such men have been examined the information has become quite general among the workers that the examination is not a serious ordeal, neither is it intended in any way as a method of discrimination but on the contrary it is intended to be a method of assisting workers to correct physical defects they may have and therefore increase their earning capacity.

At such time it is feasible to begin with the examination of applicants for work and to continue with the examination of such workers already on the job as have not been examined.

By following such procedure it is possible to install physical examinations with comparatively little difficulty or objection on the part of anyone; but, in this case as in all others, the manner in which it is done and the attitude and the capability of the person doing the examining will to a great degree determine the reaction on the part of the workers as well as the value of the work.

Perhaps the question most frequently asked in connection with physical examination is—How many people refuse examination? Our experience in over 25,000 examinations has shown that about one in every thousand refuse, a negligable number. Such persons are usually aware that they have some condition which would cause their rejection and do not wish to have it known.

Assuming that physical examination has been accepted and has become a part of the industrial medical program, let us consider what we may expect to accomplish through this medium.

First. More intelligent placement of applicants for work.

Second. The transferring of certain persons already engaged to positions for which they are better physically adapted.

Third. The elimination of persons who because of physical defects are unfit for employment.

Fourth. A knowledge of defective health conditions existing among workers, which forms a basis for corrective measures.

Fifth. Closer acquaintance between the workers and the medical department and therefore better opportunity for advice and instruction in matters of health.

We are beginning to realize more and more acutely the crudeness of our methods in selecting individuals for given jobs. Efforts are being made by those connected with this work to discover and improve the machinery for more intelligent placement of applicants for work.

A more careful interview by the Employment Department to determine requirements for different positions is being attempted. Certain tests are being developed with the idea of assisting the Employment Department to more wisely place the workers. The physical examination forms a valuable adjunct to this program of more intelligent placement, for thru this examination the physician is able to ascertain to a degree the physical and mental capabilities of the individual for the work he is selected to do.

Let us consider for the moment the physical defects we may expect to find in any given large group of individuals. Our experience has shown the following approximate percentages of some of the more important defects.

Defective dental conditions 40%
Defective eye conditions 8%
Herniae 5%
Defective lung conditions 5%
Defective heart conditions 3%

These percentages may vary somewhat from the experience of others, because of the variation of methods of classification, but certainly such an array of physical defects among an average group of individuals emphasizes the importance of these conditions in the consideration of employment and placement of workers.

The great majority of these defective individuals may be satisfactorily employed because of the great diversity of operations in the ordinary industrial plant, but it is of vital importance both for the protection of the individual and his employer that such defectives be placed in position for which they can best qualify and can contribute most to production.

The subject of "Rejection of Applicants" for work because of physical disabilities, is of importance but is quite freqently exaggerated. Industrial physicians concur in the opinion that applications should be rejected only because of the three following reasons:—

First: Employment would be a menace to the individual.
Second: Employment would be a menace to fellow workers.
Third: Employment would be a menace to property.

As an instance of the first condition we might cite the individual with advanced organic heart disease. Of the second, the individual with pulmonary tuberculosis and of the third, an individual mentally unbalanced.

No one can question the soundness of such a program. Experience shows that in industry at large it is unnecessary to reject from employment any considerable percentage of individuals because of these reasons. Our percentage of rejections during the last two years, has been slightly less than 4%.

It is encumbent on the examining physician to carefully explain to such individual their condition and the reasons why it would be unsafe to employ them, also to advise and assist him in any practical or possible way. It is as much the duty of the industrial physician to do this as in the case of the private practitioner.

It has been previously intimated, that aside from the more intelligent employment of workers a number of defective conditions discovered in the course of physical examinations forms a basis for a preventative and corrective health program. Many individuals are unconscious of the fact that they have physical defects and only learn of such conditions at the time of industrial examination. Many others, while knowing of the defect, have either thru negligence or ignorance, done nothing toward remedying the condition. The examining physician has the opportunity for carefully explaining what should be done and of making arrangements for the follow-up treatment of such defects, a great majority of which lend themselves either to complete correction or at least improvement.

It is important here to note that the examination offers an early opporunity for acquainting the workman with the physician, and the foundation of a relationship which will tend to bring the person to the doctor whenever he suspects sickness or wishes medical advice. Here again helping to build up the important feature of industrial medicine, namely, prevention.

Unfortunately we lack a reliable yard-stick with which to measure the actual financial accomplishment of physical examination. It is difficult to determine the direct effect on production which most industrial managers wish to know. Neither is it possible to separate the effects of the examinations from the other elements of the health program. We do know, however, that at least 15% of applicants for work have sufficiently serious physical defects so that their promiscuous employment would be detrimental to themselves as well as to general productivity. We also know that about 4% are absolutely unfit for work.

The physical examination then helps us to employ more wisely the 15% and to eliminate the 4%. It also discovers the large number of conditions which have a more or less direct influence on productivity and enables us to correct many of these before becoming serious.

Let us now consider the second phase of the industrial health program, namely, the treatment of abnormal conditions. This may be divided into several sub-divisions.

First: Treatment of physical defects discovered during examination.

Second: Treatment of sicknesses.

Third: Treatment of accidents.

Referring again to more common defects, we find a large percentage of abnormal dental conditions, the import of which we are beginning to realize. These conditions are in the main capable of correction and by furnishing dental services as part of the health program much lost time and lower productivity may be avoided. Defective vision frequently has a very direct bearing both on the general health and efficiency of the worker, particularly in certain occupations. An occulist can to a great degree eliminate the losses resulting from defective eye conditions. Herniae can either be cured by operation or controlled by a properly fitting truss so as to permit of safe employment. The mere knowledge of this condition is of great value from a point of protection against fraudulent claims and the resulting expense. Many heart, lung and kidney conditions by knowledge of their existence and early treatment under proper conditions of employment may be greatly relieved and the individual enabled to earn a livelihood.

We have up to this point been giving consideration more particularly to the discovery and correction of diseased conditions which constitute potential disabilities but may not as yet have caused actual disability. Let us consider cases of sickness happening in everyday life, in which the industrial physician may play a very important part.

We have been told that the industrial worker averages to lose nine days per year on account of sickness. Much of this lost time is due to conditions which at first appear trivial, and were it necessary for the worker to suffer the inconvenience and expense of consulting the family doctor, would be left untreated until such time as the condition either righted itself or became serious. In either case, valuable time has been lost, and possibly serious complications have developed.

The proximity of the industrial physician, the absence of expense, and the growing realization on the part of the industrial worker that it is better to see the doctor early, all lead toward the desirable condition of being able to treat cases of sickness while yet in a comparatively preventable stage. Many times the illness is too far advanced to prevent some disability, but the degree of severity and duration may be materially lessened.

The treatment of wounds, resulting from industrial accidents, constitutes perhaps the most dramatic branch of industrial practice. It was because of this fact that industrial surgery was the first phase to be developed. Anyone could see the nècessity for action when a worker was injured, but it has taken long constructive effort to show the need for development in some of the other branches of the health program. Then, too, because it was necessary to compensate for accident disability, it was apparent that it was good business to minimize this disability. The safety engineer has done much to educate and safeguard the worker, but a great deal of reduction in accident disability has been affected through the prompt treatment of wounds, particularly of a trivial nature. The serious cases go to the doctor immediately in any case, but through education of the worker and the foreman in the importance of treating every wound immediately, great reduction in disability has resulted. Infections which, before the time of industrial surgery, made up a large percentage of the cases of lost time, have been practically eliminated through early treatment. By the combined effort of the safety department, the foreman and the medical department, we have been able to materially reduce each year actual disability, until last year our workers averaged to lose only one-half a day because of accident. This has, of course, been a material saving to the worker, as well as to the company.

Supervision of factory, sanitation and hygiene may, to a great degree come within the realm of the technical engineer, but the direct effect on the health of the worker demands that much consideration be given to this question by the industrial physican. We are coming more and more to realize how important, from a point of production alone, the questions of ventilation, light, heat, food, and many other allied conditions are, and it is of great importance that these subjects be given due consideration as a part of the health program.

Once we have set our house in order within the factory we have not even then completed our health program. The industry is one cog in the community wheel, and as such has responsibilities outside itself, in many factors which determine public health. It is also well to remember that the worker spends hardly more than a quarter of his time in the factory, so that if we are to create the greatest possible constructive influence on his health, we must seek to improve home and community conditions, in some cases co-operating with other agencies, and in many others directly.

One of the most generally accepted direct methods of doing this is by means of home visits by nurses, supplemented, when necessary, by the physician. Home investigation of absences by nurses offers a wonderful opportunity for—first, the reduction of absenteeism; second, the creation of another helpful point of contact in the employment relationship; and third, improvement of family and community health conditions.

Nurses are the most competent investigators of absences, because at least a third of the absences are due either to sickness or accident, with which the nurse is familiar and competent to deal, and because in other cases they are not considered as inquisitors and the visit resented. A competent nurse, properly acquainted with the factory and the workers, discovers many conditions important from an employment as well as a health standpoint, and forms a relationship between the home and factory that is of inestimable value.

Our nurses investigate all cases of absence on the second day as a joint function of employment, health and administration of the Benefit Plan. This plan is entirely paid for, and administered by the company, and provides for financial benefits in cases of sickness, non-industrial accident and death. Industrial accidents are covered by State Compensation. Our experience last year showed an absentee rate of 5.35% in spite of the fact that we employ 40% women, whose absence rate is about 180% that of men. Our absentee rate has been very materially reduced as a result of home visits and improved medical supervision. Our workers averaged to lose 5.65 days last year due to sickness and accident. As has been previously stated, nine days per person is the average lost time of industrial worker from sickness alone. The absence rate cannot be attributed to home visiting alone, but must to a considerable degree be credited to the efforts of the medical department as a whole. One of the best indications of the attitude of the workmen toward the Medical Dept. is reflected in the fact during the time our employed force doubled in numbers, the number of voluntary visits has increased five times. Last year either through examinations, treatments, or home visits we averaged to see each worker ten times.

Throughout the whole program constant attention should be given to the matter of education in health and personal hygiene, concerning which the average individual knows very little. Much more can be accomplished by individual than group instruction; but individual instruction may be supplemented by health articles in the factory publications, health talks and other methods. In industrial medicine, as nowhere else, we have the opportunity for constructive and preventative practice.

In conclusion, it is, I believe, fair to state that a properly organized industrial medical department will be of material assistance in the proper selection of individuals for employment, will prevent the needless and expensive process of hiring unfit persons, will make possible the early treatment of physical defects, illnesses and accidents, materially reduce disability, and through supervision of factory, home and community conditions, generally improve health standards. It is difficult to determine the actual financial returns of this medical work, but such companies as have instituted health supervision, feel that in spite of this fact, the expenditure pays satisfactory dividends.

THE CHAIRMAN: The discussion of Dr. Quinby's paper will be lead by Dr. Sidney M. McCurdy, Chief Surgeon, Youngstown Sheet & Tube Company, Youngstown, Ohio.

DR. McCURDY: Its almost impossible to discuss a paper of this kind that has been so well written and delivered. My experience has been very much the same as has the experience of Dr. Quinby. I have been in this industrial work as part time doctor for nine years, and for the last six years as full-time doctor, in charge of a medical department. When I come to sum up the accomplishments, I have to go back to the day when I was a part-time doctor when I went to the plant once, twice, or three times a week, knowing nothing about the plant except the road to the emergency hospital and the road out; knowing nothing about the machinery or men, having no point of contact with the men in the organization or the men in the organization with me.

As a full time doctor I immediately recognized, of course, that changed relationship which has always made me feel that a medical department in industry depends for its success upon the ideals of the doctor that is selected to do the work, upon his knowledge and upon the motives which cause the company to engage him in that kind of work. Take out any one of those three factors and you will find that your medical department will not do the grade of work that you desire to have done.

In the formation of a medical department, it seems to me that a full-time doctor should be selected to be its head. I think one of the speakers tonight talked about the two masters—I am sure that no man can serve two masters as efficiently as he can serve one. Therefore, I think in the selection and organization of this department, the head, at least, of the department, should be a full-time man and should have delegated to him powers to run his own department insofar as it pertains to medical policies and does not interfere with the policies of the organization. That, of course, presupposes that an organization that is going to do this work is willing to set aside a sufficient sum of money to see that the work is properly done.

With an organization of that kind, you are then able to carry out scientifically and well the work that Dr. Quinby has outlined tonight. I am well aware that many doctors who devote part of their time to the work are doing most excellent work. I cannot help feeling, however, that if they devoted all of their time to that work, they would do far better work.

By means of having an organization which permits the meeting of superintendents, the getting acquainted with the workers in the mill, factories, etc., you always have at your disposal an organization ready to meet any emergency. That has been brought up twice during this winter in our own organization.

We have to maintain, because of the scarcity of houses, a camp which houses, at different times, from one to two thousand men. One of our division makes a daily inspection of this camp and we hold a regular army sick corps in that camp. By means of that, early in the Fall we were able to discover a case of smallpox before it was reported to us and the man was immediately isolated, the camp was vaccinated and that was the only case we had.

Later on we ran into an epidemic, mild though it was, of influenza. Our doctors were alive to the situation and immediately opened a hospital for our own isolation within that camp and we had that epidemic controlled in the camp long before the community had arisen to the occasion at all.

I simply cite those two examples of having an organization about, waiting to prevent that sort of thing.

We have been conducting physical examinations now for a period of six years. We have very little difficulty with it and the refusals are practically nil, and almost entirely due to the fact that the man has some defect that he knows we would not allow him to go to work with. Our rules are substantially the same as are Dr. Quinby's so far as disqualification is concerned. We do not disqualify because a man is not well but we disqualify to protect ourselves, to protect him and to protect property. Our disqualifications run a little higher than Dr. Quniby's, but they vary according to the type of man you get. Just now they are running in the neighborhood of 6%; they did run a little while ago. when we were getting a higher and better class of labor, as low as 4%, but they vary as to whether there is a surplus or small amount of labor available. In other words, today we are getting down to the bottom and the rejection is going up. If men were rejected for pure efficiency's sake, I am satisfied that we would have to reject better than 25% of them to get a working man who could really do a day's work anywhere in the mill.

We are able to place many men who have defects where they can work safely and where they can do a good day's work. I am sorry that we are not able to place them better but as this work progresses and as we learn more and as our employment officers and managers learn more what this work is worth, they will put more means at our disposal for placing these men, and what's more important, keeping them placed—we haven't this today. However, I am a bit encouraged that we are moving slowly and I have faith to believe that we will be placing men better next year and the year after than we are todav.

There is one phase of the physical examination that I don't like, and that's this phase—the applicant who applies for work, to whom you are under no obligation whatsoever as an industry because you never saw him before, and to whom you cannot give work because he is not fit for any kind of work that you have, but who may possibly be put in a position, with proper medical care, where he may be made fit to do the work. We have no obligation to that man—we never saw him before and I think if we take care of our own people we are doing all that can be expected of us as an industry. He is the community's obligation—an obligation which nearly every community shirks and neglects. We are not so organized in our public charities that he can always get in the communities a proper chance to get into a hospital and get proper treatment if he is without funds, not necessarily being a resident of that town.

It seems to me that we could be in no better business than taking a hand in these community problems, and if I were to point to any one thing that in my judgment the medical department in industry has accomplished, it has accomplished the driving out into public and civic problems, the organization of the industry to help stop these things that are making men physically unfit. But we should go farther and compel our communities to repair those men who are physically unfit.

There is one town in our State that I have the highest admiration for. The industries of that town have compelled an entire reorganization of the health department because they felt it reflected in their workers, that is, the ill effects of the health department that they previously had reflected in their workers. That was demonstrated beyond any question by the medical department of one or two industries in that community. In my own experience, some four years ago we had an epidemic of smallpox in which I had to get the heads of the industries in our town together with the health board and compel them to act as they should act, and when those heads met and told the health board what was expected, the health board acted and our litle epidemic of smallpox at that time was stopped and driven out.

I find that these medical departments have grown up in a queer sort of a manner to suit the needs of individual industry. In the steel industry you will find almost universally that they are better organized to take care of accidents than we are. The accident problem has always been the steel industry's big problem. Their work is so heavy and their burdens so heavy and the violence of their injuries is so great, it is necessary that they have a complete medical department, whereas, when you get into a rubber plant, your injuries are minor ones.

There isn't a more beautiful organization in this country than the hospital run by the Colorado Fuel and Iron Company in Denver, run by Dr. R. W. Corwin, that old pioneer. He probably started, although I don't know, to take care of the accidents and he immediately grew and took care of the sickness, until today they have one of the nicest, most complete industrial hospitals in the United States, and I might say, one of the best run.

This physical examination is a queer thing. I would like to cite one instance which is a concrete example of what happens when you supervise men who are sick. A man came into my office complaining of stomach trouble. He came of his own free will as he had confidence in us. I discovered he was suffering from some mental disease, having ideas of persecution. I was unable at that time to make a satisfactory diagnosis, but immediately telephoned his superintendent to discharge him at once—as soon as he returned to his work. That man was in charge of a one hundred ton hot ladle crane, had definite ideas of persecution and died in the insane asylum three weeks later. Think of that man handling hot metal in that condition!

I often think of another case. A man came in with an enormously high blood pressure, 250, and I told him that he couldn't work until he took treatments and came back and demonstrated that he was in better physical condition. Each night on the way home from work, the workers had to pass his house and he cursed us and said how much harder he worked at home, but he only did it a week, gentlemen, and the last time he mowed his lawn he had apoplexy that we had warned him against.

That action is the result of your constant supervision of workingmen. You can't find those things out in any other manner.

In conclusion, if I can leave a thought with you to take home, I would like to leave this thought—the doctor has three classes to educate,—he has the public, he has the employer, and he has the employee. You can help us educate all three of these classes if you appreciate the necessity of that education. No longer can you sit at home and refuse to face the facts of bad sanitation outside of your mill, or of bad housing conditions outside of your factory, or ignore the fact that there is an epidemic in the community, because that epidemic and those housing conditions directly affect the amount of production your organization is going to turn out. You have got to go home and get behind these civic movements of all kinds and descriptions that will benefit your health and the health of the workers before you will ever be able to make it possible for a man to work daily without an average of nine days' work lost a year, 60% of which is preventable. (Applause)

THE CHAIRMAN: We are fortunate in having with us this evening, Mr. George R. Laird, Special Field Representative of the American Red Cross, who will speak on "The Red Cross as an Industrial Factor Today."

"THE RED CROSS AS AN INDUSTRIAL FACTOR TODAY"

GEORGE R. LAIRD

Special Field Representative The American Red Cross

Mr. Chairman and Members of The Society of Industrial Engineers:

I desire to express the thanks of the organization which I have the honor to represent here, the American Red Cross, for the privilege of addressing you gentlemen in your annual convention here in Philadelphia and congratulate you upon the splendid program of your society. In my duties as special representative of the Red Cross, I have addressed many conventions and listened to many programs but never have I so greatly profited by any program as I have by this one tonight. As the hour is late and you have listened to many able speeches on many different themes, you will not of course expect me to do more than give you a brief presentation of facts concerning the Peace Time Program of the American Red Cross today.

This program is chiefly concerned with the matter of public health and public health education, a subject in which I know you are all vitally interested, because the great industrial organizations which you gentlemen here represent, as managers and executivs are, of course, definitely concerned in the health of their employees as well as of their employees' families and, I may also say, of the health of the communities and of the cities where your great industrial concerns are located.

Disease is today, as never before, industrial,—that is, a great many diseases which are today most prevalent such as tuberculosis, etc., are frequently induced by industrial conditions which are often the direct outgrowth of the lack of proper hygenic regulations. It is therefore a matter of congratulation that so many of your great industrial concerns have already secured industrial nurses and industrial doctors, who are doing a great work in remedying unhygenic conditions and of applying the latest and most scientific sanitary service to the abolition of industrial disease and to the creation of better health conditions among industrial employees and their families.

In this connection it is a great pleasure for me to say that our American Red Cross is today furnishing to many great industrial organizations, those trained and experienced nurses who are so essential in the establishment of healthful conditions and of educating employees along the lines of public health. Our organization from the very beginning has insisted upon the very highest nursing service and so today it is able to make and is making, a definite contribution, through its hundreds of nurses, who are working in industrial concerns, to the solution of the problem of Industrial disease.

As you gentlemen are practically all Industrial Engineers it is perhaps, apropos, at this moment for me to present to you a picture of our American Red Cross organization as an example in itself of Scientific engineering in business.

Picture to yourselves, gentlemen, our great organization of nearly 25 million members belonging to more than 36,000 chapters and to thousands of branches scattered from Maine to California; an organization which is divided into 13 geographical divisions or units in this country with a 14th division comprising our foreign personnel and their activities. Directing all the work of these various divisions, each of which has its own trained business manager, is our central headquarters at Washington, D. C., which headquarters is under the direction of a competent business manager or "engineer" who is surrounded by a thoroughly trained staff of executives who has charge of all the various activities of our infinitely varied Red Cross work. Our Public-Health work, our Home-Service work, our Military-Relief work, our Civilian-Relief work, each is under the direction of an experienced "engineer", if I may use the expression and in the light of experience and of the great work which our organization has done, during the war and is now doing in the reconstruction period, I believe, gentlemen, that I may rightly and, indeed, aptly adopt the parlance of your profession. The American Red Cross today is a good example of industrial as well as of philanthropic engineering, for as I have stated, our philanthropic activities are vitally interested in and concerned with the industrial problems which you gentlemen face, especially in regard to Public Health.

By reason of its thorough organization and scientific equipment, our organization is ready at a moment's notice to jump into any emergency and be "Jonny on The Spot" in relief work.

Before the Red Cross was organized and chartered by Congress thirty-seven years ago, relief work was largely a matter of haphazard endeavor, and much suffering and death often resulted because of the lack of scientific organization. Today at a moment's notice, our organization is ready to give quick relief when disaster falls upon the country; in fact, during the last year, it has made a record for scientific service in relief work which has excited the admiration of the world. In 39 great disasters, which desolated nearly every section of our country, either by flood, fire, tornado, drought or disease, our organization gave relief to more than 50,000 people who were rendered homeless; to the relatives of more than 600 who were killed and to thousands whose property and homes were destroyed and who were left destitute and in dire distress. Just recently we have appropriated $50,000 to relieve the situation caused by the severe droughts and consequent crop failures in the Northwest, among the farmers of the Dakotas, Montana, etc. Our great organization in this work has adopted the most modern principles of business practice and scientific engineering, and has seen to it that our relief and charity have been practical and really helpful to those, and to those only, who were in need of help. No maudlin sentimentality has governed our activity but our service has been definitely directed to the performance of definite tasks of mercy and of relief.

But the greatest work before our organization today and the work in which I know you gentlemen, as business managers and executives of industrial concerns, are vitally interested, is the work of Public-Health education.

Several of your speakers this evening have referred to the industrial inefficiency and incapacity resulting from industrial disease. They have referred to the fact that more than 30% of our draftees were rejected and that more than 40% of those called to the colors had some physical impairment. Perhaps I may add a still further fact, which seems to me of the most vital importance to all industrial organizations. We have in this country today an army of more than three million people who are continually sick, an army of men, women and children, many of whom should be "up and doing" and contributing to the productive forces of the nation. This army includes not only the aged and infirm, not only the infants just "coming to town" and often naturally ill, but it includes millions of men and women who are stricken down daily by the ravages of disease, who are withdrawn completely from the industrial activities of our country and who thus become not only a minus quantity as far as industrial service is concerned, but a burden upon the community, the city and the state. And the disaster—"the continuing disaster" as our able Red Cross chief executive, Doctor Livingston Farrand, has so aptly phrased it,—of this whole situation is that this army of those continually and seriously sick is recruited from the ranks of those who should be continually well and active. The medical profession has agreed that at least 60% of modern disease is preventable. In other words, nearly two million of this vast army of industrial ineffectives and non-combatants who ought to be on the "firing line" of industrial service and progress, are instead in hospitals and on sick beds.

Dr. McCurdy has just stated that investigations show that industrial organizations lose on an average nine days of work a year per each employe from sickness, etc. What a terrible drain this is upon production and what an undoubtedly big element it is in contributing to the high cost of living. Uncle Sam has about 100,000 employes in Washington, D. C., alone and if we are to accept Dr. McCurdy's statement as accurate, and undoubtedly it is approximately accurate, Uncle Sam loses nearly a million days work a year in Washington alone from the sickness of governmental employes. Certainly it would be a definite contribution to governmental efficiency if 60% of this sickness and consequent inefficiency could be eliminated.

Some time ago I was engaged in the United States Public Health Service and I frequently had occasion to notice how seriously that service is handicapped because of the epidemics of disease among the employes of the mills, factories and stores from which the United States Public Health Service gets its supplies and equipment. Although this service often has priority of shipment, its orders for supplies are frequently unfilled for several months and sometimes a year after they are given. I am glad to say, however, that in meeting the emergency which has been created by the thousands of convalescent soldiers and sailors who have applied to the U. S. Public Health Service hospitals for treatment, our American Red Cross has been of great service to the Government. Only a few months ago our organization turned over to the United States Public Health Service nearly seven hundred thousand dollars worth of medical and surgical supplies. And I am especially glad to say that in carrying on the work of Military Relief and of Hospital Relief, our Red Cross organizations have given to the United States Public Health Service more than 700 Red Cross nurses who are today rendering a service to our returned heroes in khaki which is of inestimable value.

In speaking of the work of our Red Cross nurses, I cannot at this time neglect to mention the fact that our nurses are now doing a service here at home in America just as practical and often as heroic as that which they performed on the battlefields of the old world. They may never be decorated for this service, as more than 200 of them have been decorated by our own and foreign governments for their foreign service, but they will forever receive the gratitude of thousands and millions among whom they are spreading the gospel of Public-Health and Public-Health education. More than 800 of our Public-Health nurses are now carrying on their practical work among the homes and schools of the people all over this broad land, away out on the prairies, among the mountain districts, as well as in the great cities, and in the great industrial concerns which you gentlemen represent, their ministering care and kindly helpfulness is going on, uplifting and strengthening as well as inspiring those who are in need.

We also have an army of more than 19,000 instructional nurses who are giving our courses in Home-Hygiene and Care of the Sick, courses which are everywhere recognized as a practical contribution to health education. They are founded upon the practical and scientific text book which was written by our great Red Cross Nurse, Jane Delano, a book thoroughly revised and brought up to date by the most expert medical opinion. During the last year more than 49,000 women were certificated at the completion of these courses and approximately 100,000 women took the courses and were benefitted thereby. These courses are given in many great industrial concerns, to the employes of stores, mills and factories as well as to society and business women; and women everywhere testify to the value of this training. So the work goes on. So the gospel of good health is spread abroad among the people, and so gradually but inevitably we shall spread the truth and banish those dark clouds of ignorance and superstition which for ages have enveloped the minds and blighted the health of mankind.

Yet it is astonishing, gentlemen, what a lamentable lack of intelligence and of intelligent action there is even today among many of our people concerning sanitary science. Last year I was traveling down south, speaking for the Victory Loan Campaign and when I went into the hotel of a certain southern city, being travel-tired and dusty, I went into the washroom to clean up a bit. Never shall I forget the experience; a veritable army of flies was swarming in that washroom, millions of them charging by battalions and brigades upon myself and two or three other traveling men there. Naturally we cussed a little and a boot-black, a little black boot-black, who was there said, "Boss, how long am you goin' to stay here?" "Not long, I hope," I said. "Well," he replied, "If you wants to come out heah, when dey haint no flies, come out at noon, den deys all in de dinin' room." **(Laughter)**

Well, the boot-black was right; when we went into the dining room the army of flies was swarming there, the windows were wide open, not being screened whatever, and the flies came in by the million and camped on the meat and potatoes, I picked two or three out of my coffee and talk about pie a la mode it was fly a la mode. (Laughter)

Gentlemen, this condition is not exceptional with a southern city. You gentlemen who travel much know that you find it everywhere, not only in the hotels but in cafes and restaurants and right among the homes of the people. In many of our most progressive states and in many of the large cities as well as in the smaller towns, sanitary science is almost an unknown quantity. An old student of mine in the University of Wisconsin who is teaching in the University of Kansas as Professor of Sociology, recently made a survey of a certain town in Kansas, a town of about 2500 people. Before the survey was made, the City Engineer was very optimistic over his town and said that at least 80% of the homes had sewerage connections. Well, they made the survey and Professor Elmer informs me that only 36% of the homes had any sewerage whatever. In other words, two-thirds of the homes were without sewerage.

The old Romans in their ignorance and superstition believed that disease and death were a visitation of Providence, of some God who wished to punish the people, and so on one of the beautiful hills which surrounded their old capitol city, they erected a temple to the God Fever whom they sought thereby to propitiate. It wasn't so many years ago, right here in this country, that some good. people believed that good health was almost a disgrace. They thought their preachers ought to be sickly, pale, consumptive-looking men and all such nonsense. Happily, modern science and education has wrought a great change among the masses in regard to public-health. The invention of the microscope and the discoveries of the great French savant Pasteur and other modern scientists have revealed the real causes of disease and death, have shown how infinitely small bacteria and protozoa are most frequent causes of many of the great epidemics of disease, and modern sanitary science has shown that flies and mosquitoes and some small animals such as rats are the frequent messengers of death and disease and that if we take the proper precautionary measures to prevent these animals and insects from poisoning our sources of food supply, and especially if we educate the masses to the adoption of the proper food, clothing, exercise, and all other proper measures and precautions necessary for health and happiness, we can largely demobolize this vast army of three millions who are continuously and seriously sick and by so doing, make a definite and a vast contribution to the industrial progress and prosperity of our country.

Gentlemen, of The Society of Industrial Engineers, as Special Representative of the American Red Cross, I desire again to thank your genial secretary, Mr. George C. Dent, and well as your able and efficient president, Mr. Wallace, who happens also to be our own Red Cross executive in charge of our hospital for the blind at Baltimore—I desire to thank these gentlemen and your officials and you all, members of your Society, for the privilege and the pleasure of addressing you at your Annual Convention; and I know that as a Society you will be glad to co-operate with our organization in the promotion of those measures for Public-Health, and I may say for Industrial-Health and happiness, which are so vitally concerned with your work and welfare. As Industrial Engineers you know and recognize the complexity and I may say the strenuosity of the work and of the problems confronting us. Undoubtedly it is "up to us" to keep the ideals of Public-Health and Public-Welfare always in the foreground of our activity and to see to it that no sinister or selfish motive or men shall hinder or prevent the accomplishment of our ideals. The medical profession through its most enlightened leaders joins hands with us and all health agencies and health officials in the accomplishment of our Peace-Time program, and we are sure that your great Society which represents one of the most effective instruments for the development of modern business methods, as well as of correct industrial ideals, will stand with us and stand by us to a man as we march forward. (Applause)

Gentlemen, I thank you.

THE CHAIRMAN: The meeting is adjourned.

THIRD SESSION

Thursday Afternoon, March 25, 1920

Chairman: HARRY ARTHUR HOPF

Organization Counsel, Federal Reserve Bank, New York City

MR. L. W. WALLACE: You will recall that yesterday I said that the scope of industrial engineering was almost unlimited and that that was evidenced by the fact that the principles of industrial engineering had been applied in various educational, manufacturing and commercial enterprises. One of the outstanding installations of industrial engineering in a commercial enterprise has been in the Federal Reserve Bank of New York. The Chairman of the meeting this afternoon is Organization Counsel for the Federal Reserve Bank and has had a great deal to do with the installation of the principles of industrial engineering in that organization. We feel that our Chairman, as a professional engineer and as an organization counsel in a large banking concern is quite qualified to act as Chairman of this meeting.

I take great pleasure in introducing to you our friend and associate in the Society work, Mr. Harry Arthur Hopf, of New York. (Applause)

THE CHAIRMAN: While I must confess to an abiding interest in the subject of organization, I do not conceive it to be any part of my duty this afternoon to inflict upon you, even if only in a general way, such views as I have been able to develop in the course of many years' experience in dealing with that subject.

Our time is limited and we have two excellent papers to be presented, so without spending any time on preliminary remarks, I shall take the pleasure in presenting the speakers of the afternoon.

When I looked at this program, it struck me immediately that the Program Committee had, inadvertently, perhaps, committed a slight error in arrangement. I therefore decided to avail myself of the privilege of changing the arrangement. It seems to me that any discussion devoted to organization and to definitions, had better begin by discussing definitions and then proceed logically to the subject of organization. Therefore, I take the liberty of reversing the order indicated on the program.

The speaker who is to present the first paper, "The Importance of Definitions to the Industrial Engineer," is one with whom I have had the privilege of acquaintance and friendship for nearly seventeen years. I sat at his feet as a student in the School of Commerce of New York University many years ago, and it is now my privilege to be a colleague of his in the Department of Management of that School. New York University is doing a splendid work in co-operating with this Society and it is only due the University that that fact be made known. One of the speakers, Mr. Knoeppel, is a lecturer, with members of his staff, at the School of Commerce, and he can portray a very close relation between what is being done at the School and what this Society stands for.

The first speaker is at the head of the Department of Management. He has capitalized an opportunity to make that department one of the most important of its kind in the country. If you will remember that the School of Commerce was the pioneer school of its kind in this country, organized over twenty years ago, you will appreciate that many of the principles and phases of management have passed review from the academic as well as the practical standpoint in that particular Department.

It gives me great pleasure to call on Dr. Lee Galloway, Director of the Department of Management of the New York University School of Commerce, to present to us his paper on the subject of "The Importance of Definitions to the Industrial Engineer." (Applause)

DR. GALLOWAY: I have often wondered at the peculiar kinks that definitions take and how indefinite they are at times; what peculiar impressions they give, and in thinking over this subject, trying to organize the impressions that have been made upon me by different types of definitions, a story occurred to me of a little girl over in a Brooklyn school a short time ago, who was asked to give a definition of the word "average." She said, "An average is what a hen lays on." "Well, a hen lays an egg on an average of one a day." (Laughter) So I thought that a good many of our definitions in industrial engineering meet about the same test—more descriptive than accurate, and with that in view, I have tried to bring out in this paper some of the fundamental, important relationships existing between the promotion of the purposes of an industrial society of this kind and the science itself.

"THE IMPORTANCE OF DEFINITIONS TO THE INDUSTRIAL ENGINEER

DR. LEE GALLOWAY
School of Commerce, New York University

To get at the importance of definitions we must consider The Society of Industrial Engineers as an organization formed for the accomplishment of a definite purpose. And in our analysis we must not be influenced too much by the "declared" purposes for they are often built on the hopes of the promoters who adopt expressions more in harmony with the spirit of propaganda than in line with a possible goal. Most societies start out with a "brass tack" ambition but they seldom arrive at the brass tack stage of giving information until the society is in its dotage and the members feel that a surrender of formulas or information involving the "how" of procedure is no longer a menace to their private practice. To be sure there are always a few far-seeing men in any profession who are willing to give information which to most men would appear to be strictly private and confidential. Brass tacks are pulled up and given away to engineering competitors with a recklessness that causes amazement. They come before societies and tell all they knew—not know, mark! For they realize that the "how" of yesterday should be only the fodder of today and the listener or engineer who mistakes the importance of this distinction is always a harvest season behind the times. A competitor can copy the "how" of any procedure but he can't carry away the brains that conceived the methods in the first instance. Anyhow the live part of a tack is not the brass head but the point, and the latter is usually out of sight doing the real duty of a tack in holding the carpet down. So it is true of methods; the real vital part lies in the principles which holds the system together.

A national society, therefore, that pretends to be professional, should first of all test every activity by the guages of its underlying principles. If some special method of procedure works in a factory it is a case of brass tacks only if it can be analyzed into its basic factors and explained in terms of the underlying principles of the profession.

All this, however, is quite different from talking in abstract terms and dealing in vague theories. Quite the opposite is the desired goal. But this can come about only through a comprehensive list of definitions whereby every discussion can be reduced to the minimum in volume and in complexity, because each person is thinking in the same terms as every other.

I take it that the goal of this society is advancement of the profession of industrial engineering, and that this is to be done through the interchange of information and knowledge gained by the various agencies connected with the work of industrial engineering. In other words, the society is a machine for turning out ideas and information for and engendering a professional spirit among its members. Its chief tool is the language with which the members communicate, and if we carry the simile further the greatest efficiency is gained when the tool is standardized. That is, this society should apply the leading principle of its engineering practice, i. e., standardization, to its own organization. We should standardize the strategic terms of intercommunication by working out and adopting definitions for those terms that will be generally accepted by all members and used by them in presenting papers, reports and discussions to this society. This will steer the discussions away from the abstract and theoretical, for 90% of the work of most society gatherings of this kind is given over to explanations or controversies involving a straightening out of fundamental interpretations of the terms used in the discussions. When a member uses the term "functional management," every other member ought to begin thinking in the same way that the speaker is thinking. As it is, no two persons think alike about the term since no two have the same conception of either "management" or "functional." It is this lack of close thinking and hence the loose generalization on the part of practical men that develops vague abstractions and hermaphroditic theories about industrial engineering. Nothing would tend more to spread the results of practical application of the principles of industrial engineering, than a working kit of definitions applicable to this profession.

The language, or as we have said the tools of a professional communication grows and accumulates very much as the stock materials grow and accumulate in an old-fashioned machine shop. Each foreman brings in something new, uses it for awhile, often orders an oversupply, stacks it up in corners and along the aisles, tries to use some of it for purposes entirely foreign to the original intention in order to dispose of it and so on until the department is cluttered up with a varigated and useless stock of little use to anyone. In fact, it is difficult for a stranger to the shop to move about the department. And one of the first things an industrial engineer has to do is to clear things up. So with a professional society of this kind. Each member brings in a new set of terms, tries out a few of them on the society. Some of them are adopted for a short time, others get lodged in the minutes or reports of the discussions and in a short time it is impossible for the student of the subject to find his way among the surplus rubbish, waste, and useless verbiage of the profession. One of the serious problems of this society is the establishment of an organization that will start off on the straight-line-production principle. It should not wait until an expert is needed to remove the impedimenta from the aisles and passageways of its means of communication.

A testing department in the machine shop has done much to stabilize production and to remove surplus stock. But a testing department without standards is unthinkable. It is this then that we need in a society of Industrial Engineers—a testing department through which the materials of communication should go and this means standards, and first and foremost among these standards we would mention standard definitions, and standard methods of preparing reports. The first of these is the subject of this paper, the second standard should be taken up by the society at once.

What terms then should be defined by this society? To begin with, I would suggest that the society bring to the attention of its members the importance of understanding the fundamental terms involved in the work of any scientific organization. It is astonishing to find how few men know the meaning of the term science itself. Speakers use the term with as much abandon as Joe Jefferson whistled for "Snyder." No one ever saw Jefferson's Snyder and the psychology of the theater demanded that each one in the audience paint his own dog into the picture. But the purpose of a gathering of industrial engineers is not emotional but professional. Men come here to gain information about their work, yet as long as we whistle at the real meaning of the terms used it will be just as difficult to build up a science of Industrial Engineering without an agreement as to the meaning of the term, science, as it would be to build up a canine pedigree from old Rip's visionary and elusive Snyder.

I mistrust that most men in defining the term Industrial Engineering start out by saying "Industrial Engineering is a science"—throwing in the term science because the word seems to be vague enough to embrace almost anything and hence to just about fit their own mental condition covering the subject of thought. To still further protect themselves they throw in the term, "art" for good measure, and then if they are particularly sensitive about their reputation they modify these terms with some reference to service to society or the "utility to mankind." They only leave out a reference to religion and Deity for fear they may be called visionary. However, in these days of spirit engineering they should take no chances through such omissions.

As a first essential, therefore, the society should have a good working definition of the term, Science, itself. It should be shown that science has both an **essence** and a **method.** The essence, the prime requisite of any thing in order to be classed as a science, is the possession of qualities involving "force" or "power" or energy." The second requisite is the amenability of its phenomena to analysis, classification, and the reduction of activities to laws and principles. Thus when we say that engineering is a science it is true, first, because it involves the direction of the forces of nature, and secondly, because the activities pertaining to construction, mining, mechanics or electricity, can be reduced to laws and principles and hence conforms to the scientific method and satisfies the mind in its demand for a logical arrangement of cause and effect. On the other hand "Salesmanship" is still on the border land of adoption into the catagory of the sciences because the phenomena pertaining to the activities are still only partially reduceable to the form of laws and principles. It has, however, passed the border of doubt surrounding the essential essence of its nature. It deals with the forces of the human mind and while the display of energy is more subtle than the working of a blast furnace, there is little doubt of its potency through the power of suggestion. In fact the "sales engineer" has appeared already in the market place.

And then, too, while the society is about it, the haziness surrounding such fundamental terms as philosophy and theory and profession, should be cleared up. I shall not attempt this here as our purpose is not to define but to agitate for a program of definitions. And finally in this connection, the term, definition, itself should be thoroughly explained. Few people know when they have defined a term accurately. In fact a definition like every other standard is only a means to an end and the end should always be kept in mind when framing a definition. But I am afraid that too many people have kept this particular thing in view to the exclusion of accuracy. A well framed definition eliminates all superfluous words and touches upon no qualities that are not needed in identifying the thing as belonging to the class defined. For "a definition is a brief specification of a class" and hence should include every member of a given class and exclude everything not a member of that class. Judged by these two standards F. W. Taylor's definition, or rather description of scientific management is both good and bad: You recall that he says scientific management constitutes a combination of:

1. Science (not rule of thumb)
2. Harmony (not discord)
3. Co-operation (not individualism)
4. Maximum output (not restricted output)
5. Development of each man to his greatest efficiency and prosperity.

The end in view to was reach the comprehension of the ordinary thinker, therefore, the disregard for accurate and careful pruning of attributes, included in his statement. From this point of view it is good, but from a scientific point of view it is a jumble of the worst sort. I should say that from the standpoint of this Society such definitions are not acceptable. The difference between this definition and one properly constructed for this organization of industrial engineers, is as wide apart as the definitions of water, as "something to bathe in when defining the term to a prohibitionist, and as "being a molecule composed of two atoms of hydrogen and one of oxygen when describing water to a chemist."

It might be well to mention a few other terms that need clear definition at this time, since the magazines seem to have difficulty in classifying the Industrial Engineers either as scientific or as professional men. Industrial is one term, engineer is another that should be rigidly defined. Closely allied to these are the terms, art or "applied science" and profession. The term profession seems to give special trouble; one man says Industrial Engineering "as a means for subsistence becomes a distinct profession." A good definition of Industrial Engineering as a profession would at least exclude thieves and beggars. The term profession like science has an essence as well as a method and a purpose, and a good definition is the result of digging deeply and selecting carefully, and in the search for a definition of profession the chief function of this society suggests itself. For the history of national associations throughout the world shows that only those societies that have specialized upon problems connected with the advancement of the professional ideals of the members, have been enduring. The reason for this is that the scope of the society then coincides with the scope of the purpose of the members composing it. That is, the instructor, the student, the practitioner, the business man, and the science itself are all interested in the interpretaion of the forces, the methods and the goal to be attained by industrial engineering, and when these forces, methods and purposes are all bent toward the goal of social service, then and only then are the conditions established for a true profession. In short, we may say this applies to all kinds of professional associations. They may be dubbed technical, religious, philanthropic, or business, but they must all have the common goal of public service or they will go the way of all expedients. Did you ever notice how hard it is to kill a national society? Neglect, ridicule, competition, and poverty may send them into hibernation for a time but if they have ever breathed the professional air of social service they seem always to revive again. The only explanation for it seems to be that men are loath to part with a single gain which has been made toward a higher standard of social efficiency. And thus when an association has adopted the professional principle into its articles of faith it has then partaken of the bread of eternal life.

We have gone far enough with the subject of scientific management to discover the need for rules of "standard practice" with which we may compare specific instances of practice.

This is only another way of saying what the scientist has already stated—"In all forms of mental work the use of principles and types is indispensable. The beginning of reasoning is to attain a conception of general facts, such as a law or a system of laws, to begin the process of grouping general facts into conveniently handled types or standards, and to form the habit of judging specific instances by comparing them with the standards."

Industrial engineers and others need a system of standards implied by a series of definitions which cover at least the strategic points of the field of their activities. They need these definitions for the same reason that business men, and manufacturers and others seek standard machines, equipment, methods and the like. Standardized Symbols for the leading ideas involved in the science of management. These will aid the individual in thinking, the society gatherings in their discussions, the professional engineer in explaining his position to the business man, and it will aid the latter in understanding the arguments of the engineer. We want all this to economize the effort needed for promotion of the efficiency idea. The advantage of forming a habit of judging specific instances by comparison with accepted standards lies in its economy of effort, William James has put it well by saying: "The best possible sort of a system into which to weave an object mentally, is a rational system, or what is called a 'science.' Place the thing in its pigeon-hole in a classificatory series; explain it logically by its causes, and deduce from it its necessary effects; find out of what natural law it is an instance—and you then know it in the best of all possible ways. A 'science' is thus the greatest of labor-saving contrivances. It relieves the memory of an immense number of details, replacing, as it does, merely contiguous associations by the logical ones of identity, similarity and analogy. If you know a 'law', you may discharge your memory of masses of particular instances, for the law will reproduce them for you whenever you require them." And the handmaiden of a science is an accurate definition.

The adoption of standards will aid thus:

(1) The instructor in presenting the fundamentals
(2) The student in comprehending
(3) The practitioner in comparing methods
(4) The business man in proving results
(5) The science by opening the windows of its own house to the ideas which come from other sources.

THE CHAIRMAN: We will give some little time to the discussion of Dr. Galloway's paper.

MR. STAFFORD MONTGOMERY (Chicago): I want to correct the chairman on the statement that the New York University had the first School of Commerce—the University of Pennsylvania had a School of Commerce about twenty years before New York did. The New York University ranks a close second. I don't know how the other colleges come in.

In regard to definitions, I should say that one of the worst that has been worked off is the "efficiency engineer." That term is almost extinct now because the engineers, as a general thing, that did use it have dropped it.

"Production engineer" was the next term introduced, and I understand that that term seemed to apply to a man who made most of the studies, routed the material through the factory, and who set piece rates. In other words, he took over some of the formal functions of the old master mechanic.

The term "industrial engineer" I think was first used here in Philadelphia, and the term, as near as I could gather, seemed to mean an engineer who combined the functions of a real architect with those of a production engineer. A real architect differs from a common garden architect in that he devotes most of his time to designing a building rather than working on details in architectural work and the garden architect devotes something like 85% to gardening. The word has come into general use and we have accepted the definition of the word as being mill architect plus production engineer. Roughly speaking, a master mechanic. And so it would be better to limit the term "industrial engineer" hereafter to those more in line of the mill architect, plus the production engineer, and call others counsels or advisors in industry.

THE CHAIRMAN: The chair is not unwilling to accept the correction offered by Mr. Montgomery. However, the chair has not forgotten the Wharton School of Finance which was organized in 1883. The prior existence of the school nevertheless does not negative the claim of the School of Commerce of New York University to be called a pioneer in the field of university training for business.

MR. HUGO DIEMER, New Haven, Conn.: I want to include in the pioneers in the use of the term "industrial engineer" the Pennsylvania State College. It was my opportunity to present to the college for the promotion of engineering education along in 1906, a proposed course in industrial engineering. I don't know whether that was incorporated under the title of "Industrial Engineering" or not. I recollect very distinctly the use of the term "production engineer," and Mr. Dunlap also prepared a paper in which he proposed a course of industrial engineering in the Engineering Magazine in 1908. We conducted a course for ten years in industrial engineering, which meant engineering as applied to industry. That type of knowledge has a great many things to accomplish other than grand lay-outs and production. The industrial engineer's type of mind can be applied to sales engineering, and should include planning, scheduling, preparation, dispatching, production, whether in finance or personnel problems, whether in distribution, or any field, and I think that this is a point of view which is widely adopted—that it should not be disregarded in a study of this question.

DR. GALLOWAY: We all accept the fact of standards. As a suggestion given by Mr. Montgomery that we had first this and then that term, and then another, it only shows us that standards as applied to language carry right over into your every day practice. Standards are not something that are supposed to last forever—they last for the time for which you have created them in order to use them. When they are outgrown, you can revise them.

One thing further—this Society should have a Committee on Standard Definitions, so that they could be accepted by that committee and put into our literature, in order that a man wishing to use a term might come to that committee as a source of information.

It was also suggested that this committee might join committees of other industrial engineers, the Taylor Society, the National Association of Employment Managers, and so on, and they might get together and make a study of the field and bring in and adopt these terms and define them and then keep them up to date. I imagine that just two or three terms a year would keep them busy.

THE CHAIRMAN: I want to take the time to define the term "Comptroller." In the course of a search which carried me through all the dictionaries of the English, French and German languages, I discovered that the word originated in the Middle Ages, and that it was used to describe work of a checking character done by one who kept the counter-roll and was therefore known as the counter-roller. In course of time the word was contracted to "controller" and finally through possible influence of the French language to "comptroller." Consequently, the latter, spelling has no justification, etymologically speaking and it should always be spelled "Controller." I might add that it took me two weeks to find that point.

MR. GILBRETH: I would like to say, Mr. Chairman, that you have established a precedent of simplified spelling and if we can get this Society to break some of the old traditions in spelling, we have done a great job and I put before you now the habit of breaking the old spelling and using more simplified forms. I know that will evoke a good deal of discussion and not wishing to discuss it, I suggest you go on with the next paper.

THE CHAIRMAN: The thinking through of a philosophy of organization is an intensely personal matter. It has been my experience that when a man is permitted to think through some sound form of organization, even though it may not appeal to the powers that be, it is usually wiser to adopt that form without mutilating it rather than to attempt to introduce a plan of organization which represents the compromise opinions of many who have given but little attention to the subject. I think those of you who have been responsible for the recommendation of a plan of organization to business executives will understand what I am trying to portray. A man develops and grasps a plan of organization only after dealing with many elements which gradually resolve themselves into a well-balanced scheme. In other words, it requires much experience to acquire the ability of thinking in terms of organization. Now, it isn't a national trait to think in terms of organization, and to this fact may be ascribed many of the difficulties which we encountered in doing our part in the late war.

The man who is going to speak to us now is a man who has gone through a process of continuous and hard thinking about organization. He has subjected himself, whether by force of circumstances or by natural inclination, to a period of self-discipline that elicits both admiration and envy. He was a molder and a draftsman, an office man, a systematizer, and in his connection with one or the other concern gave way to service in behalf of many. Gradually after years of experience, he reached a point whereby intimate contact with all the varying factors that make up organization, he found himself. I have witnessed this development, especially within the last five years, and I gladly testify to my appreciation of his grasp of organization principles and his ability to integrate those principles successfully with practice. He is at the head of a remarkably successful professional organization, and it would embarass him, I am sure, if I were to describe to you just how much he has been able to accomplish and is now accomplishing in that capacity. He is to present for our consideration his latest thought on organization, and having had the pleasure of reading his paper, I am convinced that it branches out into a new path and also draws a remarkably interesting parallel. Rather than steal some of his thunder by referring to his paper, I think I shall content myself with calling on Mr. Knoeppel. (Applause)

MR. KNOEPPEL: I am going to ask you to bear with me somewhat. You know we live in dry times—whether that is fortunate or unfortunate, I don't know—with the result, however, that the subject may appear dry. Further, your very efficient Program Committee very nonchalantly handed me the Bible and said that it was to be my text. You can imagine what a preacher would attempt to do if he had to take the whole Bible as his text. I feel rather in that position. If the committee had said, "Describe an effective type of organization," I could possibly have taken any organization and developed arguments as to its weaknesses, but when the topic assigned was "The Most Effective Type," a premise had to be arranged for and from that an argument built up. So I ask you to bear with me and see whether we can't get something out of a dry subject.

"THE MOST EFFECTIVE TYPE OF INDUSTRIAL ORGANIZATION"

C. E. KNOEPPEL

President C. E. Knoeppel Company, Inc., New York City

It is obvious that the most effective type of industrial organization is that which can produce the greatest net results, in the easiest possible way, in the shortest possible time.

Study if you will, the whole history of mechanical development, of machine design, and it will be at once apparent that the aim has always been, is, and always will be, to secure maximum attainment, with maximum economy, with maximum speed. The automobile is the most excellent example of this. Speed, economy of operation, riding qualities, acceleration, weight, power, wear, appearance and other features are given more than ordinary consideration in automobile manufacture. As a result, we have witnessed for the past ten years, a phenomenal development in this particular mechanism.

The steam engine, the electric locomotive, the aeroplane, the telephone, the telegraph, the wireless, electrical equipment, are other examples of the aim to secure results quickly and easily.

What is a machine and why this aim?

As regards the first part of the question, the best definition that I have seen is—"An apparatus so designed that it can transform one kind of energy into another."

With reference to the second part of the question—is not the law of life a constant desire for advancement, for progress, for a higher standard of living, for a restless seeking for perfection, and for expression of individuality and creativeness?

With reference to these answers, let us turn to life itself for a few moments. Is not the human body a machine that converts one kind of energy into another? Elements contained in food, in air and in water are taken by the bodily mechanism and converted into energy which sustains life. Eliminate any one of the three and there would soon be no life.

As a piece of machinery the human body is a marvel, a more efficient machine than man has ever been able to build. In fact, we sometimes speak of a machine as being "almost human."

Do you know of a more efficient pumping mechanism than your heart, pumping at the rate of fifteen gallons per hour for 613,200 hours during the average life of a person, at the rate of 4,320 strokes per hour? This means 2,648,024,000 strokes in the average life time, or to put it another way, the pumping of 9,198,000 gallons in a life time. Do you know of a more wonderful moving picture than the human eye? Are not the voice and ear the most efficient wireless apparatus we have? What about the nerves and the nerve centers as a telegraphic machanism of the highest type? Do we have any artificial waste disposal machinery any more efficient than the eliminative organs? Is there any induced or forced draft apparatus equal to the nose and lungs? Is a boiler, using coal and water and generating steam for the engine, as efficient as the stomach and connecting organs, using food and water and generating blood? What electrical switchboard can compare with the spinal cord? Is there anything in all mechanical development to compare with the brain and the senses? Where is there a mechanical governor as efficient as the pneumo-gastric nerve, which keeps the heart and lungs from running away through excessive activity by applying a brake? Do you know of any more efficient maintenance and repair crews than the white corpuscles of the blood? Where is there a power transmission apparatus equal to the red corpuscles, which carry oxygen to the tissues How about the heating plant in the body and the skin as a ventilating apparatus?

What is the aim of this human body?

A moment's reflection will show that the principal aim of the human body is economy in the expenditure of bodily power and energy required to secure the attainment of efficient results, in the form of protective and aggressive action and accomplishments. The Great Designer so built the parts, and arranged the relationships between them, that through proper **coordination** of functions and parts there would be **control** of the body as a whole, or control of certain parts of the body performing the same major functions. In other words, insofar as the human body as a machine is concerned, control and coordination equals economy and efficiency in operation.

Let us now turn our attention to the human body as an organism.

Everywhere in the human body it is found that while each organ performs some definite function, the co-operation of all is necessary to complete life of a person. Further, it can be stated that while two or more organs perform totally distinct functions, they cooperate for some major or compound function in which their individual functions are merged.

There are four major divisions of the human body as follows:

1—The brain as the directive agency of the body, deciding, judging, reasoning and issuing instructions.

2—The twelve cranial nerves along the five sense terminals —the eye, ear, nose, tongue and skin, merge to form a function of sense, of counsel, of formulation and of standardization.

3—The mouth, stomach, intestines and connecting glands constitute the digestive function. The capillary blood vessels and lymphatic vessels of the body constitute the absorptive function. The heart and blood vessels constitute the circulatory function. The lungs, trachea, diaphragm and walls of the chest constitute the respiratory function. The kidneys and bladder constitute the urinary function. The skin with its sweat glands constitute the perspiratory function. The liver and connecting glands constitute the excretory function. All of these functions merge to form a major function, the object of which can be stated as the preservation of the individual, applying the service that is necessary to living and doing.

4—The nerves and muscles constitute the motion function. The larynx, lungs, trachea, respiratory organs and mouth constitute the vocal function. The generative organs constitute the reproductive function. These three functions merge to form a major function of performance and accomplishment.

Briefly described, these four major functions are:

1—Coordination.

2—Control.

3—Service.

4—Performance.

All through the human body there is this grouping of smaller functions into larger ones, and the larger functions into the body as a whole, the principle of which is that there shall be efficient performance, proper service, a minimum of friction and strain, the securing of the greatest results, in the easiest way in the shortest time by perfect coordination and control.

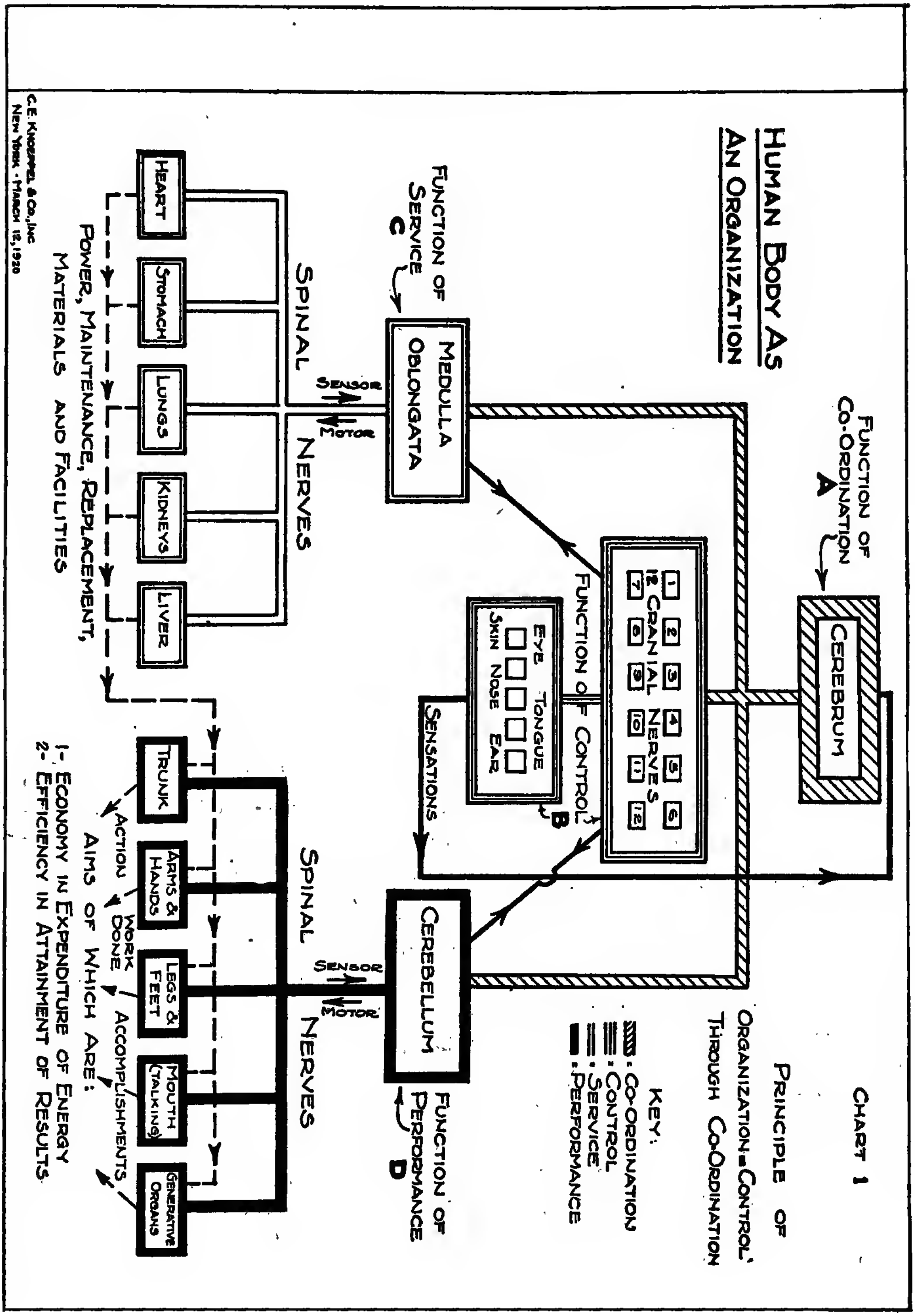
We have presented the human body as a machine and as an organism. Let us now consider it as an organization, referring to chart No 1 in so doing:

First in order of importance is the central directing agency—the cerebrum, as the chief executive of the body, where thought, judgment, reason, sense, cognition and volition are centered. This chief executive has two major assistants:

(a) The cerebellum which coordinates and harmonizes the voluntary organs, such as those of the trunk, arms and hands, legs and feet, those of the mouth as a talking agency, and the generative organs so that **performance** may be properly guided. This is the division of action.

(b) The medulla oblongata which coordinates and harmonizes the work of the involuntary organs, such as those of digestion, respiration, circulation, and the like, so that **service** may be properly rendered. This is the division of routine.

To enable this bodily chief executive to coordinate the efforts of the


Human Body As
An Organization
Chart 1
Principle of
Organization-Control
Through Co-Ordination
Key:
: Co-Ordination
: Control
: Service
: Performance
Function of
Co-Ordination
A
Cerebrum
12 Cranial Nerves
1 2 3 4 5 6
7 8 9 10 11 12
Function of Control
Eye Tongue
Skin Nose Ear
B
Sensations
Function of
Service
C
Medulla
Oblongata
Sensor
Motor
Spinal
Nerves
Heart
Stomach
Lungs
Kidneys
Liver
Power, Maintenance, Replacement,
Materials and Facilities
Cerebellum
Function of
Performance
D
Sensor
Motor
Spinal
Nerves
Trunk
Arms & Hands
Legs & Feet
Mouth (Talking)
Generative Organs
Action
Work Done
Accomplishments
Aims of Which Are:
1- Economy in Expenditure of Energy
2- Efficiency in Attainment of Results
C. E. Knoeppel & Co., Inc
New York - March 12, 1920

performance and service functions, it is provided with a combination intelligence, formulative and standardization bureau, in the form of cranial nerves and sense terminals. This is the division of control and links up the action and routine divisions with the coordinating division.

The spinal cord with its definite areas, can be likened unto a series of minor executives with limited fields, which connect with the chief executive and his major divisions. Relations between these minor and major executives are established through wonderful mechanism—the nervous system, divided into:

(a) Twelve cranial nerves
(b) Thirty-one spinal nerves

the functions of which are:

1—To unite and associate the organs and tissues of the body so they may coordinate for the accomplishment of definite objects.

2—To raise in the individual a consciousness of the existence of an outside world, thereby enabling him to adapt himself to his environment.

Through the spinal cord and the nervous system, the cerebellum is kept in touch with the departments of the action division by the reflex centers, while the medulla is kept in touch with the departments of the routine by the sympathetic ganglia.

The nerves are of two kinds—sensory and motor, the first collecting information and relaying same in the form of sensations and impressions to the proper terminus; the other sending out orders to the parts needing direction and guidance. As can be seen, the sensor nerves constitute the staff organization, and the motor nerves constitute the line organization.

The spinal nerves having to do with service and performance, are linked up with the cerebellum, medulla and the spinal cord, and need no special mention here beyond that already given. As efficiency and economy of the body, as an organization, depends however, upon control and coordination, a slight elaboration should be made with reference to the organization of these two important functions.

The cranial nerves, or nerves of special sense, nerves of general sensibility and nerves of motion, are twelve in number, and are the experts or bodily specialists. They are absolutely indispensible in the human body, as the brain does not in itself achieve, nor does it counsel itself nor sustain itself. It relies on these specialists in order to formulate, coordinate and direct.

These nerves are:

> 1st—Cranial nerve—a sensor nerve of odor, carrying impulses from the cells in the nose to the cerebrum direct, and so sensitive as to be able to detect 1/1,200,000 of a gram of Oil of Roses.

2nd—Cranial nerve—a ~~sensor~~ nerve of light and color sensation, carrying impulses from the organs of vision direct to the cerebrum, and so wonderfully made that a cross-section shows from 450,000 to 800,000 nerve fibres.

3rd—Cranial nerve—a sensor and motor nerve, controlling part of the muscles of the eye and having 15,000 nerve fibres.

4th—Cranial nerve—a motor nerve, transmitting nerve impulses to excite the eye muscles to contraction, a movement which brings the eye downward and to the side.

5th—Cranial nerve—a sensor and motor nerve, which transmits to and from the muscles of mastication.

6th—Cranial nerve—a sensor and motor nerve which governs the movements of the eyes from right to left.

7th—Cranial nerve—a sensor and motor nerve of expression, transmitting impulses to and from the muscles of the head and face, so that they can by individual and cooperative action express ideas and feelings.

8th—Cranial nerve—a sensor nerve of sound.

9th—Cranial nerve—a sensor and motor nerve of pain and taste sensation.

10th—Cranial nerve—a sensor and motor nerve of sensibility and reflex actions, transmitting impulses to and from the heart, stomach, intestines and lungs.

11th—Cranial nerve—a motor nerve, transmitting impulses to the vocal cords in speaking, the respiratory muscles after muscular effort, and the muscles used in transmitting food from mouth to stomach.

12th—Cranial nerve—a motor nerve, transmitting impulses of the mouth for articulation and mastication.

These twelve control specialists are in contact with the various service and performance organs of the body, the cerebrum receiving messages and transmitting instructions, some of them sensor, some of them motor, and some both sensor and motor.

As it is the function of these specialists to bring the individual in conscious relation with the outside world, nature has provided terminals, five in number, called the sense organs, and which are highly specialized and wonderfully organized—the skin, tongue, ear, eye and nose, the functions of which combined make a major function of specialization, counsel, and of formulation. The relationship between these five terminals, or experts of the cerebrum, is purely sensor. Each terminal responds to but one form of stimulation:

(a) The skin through mechanical pressure.

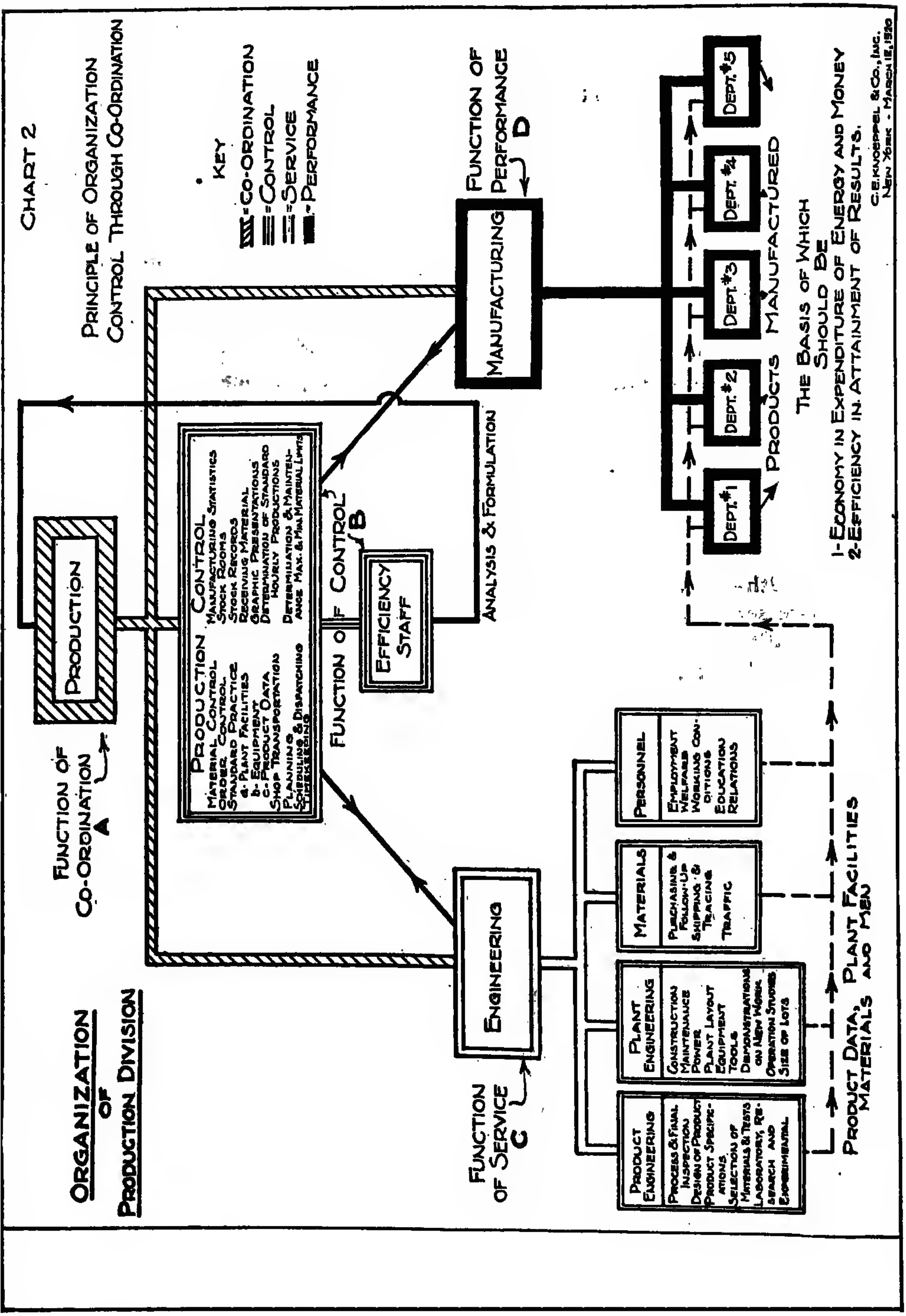


CHART 2
PRINCIPLE OF ORGANIZATION CONTROL THROUGH CO-ORDINATION
KEY
=CO-ORDINATION
=CONTROL
=SERVICE
=PERFORMANCE
ORGANIZATION OF PRODUCTION DIVISION
FUNCTION OF CO-ORDINATION A
PRODUCTION
PRODUCTION CONTROL
MATERIAL CONTROL
ORDER CONTROL
STANDARD PRACTICE
a- PLANT FACILITIES
b- EQUIPMENT
c- PRODUCT DATA
SHOP TRANSPORTATION
PLANNING
SCHEDULING & DISPATCHING
TIMEKEEPING
MANUFACTURING STATISTICS
STOCK ROOMS
STOCK RECORDS
RECEIVING MATERIAL
GRAPHIC PRESENTATIONS
DETERMINATION OF STANDARD HOURLY PRODUCTIONS
DETERMINATION & MAINTENANCE MAX. & MIN. MATERIAL LIMITS
FUNCTION OF CONTROL B
EFFICIENCY STAFF
ANALYSIS & FORMULATION
FUNCTION OF PERFORMANCE D
MANUFACTURING
DEPT. #1
DEPT. #2
DEPT. #3
DEPT. #4
DEPT. #5
PRODUCTS MANUFACTURED
THE BASIS OF WHICH SHOULD BE
1- ECONOMY IN EXPENDITURE OF ENERGY AND MONEY
2- EFFICIENCY IN ATTAINMENT OF RESULTS.
C.E. KNOEPPEL & CO., INC.
NEW YORK - MARCH 12, 1920
FUNCTION OF SERVICE C
ENGINEERING
PRODUCT ENGINEERING
PROCESS & FINAL INSPECTION
DESIGN OF PRODUCT
PRODUCT SPECIFICATIONS
SELECTION OF MATERIALS & TESTS
LABORATORY, RESEARCH AND EXPERIMENTAL
PLANT ENGINEERING
CONSTRUCTION
MAINTENANCE
POWER
PLANT LAYOUT
EQUIPMENT
TOOLS
DEMONSTRATIONS ON NEW WORK
OPERATION STUDIES
SIZE OF LOTS
MATERIALS
PURCHASING & FOLLOW-UP
SHIPPING & TRACING
TRAFFIC
PERSONNEL
EMPLOYMENT
WELFARE
WORKING CONDITIONS
EDUCATION
RELATIONS
PRODUCT DATA, PLANT FACILITIES MATERIALS AND MEN

(b) The tongue through soluble organic and inorganic matter.
(c) The nose through volatile or gaseous matter.
(d) The eye through ether vibrations.
(e) The ear through atmospheric undulations.

The sensations from these terminals through stimulation do not in themselves constitute knowledge. They are but the elementary states of consciousness, or raw materials, out of which the mind conceives and forms judgments. In other words, the special senses are analytical, informative and formulative functions only, the cerebrum translating, acting on advice given, and coordinating the various elements into efficient action.

Having outlined the body as a mechanism, as an organism, and as an organization, let us now turn our attention to the lessons which this study points out, that we may use such analogies as are practical. Let me also urge that you keep industrial organization in mind as each lesson is pointed out, and mentally note its application.

In discussing this phase of my presentation, let me make plain that I speak of the human body in its normal condition and in a state of health.

These lessons are:

1—DELEGATION.

The human body is the most excellent example of delegation of authority. Regardless of from which point instructions or impulses may be received, the brain decides and then delegates the task to be done, to the function or functions designed to perform the task.

2—LACK OF CONFUSION.

There is an absolute lack of confusion in the human body, the work to be done being performed by the proper function in the quickest and best manner.

3—EXPERT SERVICE.

The human body is run by experts. The heart does not attempt to breathe, nor the stomach to carry blood from place to place. The ear does not make an effort to see, nor the tongue to smell. Everywhere in the human body the work to be done is in the hands of specialists.

4—CENTRALIZATION.

The human body does not operate on lines of divided authority, nor is there uncertainty or indecision as regards what is to be done, as each organ or group of organs has certain definite things to do.

5—LACK OF EXCUSES.

The game called "passing the buck" is unknown in the human body. A piece of work is to be done and if the duty is placed on the stomach, it does not attempt to throw the load on other organs, or to "get out from under" as the saying goes.

6—AUTHORITY AND RESPONSIBILITY.

Everywhere in the human body, an organ is created for certain work, and it is not only responsible for this work, but is given the necessary authority to get results.

7—NO INTERFERENCE.

There is no "butting in" by major officials of the body, in the work of other major officials. Decisions are made and tasks are transformed to the organs affected.

8—COOPERATION.

The body is a "we" proposition and not an "I" affair, cooperation being the order of bodily procedure.

9—DECISIVENESS.

Emergencies are met with quickness and dispatch, and under any and all circumstances, the body is obliged to match itself against unforeseen contingencies.

10—PLANNING AND DISPATCHING.

The body plans and dispatches in the most efficient manner. If something is to be done involving activities of several different functions, plans are at once made and dispatching arranged for, with coordinated action as a result.

11—LOGICAL FUNCTIONING.

The body is not run on a purely line or performance basis. There are specialists of the most intelligent and efficient kind, and service of the highest order, working under the direction of the bodily executive, for the use of action or performance division.

12—MAINTENANCE.

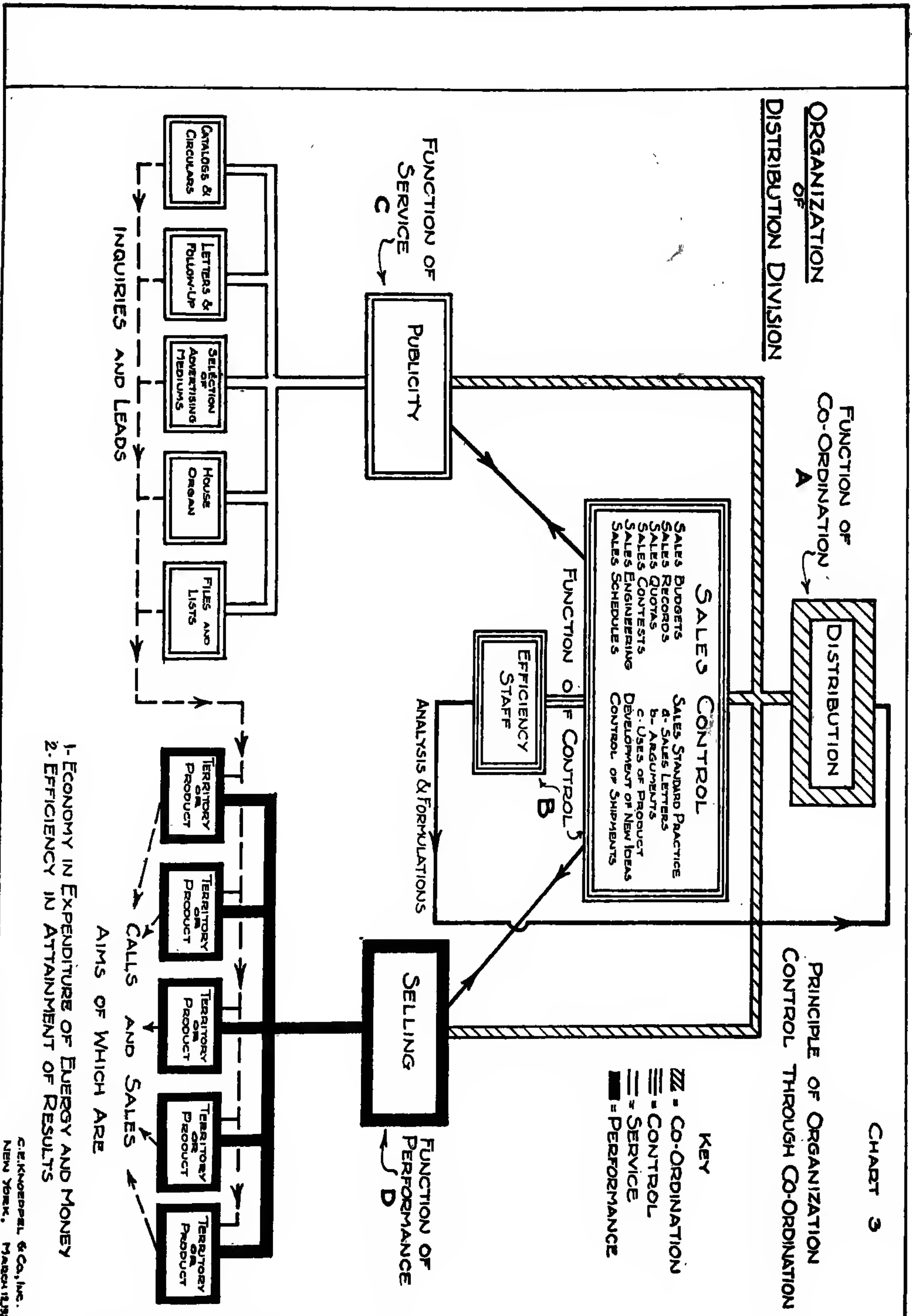
Provision for maintenance of the body is not made at some convenient time, but immediately. You cut your finger and you feel the prompt response to the sensory impressions by motor impulses, and the repair crews get right to work.

13—CONCENTRATION.

The body concentrates. It places within a function all the factors which affect its performance. Fingers are not under the jurisdiction of the lungs; the eyes are not subordinate to the leg muscles; the stomach is not ordered about by the heart.

14—SPECIALIZATION.

The body specializes. It does not ask the heart to do what the heart was not designed to do. At the same time, the body considers a reasonable factor of safety. The heart can beat faster than normal and up to a certain point no harm is done, beyond which point the pneumo-gastric or 10th cranial nerve, gets to work as a brake or governor.


ORGANIZATION OF DISTRIBUTION DIVISION
CHART 3
PRINCIPLE OF ORGANIZATION CONTROL THROUGH CO-ORDINATION
FUNCTION OF CO-ORDINATION A
DISTRIBUTION
SALES CONTROL
SALES BUDGETS
SALES RECORDS
SALES QUOTAS
SALES CONTESTS
SALES ENGINEERING
SALES SCHEDULES
SALES STANDARD PRACTICE
a- SALES LETTERS
b- ARGUMENTS
c- USES OF PRODUCT
DEVELOPMENT OF NEW IDEAS
CONTROL OF SHIPMENTS
FUNCTION OF CONTROL B
EFFICIENCY STAFF
ANALYSIS & FORMULATIONS
FUNCTION OF SERVICE C
PUBLICITY
CATALOGS & CIRCULARS
LETTERS & FOLLOW-UP
SELECTION OF ADVERTISING MEDIUMS
HOUSE ORGAN
FILES AND LISTS
INQUIRIES AND LEADS
SELLING
FUNCTION OF PERFORMANCE D
TERRITORY OR PRODUCT
TERRITORY OR PRODUCT
TERRITORY OR PRODUCT
TERRITORY OR PRODUCT
TERRITORY OR PRODUCT
CALLS AND SALES
AIMS OF WHICH ARE
1- ECONOMY IN EXPENDITURE OF ENERGY AND MONEY
2- EFFICIENCY IN ATTAINMENT OF RESULTS
KEY
= CO-ORDINATION
= CONTROL
= SERVICE
= PERFORMANCE
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NEW YORK, MARCH

15—OBJECTIVES.

Each function, group of functions, and all functions together, have definite objectives which can be clearly stated.

16—GREATEST COMPLICATION.

The more complicated the parts of the bodily mechanism, the greater the attention to their structure and connecting elements. The sciatic nerve is an example of this.

17—PERMANENCY.

The body has been designed with steadfast continuance in mind. One lung may be diseased and the other continues working. An arm or a leg may be lost but the remaining member can still be used. Even the brain is divided into two sections. The body also replaces itself every seven years. In this connection, a prominent man of my acquaintance stated to me recently that his experience of fifteen years in business convinced him that the length of life of business enterprises, comprises strikingly with a man's "three score and ten."

18—RELATIONSHIPS AND INSTRUCTIONS.

The body understands clearly the matter of relationships and instructions. The lungs know what work they have to do and they do not expect other organs to do their work for them. Instructions transmitted to the muscles of the eye are not misunderstood; the eye muscles not looking to the leg muscles for the performance of the task outlined by the instructions.

19—COUNSEL.

There is no element of "know it all" by the major officials of the body. Advice, impressions, impulses, sensations are given most respectful attention and acted upon immediately.

20—COORDINATION.

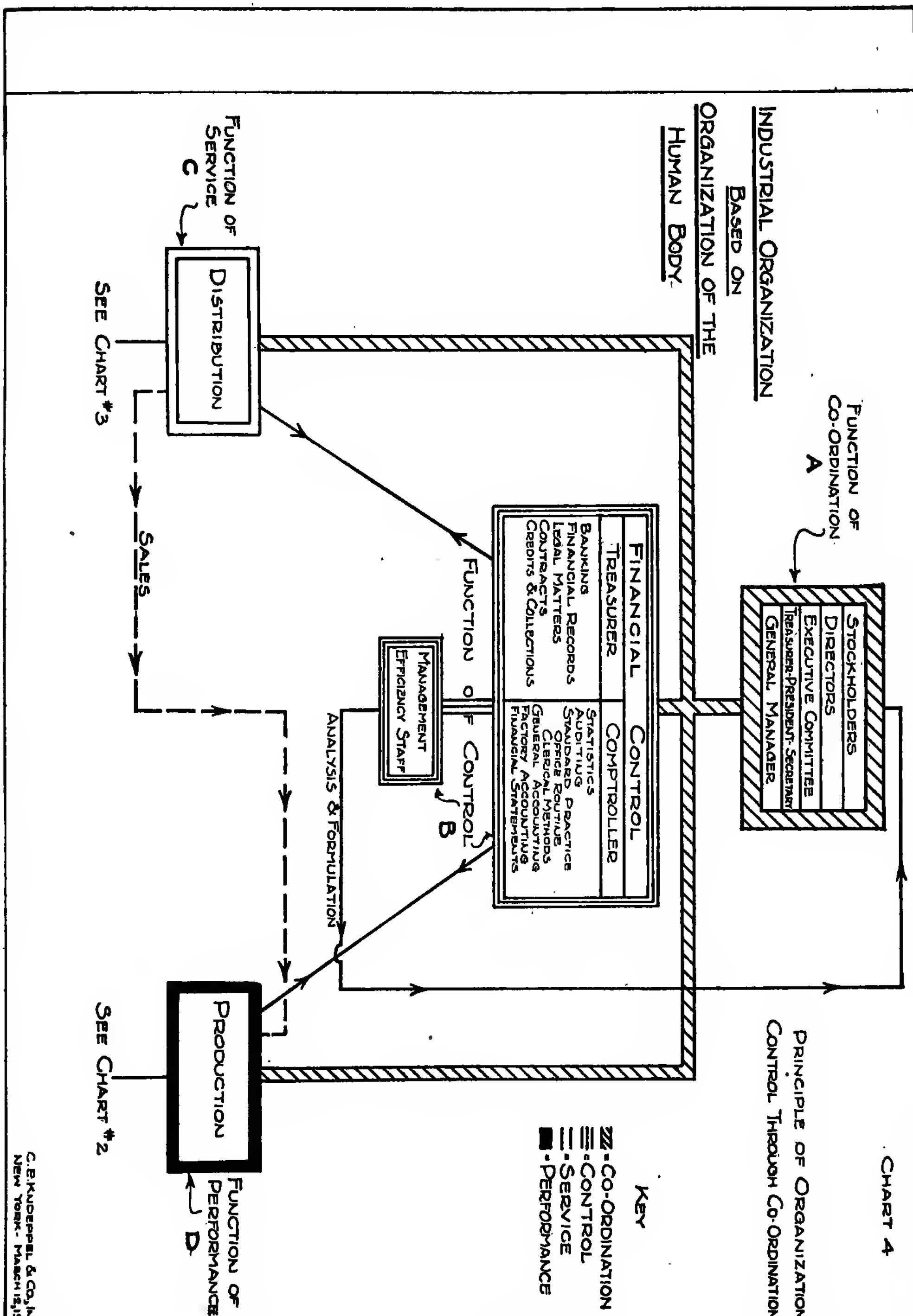
Coordination is practiced to the nth degree on the human body. I may step on some thin ice and immediately my feet sense the thinness, my ears hear the crackle of the ice, my eyes notice the danger, and as a result orders are given to jump back. In driving an automobile, my foot on the accelerator, my hands on the steering wheel, and my eyes on the surrounding country, are coordinated for both driving and protection in case of an emergency, when a quick turn of the car, or both feet on the brake and clutch, enables me to avoid danger.

21—DUAL FUNCTIONS.

The body is so designed that the same organ may perform different functions without confusion, as in the case of the nose for breathing and smelling; the mouth for taste, speaking and mastication; the skin for touch and bodily breathing.

22—CONTROL.

The matter of bodily control is in the hands of experts working under


INDUSTRIAL ORGANIZATION
BASED ON
ORGANIZATION OF THE
HUMAN BODY
FUNCTION OF CO-ORDINATION
A
STOCKHOLDERS
DIRECTORS
EXECUTIVE COMMITTEE
TREASURER-PRESIDENT-SECRETARY
GENERAL MANAGER
FINANCIAL CONTROL
TREASURER
BANKING
FINANCIAL RECORDS
LEGAL MATTERS
CONTRACTS
CREDITS & COLLECTIONS
COMPTROLLER
STATISTICS
AUDITING
STANDARD PRACTICE
OFFICE ROUTINE
CLERICAL METHODS
GENERAL ACCOUNTING
FACTORY ACCOUNTING
FINANCIAL STATEMENTS
FUNCTION OF CONTROL
MANAGEMENT EFFICIENCY STAFF
B
ANALYSIS & FORMULATION
FUNCTION OF SERVICE
C
DISTRIBUTION
SEE CHART #3
SALES
PRODUCTION
SEE CHART #2
FUNCTION OF PERFORMANCE
D
CHART 4
PRINCIPLE OF ORGANIZATION
CONTROL THROUGH CO-ORDINATION
KEY
CO-ORDINATION
CONTROL
SERVICE
PERFORMANCE
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the direction of the cerebrum. In other words, the entire task of coordination and control is not thrown on the shoulders of the bodily chief executive. To a greater degree than we may realize, the control function secures the cooperation of the functions of service and of performance through the medulla and cerebellum.

23—TRANSFER OF WORK.

There is a logical transferring of work at the proper time, in the human body, to a greater extent than is realized. In learning to play a new piece of music, the cerebellum takes over the task, but later on as the work becomes more subconscious, therefore involuntary, the task is shifted to the medulla and its organization.

24—COMPETENCE.

Skill, fitness and competence are demanded in the bodily organization, and as a result bodily functions are designed with reference to the work to be done, and orders are issued to these different functions. There are no square pegs in round holes in the bodily organization.

25—REPRODUCTION.

The human body reproduces itself, the result of this reproduction being a composite of all the physical and mental characteristics involved, in which both cooperation and coordination are essential factors.

26—OUTSIDE KNOWLEDGE.

The body is at all times in touch with the outside world, as well as with the inside world, and is therefore in a position to gather from every conceivable source, the assistance it may need.

27—FATIGUE.

The body stores energy and gives due consideration to fatigue and rest.

28—EXERCISE OF FUNCTIONS.

The body recognizes that it develops itself only through proper and constant use of its various functions.

29—CHANGE OF ENERGY.

The body changes one form of energy into another that it may live and operate, develop and grow.

30—SELF-EXPRESSION.

The body recognizes that its aim in thinking and doing is self-expression and improvement.

31—BODILY LAWS.

The body is subject to definite laws of health and nature, which if violated result in the exaction of penalties.

32—BODILY CYCLES.

The body passes through four different cycles—childhood, youth, manhood and old-age. These correspond to the cycles in industrial organization, to which attention has been repeatedly called—conflict, development, refinement and retrogression.

33—WORKING CONDITIONS.

The body demands proper working conditions in the way of cleanliness, sanitation, ventilation, heat and the like.

34—TRAINING.

The body insists on training and development that the purpose of life may be expressed to best advantages.

35—CONFERENCE.

While it is difficult to intelligently outline just how conferences are carried on in the human body, the evidence indicates that there is a conference relationship between the cerebrum, or conscious brain, and the medulla, or the subconscious brain. How else can we explain a consideration of pros and cons by the mind, or the reasoning process prior to decision

The Bible says with reference to work—"Go to the ant, thou sluggard, consider her ways and be wise." It might also have stated with reference to organizing for work—"Go to the human body, thou searcher after truth, pattern after its workings and be efficient."

In reviewing this study of the human body, these major conclusions stand out prominently:

1—That man as to thinking and doing is organization in the individual sense, and as industry gets back to thinking and doing, therefore to man, organization is man in the collective sense. More briefly stated, this means that as man is organization, organization is man.

2—That the most effective type of industrial organization would, therefore, be one patterned after the organization of the human body in which these factors are included:

(1) Coordination, or decision and direction.
(2) Control, or staff.
(3) Service or facilitation.
(4) Performance, or doing.
(3) That the thirty-five elements which are recognized by the human body are elements in industrial organization.

Let us, therefore, take up this matter of industrial organization with the idea in mind of using the bodily organization as our design or model. Call it imitation if you will, but as far as I am concerned, I am content to follow the plans of the Almighty.

In the first place, is there need for better organization in industry and in affairs as a whole, of which industry is a part? I can go only by my own experience and the experience of my associates, which is, that the

inefficiencies we are constantly in contact with, are in the last analysis, a result of faulty or incorrect organization, and sometimes of a total lack of organization.

We informed a client recently that organization was his starting point and our contention was based on this principle—"That economy and efficiency are the result of control, and there can be no control without co-ordination."

The reasons for the above conclusions are:

1—The general tendency to build organization around personnel without reference to plan and design.

2—The woeful lack of knowledge of what constitutes plan and design in industrial organization.

3—Failure to consider that no attainment is more efficient than the organization which makes it possible.

4—Troubles and weaknesses at the bottom are but a reflection of troubles and weaknesses at the top.

5—Failure to consider the four major functions that were shown as existing in the human body.

We generally find industrial organization, where there are the performance division and the executive division, or two out of the four essential elements. Once in a great while we find service and performance divisions along with executive division, or three out of the four elements. **Never have we found an industrial organization containing the four divisions of coordination, control, service and performance.**

At this point, let me ask this question—What would happen to the body if the cerebrum should cease to function? Would the body be result producing if we suddenly eliminated the senses of smell, sight, hearing, taste and touch? If the involuntary functions of the body should stop rendering service, how long would the body keep up its work? What would happen if the performance division should go on a strike? All these functions, independent, yet interdependent, are absolutely vital to the successful working of the body organization?

This is rather a bitter arraignment of industry, but our years of experience in matters of organization justify it.

Let us turn for a moment to activities as a whole.

Franklin K. Lane in his report to President Wilson on leaving the Cabinet said:

> "The call is for thinking, planning, engineering, statesmanship. For we are quickly passing out of a rough-and-ready period of our national life, in which we have dealt wholesale with men and things, into a period of more intensive development in which we must seek to find the special qualities of the individual

unit, whether that unit be an acre of desert, a barrel of oil, a mountain canyon, the flow of a river or the capacity of the humblest of men. To conquer and to master—the same old task is ours; but not in the same old way. We have discovered this land and made it ours but this is not the end of the journey, for now we are to give thought, the deepest thought to the ways in which it may be made to yield most abundantly in the things which a complex society with a most imperious curiosity demands."

That he had organization in mind will be apparent when further in his report he says regarding Washington:

"But it is poorly organized for the task that belongs to it. Fewer men of larger capacity would do the task better. Ability is not lacking but it is pressed to the point of paralysis because of an infinitude of details and an unwillingness on the part of the great body of public servants to take responsibility. Everyone seems to be afraid of everyone. The self-protective sense is developed abnormally, the creative sense atrophies. Trust, confidence, enthusiasm—these simple virtues of all great business are the ones most lacking in government organization. We have so many checks and brakes upon our work that our progress does not keep pace with the nation's requirements. We could save money for the government if we had more discretion as to how we should use that given us. For the body of civil servants there should be quicker promotion or discharge and a sure insurance when disability comes. For the higher administrative officers there should be salaries twice as high as those now given and they should be made to feel that they are the ones responsible for the work of the department; the head being merely an advisor and a constructor of policies. As matters are now devised there are too few in the government whose business it is to plan. Every man is held to details, to the narrower view, which comes too often to be the department view or some sort of parochial view. In a word, we need more opportunity for planning, engineering, statesmanship above and more fixed authority and responsibility below."

The fundamental flaw is that we have centered most of the power in Government in the coordinating function—the Presidency of the United States, and have provided it with a weak staff, a weak service section and a weak performance section.

Let me support this statement in the words of William Allen White in the article "President Broken by Great Responsibilities."

"We have created in America a political institution called the Presidency which must mean a death sentence to the man who functions fully under it. Every year for a score of years the institution has been accumulating power. With the power comes tremendous responsibility which hardly can be delegated.

Cabinet members who are directly responsible for this administrative work, look after the details; but the administrative policy, the selection of the chiefs under the Cabinet members, must come before the President. The more or less intimate knowledge of what is doing in a thousand great activities all over the land, and all over the earth in recent days, must be in the President's mind. This consciousness of his power, quite apart from the fearful weight of its responsibility, must create a psychological impact upon the mind and a strain upon the heart which will grind the youth out of any human body, however hard that body may be.

Then add to the merciless sense of power, the still more awful sense of responsibility that comes from the fact of political leadership, and we have a Frankenstein of human duties made by a free people to curse the man they choose to lead them.

As if that were not enough we are about to force upon the President leadership of all the nations of the earth. For if the League of Nations works, it will work only because America leads it. America can lead it only through a President who takes world power and assumes world responsibility.

However that may be it is interesting to American readers to know how Congress has shrivelled under the growing power of the Presidency.

It is not Wilson's power. Roosevelt took it. He had to take it or fail. Taft tried to shirk it, tried to be a President under old constitutional limitations and the people cast him out in contumely because he would not kill himself in their service.

The President, constitutionally, is supposed to pass upon laws submitted by Congress. As a matter of fact, when a President comes into office his party comes in with him, and he has to assume leadership of Congress. That means, he has to draft laws, to submit policies, virtually to say what Congress should do and what it should not do; to be the prime mover in national legislation.

More than that the President must prepare public opinion for his policies, must exhort, advertise, and be the voice interpretative between his party council and the entire people. The second year of his administration either sees a new party come in or his own party endorsed.

If his own party is returned by the people the President has to continue his leadership. If the opposition party controls Congress it generally fears to take responsibility under an opposition President. That is the situation in Congress today.

The check of Congress upon the Presidency is through the Congressional investigation. A Congressional investigation chills the heart of Washington like a Red Terror! It is the veto of Congress, through publicity, upon the tremendous power of the executive! Now all this is not in our school books upon the Constitution. Yet all of it should be. For these changes are permanent in our Government, and they are fundamental.

So deep is this veto power of Congress upon executive action that when President Wilson came back from Europe the Senate maintained the right to summon even the President himself and quiz him in a Congressional investigation. With all his vast power, he had to kiss the rod of Congressional investigation, like an ordinary bureau chief!

This power of Congress to veto him pesters and bedevils the President and wears out his nervous energy like a growing pain —not particularly this President in his relations with Congress, but all Presidents in all their relations with Congress."

The reasons why the three divisions under the coordinating function are weak, are, according to Herbert N. Casson, as follows:

1—There is no payment by results.
2—There is no fear of discharge.
3—There are no profits to be made.
4—There is no danger of losing customers.
5—The main thing is accuracy, not success.
6—Time is of no consequence.
7—The work is impersonal.
8—There is no competition.
9—Routine is put ahead of service.
10—There is no enthusiasm.

Faulty organization is the one great curse of our modern life. It was a curse to the Allies in the conduct of the war, resulting in five long and weary years of strife because the enemy was organized and the Allies were not. It cursed us industrially during the war, the war costing us at least twice as much in money as it should have, with the result that we will be paying for it in one form or another for a generation to come. It is cursing us now because we have no plan; we do not think ahead; we do not get down to fundamentals; industries flounder along on one or two cylinders, never on all four; Capital fights Labor and Labor fights Capital because neither fully understands the facts on which good organization must be developed.

That we are living in an age of lack of coordination, is beginning to dawn on the intelligence of the leaders in all walks of life, the world over.

Let us begin to develop industrial organization using the human body as a basis. Obviously, industrial organization is a mechanism to transform one kind of energy into another. The product of any plant is but the composite of the mental and physical energies of those making up the organization of the plant. It is also apparent, if one analyzes closely enough, that as in the human body the law of the plant should be advancement, improvement, a restless seeking for perfection, or in other words, self-expression and creativeness; but as self-expression of the entirety is impossible without self-expression on the part of those making up the organization, the matter of the individual is a most important one indeed.

The purpose of the industrial body should be the same as that of the human body—to secure the greatest results, in the easiest way, in the shortest time.

The industrial body also can be said to reproduce itself as does the human body, in that the ideals of those at the top become the ideals of those at the bottom, if there is a proper interpretation of these ideals reflected by the contact of those making up the organization, with the outside world.

We have, therefore, these four major fundamentals:

1—Conversion of mental and physical energy.

2—Provision for self-expression and creativeness.

3—Efficiency in attainment of results and economy in the expenditure of energy.

4—Reproduction of high ideals as a foundation for strong industrial organization.

We have come to look upon types of organization as four in number:

1—Usual or line type of organization, which gives responsibility and authority (the latter sometimes not being given) to definite individuals. It does not recognize, however, a classification of logical functions, nor qualifications in men required for them.

2—Taylor or functional type, in which the work to be done is divided into certain logical functions, with specialists in charge.

3—Emerson or staff type, where the line organization is
Central augmented by a staff of specialists acting in an advisory and

formulative capacity, whose function it is to furnish standard practice and to counsel the line organization.

4—The type called Committee Organization, which serves to bring together the best minds representing different factors in the organization, that they may discuss and decide on actions to be taken by the line organization.

My experience in matters pertaining to industrial organization, and my study of the human body, as it relates to organization in industry, has convinced me that no one type is in itself sufficient to secure maximum results, and the conclusion I have reached is—**that all four types are needed in the work of organizing industrial plants.**

We need the line type for performance; we need the staff for intelligence and control; we need the logical functioning, and we need conferences for discussion and deliberation, all to be directed and coordinated through the plans of the directive or executive agency.

Bodily organization is made up of staff, of performance through a line organization, is divided according to functions, and gives due consideration to conferences. Why should not the industrial organization? Our military organization in the great war paralleled the bodily organization, which is shown on Chart I, with President Wilson, Secretary Baker and Secretary Daniels as coordinating function; with General Staff as the function of control under General March; with the "services of supply" as the function of service, and the fighting forces in the field under General Pershing as the performance function.

Management can be defined as the wise use of coordinated knowledge. Therefore, there must be a function whose purpose it is to coordinate facts and information to know what is being done, to know what should be done, to be in constant contact with the latest and best developments as to those things having to do with the work in question; in other words, a combination intelligence and standardization bureau.

With control functioning as outlined; with advisors knowing what is to be done, and in touch with what is being done, management is then in a position to reason wisely, form conclusions quickly and execute decisively —coordination in other words.

What will management coordinate through the aid of control functions?

Let me answer this by going back to the human body. What a grand mix-up there would be if the performing machinery and the service machinery were all merged under a single head; if the hands and feet and the heart and liver were part of the same function. Imagine if you will, the functions of performance waiting until the heart pumped some blood or the lungs did the required amount of breathing, or the stomach digested the proper amount of food. Consider also, what the results would be if the organs of service decided that the organs of performance were sufficiently supplied with all the elements needed to do work and, therefore, determined to let up in their efforts. No, the doing of things is so divided that the organs of action and those of routine, while independent are interdependent; that while separate and distinct, they work together for the accomplishment of a common end; that while one is voluntary and other involuntary, there is cooperation of the highest order. The perfomance function goes ahead with its work, giving no particular thought to the matter of service, **knowing that if it is to undertake a certain task, the service function will be on the job.** The service function not in direct touch with the performing function, is at the same time doing its work regularly and properly, anticipating requirements and preparing itself for any sudden demand which might come.

These elements of doing are what are coordinated through the control function by the bodily arrangement.

Let me ask this question—Where is there any difference when it comes to the industrial organization? Performance must proceed unhampered and without interruption. Service must be rendered and requirements anticipated. The two must be directed and coordinated by some agency which can rely for information and advice on experts and specialists who are in possession of the required knowledge to reason, conclude and act.

To give you a type of industrial organization which parallels the organization of the human body, attention is called to Charts 2, 3, and 4. In developing this type from the analogies worked out through the study of the human body, it became apparent that in the majority of cases a concern was in business to manufacture a definite product, either sold prior to or after making. Therefore, production becomes the performance function and distribution the service function. In some types of commercial ventures production is more or less incidental to and serves distribution. In such cases, distribution becomes performance and production service. Further it seems logical to consider the control function as financial and economic in character, the three being under the direction of the coordinating function, consisting of the stockholders, directors, executive committee, officers and general manager.

It also seemed logical to divide the major sections:

(a) Distribution, into:

1—Advertising as service.

2—Selling as performance.

(b) Production, into:

1—Engineering as service.

2—Manufacturing as performance with each having its own control function for intelligence and standardization.

The charts are self-explanatory and such notations as to detailed functions that are listed are to be understood as being simply suggestive in character, it not being the purpose of this paper to do more than present a recommendation as to type of organization, based on something so fundamental and logical, as to serve as a means of getting away from the differences in ideas, and the constant changes in the work, known as Industrial Organization.

The bodily organization is governed by laws of health and nature. If I do not sleep, or will not eat, or stop using certain muscles and faculties, there is soon a bodily disarrangement which causes trouble. The same applies to industrial organization. If laws are violated then there is disarrangement, which causes confusion and waste.

The laws of industrial organization, as worked out from long experience are as follows:

1—**Objective**

Working up a tentative plan with reference to the ultimate development desired.

2—**Greatest Complication.**

The determination of the most complicated phases of the objective.

3—**Concentration.**

Placing in each division of a business all of the factors which effect the performance of its own function.

4—**Specialization.**

Dividing work so that a man may operate in limited rather than in many diversified fields, in order that a few things may be done thoroughly rather than a large number superficially.

5—**Mental Capacity.**

Dividing the work in an organization, with reference to the knowledge and ability that will be required of a man in charge of one or more functions or details of a business.

6—**Personnel.**

Analyzing the requirements of given positions and finding men whose qualifications match the analysis of these requirements.

7—**Individualism.**

Placing in the hands of one man, most competent to handle the work, one or more functions or details of a business.

8—**Relationships and Instructions.**

Providing a man with a clear-cut conception of the relationship existing between himself and his associates, as well as with a written outline of duties, functions, responsibilities, results expected, and methods affecting his work, or instructions covering same.

9—**Responsibility.**

Holding a man responsible for the total proven results he secures in his division or work and not for the details or the methods that he uses in securing these results.

10—**Permanency.**

Training men to fill other positions than their own and providing for understudies so that changes in an organization may be made without disruption.

11—**Cross Fertilization.**

Giving each pivotal man in an organization some opportunity during the year to learn the methods of the departments his work influences as well of the departments which influence his work, also giving men a change of work to avoid monotony.

12—**Conferences.**

Creating a conference plan to make it difficult to determine where staff advice ends and line acceptance begins.

In this connection, an analysis of the thirty-five lessons from the human body shows that most, if not all of them, logically arrange themselves under these twelve laws of industrial organization, just defined.

To interpret these laws, so that in a general way their application may be more clearly understood by those interested in the subject, let me say that the first law objective—means developing an ideal plan of organization **without reference to personnel,** keeping in mind the future of the business, insofar as this is possible. The nature of the business, the aims and purposes of those at the head of the Company, the requirements of the business and the elements which must be taken into account, should serve as the basis of the development of his ideal plan, or determination of organization objectives.

The second law—greatest complication—demands that a consideration be given to relative complication of the elements in the objective, which will establish the factor of greatest complication, to which the most attention should be given. This element of greatest complication will be different in different plants in the same industry, due to peculiar local conditions, and the nature of the problems to be met. In one plant it was found that the most complicated phase of the objective was equipment and maintenance. In another it was material flow and balance, and in still another, it was planning and scheduling of work.

The third law—concentration—requires us to make a close study of all the different functions of a business, in order to properly arrange minor functions under major functions, the major functions being the divisions as determined through considering the first and second laws. For instance, to attempt to control production with full knowledge of the labor side of things, but without a control of the material situation, would be violating this law, because the factors which effect control of production are not under the function of production control. To hold a function responsible for the proper operation of plant equipment, with the maintenance function under another division, would be illogical, as maintenance effects directly, the matter of plant operation, and should therefore be placed under it. Factors which have a direct relation to, and exert an influence on the performance of a definite objective, should be placed together.

The fourth law—specialization—demands that man should not be given sections of this, that and the other work, which have no relation to each other or to a definite function or functions. To ask a man to sell goods and buy materials or to design machines and then build them, is a violation of this law, as he is then operating in widely diversified fields, and cannot secure the greatest results as to each. We found these two conditions however, in two large plants.

The fifth law—mental capacity—demands that after considering the matter of objectives, which defines the major functions, the matter of greatest complication, which localizes the most difficult work; the matter of concentration, which places like factors together and the matter of specialization, which limits the different things a man should do, the question then arises—what will be the degree of difficulty in finding a man to take charge of the work? Or to put it another way, what knowledge and ability will be required of a man to handle the functions decided upon? This would mean a general analysis of the requirements of given positions, to determine what is wanted, and the ease or difficulty in locating the proper talent, either in or out of the organization, and to serve as a basis for selection and renumeration.

The sixth law—personnel—demands that we analyze the requirements as determined through the observance of the fifth law, to find men whose qualifications in the form of training, experience, mental and physical qualities, and character, match the final analysis determined upon.

Through the observance of the seventh law—individualism—we will place the man selected, through the observance of the sixth law, in full and complete charge of the function or functions for which we engage him. This laws means "one man control," instead of several having to do with the same thing. It means eliminating conditions that are sometimes found where too many cooks spoil the pudding.

Through the eighth law—relationship and instructions—we tell this man what will be expected of him in the way of results, what his function is, what his duties and responsibilities are, what methods he is to use in securing his results, what his relationships to others and of others to him are to be. In other words, we must thoroughly define his work as to what and how.

Through the ninth law—responsibility—we say to this man—"here is your work; you are responsible for certain results and you have full authority to get them in your own way." In other words we put things squarely up to him. His success or failure is then in his own hands. We adopt "manbuilding" tactics which develop doers, instead of "detail-chasing-heel-crowding" tactics, which develop leaners. This law is violated more than perhaps any other of the twelve, and the result is always a destruction of a man's initiative, ability and individuality. With reference to this law W. W. Atterbury, Vice-President in charge of Operation of the Pennsylvania Railroad says:

> "I believe in giving men authority, in giving them freedom to exercise their initiative. Ever since I have been an executive, I have followed this policy of giving my subordinates absolute authority to do things falling within their sphere. I do not, as a rule, tell a man how to do a thing. That is his business. But all decisions and all results must naturally come to me, and the men are very careful, therefore, to use their best judgment, so that they will not have to be over-ruled.
>
> When you give a subordinate freedom to work a thing out, he has a sense of responsibility, and just as a judge in a lower court does not relish having his rulings found unsound and consequently reversed, so those lower down in the organization do not relish having their judgment found faulty and reversed.
>
> When you give men scope you are then able to give them credit for the successful results, and since I am always prepared to give credit to those working under me, these men learned to give credit in turn to those under them; and this in time permeates the whole organization. Nobody, therefore, goes strutting around and claiming that 'I' did this and 'I' did the next thing. Everybody avoids the first person pronoun and talks about what 'we' accomplish. This creates what we in the Pennsylvania call the 'organization spirit.'"

What a lesson to the executives of this Country, in the words of the man who was Commander-in-Chief of our overseas Army transportation in the late war, and considered to be the ablest railroad man in the United States!

The tenth law—permanency—demands that we give consideration to a factor generally ignored—that of providing for understudies to take care of changes due to sickness, death, promotions, resignations and discharges. Rearrangements are being made constantly in industrial plants, due to these causes, and in most cases they come with no preparation having been made for them, when a program of logical transfers, promotions and understudying, would have assisted in eliminating many of the difficulties contingent upon changes, which are usually disruptions.

The eleventh law—cross fertilization—requires that we provide some plan, whereby pivotal men can be given an opportunity during the year to become acquainted with the work of the department their work influences mostly, and the work of the departments which influence their work. Clash in plants is usually the result of misunderstandings and misconceptions. Changing men about, grouping them together for brief periods, conferences, getting each man to study the work and methods of other departments directly related to his work, are suggested methods of cross fertilization.

The twelfth law—conferences—demands that for discussion, formulation, determination of actions, settlement of disputes between functional heads, and for approving procedure, a conference plan will assist materially. In this connection let me make plain **that a committee should not execute,** or put decisions into effect. This should be done by one man. A committee simply debates, discusses, considers pros and cons, and after reaching some decision, delegates to one man the matter of execution.

To further assist the executive and student in this matter of industrial organization, the following questionnaire is offered.

1—In which of the following ways is your business divided into departments or divisions:

(a) In accordance with functions?
(b) In accordance with products?
(c) Through accidental groupings?
(d) Through the gradual growth of individual responsibility?
(e) In accordance with the physical arrangement of the plant?
(f) In accordance with the geographical location of the plants or offices?
(g) Any combination of the above or other factors?

2—If your organization is divided in accordance with functions, what are the divisions and what functions independent of each other in authority and responsibility do they represent?

3—Do these divisions represent an effort to divide your business intelligently into those sections under which it can be most competently managed with the least managerial effort?

4—Which of the above divisions of your business report directly to the chief executive?

5—Do the departments under the chief executive report to and receive instructions from him only, or are there others who are empowered to give instructions?

6—Do the various divisions of each department report direct to the departmental head or does the chief executive often instruct them direct?

7—Does the head of each department control all factors affecting the successful accomplishment of his functions or are there many factors not under his control, or is he obliged to split his authority?

8—Have the heads of departments any say concerning the order, production, or cost system, repair methods, or any factor directly affecting the accomplishment of their own and other departments?

9—Are there any committees composed of the departments interested, organized for the specific purpose of considering these questions; and if not, how are they to be adjusted?

10—Has the chief executive any staff or employees under him whose sole duty is the study of unsatisfactory inter-departmental systems or unsatisfactory conditions in individual departments? If not, what is the method of remedying such conditions?

11—Do you find it possible to permit your sub-executives to make their own decisions as to their departmental policies, or is it necessary for you approve all such plans and decisions?

12—Can sub-executives make expenditures for improvements in their departments without your approval? If so, within what limits?

13—Can a sub-executive employ additional help for his department without your approval?

14—Can a sub-executive purchase equipment or machinery for his department without your approval?

15—Do you have charts of organization showing the course of authority and relationship between departments?

16—Have you any written statement definitely defining the duties and responsibilities of your various executives and departmental heads, or do you depend on oral instructions?

17—Is your business divided into departments or divisions in such a way that the various positions can be completely filled by average men, or is it divided in such a way that extraordinary men are required?

18—Have you ever attempted to arrange the duties of your various positions so that they could be competently conducted by the average type of man who could be hired to fill the position?

19—Is your organization so arranged that the knowledge required by your various departmental heads for the performance of their functions is sufficiently restricted to permit them to become specialists?

20—Do you have difficulty in procuring executives and employees competent to fill satisfactorily your various positions as they are now arranged?

21—Do you carefully analyze the characteristics necessary in a man for the competent filling of your various executive positions and do you measure the men selected against these requirements?

22—Are your present executives, men selected from your own organization, or were outsiders brought in to fill these positions?

23—Are your sub-executives independent or are they leaners depending on their superiors for guidance in all their decisions?

24—Have you provided understudies for all important positions? If any executive leaves, is there some one in the organization who can competently fill his position?

25—How do you judge your executives or departmental heads; by the proven results of their section of the business, or by little things which you happen to notice are wrong?

26—Do you consider that you have sufficient data to judge fairly the accomplishments and ability of your various executives?

27—Have you noticed any antagonism or friction between executives, or any tendency to form political factions?

28—Do you consider such animosity personal or is it due to the faulty relations under which your executives are forced to work?

29—Is the general attitude of your executives one of contentment and energetic accomplishment or one of worry, dissatisfaction and indifference?

30—Do your executives express their opinions to you freely and with conviction, or is their attitude apologetic, or do they attempt to excuse their faults and court favor with you?

31—Do you find that executives brought into your organization develop beyond your expectation, or that they seldom ever live up to their recommendations? In other words, is your organization a man-builder, or a developer of leaners?

32—After a consideration of all the above, do you find that your organization meets with your ideals as to organization?

33—What are your ideals as to organization?

The adoption of the type of oganization herein described, modified to suit local conditions, as well as acceptance of the laws of organization just presented, will produce results which will mean an industrial organization from which the same lessons can be pointed out as were mentioned previously as these developed from the study of the human body.

On the sixth day of the Creation of the world, we are told in the Book of Genesis, Chapter 11, verse 7; "The Lord God formed man of the dust of the ground and breathed into his nostrils the breath of life; and man became a living soul."

Thus the Master Designer of the Universe brought into being the highest development of His handicraft, the human body—the most perfect type of Organization.

So perfect was this Organization in its inception, so flawless in its functioning under the severest conditions, that not in the slightest detail, has a change been made since its creation, 7000 years ago.

We little realize what an efficiently managed and complicated manufacturing plant we possess built upon that framework of bones and in a still lesser degree do we realize how the complex system of the body is so admirably controlled under the scientific management of the brain and nervous system.

A better example of organized control cannot be found anywhere in the whole wide world; its component parts are of a finer kind of design than we will ever approximate, and the functions and their relations are coordinated more smoothly than we will ever be able to arrange human relations.

We can, however, pattern our industrial organization after this perfect model with the full expectation of securing both economy in the expenditure of energy and efficiency in the attainment of results.

THE CHAIRMAN: I think you all agree with me that we have heard a masterly presentation of the subject. The thought uppermost in my mind is that for an industrial engineer, Mr. Knoeppel is certainly a wonderful medical man. (Laughter)

Before taking up the discussion of Mr. Knoeppel's fine paper, Miss Cooper will speak for the League of Industrial Women Workers.

MISS COOPER: I am representing the National League of Women Workers and I want to say, at the beginning, that this is not an industrial organization. We are a system of girls' clubs which are really recreational and educational in purpose, and we are not affiliated in any way with any partisan organization. We are not affiiliated with labor organizations or any organizations of capitalists—we are entirely free.

The fundamental principles of our clubs are three—they are nonsectarian, self-governing and self-supporting, so that you can readily see what we are trying to do. We are trying to teach girls responsibility and loyalty, team-work and co-operation by making them managers of their own affairs.

The thing that I want to bring before you particularly today is our National Convention in June, which is to be held at Bryn Mawr College. We are expecting about six hundred girls at this convention and the entire college is going to be turned over to us, with all the space that we can get in Bryn Mawr in addition, and on Saturday, June 12th, all day we are going to have an open meeting, which is going to be an industrial meeting. At that meeting we are expecting to have one big speaker to represent the employer, one big speaker to represent the technique of the employer and one or two speakers from the girls, to present their side of the case, and we are anxious to have your co-operation and your support at that meeting.

We will be delighted to send you tickets to the meeting if you will let us know of your interest in coming. We are anxious to get all the names of employment managers or their representatives who would be glad to come to that meeting. (Applause)

THE CHAIRMAN: The meeting is now open for discussion.

MR. KNOEPPEL: I want to give credit where credit is due. Five years ago Dr. George W. Reid of Worcester, Mass., made a sketch of the body as an organization, which gave me the original thought behind the paper. Along about that time Mr. Harrington Emerson discussed the same question with me, also Dr. Robert H. Rose, Dr. Richard Wawless and Dr. Douglas H. Stewart all of New York, as well as Dr. H. W. Sanborn, of Akron.

I am also indebted to two books—Gray's "Anatomy" and Brubaker's "Physiology."

THE CHAIRMAN: It has been among my past experiences to have a great many dealings with medical questions. For fifteen years it was my responsibility to underwrite risks for life insurance. In that capacity I believe I was called upon to pass on the insurability of at least one-quarter million cases. I would hesitate, however, to take up the discussion, personally, from any medical viewpoint, chiefly because the analysis Mr. Knoeppel made is so thorough and requires so much study that I can appreciate, on the spur of the moment, the difficulty in making deep rooted comments on it, but with some expert analysts present, I should think no one would be gun-shy at discussing so common an object as the human body.

MR. LOWE (Baltimore): How does the industrial death rate compare with human death rate?

MR. KNOEPPEL: I couldn't answer that. As I said, this particular friend of mine, who was one of the most successful promoters in New York City, after fifteen years of experience, stated that there was a similarity between the man's life and the life of the average industrial enterprise.

THE CHAIRMAN: I think I might enlighten you on the subject of the longevity of women in industry before the war. The average life of women in business was not longer than seven years before the war, but that, just like almost everything else has changed in the meantime.

It appears to me that sufficient courtesies have been extended to my reluctant friends in this discussion. There will now be in order a policy of calling people by name. As we have an exponent of physiological fatigue in the audience, perhaps Mr. Gilbreth will talk to us.

MR. FRANK B. GILBRETH: Mr. Knoeppel's paper is so complete the lack of discussion is all that he could ask—it's a perfect tribute.

THE CHAIRMAN: I don't think I will let you get away as easily as all that. Mrs Gilbreth, won't you have the last word?

MR. GILBRETH: I can testify that she does always. (Laughter)

THE CHAIRMAN: For once, this group is speechless. I don't want to think of Mr. Knoeppel's paper in terms of perfection—I don't think he would like that either. We can never reach perfection in organization, and surely, the human body is by no means a perfect organization, as most of us are not more than 50% efficient in maintenance and 35% efficient in operation.

I want to tell you what I did with this paper. First, I wrote Mr. Knoeppel a courteous note, asking him to be sure to have his paper in writing and send it to me. I received it a few days later and then I turned it over to the Chief Medical Adviser of the institution which I serve, and she and I had a very interesting discussion on the subject. She thought the parallel drawn by Mr. Knoeppel was quite appropriate but she took occasion to disagree with one or two conclusions. She asked me to question the theory that the human body renews itself every seven years. I am acting in accordance with her wishes.

Another statement was that we should carefully distinguish between the body in health and the body in disease. Mr. Knoeppel emphasized that point but I think it bears emphasis again. Most bodies are not in health, and I don't speak in any other than the accepted definition of the term.

MR. R. A. PETTINGILL (Chicago): I suggest that since you had the paper for several days and had the opportunity of reading it, you furnish some other thoughts for our assistance.

THE CHAIRMAN: In addition to the suggestions I have offered for your consideration, I know, first of all, that Knoeppel has a capacity for thinking in terms of organization, and that's a very important capacity. He also, as you will observe when you read the paper later on, has the ability to compare and to contrast, all of which leads to accurate judgment. So far as his medical knowledge is concerned, I don't know anything about it. I think he is a deep student of the subject. I hope from an academic standpoint and not as the result of any experience of a personal character.

MR. FRANK B. GILBRETH: This paper of Mr. Knoeppel has not received sufficient consideration by this Society. It has a great many points that we should consider besides those points that Mr. Knoeppel has brought out in his abbreviated reading of it.

There may be those who will contend that it is not close reasoning to say that the Almighty designed a human being, therefore, that particular plan or design is the correct form also for an industrial organization. However that may be, it takes a good deal of nerve for an engineer to sit down and write a paper like this, and he must have put a great deal of time and thought on it. Therefore we, as engineers, should read and treat the presentation of it very seriously, and I am disappointed that there is not more of a discussion.

Mr. Knoeppel has acccpted a very important principle of work, namely, a comparison of likenesses. For example, one of the peculiar features of Mr. Knoeppel's particular specialty, the foundry, which is typical of all trades, is that there is no systematized plan for the interchange of information and the transference of skill and experience in trades that are not alike. Foundrymen meet, machine and tool builders meet, labor unions meet, The Society of Industrial Engineers meets, but each of them consists of people of somewhat the same experience. Whoever heard of metal foundrymen intentionally interchanging information with those of a foundry for concrete castings or for artificial stone? Probably Mr. Knoeppel has visited such organizations, because he is broad minded. Yet the underlying principle of casting stone, which is a cold, wet material, and has become hard on account of chemical action, is identical in most of its aspects with casting liquid metal, which gets hard on becoming cool.

Mr. Knoeppel has brought out in most interesting fashion the value of calling attention to likenesses and the resulting transference of skill. Emphasis on this brings us to a natural result of such comparison of likenesses, namely, investigating what other peole are doing in other kinds of work, which, tho similar, are handled by experts who are not in the habit of meeting regularly for interchange of ideas, before we bring out our own standards. The concrete man can learn much from the hot metal foundry. I do not mean the concrete man on building alone. I mean those who are in concrete foundries, where they make cast stone. They can learn a tremendous lot from the men whose knowledge has come down thru the centuries; from men who have been investigating the problem of casting hot metal. Yet I have known only two men in the metal foundry work who ever seriously considered what the foundryman in artificial stone work was doing.

Mr. Knoeppel has emphasized, therefore, a great thought for the Society when he brings out a comparison, correlation and indexing of information on lines of work about as far apart as can be cited, when he compares the standardizing of the plan of an industrial organization to the plan of a human body.

In this matter of standardization, which should be the result of the comparison of various workers in the same kind of work, coupled with information in entirely different kinds of work, you come down to new lines of thought in your standards.

My message to you, which I bring to you with all the emphasis I have, is a mesage which not more than ten per cent of the men in this room will walk away with. It is the message suggested by Mr. Knoeppel's emphasis on comparison, and its influence on standards. It is a message concerning Super-Standardization.

We must all recognize, in these days, the importance of standardization. But this is not enough. The industrial crisis that confronts us demands that we **superstandardize**,—find and use the One Best Way to do every kind of work.

We **must** super-standardize, if we are to keep our place in industrial progress. We note from the magazine that we have recently received from the Verein Deutscher Ingenieure that Germany is already busy at this work, and undoubtedly other countries abroad are also. There they are even standardizing details of construction, from window frames to handles on faucets. This is not with the idea of preventing any one who desires, to express his personality by deviating from standards, but in order to cut down cost for those who are willing to follow an accepted design.

The problem of cutting down costs and reducing the cost of living is no more a local problem—it is a world problem. The sooner we wake up to this the better. Standards and superstandards are an important element in the solution. A recognition of likenesses is essential to the making of a worth while standard. It is here that we return to an appreciation of what Mr. Knoeppel has done in this paper. Mr. Knoeppel, I congratulate you for what you have done, and I assure you that the reason that this Conference does not discuss your paper is because they do not dare to.

MR. W. H. LEFFINGWELL (New York): I think Mr. Gilbreth is right we do not dare to discuss the paper. While I listened to the talk, I wondered why I didn't pay more attention to the subject of physiology when I went to school. I hadn't thought of Mr. Knoeppel's application of it to industrial engineering. While he was talking, one thought came in my mind,—one analogy that he didn't bring up was that we know that the body is composed of cells and these cells do not ordinarily have the power of independent action. We may call the business organization the body, and the cells the people in that organization, and they do have the power of individual action. When a cell in the human body decides to become an anarchist and go off by itself, it creates a wart or cancer and I simply want to say that I find that many businesses are quite cancerous in their growth.

MR. THOMAS MACK (Chicago): I want to compliment Mr. Knoeppel on his wonderful work and this thought came to my mind, that in the early days, the old architect of those days used the human form as a sense of proportion, and it has been brought down to us. If you will study the old Egyptian architecture, you will find the human form with arms outstretched was their scheme of measurment and their scheme of proportion from which all those buildings were built, so with all due regard to Mr. Knoeppel, we had something of that sort in the early days.

MR. BIGELOW (Boston): I think a good many manufacturing concerns have difficulty in getting the proper personnel to function. I would like to ask Mr. Knoeppel whether his form of organization could be modified if the adequate personnel could not be obtained to function in that organization.

MR. KNOEPPEL: That question is probably in the minds of many. Getting back to this several years ago, I will say that physicians were in agreement that the body did replace itself every seven years. Others, however, say that it does not. Let's waive the matter of seven years and get this in mind—that the body replaces itself.

This question of personnel under engineering, can, in a sense, be considered arbitrary. The thought that I attempted to convey was the relationships under proper management. Obviously, if a manufacturing department or a manufacturing division works to the best advantage, it must be served not only with information, equipment and plant, but also with people to do the work. If its logical for a foreman or superintendent to go through all the work of engaging and discharging workers, it is also his function to make specifications, to get bids on materials and buy, the thought being the more you can get the operating division to think in terms of quality and not quantity, the better your results will be.

We meet people and plants where there is an efficiency in the attainment of results but at an enormous expenditure of energy and money. A man may drive himself and get results, but he is violating the laws of nature and suffers. In order to get the most efficient results, it was thought advisable for the successful organization, at least, to start a discussion on this subject, including the production in the plant, materials and men—the elements that must be coordinated so that the operating division could work to the best advantage.

The term "engineering" might not be the best one to use—it was suggested to me by one of my associates that we call that the "service division." That would have been very good, but service includes that, and I used the term "engineering" to avoid duplication. One of the big thinkers in this country advocates the phrase "man power engineering." We are all talking of sales engineers and we are talking of purchasing engineers, so it seems logical to include personnel as part of an engineering function to serve the performance organization.

With regard to the question of anatomy, I can only say that I have been doing some study of that with that major premise in mind to find out how it was built, and then drew the parallel in getting something started like Mr. Gilbreth stated—super-standardization.

Mr. Gilbreth's method was complete—glass making is comparable to iron foundries, and I would appreciate any written comments as to the printed manuscript when studied. Our idea is to answer as many points as we can in the interest of the movement.

THE CHAIRMAN: I am sure I voice the sentiments of this meeting in expressing to Mr. Knoeppel our earnest and sincere thanks for his admirable contribution to the subject of organization.

Adjournment.

FOURTH SESSION

Thursday Evening, March 25, 1920

Chairman: PROFESSOR G. F. BLESSING

Department of Engineering, Swarthmore College, Pa.

MR. L. W. WALLACE: Just at the close of the meeting this afternoon, Mr. Gilbreth received a wire calling him home on account of the serious illness of his Mother. He has left his paper and slides here so his address will be read, and the slides shown.

I take great pleasure in introducing to you the Chairman of the evening, Professor G. F. Blessing of Swarthmore College. (Applause)

THE CHAIRMAN: Industry is composed of four primary factors—materials, machines, money and men. The old line technical engineer confined his activities and served industry through his knowledge of the first two factors—materials and machines. It is only recently that the engineer has considered the last two factors—money and men, as coming within his province. Now, however, he realizes that these two are often the controlling factors in an industrial enterprise. The program of the evening considers these last two factors—money and men.

The business engineer is a product of our present system of industry. The first speaker on the program is in the truest sense a business engineer, having been educated as an engineer and having practiced the profession before he took up the matter of finance as a specialty. The first paper of the evening will be "Financing for Stability," the speaker, Mr. F. C. Schwedtman, Vice President of the National City Bank of New York. (Applause)

MR. SCHWEDTMAN: If I had not served an apprenticeship in industry for many years, I might be afflicted by a disease that is prevalent now the world over and which is probably not recognized as much as we should recognize it. It is probably the basis of most of our ills today. I didn't realize it until someone told me the other day that we were all really suffering from the "I" disease. I didn't catch the meaning immediately and he said, "I don't mean e-y-e, I mean the capital 'I' ". I believe if we all had a little less "I"—if we thought a little less of ourselves and if we had a little less selfishness, I think we would have a cure for most of our ills, especially our industrial ills. I thought that when the Chairman introduced me I felt a little touch of the "I" disease getting over me, but I am sure it will not be of long duration.

I would very much rather talk upon the human element of industry because try as you will, you may become interested in almost all features, even a financial feature in modern industry, but there is none of them that is half as interesting as the human element and the human element in industry follows us in a big bank as it does in a big factory—there isn't much difference between the two, because it deals with the problem of the employer and employee and the public, and that, to my mind, is the greatest of all problems in modern economics—not only modern industry.

I think this organization is to be congratulated upon dealing with that important phase and that it pays to deal with such a phase is clearly demonstrated by the attendance here tonight. I remember in the early meetings of this organization, there were hardly enough people to make them worth while, and when tonight I look into these hundreds of faces of interesting and interested people, I certainly feel that this organization in a very short time will not only take its place among the important engineering organizations but will be far more important than either the mechanical, civil or electrical, or any other branch of engineering.

"FINANCING FOR INDUSTRIAL STABILITY"

F. C. SCHWEDTMAN

Vice President National City Bank

New York City

It is upon your committee rather than upon myself that the responsibility for the selection of the title of my talk really rests. Industrial engineers are expected to be experts in stabilizing nearly all phases of life and existence, but I hope that in discussing the financial phase I may suggest a few thoughts for discussion.

The positions in economic life of the industrial engineer and of the banker are similar. Both are primarily advisors of others and they constitute, therefore, secondary agencies for the application of sound principles in industry and commerce. The large majority of industrial engineers do not control commercial and industrial institutions; they are the expert advisors of the owners. They are the agency for gathering and distributing the latest and best accumulation of wisdom upon scientific management, production, salesmanship, etc. Similarly the majority of the bankers of our country are not the owners of the money they are handling; but they are the experts whose advice and action in accumulating and in distributing the money of their customers have a vital bearing upon the economic welfare of the country. It may be well to bear in mind in considering the international field which must be financially stabilized that different nations have had different ideas and policies in connection with their banking systems. In some nations banks have been the controlling factors of commerce and industry; in other nations banks have been purely engaged in accumulating and lending the funds of their customers to responsible borrowers. There is a fundamental difference. The first system means long time investments with accompanying chances of heavy gain or loss, the second system means short time loans to reliable customers for short turn over, a safe loan at a low interest rate. The national system of our country comes under the second description. Time and again the question is asked by men well informed in other matters; why do not the banks make international loans to stabilize exchange? The American banks tying up its own funds in long time loans would not be unlike the foundryman who melts up his foundry tools to supply castings. Neither the banker nor the foundryman would have anything left to work with. American bankers can place international loans only to the extent of the ability and willingness of the American public to invest in such loans. I need hardly state that the suggestion of fixing exchange rates which appears here and there has no basis of fact. It is imagination pure and simple. Exchange rates like other economic values are based on supply and demand and until we find a way of turning trade balances, exchange rates on foreign currencies are bound to remain unfavorable.

Economically we are Intertwined with the World

The war is over, but its economic consequences remain. Irrespective of our wishes, our own economic prosperity is intertwined with that of the world. We are heavy creditors, and we are, in consequence, much interested in the welfare of those who are indebted to us. If Congress authorizes the funding of the interest on the loans to our allies, the amount owing to us on government account alone will be in excess of $9,000,000,000. But this is only a part of our total claim. Our heavy export balances outstrip not only the recorded loans that we have made on private account to Europe, but also the repurchase of American securities that were held abroad. Consequently, it must be concluded that American exporters have extended millions in credit to foreign buyers which sums are being carried abroad in terms of foreign money. The decline in the foreign exchanges has induced many holding such foreign funds to await more favorable rates before trying to dispose of them in order to realize dollars at home. Furthermore there is conclusive evidence available that many millions of dollars have been put into foreign currencies by Americans purely as a speculation. The credits so carried and the foreign funds so purchased represent claims that we expect some day to be paid.

The world's financial balance is so onesided that some thoughtful and capable economists have put forward the suggestion of cancelling part or all of Europe's debt to us. Personally I believe this would not be wise especially in view of the present over-expansion of credit at home. At best, however, it will take many years before Europe can hope to pay and then only to the extent that she can send her exports here. In other words we must buy from Europe. I am well aware that most American industrial engineers, just as in the case with many manufacturers, look upon all importation as an evil. If it is, it is certainly a necessary evil. Most of us believe that we can have no prosperity at home without a foreign trade balance in our favor but we cannot hope to have the conditions of the last few years continue which allowed us to export almost anything we had to sell to Europe and at extraordinary prices. In the future we must buy from Europe in order to supply the money Europe needs to buy from us. You know as I do that under normal conditions Europe can produce some of the goods we need at a lower cost price than we can, and that on the other hand we have reason to expect that we can produce something to meet Europe's need at a lower cost than her own. Among these latter products are raw materials, cotton, grain, meats, oil and metals. But this is not all.

Need of Steady Absorption of Product

The business genius of America has shown itself chiefly along the lines of large-scale, standardized production. Automobiles, agricultural implements, typewriters, sewing machines, etc., come to mind as some of the typical American manufacturers contributed to world trade. The success of large-scale production depends, however, upon steady absorption of output. This in turn rests upon the existence of secure and certain markets. The home market alone will not suffice for this purpose. Its powers of absorption are not sufficiently extensive. Despite our huge agricultural domain it is stated that 40% of the output of the International Harvester Company must be disposed of abroad. Any great expansion of American industry in the future, therefore, would seem to be predicated upon a corresponding development of our foreign trade. This implies the existence of a heavy buying power in foreign markets. Bearing these considerations in mind, who would say that economic stability in Europe is not of great material consequence to us in America?

What, however, does this situation demand of us? The answer to this question requires a certain amount of analysis. The outstanding characteristic of the world's economic life at the present time is its relative exhaustion. Modern warfare is terribly destructive of wealth as well of life. So great are its demands that practically all the activities of a nation waging war must be directed into that channel. The recent war thus made ravenous inroads into the economic life of the belligerents, especially those in Europe. Not only was there direct destruction of wealth incidental to hostilities but, owing to the necessity of concentrating all efforts on supplying the forces in the field, machinery, buildings and equipment could not be adequately replaced, and stocks of finished goods were used up without possibility of the usual replenishment. As buildings, machinery, equipment and the great stocks of material of all kinds make up what we know as the world's supply of capital, the economic exhaustion caused by the war has been an exhaustion of the capital fund.

Our Capital Fund Must Be Augmented

It is of first importance that this capital fund be now speedily replenished and augmented. Our economic system is one based upon specialization or division of labor in which natural forces like steam and electricity are extensively relied upon as aids to wealth production. But there is one fact in connection with such a system which is too often overlooked by those who are concerned with the reformation of the evils of inequitable distribution of wealth, and that is the circumstance of division of labor and machine industry require as a **sine qua non** an adequate supply of capital. The stream of wealth production from the logger to the purchaser of furniture can maintain its flow only with adequate capital investment all along the line. The logs must be sold to the sawmill, the lumber to the lumber merchant and then to the furniture manufacturer, the furniture to the wholesaler and so on to the final consumer. The finished product of one industry is the raw material of the next, but every purchase of such raw material represents somebody's investment of capital, and the whole scheme would break down if at each stage adequate supplies of such capital funds were not forthcoming. In like manner the factories, machinery and other equipment needed in each branch of industry also represent somebody's capital invested, and the replacement of all such equipment, as well as its enlargement, depend vitally upon somebody's willingness to tie up investment funds for these specific purposes. It is this physical dependence of modern productive methods on capital, apart from any question of the ownership of the capital, that justifies the designation of our present system as a "capitalistic" system.

It is generally agreed that it is only through saving that the capital for production can be made available. Fundamentally this is merely a question of directing the forces of production. If I spend $2500 for a sedan automobile, I have "spent" the money in the ordinary sense. But if the $2500 are put in a truck for my business, we think of the money as being saved and invested. The difference between the two is thus simply one of directing productive effort. In the one case effort is directed toward the production of wealth for consumption; in the other case it goes toward wealth to be used in the further production of wealth.

Europe Needs Capital

New capital is Europe's greatest need. War for the nation is like riotous living for the individual. Useful resources are diverted from productive to destructive ends. It is to get its system started again that Europe needs capital, needs it to stock up food, to supply raw material and to restore its wornout equipment. Some of its war equipment may be available for peace, but most of it will have to be scrapped. When production has once gotten under way Europe will be in a position to direct a part of its effort toward capital maintenance but much of the new capital necessary to start the process must be looked for elsewhere.

It is to the United States that Europe is now looking for help. In view of our efforts during the war there is no question about our fundamental ability to be helpful. But there is a serious question as to our willingness to make the implied sacrifices and of our ability to construct the requisite machinery to collect the capital and to apportion it among the European countries to the greatest advantage after it has been collected. Our willingness to act is primarily due to our lack of confidence in European conditions. We have a well grounded fear that even greater chaos is in store for many nations. There is no doubt that this danger is greatest at this very time and that another three months of law and order preserved will materially reduce the danger of a general European conflagration. There is, however, another reason at this time for our hesitating to help finance Europe. This is our own business situation which is far from bright. By putting our own house in order first, we can be of greatest lasting help to Europe. Concerted action based upon a better general understanding of the whole situation and the relation of world progress to our own prosperity will aid our task.

A part of the task before us is to show the American people that the restoration of Europe is a matter of great importance to ourselves, and that such restoration is possible only insofar as we greatly restrict our own consumption and make available to Europe a large part of our savings. During the war individual consumption was restricted through taxation, through issues of bonds and through inflation of credit. What we paid in taxes and in bond-subscriptions we could not spend on ourselves. Moreover, as a result of soaring prices caused mainly by credit inflation, the money that remained to us to spend would buy only a portion of what it bought before. So in actual consumption we had to be satisfied with much less than we were accustomed to have.

We Should Curtail Consumption

At the present time, however, voluntary curtailment of consumption by each individual is the only feasible method of procedure. Further loans to Europe by the Government are pretty generally opposed. This opposition is based not only on political considerations but also on recognition of the fact that further governmental loans would imply renewed inflation here. The funds to be provided must come from a positive curtailment of expenditure by the individual, and by a release of funds so saved for investment abroad. As already indicated our banks can do very little. Their resources are in the main based on deposits subject to withdrawal on demand. Then, they must keep their assets in the most liquid condition possible. The Federal Reserve Act makes ineligible for rediscount, paper running longer than 90 days. Europe needs relatively long time investment credit, not short time commercial credit. Europe cannot restore her industry in ninety days. It is the investor who can forego the use of his funds for a period of from two to ten years or longer who must now step into the breach.

The initiative in appealing to the investor must be taken by the interested exporter whose profits are at stake, but machinery must be constructed to gather together adequate security in Europe to guarantee advances made here, and at the same time to distribute debentures, etc., among American investors. In view of the large need for funds in developing our own resources, and in view of our relative ignorance of and lack of interest on foreign investment, the task ahead of us is one of no mean dimensions. But the task must be essayed, and every thoughtful and studious American must contribute directly whatever he can, and he must assist indirectly by helping his compatriots understand the situation. The Edge Bill provides machinery under the supervision of the Federal Reserve Board. Some of the States have also enacted legislation to enable the formation under state charters of corporations whose main purpose is the financing of foreign undertakings. Voluminous and widespread purchase of the investment securities issued by such agencies offers the only sound and business-like method that contains any serious hope for the effective restoration of the European economic structure.

The foreign exchange situation, to which so much attention has been given is, after all, only a symptom of the underlying ailment. If all the gold in Europe were gathered together and were shipped to America only a portion of the outstanding indebtedness would be liquidated, and if nothing further were done the situation would in a short time, again become as desperate as it is now. We exchange goods **with**, and not **for**, gold. Hence, anything like continuous exchange stability means for all parties involved not only a sustained but practically also an equal production.

Efficient Production and Economical Consumption as Basis

Underlying the superficial financial aspects of our problem of stability is therefore the broader problem of efficient production and economical consumption. "More production and less consumption" means turning our look to the future and directing our productive forces toward the upbuilding of our capital equipment rather than toward the multiplication of goods for immediate consumption. But efficient production itself is now a world rather than an individual, a shop or, even, a national problem. Our tariff policy, our immigration laws, our enactments and practices in banking and other departments of our business life must now be re-formulated on a basis as broad as the world itself. Exclusive and narrow protectionism is today an anachronism. If only to let Europe pay us what she owes us we shall have to make it possible for her to send us more goods. Debts are ultimately paid, as exchanges are made, in **goods**. We use money only as the counter in the process.

Protection must hereafter be approached on the basis of actual needs in particular industries and not on the basis of a sweeping policy applying to industry as a whole. Exclusive banking and excessive restriction of immigration may become too costly to command continued support. While within our own boarders banking is highly competitive, from an international point of view we have the highest possible kind of protection, namely, positive exclusion. This may be wise, but we cannot simply assume that it is. But without dwelling further on individual aspects enough has been said to indicate the necessity of envisaging the economic situation of the world as a whole if we are to rear our own economic structure in the future on a stable and well-integrated foundation.

A further word must be said about our basic financial standard. The importance of maintaining the gold standard at home and abroad surely needs little emphasis to industrial engineers. Their creed is one which demands adaption of practice to sound standards of procedure. The gold standard has been evolved after centuries of trying experience. The judgment of the world supported it. Now, as a result of immediate pressure we hear talk of debasement and repudiation. No good can come from debasement or repudiation. The more quickly the world can reestablish its finances on a solid gold basis the more stable and secure its economic life will be.

Suggestions for Cooperation

So much for the general discussion! What now are the specific suggestions that can be formulated as a result of this discussion?

1. Cooperation with all forces working toward efficient production, toward thrift and toward elimination of personal, business and governmental waste and extravagance.

2. Cooperation with all forces working for a better understanding of the advantages and disadvantages of foreign investments, toward the end of obtaining sound and adequate security for investments abroad as well as distributing such investments broadly among the American people.

3. Cooperation in analyzing the needs and possibilities of our foreign trade with a view to establishing in what directions we can hope to sell and in what directions we ought to buy abroad.

4. Cooperation with all forces striving to maintain the soundness of the world's credit structure through restoration and preservation of the basic gold standard.

THE CHAIRMAN: You have heard Mr. Schwedtman's very thoughtful paper. It certainly is timely and I feel that it will become an important part of the literature of this Sociey.

Man engineering is the latest phase of engineering, and strange to say, the technical engineer has been very slow to realize the economic possibilities in studying the man as he would the machine. I don't mean to study the man as a machine, but to put the same thought on him that is put on the machine. We have all seen the bricklayer do a vaudeville stunt before he places the brick on the wall, but it remained for the writer of the next paper to point out that one and three-quarters motions could lay a brick as effectively as eighteen motions that the bricklayer was making use of, provided, of course, you are willing to go elsewhere for your vaudeville stunts.

Motion study has not always been popular, especially among working men and you can easily understand that because it is too much like treating a man like a machine intsead of treating him as a human being, but motion study naturally leads into fatigue elimination and that is probably the important feature of motion study.

The next paper that we have is on fatigue elimination—"Fatigue Study—The First Step in Better Industrial Relations" by Frank B. Gilbreth, President of Frank B. Gilbreth, Inc., Montclair, New Jersey. This paper will be read by Mr. Wallace, President of the Society.

FATIGUE STUDY

The First Step in Better Industrial Relations

FRANK B. GILBRETH and L. M. GILBRETH, Ph. D.

At the present stage of progress in Fatigue Elimination, the most important thing to be done is actually to install methods and devices that eliminate fatigue. In this way **alone** will all parties to industrial relations be able to judge of the value of such work, and as to the possible part that it can play in bettering industrial relations.

It is the aim of this paper to present, in the most practical way, suggestions for fatigue elimination. These consist of methods and devices that are actually in use, and that have proved their value.

This Society has put itself on record as favoring Fatigue Elimination, and as willing to DO SOMETHING. Here follows a list of the things that can be done **at once.**

First, join all those who are already engaged in or interested in such work, and thus use the results of their work, and gain all the benefits of co-operation.

Jot down in your Reminder File that the first Monday in December each year is Fatigue Elimination Day, and resolve to spend at least that one day in doing all that you can in the work. Let this slip come out, say, the fifteenth of November each year. If you have no Reminder File, make a note in your diary. (See Figure 1.)

Second, have some sort of a program of things that can be easily done on that day, such as:

A. Foremen's meetings, enlivened by showing lantern slides of the present, everyday condition of the plant, followed by a discussion of what can be done to make greater comfort and greater output, due to less fatigueing working conditions. Lantern slides can be made for very little expense, and the results will pay in dollars as well as in better industrial relations.

B. A talk by the doctor or nurse in charge of the factory hospital, or by some outside doctor or nurse, on proper lighting, heating, ventilating, eye strain, or any other topic of plant hygiene.

C. A talk by a representative of the Safety First Department, on the relation of fatigue to the reduction of accidents. The National Safety Council have recently come into line on this work with their entire splendid organization. This is most encouraging, for when we first approached them years ago, they could see no close connection between Safety First and the campaign to eliminate unnecessary fatigue.

D. A talk by a representative of an Accident Insurance Company. Such companies co-operate gladly not only on furnishing and receiving data on the influence of fatigue on the frequency of accidents, but also in the elimination of unnecessary fatigue.

E. A discussion of the relation of Fatigue Study to Motion Study, and a demonstration that any work done in the elimination of fatigue is a first step in helping every member of the organization, from the president of the company to the newest worker, think in terms of the sixteen subdivisions of a cycle of motions. This by-product alone will pay in dollars and cents for all necessary time and effort spent in the subject of fatigue elimination.

After the first Fatigue Elimination day, the program will profitably outline the progress made during the year that has passed, and the plans for the year that is to follow.

Interest in the subject grows. This is testified to by Professor Blessing of Swarthmore College, and by Professor Spooner, of the Polytechnic School of Engineering, London, who have been pioneers in interesting their students in fatigue elimination. Professor Spooner distributed to his students on December 1, 1919,—the Third Fatigue Elimination day,—a short outline of what the fatigue problem is, in the factory and also in the ordering of ones own daily program. He says, "But, quite apart from what the management of a works may do in such matters, every worker, by self examination and by observations, and by exercising his common sense, is capable of making some little improvement in his methods, leading to an increase of his output with less effort, and, however slight this may be, it becomes important in its cumulative effect." He calls, as in the two previous years, for essays from the Poly Engineers, these to be only a page in length, to be handed in December 8th, and the names of the most successful students to be announced.

Every part of this program is to be commended, and could be easily used in the industries,—the general outline of what is to be done, the field in group and individual activity, and the opportunity for everyone to compete in contributing to the work.

Besides joining those interested in the work by celebrating Fatigue Elimination Day, introduce work and rest chairs immediately into the plant where you are at work.

One does not have to spend more than a few minutes to realize that the fatigue of a worker can be lessened materially by some sort of a chance to sit down a part of the working day; and that many kinds of work can be done while sitting that are usually done in the most awkward and fatigueing posture. For samples of easily made chairs that will afford a chance to sit, and a comfortable posture, we refer to previous papers delivered before this Society, also to "Fatigue Study. A First Step in Motion Study.*

We also show here some "home made" chairs that cost very little and add a great deal to the comfort of the worker. (See Figure 2, 3, and 4.) These chairs are far from perfect as specimens of art. They make no pretense to beauty of design or finish. They serve merely to show what can be done quickly and inexpensively, while industry in general is waiting for the great chair manufacturers to make on a large scale and at a low price chairs and stools specially designed to eliminate all unnecessary fatigue, rather than to serve as a "perch". (See Figure 5.) Such perches are by no means a thing of the past. We quote from "Bulletin of the Women in Industry Service No. 4, June 28, 1919.

"The same complaint, lack of planning, was noticed when it came to seats. In one plant the seats were actually so unique as to be interesting. They showed ingenuity and variation—an old packing box 3 feet high for one dipper, a stool a little taller for the next, a chair without a back for the third, and a nail keg finishing up the line. No back rests were seen in this plant nor in many others; in fact only five factories supplied seats with backs and these not in all departments. In some plants the packers stand, while in others they sit on stools. One girl said she thought it 'would be nice if you could stand and sit.' This ideal would certainly seem easy of attainment, for in certain departments of some establishments all were seated, while in others all stood, and it would appear that it might easily be arranged for girls to sit when they choose while at work."

The "American Posture League," with Miss Jessie Bancroft at its head is doing wonderful and unappreciated work in arousing interest in chairs, clothing and everything that has to do with correct posture, and its effect on health, and is glad to co-operate with anyone who wants to better his equipment.

Conditions in the world today are so different from those of but a very few years ago that old standards for working must be revised. The great wastes resulting from the war must be replaced. Before the war there was talk everywhere regarding the possible monotony resulting from the standardizing of work, and the "deadening" and "dehumanizing" effects of such standardization. There were cries for the return of the "singing worker." This is now all changed, at least for our generation, and perhaps for a long time. From now on all who are able to work MUST WORK. Present conditions demand the highest possible output per worker, for in

*MacMillan Company, 64 Fifth Avenue, New York City.

no other way can there be produced enough for all. The working day must be full of hard work. This does not, however, mean over fatigue and real monotony, which consists of making the mind constantly make unimportant decisions. It means interesting work for everyone. It means chairs or stools for everyone, that will permit of alternate standing and sitting. The worker must be made to feel like singing, without the pay reducing motions of the actual singing, unless he gets rest and recreation from these. The worker must be taught how to make large outputs with fewest motions, in the correct posture, with such changes in posture as will give him least fatigue when quitting time comes. That is the real time for him to sing,—and especially will he sing on pay day!

After chairs, then, study work places, benches, tables and desks, and all devices and tools in use. We show some simple equipment, in order to suggest what can be done along these lines. (See Figures 6, 7, 8, 9, and 10.)

The question is often raised as to how high the work table or work bench should be, to be right for the worker from an anti-fatigue standpoint. The height varies in two ways, first, with the kind of work, and second with the height of the worker.

The height of the work bench is a height in relation to the height of the worker's elbow when standing erect. The height is best determined by the most skilled worker or foreman, while standing at the work himself, measuring from his elbows. The top of the table should then be located at the corresponding height below,—or in rare cases, above,—the elbows of the worker who is actually to work at the table.

We also suggest as an immediate necessity the making of a Fatigue Survey. Supplement this with charts (See Figure 11)showing the percentage of workers who have their chairs and work places and conditions actually tried out by the Motion Study engineer, or some one of the management during the month. Show the percentage in each department of workers who can alternately stand and sit during their work day. Find the percentage of foot rests. Make records of the different kinds of seats in chairs, and especially of the iron bottomed chairs. Find the percentage of those who sit back in their chairs during the work. Find the percentage of cushioned chairs. What chairs have the backs in the way of their occupants? What chairs have a sharp front edge that stops the circulation of the legs?

The cost of a Fatigue Survey varies according to how systematically it is undertaken. It is but a small sum per worker. It will pay for itself immediately, if it is made intelligently.

The number of factories having Motion Study Research Departments is growing yearly, and it will not be long, we hope, before it will be customary for them all to have equipment for eliminating and overcoming fatigue, as have our clients at the present time.

Those employers who have not yet arrived at that stage in their managerial development where they chart the output of their workers daily, do not realize the money they are losing by not having provided for the greatest fatigue elimination possible, with all equipment designed for most output because of least fatigue.

We wish in this paper to appreciate especially the co-operation we are receiving in Fatigue Elimiation work from England. Professor Bernard Muscio, of the University of Cambridge, in his new and masterly book "Lectures on Industrial Psychology"* has shown the fundamental relationship between fatigue elimination and progress, and the English press, led by such journals as "Engineering and Industrial Management" are bringing the subject of fatigue to the general attention of the people. Other countries abroad are also pushing the work, and we must bestir ourselves or we shall lose the leadership.

Especially, also, must we work to supply the energy of leaders whom we have lost by death in the last few months,—Mr. Henry L. Gantt, the great engineer and thinker along lines of Industrial Leadership, and, just recently, Dr. E. E. Southard, the great neurologist, and pioneer in his line to suggest the co-operation of psychiatry and industry. It is for us to see that the things they advocated are incorporated into leadership and industrial development,—to carry on!

The more we study industrial relations, the more we appreciate the necessity of building up co-operation between all elements in industry, thru common interests like fatigue elimination. The employment managers are showing the employers some facts today that are making them sit up and stop laughing. The employers are now realizing that the scientific selection and training of employees is indispensable in modern industry, and that these must be coupled with a definite and adequate plan of promotion**. Thru this realization, Labor Turnover has been reduced tremendously, for the employment managers showed the cost of labor turnover, and pointed out these remedies.

We must now demonstrate thru actual practical installations, that fatigue elimination also effects Labor Turnover. When the COSTS of fatigue are realized, there will be an instant effort on the part of employees and employers alike to make Fatigue Study a factor in higher wages, lower labor turnover, lower manufacturing costs, greater production, lower costs of living, more Happiness Minutes, and better Industrial Relations.

*London—Geo. Routledge & Sons Ltd. New York—E. P. Dutton & Co.
**See "Applied Motion Study", Page 187 MacMillan & Co., 64 Fifth Ave. New York.

AP-7

REMINDER

BASKET NO . USE BASKET NUMBER INSTEAD OF NAME FOR FEWEST POSSIBLE NOTIONS

OR NAME, MR Geo. C. Dent THIS IS TO REMIND YOU TO

Make arrangements for Fatigue Elimination Day - 1st Monday in December each year

SYMBOL

DATE TO COME OUT

YEAR	MON.	DAY	HOUR
191	yearly		
191	11	15	
191			

SEND THIS SLIP BACK TO REMINDER FILE TO COME OUT ON A LATER DATE IF YOU HAVE NOT ATTENDED TO THE WORK.
WHEN THIS HAS BEEN ATTENDED TO, REPORT TO
WHEN THIS HAS BEEN ATTENDED TO, SEND THIS SLIP TO 7 SIGN HERE.
4M-11-18

Fig. 1

Figure 2

This chair made entirely of wood except the upholstery has recently been used on a machine where the feet were in use on pedals controlling the machinery. The seat is much like a bicycle seat and the chair was used successfully where it was said that the work must be done standing only. It is adjustable in height and as to pitch of the seat.

The bicycle seat type of chair has not been properly appreciated as a special seat where usual types of chairs are difficult, and sometimes almost impossible to use.

Figure 3.

This shows a chair which is particularly comfortable on work that can be done alternately sitting and standing.

Figure 4.

This is a box stool 8x16x20 inches and upholstered on 3 sides. Owing to the differences in its dimensions, it is particularly well adapted to the use of assemblers and repairers of machinery, particularly where it is necessary for the workers to work at different heights and where they are obliged to get in under the machines. This stool was so successful that one old timer disapproved of it, and said it was so good he was "afraid the men would go to sleep on it."

Figure 5.

These are the kinds of ridiculous chairs that can be found in the better class of factories. These chairs are designed and made to sell purchasing agents who do not have to sit in them.

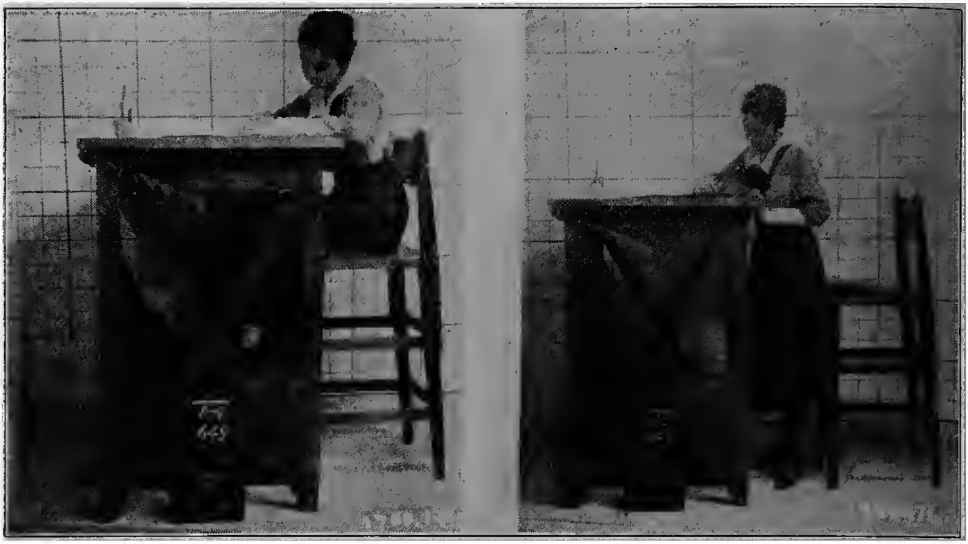
Figure 6.

There is no longer any excuse for requiring a sewing machine operator to hold the treadle down by continuously pushing her toes downward in a most fatigueing position. There are several ways for clamping the treadle down, that will release instantly by dropping the foot from the comfortable footrest immediately over the treadle.

Figures 7 and 8

One cause of a large amount of unnecessary fatigue in the factories is the kind of trucks used. Figures 17728 and 17730 hold the same amount, but 17728 is much quicker to unload and is much less fatigueing to load and unload.

The first cost of building trucks up in the air is small compared with the amount of fatigue saved.



Figures 9 and 10.

The Barney work table and chair.

This is an attempt to design a work place that will enable the worker to do work with least possible fatigue.

Courtesy of Remington Typewriter Company.

Figure 11.

This chart shows the seating heights of thirty six girls in one room of a large highly systemized factory.

Curve 1 shows the height of the girls' elbows from floor when standing.

Curve 2 shows the height of the top of the girls' head from the floor when standing.

Curve 3 shows the height of the girls' elbows from the floor when sitting in the chair provided for them.

Curve 4 shows the height of work bench above floor.

Curve 5 shows height of chair above floor.

Curve 6 shows height of foot rest above floor.

Curve 7 shows height of work above the floor.

* indicates height of seat of the chair itself. The distance from the points marked * to curve 5 shows the amount that the seat is raised by putting boards, boxes, or pillows on the seat of the chair.

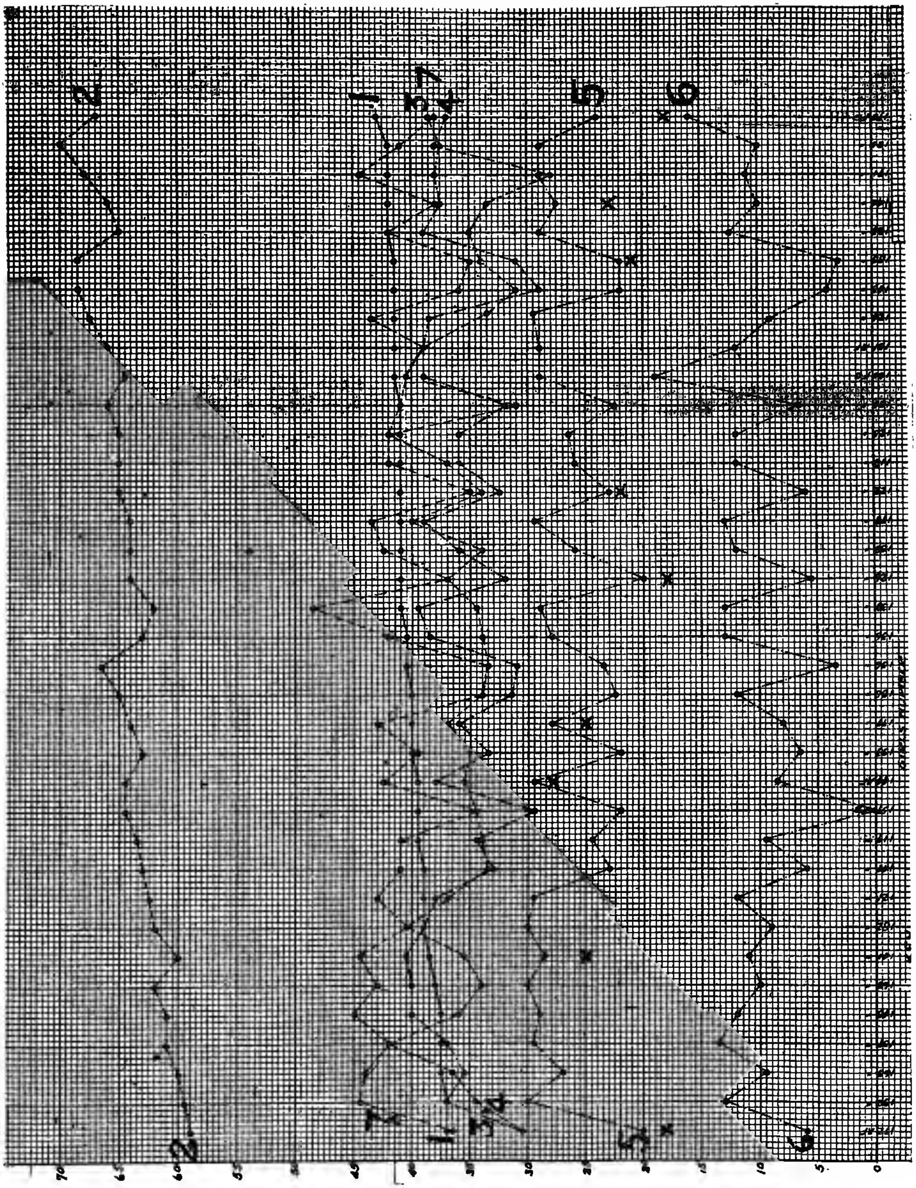


Figure 11

Figure 12.

A Home Reading Box in successful operation. A typical device for overcoming fatigue. First eliminate all unnecessary fatigue, then overcome such fatigue as is necessary.

DISCUSSION OF FRANK M. GILBRETH'S PAPER ON "FATIGUE"

H. T. DEALEY
Department of Educational Psychology,
University of Minnesota

The fact that attention is now called to the specific problem of "Fatigue" is a psychological sympton of future progress in the study and elimination of fatigue. The fact that the paper under discussion describes "methods and devices that are actually in use and that have proved their value" indicates the existence of a "pragmatic sanction" resultant from scientific research.

Study of fatigue involves discussion of a group of significant problems all of which directly pertain to better vocational adjustments, for instance, discussion of mental and physical health, dress, posture, "safety-first," motion study and scientific standardization of vocational processes. Recognition of the need of Fatigue Elimination and adequate study of pertinent problems must result in the amelioration of many conditions which heretofore have hampered workers in industry.

Broadly speaking, elimination of fatigue implies not only that the worker must be **fit** but also that surrounding conditions and necessary tools must be **fitted** to meet the requirements of the individual worker and the work he is doing. In the light of this interpretation it is important to note certain facts.

1. Fortunately the human organism is so constructed that it may form countless habits. The essential characteristic of "habit" is its automatism. This accounts for the ease with which habitual forms of behaviour are performed—such as walking, eating and reading. Standardization of the different processes in industry implies the formation of specific habits constructed **economically** e. g. thru **motion study,** etc., so that the employee works with the minimum of organic tension and hence with least fatigue.

2. The primary characteristic of human beings is activity, hence the maintenance of any one position during the working day increases fatigue unnecessarily. Variation in position is essential. A valuable proof of this statement is shown in the introduction of "work and rest chairs." They relieve the worker; he can vary his position, yet at the same time continue to maintain qualitative and quantitative standards.

3. Gilbreth rightly emphasizes the importance of proper adjustment with respect to **height** of tables, benches and chairs. A pianist is uneasy and distracted if his chair is not correctly adjusted. The expert typist wants his machine at a certain height in order to attain maximum accuracy and speed. Strange, but it has been discovered that children in school like blackboard work better if the board is low enough so they can reach it without undue stretching. It is the accumulation of petty annoyances brought about by poor conditions and tools which acts against human satisfaction and hence precipitates fatigue.

4. The paper under discussion stresses problems of the employment manager. Owing to the relatively few psychological applications which have been made in the field of vocational guidance it is no easy matter to select workmen and to effect adequate vocational adjustment. We know, however, that an individual who is beyond his depth in the job and can't swim, or one who is simply paddling around when he might be swimming, is going to be dissatisfied. In other words, his emotional reactions will not be conductive to uniform success in the work; the work he actually does will require more effort than should be expended; it will produce more fatigue than is necessary.

It is in this particular field that the psychologist has much to offer. Essentially thru the activities of well-known psychologists working with the Council of National Research there is developing at present a nationwide movement to incorporate into school procedure a system of standardized psychological tests. These tests aim to show the relative capacities of individuals, **beginning with the first grade.** Psychological analysis of children during the first four or five years in school, supplemented by proper physiological and educational measurements, will give an evaluation of human nature such as has never before been experienced and which will enable schools to predict what vocational level each child may be expected to reach.

Scientific engineers and educational psychologists agree in their interpretation of "measurement." The two fields in which they work overlap and are substantially related. **Measurement is fundamental,** in that it can reveal much waste of time and energy and can show what capacity an individual possesses to apply time and energy to the best advantage.

In short, from the psychological standpoint, the worker is a human mechanism characterized as an interrelated mass of instincts, emotions and habits. According to an individual's natural capacity (1) to form habits which pertain to vocational and all other activities which make for social adjustment and (2) to make provision for adequate emotional outlets, in this measure he will "make good."

Unnecessary suppression of the natural activities of the human mechanism thru conditions so ably suggested or described by Gilbreth and lack of understanding of the limitations of the potential capacity of individuals as related to vocational fitness, make the constructive suggestions of the paper doubly significant. In my opinion "Fatigue Elimination" rightly deserves an important place in the campaign for increased industrial output and increased human happiness.

Discussion by

W. R. DUNTON, JR.

President, Society for the Promotion of Occupational Theraphy

I feel that everyone of us owes a considerable debt of gratitude to Mr. Gilbreth for the research which he has made upon fatigue, but that it is necessary to have a greater number of individuals who are preaching this doctrine, and spreading the knowledge of how valuable a conservation measure is fatigue elimination. He has shown that not only in our factories, where returns can be measured in dollars and cents, but also in the world in general, in our daily lives, where a financial measure is less easy, that fatigue elimination will add much to the prolongation of human life, to an ability to accomplish more in a given time.

Probably more persons know the value of fatigue elimination than practice it, and I trust that at an early date courses of lectures will be given in all of our institutions of learning, given not only to those who are pursuing vocational training, but to children in the grammar grades, upon how much may be accomplished by motion study. A knowledge of it should certainly be included as a part of physical hygiene, and also it is an extremely important feature of mental hygiene.

I feel that my contribution to this discussion can do little more than emphasize the importance of motion study with its consequent fatigue elimination as a factor in reducing mental fatigue. Considerable work has already been done in the study of mental fatigue, and it has been possible to demonstrate scientifically what is known practically to many manufacturers over a considerable period, that a man's output is reduced more rapidly during mental fatigue than during physical. It is, of course, practically impossible to dissociate these two forms, but it is a well-known fact that by mental stimulus, mental fatigue can be overcome and the output increased, even though there may be no rest periods in which to recover from physical fatigue.

As yet, however, we have no simple and easily applied test to measure the degree of mental fatigue, but I believe that the future will bring them forth and a greater recognition will come to this important subject.

Discussion by
FRANK E. SANBORN
Oteen, N. C.

I am over 6 ft. tall, weigh 170 lbs. I sit in an ordinary chair 18 inches from floor and then I stand up. In doing so, I calculate that I raise 140 lbs. thru a distance of about 2 ft. In other words I do 280 ft.lbs. of work or thereabouts. In getting up from my office chair to receive a visitor, to get a book or paper across the room, or to attend to any of the numerous calls of my work, I find that after 100 of these downsittings and uprisings, the latter alone have then used up 14000ft.lb. of my energy. This does not take into account the energy expended in downsitting for I am not a reversible energy machine.

So I find that I am not apt to get up unless the need is urgent, to delay going on a trip for a paper or book until I can combine two trips in one. This is the tendency and it does not produce the best results.

Therefore I raise my desk to the elbow height and improvise a stool as a temporary arrangement pending a better one. Now I easily slide or go from a sitting or standing position. The energy required I calculate roughly to be about 14 ft.lbs. or 1/10 as much as before. I find I am more likely, barring the previous bad habit, to go for needed things, because the effort required in starting movements is so much less. I also work at my desk standing or sitting and find the change in position pleasurable.

I feel that a scientific arrangement of seats is one which produces less unnecessary fatigue. Why do all furniture makers make seats of chairs, most ordinary chairs, at the same height? Of course it is uniform production. But oh! for the man who will have the courage to furnish a set of chairs of varying or variable heights. I go a-calling and I draw a chair for results like figure 1.

Fig. 1 Fig. 2 Fig. 3

While my wife is probably more comfortable as in figure 2, but why not have it possible to have chairs to fit, see figure 3.

Fatigue is receiving much more attention and rightly so. It would seem that a well regulated fatigue, such as should occur in the best of fatigue families, should run as in figure 4, shown by energy curve.

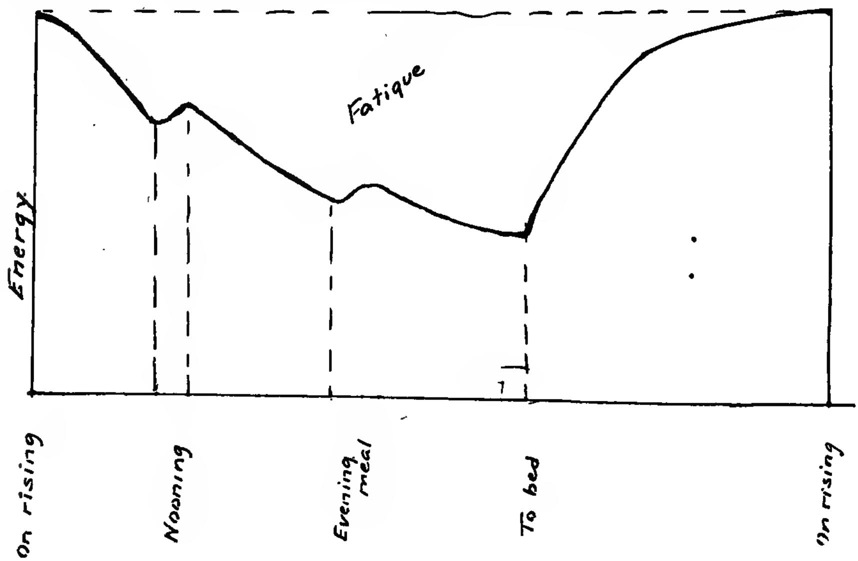


Fig. 4

The curve is only qualitative and no attempt is made to show exact quantities.

If a man during the night acquires the energy lost the previous day, then he could go on daily doing his task. We could assume that he was not overworked. But it seems fair to assume that on rising the second day he did not quite reach his energy point of the morning previous, and so on for a week. Then by Sunday he would need a day of rest or such recreation as to resore his energy to his standard Monday morning maximum.

Unfortunately, for our beautiful standard, a priori curve, the results of fatigue tests would make lines go across it at all angles. Some would fit fairly well, others vary widely. Man is not just an energy machine. His habits, likes, tastes, use of leisure time, sicknesses, worries, family troubles, anticipations and hopes, all influence energy and alter the curve.

Then too, has the best way of measuring fatigue or remaining energy yet been determined? Is it known that the number of movements of a finger raising a weight is a true measure of remaining energy? The finger may have been resting all day and none of its stored up energy used at all.

It would seem as if the stored energy in the body were akin to that of a storage battery; also as if a primary battery action took place. In a celebrated primary battery for getting electrical energy direct from coal, the removal of the ash and impurities formed a commercially insurmountable problem; so the "Fatigue products" in the body, whatever and whereever they are, need to be removed.

A person may be very much fatigued, yet under sufficient stimulus will do things that seem impossible, apparently drawing upon the "storage battery" energy of the body. The result is usually an excessive fatigue from which a recovery occurs after a long rest with proper food.

It is this stimulus, calling in play reserve power, second wind, etc., which causes some of the fatigue curves, plotted from work done, to vary widely. So there should be some method devised of measuring what I have called "storage battery" energy in the body which method should be independent of the person's volition or should take him in a passive state.

Discussion by

COLONEL O. O. ELLIS

John Hopkins University, Baltimore, Md.

Is the first thing to be done "actually to install methods and devices that eliminate fatigue?" It has been my observation that the first thing to do is to convince the people for whom these appliances are intended, of the necessity for them. Get their support. Hundreds of thousands of dollars of such equipment is installed each year and never used. This is especially true of the largest plant in the United States—The Army.

If this criticism is sound, then this entire paper should be re-written. The first step is to inaugurate a campaign or plan of education in the factories. If I were in charge of a big plant, before installing many fatigue eliminating appliances, I would first cast about for some plan of proving to my workmen that these appliances are desirable. A plant equipped fifty years ahead of the times, full of workmen a hundred years behind the times; would not be profitable. (Note: Motion picture work in the Army.) Consequently the question is "how can I educate my men up to a point where they will see the need of and will request these fatigue eliminating appliances.

I would suggest the article take up the way some efficient factory successfully met the situation, or recommend a way to meet the situation.

I recommend this way. Appoint committee consisting of the men who are to use each fatigue eliminating device. Have each committee recommend and support each device installed. Get behind it. Educate and get their co-workers educated and behind it. If an intelligent worker cannot see the advantage of a new device, it will probably be a poor investment to equip a plant with it, irrespective of its value. The proof of the pudding is in the eating. Likewise the proof of a new device is the using of it. A few changes or new devices create interest, a large number of changes or new devices often create hostility.

The same thing holds true of installing better methods. The worker must be convinced that the elimination of lost motion does two things, namely:

1. Eliminates unnecessary fatigue.
2. Cause him, by the interest aroused, to use his brain or sets him to thinking. This latter result is as important as the first in this age where men become so mechanical and their brains consequently solidify or atrophy. One is an offspring of the other.

I have often thought that there should be an unseen organization in each plant (like an unseen and unknown detective system in an army) to present new ideas to workers; to work to keep them loyal; to look after their morale; to swing plant opinion, etc. Such an organization, if properly used, would be a mighty factor in successfully introducing Fatigue Eliminating devices, combating I. W. W. agitation and the like. If the bad organize, the good should do likewise or expect to lose out.

Discussion by

GRACE E. BIRD, PH. D.

Professor of Educational Psychology, Rhode Island State College

The prevention of fatigue is more essential than its cure. The first element of such prevention consists in the subordination of distractions, thru control of the environment. One of the strongest distractions is bodily discomfort. Nothing more instinctively and insistently demands attention. A tight shoe may make one utterly oblivous of the most inspiring discourse. Instinctive attention of this character is controllable only thru strenuous effort, thus shifting energy from the work in hand to the distraction.

This divided attention occasions a conflict between the instinctive attention demanded by bodily discomfort and the acquired attention directed toward the work to be performed. By this means the nervous system is so taxed as to generate in the nerve cell a poison which destroys temporarily the nutritive element of the cell. The reaction of this poison we call fatigue. The result is the mental and bodily discomfort recognized as weariness, accompanied by inertia and weakened uncertain action of the muscles, occasioning motions too small for accuracy.

One of the most serious distractions causing bodily discomfort is involved in the worker's working environment, which in the interests of efficiency must be controlled. As in the school so in the office or industrial plant where rest or work proceeds while the worker is in a seating posture, seats, benches, tables, etc., should be made to conform to the worker. It is desirable to protect the worker from being obliged to conform uncomfortably to the surroundings.

Seats should be low enough to permit the feet to rest squarely on the floor. Otherwise, especially in children, the thigh bone may be injured. According to Dr. Dresslar the height of the seat should be two-sevenths of the height of the sitter. A seat too low is as uncomfortable as one too high. Seats are more comfortable if hollowed out to fit the curve of the body. Burgerstein recommends a width of two-thirds the thigh length. The seat should be tilted slightly back to bring the body against the back rest, the back rest tipped to support the spine. A back too low, and fitted too closely against the lumbar region of the spine, may result in kidney disorder. When a table or desk is too far from the seat, the worker suffers the same discomfort as a person sitting at a soda fountain, on a revolving stool fastened to the floor, too far from the counter.

It is well also to have the top of the desk or table slant, so that material thereon may be as nearly at right angle as possible with the line of vision. This necessity is illustrated by the business man who, at the breakfast table, props his newspaper against the coffee pot, instead of laying the paper down flat. The nearer the slant to forty-five degrees the better the adaptation to vision. Just as in the schools, adjustable, movable furniture is found to be the most desirable, so in certain departments of industry it permits shifting, to escape irritating sunlight, drafts, etc., which if rendered indirect may be beneficial to the worker.

Another important factor of bodily discomfort is involved in certain lighting systems. **Lighting from east or west windows is better than lighting from north or the south.** In the northern states, the glass area should not be less than one-fourth the floor space. In the far South, one-sixth would suffice. If the sky line is high, more window space is necessary. Windows should reach within six inches of the ceiling. One half of the sunlight is said to come thru the upper third of the glass. It is well, therefore, to remove every obstruction from the upper six inches of the window. It is best to have the lower part of the window about three and a half feet from the floor. Light entering below the level of the eye causes irritation, by over-stimulating the retina.

"Saw-tooth" lighting is good where fine handiwork is being done, because with it there are no disturbing shadows, and all parts of the room are equally lighted. According to this system, the roof is made in lengthwise sections, each section shaped like a saw-tooth, with one side slanting and the other vertical. The vertical side is made of glass. In most overhead lighting, however, there is the objectionable feeling of being confined within four walls, without being able to see outside.

In the case of artificial lighting, direct rays of light should be prevented from entering the eye. Everybody has suffered from this condition at public gatherings where clusters of lights are suspended above the speaker's head. Another cause of eye strain is flickering light. This is illustrated by trying to read by an open fire. Over-illumination also is injurious. Shadows on the work are distracting. The eye is freed from the distraction of outside stimuli if there is a strong light within a narrow area, leaving the rest of the room in shadow. Within the attention-area, however, sharp contrasts should be avoided. Any bright object on the edge of the field of vision may stimulate the eye and cause uneasiness. Even polished brass trimmings and ornaments may be distracting.

Semi-indirect lighting avoids the disadvantages of both direct and indirect lighting. In direct lighting, rays of light are thrown directly upon the object to be illuminated. In indirect lighting, the light is thrown upon a highly-reflecting surface which diffuses it thruout the room. Indirect lighting prevents direct rays from striking the eye; but in offices where it has been installed, a demand has arisen for lamps, because the absence of shadows has been found to be so unnatural as to cause discomfort to the eye.

Another matter of importance for the worker is the consideration of window shades and color schemes. To please the eye, and at the same time afford sufficient light for adequate illumination, light sage color has been found the most satisfactory. Unless shades are wider than the window, breezes may cause them to stir, and permit streaks of sunlight to appear at the sides, thereby causing annoyance. The adjustable shade of which the roller can be fastened at any point of the casing by a simple mechanism, permitting the shade to be raised or lowered so as to cover any desired portion of the glass, is perhaps the most satisfactory. Blinds, both inner and outer, cut off the breezes and admit bars of sunlight which may be irritating.

A more or less injurious distraction is occasioned by defective ventilating and heating. According to the experiments of Leonard Hill and James Alexander Miller of the New York State Ventilating Commission, over-heat promotes congestion of the membranes of the nose, resulting in susceptibility to colds. The ideal temperature for sedentary workers is **65 to 70 degrees, depending upon the humidity.** The air should **be kept as clean as possible from particles of dust.** It should be kept moist, and in motion. Also constantly changing temperatures, if not too extreme, are found to stimulate energy. The New York Ventilation Commission found that where air is kept cool, moist, and in motion, carbon dioxide and other gases present seem to have no appreciable effect upon either physiological or psychological processes. The only important effect of foul air seems to be the lowering of appetite for food. To render the conditions of ventilating and heating ideal, the scientific planning of a heating and ventilating engineer is an economic necessity.

It is a well-known fact that continuous hard work hardens the body to fatigue effects but individual limits should be carefully guarded. Otherwise the results will be wasteful. **One of the best means of offsetting fatigue is thru interested concentration.** It is said that at an ordinary dancing party, an individual who dances every dance has traversed more than ten miles. Yet real fatigue from such exertion is negligible, even among individuals who usually grow weary at the end of a one-mile tramp.

Fatigue which is the result of divided attention is wasteful, because it decreases speed and accuracy. Also it is a frequent cause of accidents. If it is reduced to a minimum, more contentment is experienced, and this, as we all know, conduces to steadier application, more stability of purpose, and more loyalty to the management in protecting and preserving property. To control fatiguing distractions a careful control of the environment is necessary.

The principles of mental hygiene thus far enumerated are suggested as a fruitful field of investigation in the Fatigue Survey advocated by Mr. Gilbreth.

THE CHAIRMAN: The next paper is "Training Foremen as Executives," by John Calder, Manager of Industrial Relations, Swift & Company, Chicago.

MR. CALDER: I feel highly complimented by the trouble you have taken to make it possible for me to address you this evening. Industrial engineers have not been permitted to do very much to the locomotives and our railroads for a year or two have not been functioning properly, and that is the reason why in coming to address you I was five hours late.

"TRAINING FOREMEN AS EXECUTIVES"

JOHN CALDER

Manager Industrial Relations, Swift & Company, Chicago

The term Foreman in this address is a general one, covering industrial team-leaders, employers, department heads, and foremen in industry; the major and minor executives of our plants and offices; the commissioned and non-commissioned officers in the industrial trenches, who must go to it and lead their workers every time they "go over the top."

First of all, let us review that area in which, and the material on which, the foreman has to operate with his qualities.

We hear much today about Industrial Democracy. What is "Industrial Democracy?" The phrase has, unfortunately, been virtually copyrighted; it is being conjured with, and, just as happened with the older slogans, "Scientific Management" and "Efficiency," it is being identified with packages having a certain label. Now this is somewhat unfortunate, but it is almost inevitable, for it is just the thing that the initative but unthinking employer is always ready to go out and buy when it is the fashion to do so, but about which he is not prepared to take any personal trouble. Now, I have to tell you that you can't buy "Industrial Democracy;" and if you try to do so, I want to warn you that you can't "wish" it upon your workers with any degree of success.

Industrial Democracy is not a plan, a condition, or a theory. It is an aspiration for self-government, for a spirit of comradeship and good will, and the form it takes is unimportant, provided it functions effectively in each particular instance. Various forms of it which ought to succeed, theoretically, fail, more or less because they are not the genuine desire of either employer or employe. They are condescensions from the one side and impositions upon the other, and are tolerated as necessary evils by their bestowers and utilized grudgingly by their recipients.

What is the Industrial Situation?

It has been abundantly demonstrated that Modern Production Methods at their best—though calculated through system and equipment to increase individual and national well-being—will not of themselves produce industrial contentment. Economic friction, even in the best ordered industrial families, is the inevitable price we must pay for a democratic basis of existence. Yet the great majority of us are convinced that it is well worth the price, and we should not confuse the present regretable "lay-off," which labor is taking, with its enduring instincts.

In fact, we have no choice in the matter of democracy. It is quite useless, in our day, to fence off any large portion of human activities and interests and declare that self-expression and self-determination may not operate there. Yet the plain facts of our industrial relations are so overlaid by various theories of reconstructing them and plans for exploiting them in the interests of minorities, that the public and many executives are bewildered by the multitude of counsel, and are asking for a precise answer to the question, "What does the Workman want?"

What does the Workman want?

It is the essence of sound public policy, of good management and foremanship, to be able to answer this question accurately, and to arrive at correct ideas as to the reasonableness of such wants and the possibility of meeting them in a way which will insure general prosperity, instead of weakly yielding to force from either side, or to political pressure on opportunist issues. What, in brief, does the workman want, and what must the foreman do in the premises?

Well, he wants more liberty in industry,—a share in the policies of the management, but only in so far as they touch his interests. He wants to be treated as an intelligent participator, not merely as the seller of a commodity. He wants to be consulted, to have some things explained to him in the first instance, not merely thrown at him or arbitrarily imposed upon him by bulletins, orders or decisions to which he is not a party.

What Should the Worker Get?

Is there anything unreasonable in that? "Oh," says the employer and executive still mentally in the last century, "can't we do anything we like with our own things and in our own plant?" The answer is that there is no law yet against trying it, but that, if we are wise in our generation, we won't attempt to play a lone hand with the interests of others.

"But," says someone, "what about the schemes to lay violent hands upon all capital, with no adequate care for skilled direction and no guarantee or responsibility for an adequate national surplus?" Let me remind you that these are not the workman's schemes, and, as I talk with him in the streets and on the cars, I find that he rarely adopts any one of the schemes of social reconstruction which are pressed upon his attention, when, rightly or wrongly, he is feeling riled: Schemes which are sometimes falsely put forward by those who are not workmen, as the specific demand of the laborer.

What is the Social Issue?

The real labor problem, as it now presents itself to the people of the United States, is this: Can the Nation's industries be so organized and administered as to bring to the service of industry the well tested principles and ideals of our political democracy, without over-turning the foundations of the Republic and without destroying the only guarantees on which order, liberty and progress can possibly rest?

I believe they can, and that employers, executives, foremen and workmen, completely informed, energized, sympathetic and keenly desirous of getting at the truth, can cooperate for an adequate national surplus, with as much harmony as is consistent with the healthy discontent with "things as they are," which is the genius of the American people. And that people is just about ready to serve notice on all whom it concerns,—Labor, Labor Leaders, Employers, Legislators, and President,—that it has just one great reservation, viz., **the right to make its own mistakes.**

A highly esteemed captain of industry recently announced that he knew what was best for his workmen, and that he intended they should be so guided. But **they** also reserve the right to make their own mistakes, and it is useless, in our day, for employers, however powerful and wise, to aim at and plan for a quite docile organization of human units, as some have done.

Instead, American and alien alike should be encouraged in self-expression and generously aided to use their self-determination intelligently. "But surely **you** have a plan, a Plum Plan, or, perhaps a plumb-foolish plan," I am asked. No, I have no plan in such a sense; just a simple remedy, to be taken in the spirit of that Chinese proverb which says: "If you want to keep the town clean, let every man sweep before his own door."

What is the Remedy?

The remedy is quite old-fashioned and rather out-of-date. It is education: a slow but sure one, but capable, in these hustling days, of acceleration with several speeds. "Educate whom, and about what?" you ask. Educate the employer, the management, the foreman, the workman, the minor, the public, and industrial councils where they exist, in the art of co-operating for an adequate surplus; and we might even, in a sanguine moment, extend the endeavor to Congress.

"Well, well," says someone, "has your mountain of premise brought forth such a ridiculous mouse of conclusion?" It has. But **remember,** it was a ridiculous mouse which freed the netted lion of the fable.

Have we a program for **all** of these? Yes, but that is another story. Our concern here is with the **Foreman,** and we will devote the rest of the time to him and to the contribution his effective education will make to industrial progress and harmony.

The Foreman's Qualities and how to develop them.

There are twelve main qualities needed by our foremen and executives today, and they must be developed where weak, and consciously applied to their men individually. Two of the qualities deal with trade skill and knowledge of production methods. They would not be foremen if they did not have the first in some satisfactory degree, and we will not dwell upon the second at this time.

The remaining qualities are ten in number: Physique, Energy, Thoroughness, Observation, Concentration, Judgment, Tact, Control, Fairness, Loyalty. We want to expand and illustrate in numerous ways these ten ideas to our foremen; and when they get to reading and studying the texts detailing these things, they will come somewhere near finding out what they have to do to improve themselves and their men.

Some professional engineers, anxious to get down to technical detail without delay, are inclined to pooh-pooh this preliminary educational canter in the essential qualities of good supervisory men, but this is a mistake. The future of your reputation, and the fortunes of much good advice and good practice lies ultimately in the hands of the man next the man who delivers the goods, namely, the Foreman. And when you have done a good job from your point of view and taken your fee, much depends upon the grade of intelligence which cusses or discusses you with the workmen for many days thereafter. Surely, it greatly concerns you, gentlemen, yet how seldom do you attempt to capture suffrage of the foreman, and how often do you use the bludgeon of delegated temporary authority from the directors' room! The failure of industrial counsel has sometimes been due to neglect of and sometimes expressed contempt for the foremen, in whose hands the fate of his efforts ultimately rested.

How, then, can we teach foremen and executives to cultivate good judgment? In other words, how can they become wise? Well, I know just three ways of being wise, namely, Thinking, Imitation, and Experience. Thinking is the finest way, but we cannot all solve our problems solely in that way, though the few men who do so are paid in five and even six figure salaries, and are carefully watched to see that nobody steals them. Imitation is the easy, lazy way. We must not allow ourselves to become lazy executives, copying all our ideas and ways from others. A good many troubles will come up with our work, which cannot be adjusted by imitating anything else that we have seen or heard of.

Again, if we go wholly by our experience, that is the most difficult way of all, for we are limiting ourselves severely, as the so-called practical men, with a big "P", do. To be wise in the right way, we and our foremen have to get the facts correctly, through observation, thoroughness, concentration, and through scientific methods, not by guessing at them. Then we add to these our own experience and what we know other people have done, that is relevant, and then put them all into our thinking machine for a decision of our very own. It is important that we bring these mental processes clearly before our foremen, and we will find them immensely interested, if we do it in an attractive way.

Tell the foreman the story of Ramsey and Argon, of Watt and the Steam Engine, of Newton and Gravitation in Euclidean space. They will show great interest in the recital, and in the mental processes, and wonderful love of truth, which characterized these great men, but they will never tackle the subject except through such an introduction.

Out of it our men have developed an interest in Einstein, who has broadened our conception of time and space and has developed a new theory of space, arising out of the discovery of the pressure of light and the recent astronomical proof of the bending of light rays by gravitation. Theory is indispensable to progress, though we prove always by facts. It takes the truth, the whole truth, and nothing but the truth, and in the education of our foremen they must be fully convinced that in their plants nothing is ever really "settled" until it is settled right.

In some plants we visit, we know cases where workmen have a big grudge against their employers, simply on account of the "bullying" of some foremen or assistant foremen. Some executives and department heads are sore also and not able to concentrate fully on their tasks, because they are abused verbally and in other ways by men still higher. Government by fear and espionage is both despicable and futile. This is inexcusable folly. It kills all team-work, and it lies at the bottom of a surprising amount of executive soreness and labor unrest, which manifests itself usually in extravagant demands, often far removed from the actual causes. An employer is often misrepresented to his workers by his own foremen. We must also remember, in our team-work, that the bridge of words between us and the workers is frequently very weak, and that ideas often fail completely to get over. Much of our poor work is due to the fact that the workman does not understand his orders.

One factory I know of kept in its employ, to the wonder of people, a very stupid man, and the explanation given by the manager was that when he had a bulletin of instruction of general interest to issue, he always tried it out on this man, and when he was sure he understood it, he knew it was perfect. In trying to press this home, I once warned a large group of foremen and executives that the workman instinctively thinks of things he can touch and handle and not ideas; in the concrete, not in the abstract. Judge my chagrin when an old foreman of yard laborers said afterward: "You done fine, but you never said what proportions of cement, sand and gravel you would use in the concrete."

In any industry today, if we are going to make a big success, foremen and executives must split up into closely related groups, or we won't get any real co-operation or team-work. We must organize to restore personality in big business, and we can only do it through the foremen. I know such men are not like school boys, adolescents eating up information at night just because they like it. Some of the them are in the T. B. M. (Tired Business Men) class, not out for information after working hours and seeking too little of it during working hours. Well, they will lose that "tired feeling" completely if they adopt our Swift motto, "Make goods plentiful and men dear." It gives a new interest in life and in the job, and that is what our foremen and workmen need above everything today.

I saw a dog smell the third rail once. He was full of information in a moment, but he was a dead dog; he died of intensive education, an overdose of fact. Such a fate will not befall any foreman or executive here, I am sure, but if he will concentrate just three or four hours a week on these subjects, he will have a thorough working knowledge of what industrial relations mean, how industry is run, and what are the universal production rules and the brainy things which must be done about people and things, no matter what the products of the business are. Such a clear comprehension is much more important than a knowledge of system detail, unrelieved by any perspective.

Twenty thousand foremen, in twenty-five states, five thousand of them with Swift & Company alone, are all thinking about the same things, studying the same books, asking the same questions, and getting the same benefits, as others may obtain if they organize to that end. Technical training will naturally follow, but it should never be mixed in with the fundamentals of organization and leadership in industry. The impatient employer and manager would like to ignore these, and get onto production details; but foremen should first be energized with the former, presented attractively, and then they will eagerly assimilate technical details pertaining to their own particular plant.

The ages of the people in these training classes range from twenty years to sixty-five years, and it is found that no man has reached his limit. Women supervisors, from office and plant alike, are also members, and not the least enthusiastic. Not all members, of course, benefit equally, for the native ability of supervisors varies considerably, but every man is able to do something more than he has done, by getting new ideas and new points of view. There is a particular advantage in the mass psychology of the training method outlined. Though all members read their texts and work their problems alone, or at least associated only with their team leader, the two to four hundred men in any one class derive great advantage from receiving their lectures, asking their public questions, and receiving the answers, in the presence of the big boss, all the executives, and frequently the president and directors of the company. Nothing serves to convince a foreman on the policy of his company about all the things and plans and people in it, as to have these policies voiced by the lecturer in the presence of all concerned, with the consent of the responsible owners.

The Ultimate Value of Foreman Training.

If an associated, enlightened group of foremen anywhere will tackle production problems and production people, as outlined, we venture to say that industrial troubles which are bound to arise, will not prove insoluble, industrial good will will be restored, and the path of the industrial engineer will be greatly smoothed for the application of his necessary and valuable services. Healthy discontent is the normal American outlook, and all our efforts should be toward eliminating the unhealthy kind, based on untruth, ignorance, suspicion and abuse. No amount of generosity, in wages, profit-sharing, leisure, and treatment, will restore harmony, if the facts of daily operation and economic truth are ignored.

In concluding this part of our topic, let me say that there is no future for the foreman who has no hope; such as the man who was told by his doctor to give up whiskey or go blind, and who replied; "Well, I think I've seen everything I wanted to see." Equally hopeless is the disloyal foreman, who spreads his disease like the "flu," and the unfair foreman, whose influence is gone with his whole gang, the moment he is "caught in the act." We cannot exaggerate the losses to industry daily through the low morale of some of the men whom we put in subordinate authority over others. Foremen are the hired teachers of the producing men in the year 1920, or else they are misnamed and misplaced.

How the Classes are handled in detail.

About two years ago, I came to the conclusion that it was neither practicable nor desirable to undertake the training of the foremen through the Government, as was then proposed; that what we ought to do was to gather in one family the executives of each individual plant, the officers, the general manager, treasurer, purchasing agent, heads of departments, and all foremen and assistants—gather them into one family, get together, and study the subject of human engineering—all study it. For this purpose I became Director of a Course for Foremen, Planned the Texts and Scheme, and helped to launch the craft and to pilot it for a little, simply as professional counsel. It now takes regular voyages under the guidance of the Business Training Corporation of New York and Chicago. It has proven quite sea-worthy, and always reaches port with a valuable cargo. One of its main purposes is to encourage the foreman to see the plant as a whole and the relation of his work to it; also to develop those personal qualities of leadership which he possesses, so that he will be able to secure his results by "leading" rather than by "driving." Thousands of foremen, managers, office heads and promising employes, in many industries, have already been enrolled, and many have graduated, so that there is nothing experimental in the enterprise of the "boss" going back to school for three months with the "boys". Three to four months is found to be the desirable limit for an energizing study campaign, in the case of people long past adolescence and in whom the reading habit has to be revived and strengthened.

In each plant a study group is organized, corresponding to a foremen's club, but it is not done by fiat, it should not be wished upon the men, but should be explained fully, and then left for their consideration. As soon as they respond, which they invariably do, if the introduction is skillfully managed, a plan of study covering six unit Texts, is arranged, each occupying the man for two weeks. He studies it in his spare time, and at the end of each unit he is required to solve a practical problem in factory management or plant experience. His solution is carefully explained and graded by an external and wholly independent secretary of the training staff, and the six solutions, worked out by him are made the basis of personal teaching and advice.

Each foreman is assumed to have technical competence to begin with, at least to the degree needed on his present job, and he is then trained from three angles: first, as a man; second, as a part of a production organization; third, as a handler of employes. The first phase is based on a very intimate study by the foreman of his own personality. In the second, he considers the development of the present day industry, its interesting history, and the factors in modern large-scale production. Thereafter he studies organization and team-work, with many modern examples for his guidance. He learns modern methods of plant lay-out and despatching; the installation of equipment and its operation; the materials and their handling. The purchase, storage and routing of material, the prevention of spoilage and waste, storekeeping and stockkeeping, the making of and keeping of records are all taken up comprehensively. The foreman is also introduced to the essentials of cost-keeping, the distribution of overhead charges, systems of control and similar problems, of management. They are illustrated by numerous large wall charts, as it is found that good graphical records reach the foreman more effectively.

Handling of Men Gets Special Emphasis.

Naturally the emphasis of the course is on the foreman's relations with those under supervision. Different types of workers and their characteristics are described and methods of handling them suggested. Employes' records and wage systems are explained. The maintenance of discipline, the stimulation of individual effort, the development of pleasant relations are treated in a helpful and sympathetic manner. Improved methods of hiring and discharging, and the cost and reduction of labor turnover are explained from the view point of the foreman and his part in the proper handling of these questions. The welfare, health, and safety of the employe and the duties and opportunities of the foreman are gone into in detail. Underlying principles of team-work, fair dealing and cordial attitudes are developed and emphasized. Examples are drawn from actual experience and applied to local conditions, and in all of this care is to be taken not to run the detail of system and management into refinements, which no foreman is called upon to practice. That is the stumbling block in some excellent, existing, professional texts, which discourage the foreman by their difficulty at the very outset, and their appeal to a higher education and understanding than they possess, or are likely to possess.

The Swift & Company forty classes, range from Boston to Portland, Ore., with fifty to four hundred foremen in each class, and about five thousand executives in all. Each class is split up into inner groups of about fifteen to twenty men, and for each team a bright, ambitious executive is selected as a team-leader. He plays "Big Brother" to his little group of men, meets with them and with the Director at intervals, and in all other ways represents the Swift Industrial Relations Training Division to his group in their studies. Every class meets as a whole once in two weeks, at a lecture, and each class meeting concludes with an Open Forum in which we engage to answer any question which may be put. To date over 1500 questions covering every phase of industrial, economic and social conditions have been asked and answered publicly in the Swift Groups, and these give a remarkable cross-section of what is in the mind of the foreman. It is a revealing experience; so many things are there in the form of doubts which you think were solved long ago, and so many as convictions or half beliefs which are inimical to industrial progress and good will. In most plants the men have found the training so interesting and their group meetings so helpful that they have effected permanent organizations, or clubs, to continue the benefits of the discussion.

In most cases, without the seed-sowing of the Course, a self-perpetuated, self-activating Foremen's Study Club would have been impossible.

In some plants, departments which have not been up to the average in safety have shown marked improvement. Where there was a tendency to put aside appliances, to throw machine guards into corners of the shop, and to forget rules, a renewed interest in employe welfare has sprung up. Where the trouble was due to an old-time foreman not believing in the "new fangled ideas," his study has made him more appreciative. Where the foreman was inclined to make fun of an employe for going to the first-aid room with a slight wound, he now understands the importance of preventive measures. Throughout many departments, with the better understanding of the policies of the management, mere rules are developing into real safety habits.

What about Collective Bargaining?

In this way some of the uncertainties of the human equation in industry are being discovered and defined. Some of the hazards in industrial relations are being removed. To many of the difficult "intangibles" the key is being found in the foreman, and his training, as already carried out in a large number of up-to-date plants, seems to offer a solution to many problems of management. Even the bogey of "Collective Bargaining" will be solved through such means, we believe. Industrial Councils and Committes, composed of such enlightened foremen, and of representative workmen who enjoy working under them and have asked for representation, might well be given full authority to adjust wages, hours and matters of government touching the employe and his status. Indeed, I can see no reason why we should assume that we know what is good for the worker better than he does himself. I feel that every true American reserves the right to make his own mistakes, and detests such paternalism. I can see no reason why either he or his hired spokesman, whether a union official or not, should not have status in such a Council when desirous. The risk is negligible if you first insure the existence of economic education, sympathy and enlightment in the Councils, and I should say that anything a worker can secure from such a tribunal he thoroughly deserves.

Where do We Go from Here?

In conclusion, let me give a word of warning, and also of encouragement to the industrial engineers before me, who more than any others, along with enlightened and energized foremen, can pave the way for the New Industrial Day in which large earnings will not justify long hours which leave no time to live, and in which a collective bargaining which is sometimes just a hold-up by one side or the other, is replaced by a collective adjustment in which the relation between wages and efficiency is kept as close as possible and the facts are respected.

Happily, we have representative government still, but it is not working hard at present. Yet no one has ever been able in the United States to "fool all of the People" even "some of the time"—though that was accomplished in Russia with dire consequences.

In this matter of social and industrial betterment, the employer **must** take the initiative and the most difficult persons to deal with are the extremists on both sides. Though noisy, it is surprising to find how relatively few they are. On the side of labor there seems to be much suspicion of one leader by another, and at present labor politics occupy the foreground to the exclusion of the present necessity for more production to give us larger Real wages.

Yet, radical or conservative, the fact remains that often the recognized labor leaders, of 20% of our workers only, will not make a just concession, not because they do not recognize its justice, but, they tell you frankly, because if they admit labor has been over-reaching, they are charged by the men with deserting them and betraying the cause. Not only so, but in acting fairly, they unwillingly furnish their rivals in leadership the opportunity to undermine their standing with their fellows. It is a shabby game to be popular in the Year of the Peace and it is not confined to labor leaders. The bourbon employer with the "openshop policy," but really strictly closed to any organization man, is often a good second in his own sphere in espionage and repression and intimidation; none the less real because they are legal; and the politician is not far off. Yet, we must say, that employers in general today are more liberal in their intentions and practice than labor and, if the latter does not take a tumble soon it will will assuredly "Spill the beans"; for we certainly cannot divide more than "all there is," and that is what some foolish people are insisting that we can do.

What are we going to do about it? We do not look for the solution from the White House, Capitol, or State House, but from patient continuance in well-doing and persistent education, in season and out of season, about the facts of industry and the folks in it and of co-operation for a surplus. There are theories and plans before us today for reconstructing business industry, and society on the assumption that no man will make any sacrifice for liberty or for love but only for gain, and many cynics in office, plant and street, and government hold the creed at least, but it is poor business for the premise is false.

True Democracy vigorously denies these assumptions. It banks with confidence on men as givers as well as getters, and it knows that knowledge touched with emotion is always inventive, ingenious, persistent and victorious. There's only one cure for Democracy of every type that you don't like, and that is more Democracy—a hair from the dog that bit you. Democracy should not be confused with any one polictical party. It has wonderful powers within itself. The self-expression and self-determination which result from man's being the only animal capable of self-conscious modification, react in the mass to make Democracy self-purifying, self-educating, self-disciplining and self-perpetuating, and the man who stands in the middle of the Lincoln Way is going to be run over. It is this clarity, sanity and humanity that have come into industy and have come to stay. He is foolish and un-American who is afraid of them. Let us provide them liberally for the non-commissioned officers of industry—

our foremen. They will spread them to the ranks, if they make men while they make things. Let our foremen and all executives and counsel in industry rise to the full height of their calling and remember that:—

> "We live in deeds, not words; in thoughts, not breaths;
> In feelings, not in figures on a dial.
> We should count time by heart-throbs.
> He most lives, who thinks most, feels the noblest, acts the best."

A rising vote of thanks was extended to Mr. Calder for his paper.

THE CHAIRMAN: Mr. Calder has given us a paper that certainly combines the practical and the inspirational in a masterly way. I am sure that we all feel highly repaid for waiting for Mr. Calder.

We will now hear a discussion of Mr. Calder's paper by Mr. D. G. Stanbrough, General Superintendent, Packard Motor Car Company, Detroit.

MR. STANBROUGH: I am going to confine my remarks on the training of foremen to men working in trades, particularly the metal working trade. The work which I supervise is the metal working trade, with a small amount of wood and leather working, and in discussing Mr. Calder's paper, I intend to confine myself somewhat closely to our own organization.

"TRAINING FOREMEN AS EXECUTIVES"

Discussion by

D. G. STANBROUGH

General Superintendent, Packard Motor Car Company, Detroit

In discussing Mr. Calder's paper, I intend to confine myself somewhat closely to the direct subject in hand; that of "Training Foremen as Executives." Mr. Calder has pointed out that two of the qualities deal with trade skill and knowledge of production methods. As you will recall he stated that they would not be Foremen if they did not have the first in some satisfactory degree, and that he would not dwell upon the second at this time. I intend to confine my remarks in a large measures to these premises. I do not think that in any discussion covering the training of Foremen we can pass over these two matters lightly.

Mr. Calder has gone to considerable length in the discussion of general education, and there is no question but that any man who is to hold a position of responsibility in industry, can better fill his office as a result of education along broad lines. I think we cannot make a mistake by appreciating to the full significance the value of general education.

I attended a Convention of Teachers of Vocational Training in Chicago, during the latter part of February of this year. This Convention was almost entirely attended by professional teachers. People from schools and colleges who had made teaching their life work were there, and I could not help but feel that these people attacked the subject of Vocational Education, from an entirely different angle than that which is usually taken by those in industry, who are connected with educational work. The impression that I got from the meeting of this earnest body of people was that in their educational campaign along industrial lines, they were attempting to implant an education that was deep-seated, requiring considerable time to assimilate, and they doubted the effectiveness of the intensive education which has been attempted in industry. Of course these people had behind them a background of life's experience in education, and they naturally would not accept the hurried methods of industry without considerable questioning .

I think it is time for us to pause and speculate upon the future trend of industrial educational work, and for this reason I do not believe that we can so hastily pass over the qualities that deal with trade skill and knowledge of productive methods. These are our stock in trade. They are the things that have to be perfected if we are to have success at all with the matters of wider education which have come into vogue in certain industrial plants.

Dealing first with the matter of trade skill—the Foremen that we have in our plants today, are the reflection of the trade skill that was implanted in the lower order of our Organizations some few years previous. They are the products of the apprentice system, and the special training courses which were given much attention some few years back. It has been generally admitted and we quite frequently hear the assertion that the apprentice system has failed. Why has it failed? There are only two reasons that I have heard; first, that it does not produce people fast enough to meet the needs of industry; second, that it does not appeal to the rising generation. I will deal with the second first.

It is a matter of salesmanship to sell an apprenticeship to the rising generation. Some say it is a matter of pay. The apprentice system is worth while, and if you have to raise the rate—do it, rather than abandon the apprentice system.

Dealing with the first question,—that apprenticeship does not produce people fast enough, this is unquestionably true, but in considering this phase of the subject, it must be realized that during the past few years—I might be more specific—during the past five years we have come to a new era in industry, that is, "mass production." Under this system we have what in technically known as a "transfer of intelligence," in which the skill of the trained artisan is literally replaced by a high order of tools, designed to produce interchangeable parts to narrow limits, and consequently our requirements have changed. We no longer require the large number of men highly skilled in the art, and those that we do require find their place in the tool rooms and in our planning departments. It is for these places that the apprenticeship system must be continued and it still admirably meets the situation. Of course it is admitted that all concerns are not organized along the mass production line, but the trend is in that direction and we must accept the advanced conception in meeting the problems of our rapidly augmenting industry.

The apprenticeship system also admirably provides the initial training department for the foremen of the future. Candidates for apprenticeship can be selected from the boys who have had high school education and in order to attract this class of lads, it is necessary that the pay and training offered is of sufficiently high standard to make the course attractive.

As an adjunct to the old type three year apprenticeship system, we have established at Packard an "Advanced Training Course." The length of this course was originally set at 78 weeks, and the requirements for admission were that a boy had to have a high school and technical education. We have since lengthened the time to 104 weeks, but have not raised the requirements. This course is essentially a shop course. A boy taking the course is given a thorough mechanical training which will fit him to hold a foreman's position after he has passed through the lower branches of executive work. A boy coming out of this course, if he is interested in the shop end of the business, is put in as a job setter or machine setter. If he shows proficiency in this work he is advanced to Assistant Foreman when the opening becomes available, and if he makes good here, he becomes a Foreman, and from there on up, depending upon his ability. However, if the young man is interested in advancing through the Clerical side of our business, he is taken into our Stock Department as Foreman of a Stock Room, after he has completed the course and is given the opportunity to advance along lines more particularly of a Clerical nature. Thus we have through the two types of apprenticeship, the one open to the high school lad and the other to the college boy, prepared the ground work for the Foreman and otherwise provided for the trade skill.

We realize as does the educator that the training of an efficient plant worker cannot be effected through the medium of a short intensive course, and while these courses unquestionably help to give those Foremen who have only just arrived a broader out-look, it must be realized that the plant can only perpetuate itself by starting in with the younger generation.

We have co-operated with the various high schools in Detroit in furnishing apparatus for manual training work. We have assisted the Cass Technical High School in a similar way.

We realized that it is a rather difficult proposition in handling a large organization to train all the men that are necessary, and consequently from time to time it is necessary for us to strengthen our Organization by hiring men who have been otherwise trained. In picking out these men, particular stress is laid on the selection of those who have served a recognized apprenticeship with a reputable concern or at least have spent sufficient time in the industry in successive executive capacities to indicate that they possess the necessary trade skill. Too much stress cannot be placed upon this point. The success of manufacturing in the mechanical arts depend upon a high knowledge of these arts, and a man whose experence also indicates that he has been with his former employer a considerable period of time, has two of the important qualifications for success as a manufacturing executive.

I will now pass to the other side of the question that governs a knowledge of productive methods, and by productive methods, I mean the methods that are in vogue in many particular plants to insure that finished pieces reach the Shipping Room doors. Of course, it is realized at the outset that the methods involved vary considerably with the size and diversity of the product, and with the extent to which individual parts are manufactured. Methods of an Assembly Plant cannot be well compared with those of a firm who manufactures and assembles, except in so far as the assembly end goes. However, the larger and more extensive a plant becomes and the greater diversity of its product, the more need there is for all those who direct labor to have a thorough understanding of the productive methods involved, as the success of the whole depends to a great measure upon the co-operation of the parts. In our business we have realized that our Foremen could obtain a general education through organized methods of education better than we could supply, and yet on the other hand the people who have undertaken the education of foremen in general, could not supply the specific education which we needed to successfully coordinate our manufacturing methods. We consequently undertook the work of training factory executives, from a production standpoint.

We organized our 700 foremen into classes of about 50 each, and during a period of one hour a day, for 15 sessions, the higher executives of our plant undertook to explain to each group the particular requirements and the relationship of the work he supervised. We discussed, "Discipline," "Methods of Paying Wages," "Inspection and Scrap," "Tools," "Time Study," "Routine Methods," "Stock," "Production," "Care of Machinery," "Employment," "Time Keeping," "Safety and Sanitation" with each group. In order to encourage a further study and broader understanding of the problems which confront an executive, the speaker discussed with each group the subject of "What Makes an Executive," touching upon decisions, initiative, ability to plan, concentration, authority and responsibility, personality, personal appearance, dignity, tact, co-operation, self-control, pep, salesmanship, progressiveness, Foremen's relation to his employes and loyalty. It was explained in this last talk the need of the Foreman and the interest that he must take in self improvement.

In order that these instructions might have a permanent value to the men, we had stenographic notes taken of the lectures, and these notes were edited, bound in a substantial way and furnished the men.

Returning to Mr. Calder's paper, I am glad to note the remarks that he has made as to imitation being a lazy way. However, we cannot overlook the value of imitation. Through imitation we are able to learn the present state of an art and consequently we cannot condemn it entirely. You will be forcibly struck by the value of imitation in the cases where you imitate new departments in a business. You take an old and well running department and it is able to assimilate new material, because the new man is all eyes and ears for the first few days, trying to catch on to the practices of the shop, but when you start out with a new department, all this is lacking, there are no practices. What trade skill the men possess, has to be acquired and the going is slow. We have tried to realize the value of imitation, but on the other hand have tried to cope with its bad side by impressing upon our foremen that you cannot imitate success. We want to imitate as far as imitation pays, in order that we may take advantage of the progress of the art, but we want to be sure and leave the impression that imitation ends with the acquirement of manual skill. Dexterity and success come through independent personal ability.

Another point that I want to bring out is that in the shops we find that the so-called practical man, and sometimes his ignorance, is set up as being a particularly worthy institution, and it should be impressed upon Foremen and others in authority the proper relation of the practical man in the scheme of affairs. As we look back over the history of the mechanic arts it can be readily realized that the arts and sciences have been introduced from their practical aspect. They have been discovered in the shop by practical men, but when once discovered they have been extended, refined and codified by theory, and have been again returned to the shops, for reproduction in accordance with definite laws. Today we are dealing with scientific manufacturing and in order that our Foremen may meet present day conditions, an open mind must be presented to the advances of science.

Another important consideration in the training of Foremen and others who engage in a supervisory capacity, is that in our large industries the Foremen and their associates in authority, represent the Company to the men. The attitude that the Foreman take with the men are to the man's mind the attiude of the Company, and any scheme of Foreman's education that does not deal in a large measure with the problems of human relations cannot hope to aspire to a full measure of success.

MR. WALLACE: We have two papers before us for discussion and the hour is getting late, so we must necessarily limit each speaker to three minutes in the discussion of these two papers.

MR. HARRY A. HOPF: Mr. Gilbreth should be congratulated on his paper and one cannot help but admire his enthusiasm and penetration as a pioneer in the field of the elimination of fatigue. I would like to emphasize what I am sure he would have emphasized if he were here, namely, that he is concerned principally in the elimination of unnecessary fatigue and that he fully recognizes that necessary fatigue is inevitable, and that that is not the subject of his attack.

In commenting on his paper, there are certain statements which are so general in character that I am afraid they cannot be separated without qualification. One of these, for example, is that lighting from the east or west windows is better than lighting from the north or south. That qualification I hardly feel inclined to share the same view in. I am well aware of the benefits of north light and also well aware of the disadvantages, speaking in terms of offices facing east and west, having a morning sun and also an afternoon sun, with the result that the shades are pulled down and the lights go on and the sun shines brilliantly.

I think there is much to be said about direct and indirect lighting, but the particular conditions must be taken into consideration to make that system beneficial. I personally lean in the direction of indirect lighting, but the thing to be considered is the intensity of the illumination in the working plan.

A demand has arisen for lamps. The life of a lamp is only one thousand hours. If dust is not taken out of the reflector, then you have additional trouble, and the efficiency of your lighting system can be increased by giving attention to those matters.

In regard to the humidity of the air, I think the percentage was from 50 to 75%—I think it is better near 68, and that's a point which should be worked out. I agree with the statement that the air should be kept moist and in motion. We should remember that the body gives one hundred calories of heat per hour during life and it is necessary to duly retard or accelerate that heat, and we are primarily concerned in that content and not in the air.

I agree with speaker in the statement that the working environment must be good, and the point I would like to make is that we should consider as the basic factors, light, heat, ventilation, noise, dust, space assignment and posture, each one of these are subjects in themselves, but in the aggregate, it is my profound conviction, based upon many years of study of those subjects, that they together, weigh at least as much in the matter of efficiency as the finest scheme of organization and the most inspired plan of personnel. (Applause)

MAJOR PORTER: I believe industrial engineers make a mistake by not attacking some of those physical aspects first. In my own experience, in one instance in a textile mill, I started out with a hard set of men to deal with. By fixing up the lighting conditions, I made those men feel that I was their friend and it paved the way to better efficiency. I think too little attention is being paid to that.

MR. MASON (Sun Shipbuilding Company): Mr. Calder, in your experience, what is the best time to hold foremen's meeting?

MR. CALDER: It has been my experience that it is never wise to take any representative body of foremen away from their work during the working hours. In the backs of their minds there is always the job and the thought of what may be going on in their absence. These classes to which I referred, are held in the foremen's own time. The packing plant begins at seven in the morning and finishes at three-thirty; the foremen remain on the job until five o'clock in connection with shipping and various things that must be done the same evening—the goods have to be on the market within two days—and they have their supper—we all sit down to supper once every two weeks, and at five-thirty we have our classes and at seven-forty-five they are all over. We all give our own time.

In connection with foremen's meetings for business purposes, these may be called at any time. In our plant at Chicago we have 15,000 men. There never could be any one meeting during working hours of any consequence, except a very brief conference, at which we could have 1200 foremen at one time, but its easy to take a few men away from their work for a short time. There is nothing to be gained by our holding a general meeting because ours is an extractive industry. Its extract is taken from the animal at the stage where it is most vital and the by-products of soap, glue and so on are all handled in different divisions. Its only in the form of executives that we really meet together and we have never had an occasion to call the foremen out during the working hours.

MR. SHEPARD: I am glad Mr. Hopf spoke of the noise. We are so accustomed to noise in our American citizen life that we are perhaps not conscious of what produces fatigue. I cannot do any better than to emphasize that that is the cause of nervous fatigue, leading finally to a nervous disease known as traumatic nervousness.

Another item of knowledge which I gained from painful experience of my own, which may be of value to others, has to do with the elimination of eye strain fatigue. Suffering from that trouble myself, a very able oculist taught me the habit of closing my eyes momentarily while working when my eyes became the least fatigued. In having to work long hours, I am very much more rested by just closing the eyes perhaps a fraction of a second and you can do this with practically no loss of time. In reading this program, for instance, I close my eyes while turning to the next page. By acquiring that habit, one can save his eyes and materially increase his productive ability.

MISS COOK (Collins Service Company:) The paper does not quite adequately represent Mr. Gilbreth's real work, in fatigue. I have had the privilege of visiting his laboratory, looking and seeing and absorbing the pictures which he uses to show actual motion study, and which I think he is rapidly promoting as a part of a scientific field because of the wonderful work he is doing. At the same time, I feel very strongly that in discussing fatigue from the point of view of motion study, we are neglecting very strongly a very important factor. I think, after all, fatigue is not a mass phenomenon—it cannot be treated in the mass. After all, it is an individual thing and I think the co-operation of the medical department has to be much more strongly enlisted than at present in coping with the problem of fatigue.

I would like to give as a challenge to all motion study men the issue that after all, the reducing of the amount of motions made may not reduce the person's fatigue but may give him a sense of monotony and distaste for his work, which in the end, will increase rather than decrease fatigue, and all these things will have to be proved by tests from the medical department to the individual himself.

MR. MONTGOMERY (Chicago): In connection with the remarks of the last speaker, the very fact that the man has developed considerable skill—almost slight of hand action in his movements—adds a zest to his activities. I think you will find that such men experience a sort of enjoyment in carrying on their work with dexterity rather than with the feeling of being bored by it.

With regard to Mr. Gilbreth's paper, any one that wants further information along that line will enjoy a publication by Frank B. and Lillian M. Gilbreth, published by McMillan, that contains a number of cuts, some of which we saw tonight. The pictures we saw tonight are, in general, a slight improvement over the original cuts that came out in this book of fatigue study.

With regard to the working temperature, where you have a high humidity, around 75% saturation, and the temperature is 75, it can be some 15 degrees lower, and still the occupants of the room will swear that the tempature has not been lowered. In other words, if you have a temperature of 70 degrees, with 20% relative humidity, you can get exactly the same degree of comfort at about 63 degrees, or less, with the humidity around 75%. Incidentally, the higher humidity will reduce the incidents due to dryness.

MR. WALLACE: Mr. Calder, I wish to extend to you, on behalf of this Association, our keen appreciation of your masterly address. (Applause)

Adjournment.

FIFTH SESSION

Friday Afternoon, March 26, 1920

Chairman: MEYER BLOOMFIELD

Editor "Industrial Relations," Boston

MR. WALLACE: Major Chas. B. Going, who was to have acted as Chairman of this session, is in Flordia and could not get here in time. We are fortunate, however, in having with us a man who has very graciously consented to act as Chairman; a man who is well known to all that have had anything to do with industry, and having heard him speak many times and having seen him preside over several meetings, I am quite sure he will fill the situation admirably. I take great pleasure in introducing to you our friend, Mr. Meyer Bloomfield, of Boston. (Applause)

THE CHAIRMAN: We will proceed to the first number on the program. It gives me a very great pleasure to present the next speaker, who was an associate of mine in the Emergency Fleet Corporation during the war, one of the most capable naval architects and engineers I have ever known—Mr. William B. Ferguson of the famous Hog Island Plant. Mr. Ferguson will present a paper written out of a rich experience, out of a very successful experience in his field of work, and will speak to us on "How the Cost System Assists the Management in the Reduction of Operating Costs." (Applause)

"HOW THE COST SYSTEM ASSISTS THE MANAGEMENT IN THE REDUCTION OF OPERATING COSTS."

WILLIAM B. FERGUSON

Assistant to the President, American International Shipbuilding Corporation

In endeavoring to present the subject of Cost Keeping from the Operating Executives' standpoint, I shall take it for granted that all those gathered here recognize the advantages and the necessity of adequate cost data and cost control methods,—and shall therefore proceed to illustrate in some detail the practical application of these principles in industries with which I have been connected.

As a text for opening up the subject, one could do no better than select a few words from the address of Mr. Joseph W. Roe upon the subject of "College Training for Industrial Executives," delivered at the Cleveland convention last fall. Mr. Roe indicates the method of presenting this subject in a course of training on Industrial Engineering, as follows:—

"Cost Accounting, or better, Cost Analysis: Making sure that this is presented as a guide and help to production and not an end in itself; i. e. from the Manager's viewpoint and not the bookkeeper's,—and that it is to be used to tell what is happening rather than what has happened."

My experience has been that there is a general misunderstanding of the difference between Cost Accounting and Cost Keeping,—that is between the accounting records for Financial purposes on the one hand, and Cost for operating purposes on the other. It seems to me that something ought to be done by this Society along constructive lines to recognize this very important distinction between the two radically different subjects; and I believe that both the accountant and the operator should familiarize themselves sufficiently with both branches or divisions of the subject to see the other fellow's point of view. As a matter of definition, one of the best descriptions of the distinction between Cost Keeping and Cost Accounting that I have ever seen is given in the report by the Keep Commission dated December 29, 1906, upon the subject of "Cost Keeping in the Government Service." I will only give a brief extract:—

"Cost Keeping as a branch of accounting is a comparatively modern development, and while largely employed in the commercial world has not yet been introduced to any considerable extent in the Government service. In cost keeping, expenditures of money, material, and service are analyzed according to the purpose for which they are used, and it thus becomes possible to know the cost of any given piece of work or of any operation upon a single unit, or many identical units. A cost system, if properly devised and operated, will furnish information enabling the responsible head of the organization to know where economies may be effected by introducing new arrangements in organizations or new methods in operation, to estimate more intelligently on the probable cost of future operations along similar lines. . .

"Cost keeping is that branch of accounting which is concerned with the segregation of the various items of expense, incurred in the prosecution of a single piece of work, from among all other items of expense incurred in a general line of industry, and the setting over against the total of such segregated items the quantity of resultant work or product."

I have made use of the above definition in former discussions of Cost Keeping which appeared in "Estimating the Cost of Work" published by the Engineering Magazine Company in 1915, and I take the liberty of further repeating myself on this subject as follows:

"Cost keeping, like estimation, is simply a means to an end; they are both only adjuncts and aids to good management. Records of cost, however accurate, do not IN THEMSELVES produce economy; it is only by the proper presentation of these records in convenient and convincing form to the executives who are responisble for costs that the executives can benefit by these records, and remedy inefficiencies pointed out by the records, through improvements in organization, in administration, and in individual processes and operations. It is better to have a few main headings for cost accounts, each with a definite and distinct meaning than to have a mass of meaningless figures scattered through a hundred account headings, all bunched together and then arbitrarily distributed all over the cost of work, and the significance and value of individual items entirely lost. Unfortunately, in the development of systems of cost records, the purpose of such records in respect to increasing the efficiency of production have not received the attention which the mere accounting for expenditures of all kinds has received. The expert accountants have made wonderful progress in devising systems of reporting total expenditures under very logical groups, and making the books balance; whereas it is only in recent years that the managers and superintendents in general have realized the great possibilities for improving the efficiency of production which proper cost records open up."

The two examples of industry in which I will go into some detail as to the development of such a cost system,— as Mr. Roe advocates—one that tells WHAT IS HAPPENING,—rather than what HAS HAPPENED,—are selected because they both have been engaged in manufacturing products requiring several months in progress,—the one example being a Rifle Factory with 10,000 employees, the other being a shipyard with 30,000 employees.

The average time from raw material to finished product in each case is anywhere from six to twelve months, which means that in order to know what the product is costing week by week, compared to a predetermined STANDARD or Bogey, we must set up a system of measuring CURRENT production, and of evaluating the amount of work being accomplished from day to day, and expressing this production (preferably weekly)as the equivalent of so many finished articles, (rifles or ships, in the examples in mind.)

In regard to Cost Keeping in a shipyard, a subject which presents so many difficulties on account of the complexities of the work and the great variety of operations which follow one another and which intermingle and are interdependent one upon the other, it is necessary to know something of these unusual complexities and difficulties of shipbuilding, with practically every class of material and every kind of craft and operation involved, in order to understand how the usual expert accountant or financial representatives hesitates to inaugurate or put into effect a real up-to-date cost keeping system. My own experience, however, has been that this very difficulty of installing a proper cost control system makes it all the more necessary and advisable to set up a system, however simple or complicated, based on CORRECT FUNDAMENTAL PRINCIPLES; and the outstanding basic principle which gives the best results and which appears best to the operating man, (who believes that authority and responsibility should go together) is that the accounts should be set up along the lines of the operating organization, so that each head of division, department or section should have within his control the means of telling him what his costs are—high or low—and why they are high or low, and how to go about reducing them, if they are excessive.

A system of accounting which does not parallel the organization makes it impossible to hold any one individual responsible for any particular excess expenditure, and THEREFORE is not any system of CONTROLLING expenditures.

Having set up as simple a method as practicable for measuring current production, within as reasonable an accuracy as the nature of the product and results to be accomplished seem to justify, then the system of accounts or charge numbers against which time charges (labor) and material charges are collected can be developed. The viewpoint of the Treasurer or Financial Department with respect to the system of accounts may not be the same as that of the operating executive or his cost engineers, at the outset, and unless they can get together and agree on the basic principle that the object of a cost system is to reduce costs, then there is apt to grow up a complicated accounting system in the making of which the operating executives responsible for costs have no voice, and

A. I. S. C. – E-[illegible]

UNIT COST REPORT

DIRECT LABOR ONLY

FOR WEEK ENDING NOVEMBER 19 1919

Yard or Pier	Way No.	Hull No.	Erection Weekly Tons	Erection Weekly Cost	Erection Weekly Cost per Ton	Erection Cumulative Tons	Erection Cumulative O/O	Erection Cumulative Cost	Erection Cumulative Cost per Ton	Reaming Weekly Holes	Reaming Weekly Cost	Reaming Weekly Cost per Hole	Bolting Weekly Bolts	Bolting Weekly Cost	Bolting Weekly Cost per Bolt	Riveting Weekly Rivets	Riveting Weekly Cost	Riveting Weekly Cost per Rivet	Riveting Cumulative Rivets	Riveting Cumulative O/O	Riveting Cumulative Cost	Riveting Cumulative Cost per Rivet
1	1	1528	97	293	3.02	413	15	889	4.97	19430	434	.022	7583	384	.051	14831	973	.086	26360	[illegible]	1787	.068
	2	1510	249	544	2.18	2598	95	12007	4.65	50772	1347	.027	23364	1149	.049	42895	3104	.072	358845	72	28896	.081
	3	1522	99	416	4.20	989	36	4034	4.07	22719	469	.021	18995	920	.048	24746	1538	.062	158674	32	11076	.070
	4	1526	86	480	5.58	917	33	3502	3.88	32057	616	.019	14202	866	.061	38686	2314	.060	147977	30	10122	.069
	5	1527	58	195	3.36	566	20	1335	2.36	14643	310	.021	10456	541	.052	12877	848	.066	60822	12	4343	.072
Yard Total			589	1928	3.38	5478	39	21727	3.92	139621	3176	.023	74600	3860	.052	134035	8777	.065	752678	30	56234	.075
2	6	1509	120	486	4.05	2595	93	12727	4.90	76560	1493	.020	23172	1609	.070	50884	4067	.080	387373	77	34334	.089
	7	1515	216	277	1.28	2687	96	10582	3.94	52779	1453	.028	24932	1180	.047	55118	4017	.073	384885	77	30496	.079
	8	1524	87	371	4.26	661	24	2554	3.86	14506	259	.018	11448	476	.042	16110	782	.049	85259	15	4617	.054
	9	1531	86	208	2.42	86	3	208	2.42	4250	77	.018	4033	94	.023	2054	80	.039	2054	–	80	.039
	10	1504	13	176	13.55	2751	99	15236	5.54	30971	1194	.039	7715	586	.076	49345	4635	.094	480740	96	42613	.089
Yard Total			522	1518	2.91	8774	63	41307	4.71	179066	4476	.025	71300	3945	.055	173511	13581	.078	1340211	53	112140	.084
3	11	1514	2	141	70.50	2618	91	9001	3.46	27996	709	.025	11598	849	.073	35269	2655	.075	304563	61	24972	.082
	12	1520	178	360	2.02	2130	75	6256	2.94	36649	781	.021	18155	877	.048	29256	2052	.070	227360	45	18549	.082
	13	1523	152	452	2.97	1284	46	2948	2.30	21845	565	.026	13548	750	.055	37138	2487	.067	146467	29	11042	.075
	14	1530	[illegible]	779	2.85	273	10	[illegible]	2.85	7573	94	.012	3268	151	.046	2302	89	.039	2302	[illegible]	89	.039
	15	1506	0	63	–	2768	99	11946	4.32	19271	1218	.063	12378	962	.078	27114	3528	.130	454046	91	44825	.099
Yard Total			605	1793	2.97	9073	65	30928	3.41	113354	3367	.030	58945	3589	.061	132696	10809	.081	1134738	45	99477	.088
4	16	1499	34	535	15.74	2634	95	15657	5.95	4029	592	.147	2142	303	.141	11911	2298	.193	500631	99	49962	.100
	17	1529	134	561	4.19	641	23	1581	2.47	16083	315	.020	15352	734	.048	21597	816	.038	39659	8	1556	.039
	18	1525	0	206	–	805	29	3805	4.72	14766	530	.036	17175	1102	.064	16767	1344	.080	103904	21	7319	.070
	19	1521	167	390	2.34	1345	48	4654	3.46	12499	488	.039	10734	813	.076	18765	1380	.074	193909	39	14334	.074
	20	1512	19	0	–	2659	96	8708	3.38	17425	957	.055	13779	1137	.083	46995	5815	.123	333770	67	28470	.085
Yard Total			354	1692	4.78	8064	58	34405	4.26	64802	2882	.045	59182	4089	.069	116035	9653	.083	1171873	46	101641	.087
5	21	674	19	44	2.32	3908	93	21759	5.57	7563	225	.030	4236	302	.071	22146	1723	.078	462321	77	50069	.108
	22	678	0	140	–	3942	94	16678	4.23	5406	576	.106	2203	135	.061	11999	1710	.143	589710	98	62894	.107
	23	1491	8	3	.38	2730	98	15383	5.64	13470	620	.046	13012	828	.064	38968	3356	.086	354147	71	31217	.088
	24	1505	152	352	2.32	1823	66	9488	5.20	22255	378	.017	8994	415	.046	12253	1045	.085	225239	45	19845	.088
	25	1517	43	268	6.23	1035	[illegible]	4484	4.34	18037	254	.014	9433	449	.048	17554	1153	.066	130277	26	8616	.066
Yard Total			222	807	3.64	13438	80	67792	5.05	66731	2053	.031	37878	2129	.056	102920	8987	.087	1761694	65	172641	.098
6	26	672	11	1047	95.15	–	–	–	–	2027	435	.214	696	111	.159	3146	1465	.466	–	–	–	–
	27	675	0	6	–	3845	86	14784	3.84	29284	785	.027	15000	747	.050	19317	1684	.087	334188	56	40127	.120
	28	1501	1	219	219.00	2746	99	12322	4.49	4463	497	.112	1598	201	.126	18656	2252	.121	473577	95	46476	.098
	29																					
	30	679	14	115	8.21	3846	74	10159	2.64	12406	569	.046	13063	607	.047	20055	1865	.093	261160	44	30920	.118
Yard Total			26	1387	53.35	10437	[illegible]	37265	3.61	48180	2286	.047	30357	1666	.055	61174	7256	.119	1068925	63	117523	.110
7	31																					
	32	1493	71	432	6.09	2733	98	17840	6.54	7597	482	.064	2869	190	.066	11728	1461	.125	498045	99	51697	.104
	33	1502	255	415	1.63	2681	96	15613	5.83	8002	574	.072	9613	449	.047	14458	1961	.136	472496	94	49990	.106
	34	1519	83	161	1.94	1078	39	4461	4.14	10931	219	.020	5320	383	.072	11653	932	.080	95256	19	6974	.073
	35	669	23	210	9.13	5297	90	38028	9.49	14466	725	.047	3705	457	.123	19651	2512	.128	598972	99	81704	.137
Yard Total			432	1218	2.82	10289	88	73312	7.14	41996	2006	.048	21507	1479	.069	57490	6866	.122	1664769	79	190365	.114
8	36	671	17	36	2.12	3763	90	29424	7.82	12925	491	.038	6427	440	.068	17738	1579	.089	446230	70	53653	.128
	37	1516	85	116	1.37	1774	64	5497	3.10	18814	399	.021	12271	712	.058	22790	1630	.072	227083	45	18428	.081
	38	1511	132	333	2.52	1964	71	9997	5.08	40345	706	.018	20302	1106	.055	23953	1882	.079	232863	47	19505	.084
	39	1494	226	74	.33	2684	97	22564	8.45	8229	373	.045	3985	362	.091	17758	2159	.122	463179	93	49015	.105
	40	676	0	56	–	3728	89	24458	6.56	13391	386	.029	4416	296	.067	18311	1703	.093	397093	66	52367	.132
Yard Total			460	615	1.34	13913	83	91940	6.60	93704	2355	.025	47431	2916	.062	100550	8953	.089	1748448	74	192968	.111
9	41	677	0	26	–	3894	93	25573	6.57	34108	1085	.032	20535	1244	.061	51762	3841	.074	465961	78	52644	.113
	42	680	105	452	4.30	1400	33	7967	5.69	23301	522	.022	7838	789	.101	15884	1193	.075	105735	18	8786	.083
	43																					
	44	1508	153	417	2.73	1966	71	12888	6.55	41385	714	.017	14653	816	.056	21177	1596	.075	232147	46	18111	.078
	45																					
Yard Total			258	895	3.47	7260	69	46428	6.39	98794	2321	.024	43026	2849	.066	88823	6630	.075	803843	47	79501	.099
10	46	673	1	131	131.00	3899	93	28086	7.18	16721	603	.036	5902	401	.068	15002	2053	.136	501746	84	62743	.125
	47	1518	134	313	2.34	1287	44	4800	3.73	16940	333	.020	9843	486	.049	11578	896	.078	133282	27	9708	.073
	48	1513	181	374	2.06	2330	74	9731	4.18	27445	508	.019	11879	556	.047	22717	1655	.073	242261	44	19386	.080
	49	1507	131	458	3.50	2539	88	11854	4.67	36765	614	.017	13748	545	.040	32555	2069	.064	289422	58	23932	.083
	50	1497	59	133	2.26	2669	95	15435	5.79	52391	899	.017	23281	1515	.065	27980	2264	.081	324904	65	29523	.091
Yard Total			506	1409	2.78	12724	83	69823	5.49	150262	2957	.020	64653	3503	.054	109832	8937	.081	1491615	[illegible]	145292	.097
Total on Ways			3974	13262	3.34	99467	71	514927	5.17	996490	27873	.028	508879	30025	.059	1077066	90449	.084	12930786	55	1267778	.098
Pier A	A-1	1486	0	55	–	2843	100	17297	6.07	75	0	–	0	5	–	106	29	.272	484570	100	48813	.101
	A-2	1500	0	196	–	2801	100	17349	6.19	449	139	.310	0	53	–	234	124	.530	502356	100	49171	.098
	A-3	1487	0	220	–	2806	100	19626	7.00	0	46	–	0	56	–	231	60	.260	499906	100	50085	.100
	A-4	1492	0	146	–	2879	100	17102	5.94	0	37	–	0	5	–	11	12	1.090	502480	100	64595	.129
Pier B	B-1	672	–	183	–	3949	94	21616	5.47	733	123	.168	0	50	–	–	0	0	565962	94	70072	.124
	B-2	670	0	377	–	3938	94	38026	9.66	7712	627	.081	0	177	–	15698	2595	.166	621142	100	80579	.130
Pier C	C-1	1495	0	224	–	2803	100	21067	7.51	1983	271	.137	0	88	–	1832	431	.235	527092	100	55070	.104
	C-2	1503	0	9	–	2791	100	19559	7.01	0	83	–	0	37	–	44	8	.182	491870	100	59705	.121
	C-3	1498	1	834	–	2762	100	15819	5.72	64	53	.831	0	81	–	–	0	0	494683	100	55397	.112
	C-4	1496	0	199	–	2613	100	17122	6.57	2005	112	.056	0	60	–	1007	327	.325	510032	100	58914	.115
Pier D	D-1	1489	0	3	–	2788	100	11643	4.17	0	0	0	0	6	–	0	6	–	485083	100	61972	.128
Total in Wet Basin			1	2446	–	32973	99	216226	6.57	13021	1491	.130	0	618	–	19163	3592	.187	5685176	99	654373	.115
Delivered																						
	1 St	50	0	0	0	140847	100	1665502	11.82	0	0	0	0	0	0	0	0	0	26072691	100	4315608	.166
	51	1483	0	0	0	2813	100	15998	5.68	0	0	0	0	0	0	0	0	0	503826	100	52998	.105
	52	1484	0	0	0	2808	100	15126	5.38	0	0	0	0	0	0	0	0	0	493368	100	59779	.121
	53	1485	0	73	–	2741	100	24974	9.08	0	0	0	0	0	0	0	6	–	515037	100	57980	.113
	54	1490	0	0	0	2796	100	18489	6.61	0	0	0	0	2	–	0	0	0	498141	100	56212	.113
	55	1482	0	0	0	2834	100	20787	7.34	0	0	0	0	0	0	0	0	0	487289	100	52536	.107
	56	1488	0	6	–	2792	100	20081	7.18	0	0	0	0	0	0	0	0	0	497314	100	50732	.102
Total Delivered			0	79	–	157628	100	1780957	11.30	0	0	0	0	2	–	0	6	–	29068662	100	4645685	.160
Grand Total			3975	15787	3.99	290068	87	2512110	8.65	1009511	29364	.029	508879	30645	.060	1096229	94047	.086	47684624	83	6567836	.138
Last Week			4649	16524	3.56	286093	88	2496300	8.73	940930	31680	.034	429461	31398	.073	885909	94987	.107	46588595	82	6473332	.139

which assists them not at all or but slightly in their efforts to reduce unit costs and total expenditures.

Costs by Organization Units

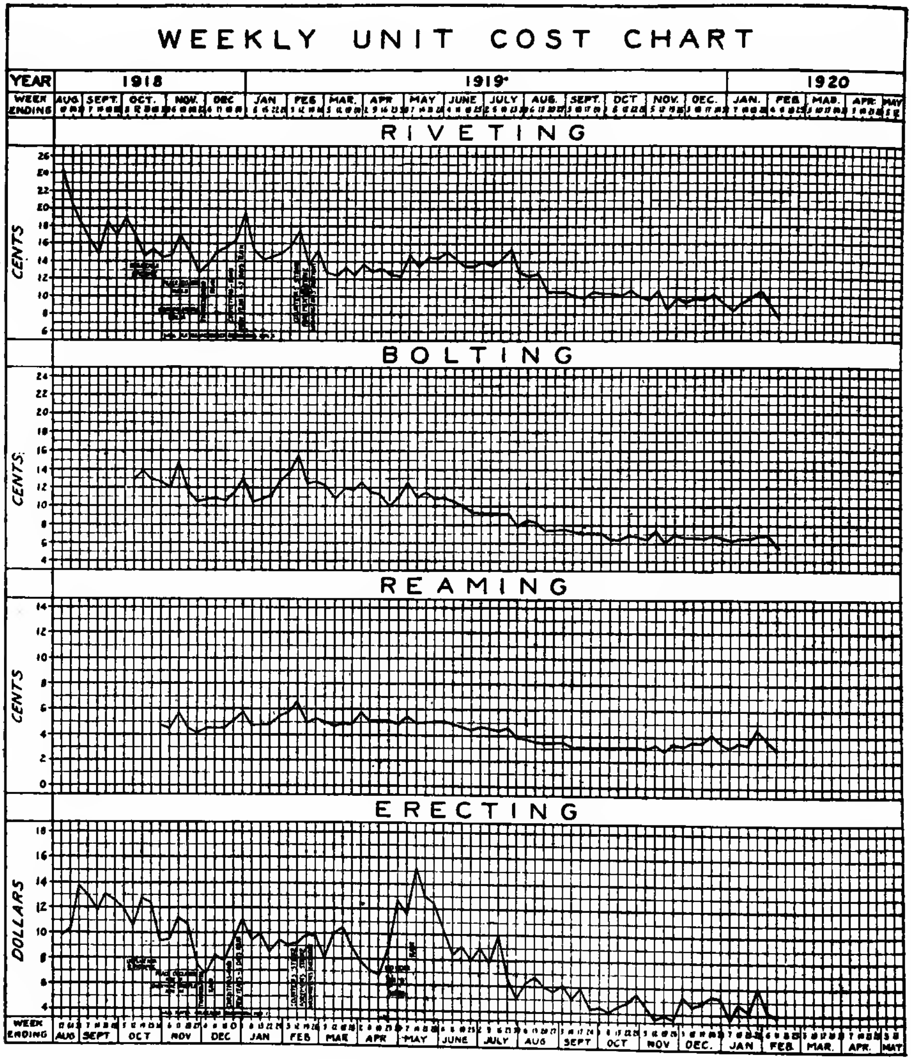
It is not enough for the manager or superintendent or foreman to know that they are spending a lot of money, more than last month, or more than their competitor,—they must know where they are spending it, in enough detail to put their fingers promptly on the very operations which cost more than they should, always comparing ACTUAL cost for a certain physical result with the predetermined STANDARD.

This leads up to the matter of organization and responsibility for costs; and a close study of this matter enables the designer of a cost system,—the cost engineer,—to set up his charge numbers or accounts in such a way that some one particular individual can always be held responsible for each group of charges or expenditures.

This may seem elementary or axiomatic to many, but perhaps a later description of the design, development and operation of the cost system at Hog Island will illustrate the point more clearly,—for in shipbuilding, for years and years, the usual cost systems have not followed the above principle of certain units of the organization being responsible for certain definite cost groups,—and Hog Island is still with the minority (if every shipyard is given one vote) in using a very simple system of labor accounts, by trades or operations for all outside or assembling work, and abandoning entirely the usual system of accounts by numerous physical divisions of the ship, such as decks, bulkheads, shell plating, etc., each one of which involves several trades. Now a shipyard labor organization is by trades of crafts, and each trade has its responsible supervisors or foremen, and cost should be collected accordingly, by trades.

Value of Graphic Presentation

In the development and operation of a cost system which will assist the management to reduce cost, particularly in a large plant, it has seemed to us very helpful to get out weekly summaries and charts in concise and interesting form so that they will be read and studied by the managers and superintendents. Then further details as needed are given directly to general foremen and other minor executives. The effect of graphic presentation of the essential and relatively important facts of production and corresponding costs has been to stimulate the spirit of rivalry and competition to a most healthy degree; it has led to a study of the best and most economical methods of performing the various operations, but it has particularly led to the co-ordination of the various trades in following the best sequence or rotation of operations throughout the ship. A number of tables and charts are shown in Exhibits 1, 2, 8, 9 and 10 which


WEEKLY UNIT COST CHART
YEAR
1918
1919
1920
WEEK ENDING
RIVETING
CENTS
BOLTING
CENTS
REAMING
CENTS
ERECTING
DOLLARS

will illustrate the kind of information that is eagerly absorbed by the operating executives, and which has assisted them so materially in reducing their costs. How great these reductions have been are shown graphically in Exhibits 10, 11, 12, 13 and 14.

Merit System

It is impossible, as you are well aware, to separate the question of of Cost Keeping or (Cost Analysis and Control) from the related questions of technical methods of increasing production, (Engineering methods and managing methods) and of incentive methods of increasing production. If men are to be paid or rewarded according to their individual production or output, then some system of recording and comparing production by individuals or groups (gangs) has to be set up. A properly designed Cost Keeping System contains such records, both as to current output per employee and to cost per unit; and thereby furnishes a fair and positive means of rewarding the efficient employees and of discharging the drones, as well as a means of showing the necessity of rightly training or instructing the inexperienced but apt (willing) employees.

The good cost system then becomes a yardstick by which to measure fairly the merit of superintendents, foremen, leadermen and workmen, thus enabling the manager to give a square deal to every man, based on correct information and not on hearsay, thereby eliminating favoritism, cliques and politics.

Cost System an Aid to Standard Practice

It may be of interest to know how difficult it was to get twenty thousand men all in favor of erecting and building a standard ship according to the predetermined methods and sequence of operations; how standard instructions were issued; how numerous meetings were held, by the managers or superintendents, foremen and sub-foremen, night after night; how instruction and discussion and persuasion were used to get both "oldtimers" and "newcomers" to try out the standard methods, which at last they have done and are doing now successfully. But the point I want to bring out is that the real and final persuasive argument was the COST record, ship after ship, as the gradually lower and lower costs of erecting, riveting, reaming, bolting, etc., were distributed in graphic form as one shipway after another fell into line. The effect of this persuasive power or lever of cost publicity is shown DEFINITELY in two or three important particulars which I will describe, resulting in enormous reductions in operating costs. I hesitate to give the total results of standardization and uniformity of practice, in dollars, such figures as can be verified by the actual results of improvements, comparing BEFORE and AFTER various standard practices were adopted, for they are actually staggering! This vast sum of money can easily be imagined, however, when you think of

STANDARD FORCE FOR "A" SHIP
12 PERIODS 24 WEEKS

	TIME PERIODS	1	2	3	4	5	6	7	8	9	10	11	12	KEEL LAYING TO LAUNCHING		LAUNCHING TO COMPLETION		TOTAL LABOR HOURS	TOTAL COST $
		KEEL LAYING									LAUNCHING		COMPLETION						
	% OF STEEL	0-21	21-27	27-34	34-45	45-57	57-69	69-81	81-92	92-99	99-100	100	100						
	% OF RIVETS	0-4	4-11	11-18	18-26	26-34	34-43	43-56	56-72	72-86	86-99.5	99.5-100	100						
	% OF TANKS					0-2	2-8	8-20	20-39	39-75	75-100	100	100						
ACCOUNT	TRADE INDEX %	0-8	8-13	13-17	17-24	24-31	31-40	40-52	52-68	68-87	87-100	100	100	MEN	LABOR HOURS	MEN	LABOR HOURS		
212 223	ERECTORS	12	10	8	10	12	14	16	16	12	10	0	0	12	10560	0	0	10560	10000
215	FITTERS & REGULATORS	28	40	32	28	32	36	40	42	42	40	0	0	36	31680	0	0	31680	30000
203	BOLTERS	10	15	15	15	15	24	28	30	30	18	0	0	20	17600	0	0	17600	18000
219	LINERMEN	6	6	6	6	6	7	8	8	5	2	0	0	6	5280	0	0	5280	5000
206	CARPENTERS	10	10	10	10	12	14	14	14	14	12	3	1	12	10560	2	352	10912	10000
205	BURNERS & WELDERS	1	2	2	2	3	3	4	4	5	4	1	1	3	2640	1	176	2816	3000
207	CHIPPERS & CAULKERS	4	4	4	4	6	8	10	12	14	14	2	2	8	7040	2	352	7392	12000
210 298	DRILLERS & REAMERS	8	10	11	13	14	17	21	27	29	20	3	1	17	14960	2	352	15312	17000
* 226	RIVET GANGS (3 MEN EACH)	4	7	8	10	11	12	18	25	33	32	3	1	16	14000	2	352	14432	44000
295	RIVET PASSERS	2	5	6	7	8	9	14	19	26	24	3	1	12	10560	2	352	10912	6000
294	RIVET TESTERS	1	1	1	1	2	2	3	3	3	3	1	1	2	1760	1	176	1936	2000
234	TANK TESTERS	0	0	0	0	0	6	14	21	24	15	0	0	8	7040	0	0	7040	8000
207	PACHERS	1	1	2	2	2	2	2	3	3	2	0	0	2	1760	0	0	1760	2000
208	CLEANERS	6	8	8	9	9	11	15	17	19	18	0	0	12	10560	0	0	10560	11000
296	BOLT RECLAIMERS	2	3	3	2	4	4	4	6	7	5	0	0	4	3520	0	0	3520	3000
297	HOISTERS	10	10	10	10	10	10	10	10	10	10	0	0	10	8800	0	0	8800	9000
[illegible]	SMITHS, CEMENTERS LABORERS & UNCLASSIF'D	5	7	7	7	8	10	12	15	17	12	7	3	10	8800	5	880	9680	10000
[illegible]	FOREMEN	9	12	11	12	14	16	21	25	29	21	4	2	17	14960	3	528	15488	25000
200 GROUP	HULL TOTAL	27	165	160	168	190	229	290	347	308	326	33	15	239	210320	24	4224	214544	225000
420 493	MACHINISTS & BOILERMAKERS	0	0	0	0	2	10	16	32	40	40	30	16	14	12320	23	4048	16368	18000
421	PIPE FITTERS	0	5	8	8	10	20	23	26	48	52	30	22	20	17600	26	4576	22176	25000
411	ELECTRICIANS	0	0	0	0	0	2	8	10	10	10	20	10	4	3520	15	2640	6160	6000
425	RIGGERS	0	1	1	1	3	5	7	9	11	12	10	6	5	4400	8	1408	5808	6000
400 NUMBERS	MISCELLANEOUS	0	1	1	2	2	4	8	12	14	16	10	6	6	5280	8	1408	6688	6000
500 GROUP	PAINTERS & CEMENTERS	0	0	0	0	0	0	0	0	20	40	40	20	6	5280	30	5280	10560	10,000
600 GROUP	GENERAL OUTFITTERS	0	0	0	0	0	0	0	0	4	6	24	16	1	880	20	3520	4400	4000
400-500-600 GROUPS	M.I. & O. TOTAL	0	7	10	11	17	41	62	89	147	176	164	96	56	49280	130	22880	72160	75000
200-400-500-600 GROUPS	GRAND TOTAL	27	172	170	179	207	270	352	436	535	502	197	111	295	259600	154	27104	286704	300000

KEY { Large figure is men
Small figure is the cumulative percentage of Labor Hours

* All figures in this line multiplied by 3 in totaling.

Note:– Index % = Average of Steel, Rivets & Tanks.

FORCE CHART No. 5 JANUARY 21, 1920.

STANDARDS DIVISION–COST & PROGRESS DEPARTMENT

Return to E. S. Reno

what an increased efficiency of only 10% in labor alone would add up to for constructing 122 ships or nearly a million tons deadweight, the selling price for ships being in the neighborhood of two hundred dollars a ton.

Cost System an Aid to Material Control

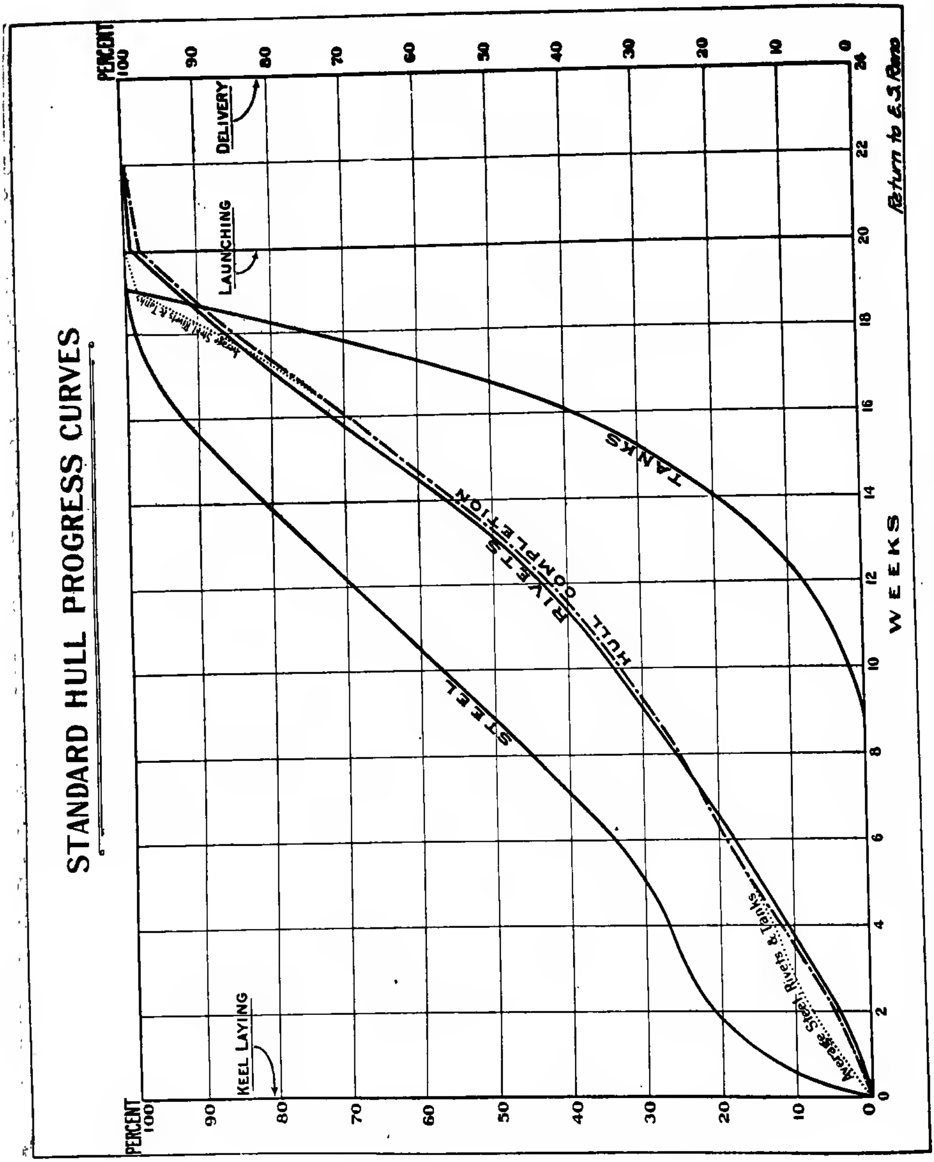
In describing specifically a few important practices in shipbuilding which are now fairly standard at Hog Island, it is first necessary to dwell upon the early practices which were due largely to the difficulty of getting materials in proper sequence,—something that all shipyards and other industries had to contend with during the war. We had to depend upon over 80 steel fabricators for our hull steel coming to us in the right order, and upon several hundred manufaturers of machinery, piping, fittings and equipment, at the same time that we were building up our organization and force of over 30,000 employees, only a small percentage of whom had ever worked in a shipyard before,—training them in some trade, (14,000 went through the Training School,)—and with all the incidental problems of transportation, housing, labor turnover, etc., that all large concerns go through with, the first year of operation,—all accentuated by war conditions.

The material situation, then, was our greatest problem, and we set out to improve the methods of handling, ordering, (requisitioning) and erecting materials, just as soon as the supply on hand was sufficient to enable us to do so.

The system of ordering and erecting materials by STANDARD CAR LOADS, as now in use, took several months to develop and perfect, and the correction of former practices took longer,—old practices, improper but customary in many shipyards, such as foremen and their assistants chasing up missing pieces, erecting in any sequence that the judgement of the foremen dictated by taking account of what material was available, and the resultant irregular distribution of the trades which have to follow one another on a ship. This is recited in order to lead up to the practical fact that it was extremely difficult to control the erection of steel,—not to erect out of sequence or too fast, but to keep just so far ahead of fitters, bolters and riveters, and no farther. Instructions were of course given, and improvment continued right along. But it finally took the Cost System to give the management the lever or supreme assistance needed to enforce standard practice in erecting. This is how it came about:—

In computing the percentage of hull work done, the percentage of steel erected was one of the three factors considered, the percentage of rivets driven and the percentage of tanks passed being the other two.

Now the standard allowable lead of erecting over riveting is 25%, but some superintendents rushed their erecting so much that in some extreme cases it led riveting by as much as 70%. This condition was


STANDARD HULL PROGRESS CURVES
PERCENT
DELIVERY
LAUNCHING
KEEL LAYING
STEEL
RIVETS
HULL COMPLETION
TANKS
Average Steel, Rivets & Tanks
WEEKS

intolerable from a technical standpoint and misleading in our completion computations. General remonstrances were of little avail so it was finally decided not to credit in our progress records any erecting in excess of a 30% lead over riveting. The result was striking. The undesirable lead which was not getting them any cost allowance on our efficiency reports, was discontinued by them on all future ships, with corresponding beneficial results in cost and quality of work. Good workmanship by various hull trades in proper sequence results in getting the watertight compartments or "tanks" ready to test under hydraulic pressure.

Tank Testing:—Why and how the cost system promoted tank testing:

At the start of production study at Hog Island, the two factors of steel erected and rivets driven were alone used as an index to hull progress. As shipbuilders, the superintendents of course realized the importance of tanks but as no mathematical consideration was given them in our progress computations they were allowed to lag far behind their proper schedule. Standard Instructions were issued, tables of "Tanks Behind" were passed out, and personal pleas made, but still the condition remained.

Cost System an Aid to Standard Sequence

Then action was taken along cost lines. Each tank was given a percentage value so that all tanks would add up to 100% and so be measurable in terms comparable to steel and rivets, the average of the three percentages being used as the index to hull completion. This put the value of "producing" tanks, or getting them finally passed for watertightness, before the superintendents in cold production figures with resulting cost credit the same as steel and rivets. The result was again striking. "Tanks Behind" began to grow less and less until today tanks are no longer our great stumbling block, but are completed according to plan the same as the production factors.

The mere fact of recognizing it as an underlying production factor and then using it as such in the computation of Hull completion fixes its status as such a quantity in the minds of superintendents.

Cost Per Unit for Each Operator More Forcible Method Than Pieces Per Hour

Comparing the effect of reports of (1) output per man with (2) cost per unit, of the work of the same man:—

In reporting production in our Daily Production Reports, we used to carry the following information:—

The following riveters worked day work:—

John Brown, 41144, 8 hours, production 58 rivets."

This statement, giving the various riveters who did not make piece work, apparently had no effect on the supervising force of the various

E F B C 1-20 E-3828

WEEKLY REPORT SHIP CONSTRUCTION PROGRESS

DIVISION No. 1 WEEK ENDING FEBRUARY 29 1920.

	WAY No.	HULL No.	STEEL		RIVETS		TANKS		HULL		PIPING		MACHINERY		M. I. & O.		ENTIRE SHIP	
			WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL	WEEK	TOTAL
WAYS	1	1528	4	61	3	48	5	5	4	38	1	16	1	10	1	10	3	31
	2	1539	0	24	2	9	0	0	1	8	1	1	0	0	1	1	1	9
	3	1522	3	81	4	67	3	54	3	67	3	46	1	44	2	34	3	59
	4	1526	5	84	4	68	9	42	6	65	1	37	3	41	1	29	5	56
	5	1527	3	68	3	53	0	20	2	47	2	23	4	18	1	15	2	39
	6	1534	2	26	5	16	0	0	4	14	0	4	0	0	0	2	2	11
	7	1537	2	24	3	13	0	0	4	12	0	0	0	0	0	0	1	9
	8	1524	5	79	6	62	4	41	5	61	3	35	7	30	3	24	5	52
	9	1531	5	46	4	35	0	0	3	27	0	10	1	1	1	5	3	22
	10	1532	2	35	3	24	0	0	2	20	1	8	0	0	0	3	2	16
WAYS TOTAL			.31	5.28	.37	3.95	.21	1.62	.34	3.59	.12	1.80	.17	1.44	.10	1.23	.27	3.04
TOTAL LAUNCHED				23.49		23.19		21.21		22.41						11.83		19.94
TOTAL WORK DONE ON WAYS	BERTH No.		.31	28.77	.37	27.14	.21	22.83	.34	26.00					.10	13.06	.27	22.98
WET BASIN		1509	"DELIVERED DURING WEEK"								1		1		1		1	
	B-3	1510	0	100	0	100	0	100	0	100	1	99	1	99	2	99	0	99
	C-4	1515	0	100	0	100	0	100	0	100	1	99	1	99	2	99	0	99
BASINS TOTAL			0	2.00	0	2.00	0	2.00	0	2.00	.03	1.98	.03	1.98	.05	1.98	.01	1.98
TOTAL DELIVERED				22.00		22.00		22.00		22.00		22.00		22.00		22.00		22.00
GRAND TOTAL ALL WORK DONE			.31	29.28	.37	27.95	.21	25.62	.34	27.59	.15	25.78	.20	25.42	.15	25.21	.28	27.02
TOTAL WORK DONE IN BASINS TO DATE				.51		.81		2.79		1.59						12.15		4.04

NOTE—DIRECT LABOR ONLY

divisions. A change was made in this report, as follows:—

"The following riveters received for driving rivets, day work:—

"John Brown, 41144, 8 hours, 58 rivets, average cost 26.2 cents."

We then gave the average piece work rivets driven per hour for the whole Island, against the day workers' average in each yard, comparing costs, etc. The effect of this report compelled the general foreman riveter to make comparisons based on a piece work and day work performance cost, because it shows in dollars and cents the cost of driving rivets by day or piece work.

Some day work rivets were costing us anywhere from $1.27 to 40c, the average cost for day work rivets being about 15c; piece work rivets average less than half that amount per unit.

In order to illustrate more clearly some essential features of this subject, it will be necesary to describe the details of the Hog Island Cost System.

Details of Hog Island Cost System

The work of assembling a ship on the Ways and in the Wet Basin is called direct labor and is analyzed along lines which have natural work boundaries, that is according to operations.

1. Ship Labor

The first sub-division of the ship labor is into (a) Hull and (b) Machinery Installation and Outfitting (called M. I. & O.) with the relative value of,—

(a)	Hull	- 3
(b)	M. I. & O.	- 1

11. Hull Labor

As previously stated, the Hull is divided into three main production factors which with their relative values are, —

(a)	Steel Erected	- 1
(b)	Rivets Driven	1
(c)	Tanks Passed	- 1

(a) Steel Erected,—This is measured by the tons of steel erected into position.

(b) Rivets Driven,—This is measured by the number of field rivets driven.

(c) Tanks Passed,—This is measured by the number of tanks passed, by giving each tank a weighted value as follows:—

A.I.S.C. 79-W-3250

HULL LABOR COSTS BY TRADES

DIVISION Nº 1

AS OF JANUARY 28, 1920

WAY Nº	HULL Nº	% COMP.	HULL LABOR COSTS: ERECTORS 212 222 STANDARD	ERECTORS ACTUAL	ERECTORS % EFF.	FITTERS & REGULATORS 215 STANDARD	FITTERS ACTUAL	FITTERS % EFF.	BOLTERS 203 STANDARD	BOLTERS ACTUAL	BOLTERS % EFF.	CARPENTERS 206 STANDARD	CARPENTERS ACTUAL	CARPENTERS % EFF.
1	1525	28	3620	3368	93	11580	11863	102	5410	6242	87	3550	4854	73
2	1609	4	810	1073	75	1810	1464	124	650	1172	55	625	1645	38
3	1522	56	6220	6810	100	19680	16355	120	12950	13076	96	6625	6615	100
4	1526	69	6560	7286	90	18200	13988	130	9865	10557	93	5975	7204	83
5	1527	87	6880	6292	109	14666	12198	120	7130	12344	57	4710	4542	104
6	1600	7	1285	1601	80	3370	1956	172	1185	1909	62	1040	1646	63
7	1607	6	810	1128	72	1810	1550	117	650	1263	51	625	2006	31
8	1530	41	4880	4555	82	15928	15599	102	8010	7955	101	5155	4541	114
9	1531	36	3700	3866	96	8900	6130	145	4200	4937	86	2600	3864	67
10	1532	15	3160	1978	109	4810	4169	116	2850	3036	94	2000	2915	69
TOTAL			36660	37748	96	102760	83672	123	60085	61571	82	38706	39642	83

WAY Nº	CHIPPERS & CAULKERS 207 STANDARD	CHIPPERS ACTUAL	CHIPPERS % EFF.	DRILLERS & REAMERS 210 220 STANDARD	DRILLERS ACTUAL	DRILLERS % EFF.	RIVETERS 221 223 STANDARD	RIVETERS ACTUAL	RIVETERS % EFF.	STANDARD	ACTUAL	% EFF.	ALL HULL TRADES STANDARD	ALL HULL TRADES ACTUAL	ALL HULL TRADES % EFF.	SPEED Nº DAYS ON WAYS STD	SPEED ACT	SPEED % EFF.	TOTAL HULL CONSTRUCTION COMBINING HULL LABOR COST & SPEED STANDARD	TOTAL ACTUAL	TOTAL % EFF.
1	3255	4421	73	4610	6115	75	9860	13559	73				48800	54189	91	48	68	71	158000	214155	78
2	520	928	56	600	913	66	986	1719	57				9000	14700	61	8	20	40	37000	48700	69
3	6840	7038	97	9050	9916	91	21120	21757	97				121600	113803	107	76	98	78	278500	358603	88
4	6190	6199	101	8800	9289	95	18745	21797	86				119350	105596	104	72	89	81	254416	288496	88
5	4565	4712	96	6125	6638	93	16580	16822	97				80850	85897	94	70	80	35	209360	240887	83
6	815	856	95	1060	1481	72	1740	2225	78				16250	17987	90	14	29	48	48750	36887	58
7	520	759	68	600	1006	60	986	1764	56				9000	14939	60	9	23	39	37000	60949	60
8	5040	4409	114	6905	6483	107	15190	17409	87				92250	98766	106	66	96	68	235350	276766	80
9	2270	1924	118	3100	4450	68	6500	8831	74				45000	46973	96	45	64	65	115000	154873	76
10	1710	1555	110	2265	2717	83	4085	5118	86				22750	21484	107	26	38	67	85750	109489	78
TOTAL	31616	33884	96	43505	48081	87	90100	110701	84				584350	586479	99	418	596	70	1600750	1736479	78

STANDARDS DIVISION - COST DEPARTMENT

Weighted Value of Tanks for "A" Ship

			Total
Tanks, 3, 4 & Reserve Fresh Water (P & S) and Machinery Foundations	value 3 each		21%
Tanks 2 and 5, (P & S)	value 4 each		16%
Tanks 1 (P & S) and 6	value 5 each		15%
Fore Peak	value 9 each		9%
After Peak	value 15 each	-	15%
Chain Locker	value 2 each	-	2%
Deep Tanks & Fuel Oil Tanks (P & S)	value 5 each		20%
Bonus for 1st Tank	value 2 each	-	2%
Total		-	100%

The straight average of the above three factors plus a slight correction gives the true or cost percentage of Hull Labor Completion.

In practice, this percentage of Hull Completion for any ship under construction is entered in a form (Chart No. 8) called "Hull Labor Costs by Trades." At a certain percentage of Hull Completion, we have a standard cost for each Hull Trade and for the group as a whole. These costs compared to actual cumulative charges received through the time-keeping department give the various efficiencies.

The next to the last column on this sheet is headed Speed. It shows the number of working days spent on the Ways compared to the number that should have been sufficient to attain present stage of completion. Evaluating each day at $2,000 for overhead transforms days into dollars, which added to the direct labor figures gives the total Hull Construction performance shown in the last column.

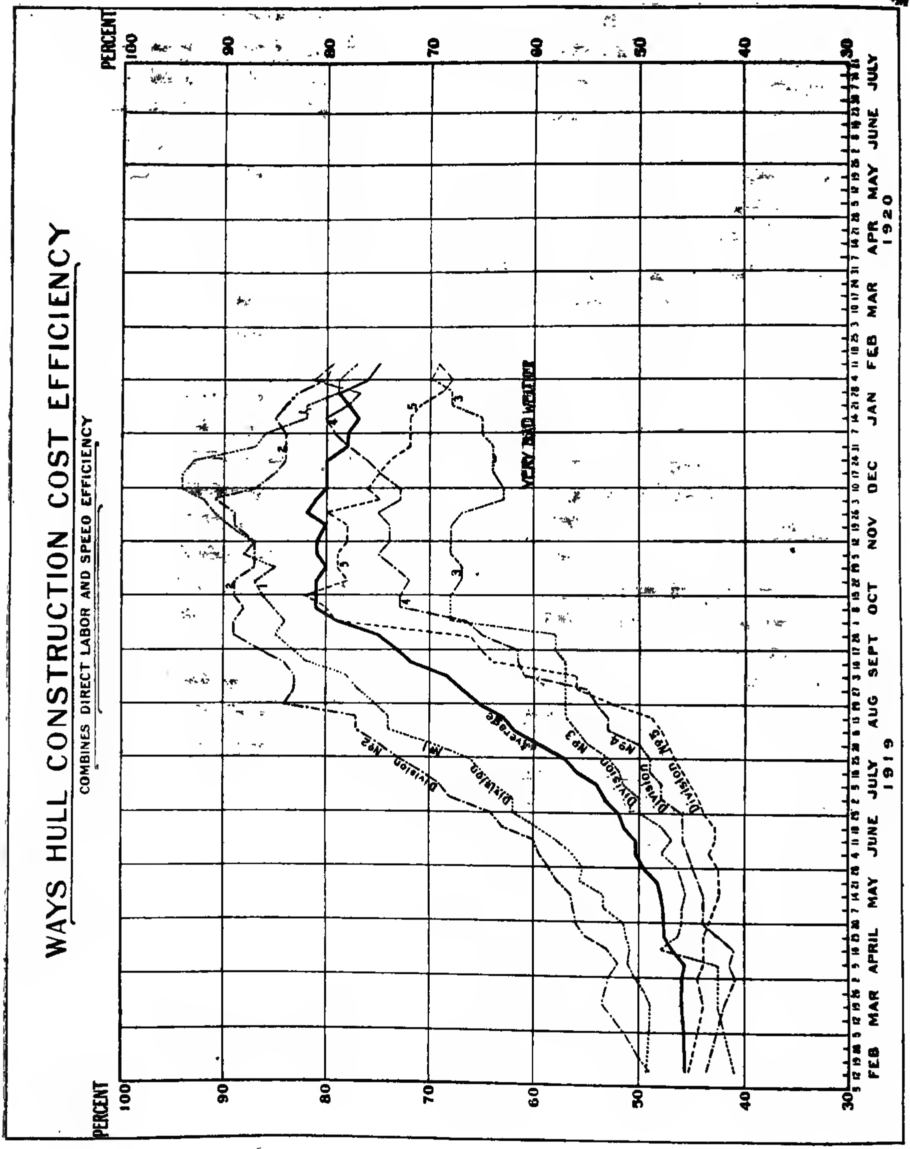
Each ten ships are summed up into a division, according to our organization, and the average Hull Construction Efficiency plotted as shown on Exhibit 9.

III. M. I. & O. Labor

Main Sub-divisions and weightings ("A" Ship)

(A)	Machinery	30.7%
(B)	Piping	42.7%
(C)	Electrical	8.0%
(D)	Gen. Outfit	5.3%
(E)	Painting	13.3%
	Total	100%

Each one of the main sub-divisions is again divided into small items which can be surveyed for completion each week by a man going over the ship. Example:


WAYS HULL CONSTRUCTION COST EFFICIENCY
COMBINES DIRECT LABOR AND SPEED EFFICIENCY
PERCENT
100
90
80
70
60
50
40
30
FEB MAR APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY
1919
1920
Division No 1
Division No 2
Division No 3
Division No 4
Division No 5
Average
VERY BAD WEATHER

(b) Piping	
Bilge	2.5
Ballast	5.3
Fuel Oil Heating	4.1
Main Steam & Exhaust	1.0
Auxiliary Steam & Exh.	5.7
Fuel Oil	.9
Lubricating Oil	1.0
Condenser Piping	.7
Main & Auxiliary Feeds	3.2
Deck Machinery & Steering Gear	2.7
Steam Smothering	2.2
Air Escape & Sounding	3.4
Steam Heating	3.2
Fresh Water	2.7
Salt Water	2.0
Fire	.7
Add for Dock Trial	.4
Add for River Trial	.7
Add for Delivery	.3
Total	42.7

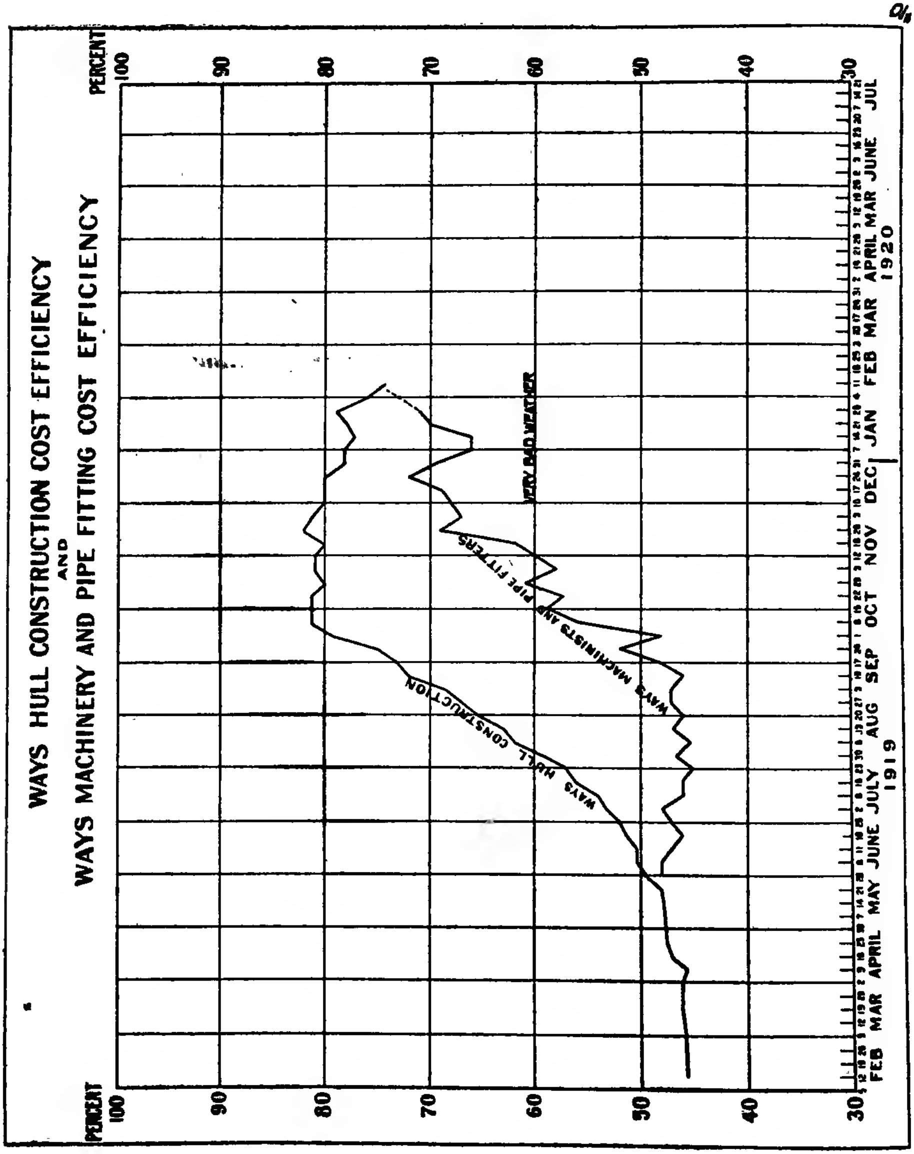
In practice, the method of analyzing M. I. & O. Labor Costs is similar to the Hull, only instead of setting standard trade costs from the percentage of completion of the group AS A WHOLE, the INDIVIDUAL trade percentages are used. Speed is not incorporated, as it is almost wholly dependent on the Hull men.

IV. Establishing Standard Hull Labor Costs
By Means of the Standard Force Chart

Refer to Chart No. 3 called "Standard Force for "A" Ship." This was carefully developed by analyzing statistics from our own and other yards in which the influence of one of our best ships predominated.

In each square there is a large number denoting the average number of men for that particular trade and period. The small figure is these large figures accumulated and reduced to a percentage BASIS. This gives the work which should be done up to the end of each period. A comparison of these work percentages for the Hull group of trades with each individual trade at each period gives the relation between those variables at different points; so that if the percentage of Hull Completion is known, the percentage of each trade should be completed is also known.

The speed standards are set by noting the percentage of Hull Completion at the end of each time period.


WAYS HULL CONSTRUCTION COST EFFICIENCY
AND
WAYS MACHINERY AND PIPE FITTING COST EFFICIENCY
PERCENT
100
90
80
70
60
50
40
30
VERY BAD WEATHER
WAYS MACHINISTS AND PIPE FITTERS
WAYS HULL CONSTRUCTION
FEB MAR APRIL MAY JUNE JULY AUG SEP OCT NOV DEC JAN FEB MAR APRIL MAR JUNE JUL
1919
1920

Before passing on, I would like to acknowledge the valuable services of my assistants who worked up the methods of progress and cost comparisons described above,—especially Mr. George Schobinger and Mr. E. S. Reno.

The above general description of the method of designing the Cost System at Hog Island to meet the needs of the operating executives, and the comments on the use which they make of the periodic reports, charts and other methods of comparison and visualizing results, may seem very crude and imperfect to a manufacturer accustomed to very accurate costs by detailed "operations" of only a few minutes duration. Yet it must be remembered that the complicated nature of this work is entirely different from ordinary shop work, and that there are numerous other checks and methods of control of labor operations required to supplement the timekeeping and cost keeping systems. The detail planning of the labor assignments, day by day, and the scheduling and supervision of the major operations, is a special study, and takes constant vigilance by superintendents and foremen, requiring considerable mechanical knowledge and experience.

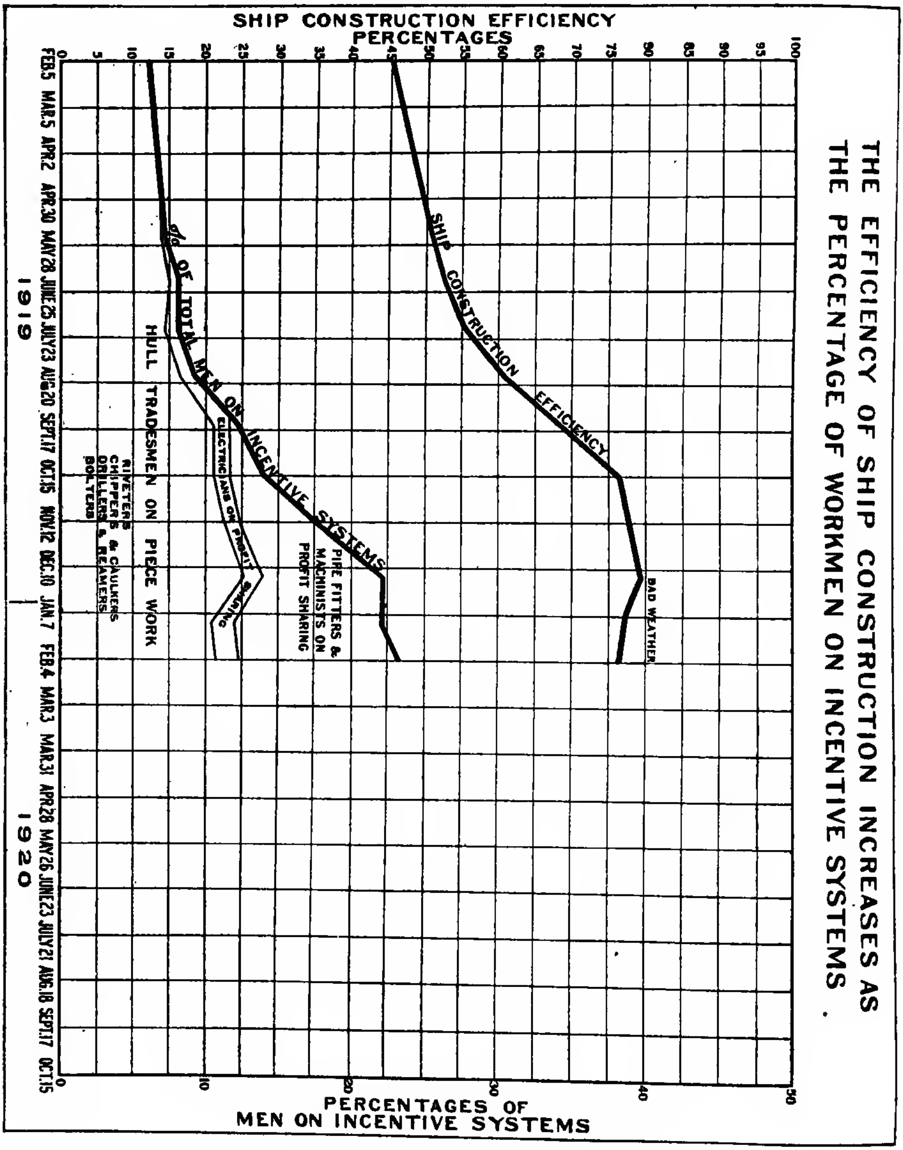
Cost Keeping in a Rifle Factory

I will now endeavor to speak, more briefly than of Hog Island, of a similar experience in the Rifle Factory at Bridgeport, where I was Production Engineer before I returned to shipbuilding in July 1917.

There we had to devise a Cost System to supplement the usual accounting system, in much the same way as had been done at Hog Island.

The equivalent rifles were figured very simply, by evaluating the work done in each department and floor in the factory on one rifle as a certain percent of one completed rifle,—based on summing up the standard labor costs of all operations in the departments.

The relative value of each operation, multiplied by the number of times during the week that the operation was performed and passed inspection, gave the "equivalent rifles" produced by each department. This was a quick and fairly accurate way to measure the "equivalent production" every week against the payroll, as shown on the sample of three months' results compared on page 237.


THE EFFICIENCY OF SHIP CONSTRUCTION INCREASES AS THE PERCENTAGE OF WORKMEN ON INCENTIVE SYSTEMS.
SHIP CONSTRUCTION EFFICIENCY PERCENTAGES
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
SHIP CONSTRUCTION EFFICIENCY
BAD WEATHER
% OF TOTAL MEN ON INCENTIVE SYSTEMS
PIPE FITTERS & MACHINISTS ON PROFIT SHARING
ELECTRICIANS ON PROFIT SHARING
HULL TRADESMEN ON PIECE WORK
RIVETERS CHIPPERS & CAULKERS DRILLERS & REAMERS BOLTERS
FEB.5 MAR.5 APR.2 APR.30 MAY.28 JUNE.25 JULY.23 AUG.20 SEPT.17 OCT.15 NOV.12 DEC.10 JAN.7 FEB.4 MAR.3 MAR.31 APR.28 MAY.26 JUNE.23 JULY.21 AUG.18 SEPT.17 OCT.15
1919
1920
0 10 20 30 40 50
PERCENTAGES OF MEN ON INCENTIVE SYSTEMS

Payroll and Equivalent Rifles

Week Ending	Total Weekly Payroll	Total Weekly Equiv. Rifles	Total Payroll Cost Per Equiv. Rifle
March 3,	$216,592	11418	$19.98
March 10,	226,849	13503	16.80
March 17,	228,678	14487	15.80
March 24,	227,666	14883	15.27
March 31,	227,638	15191	14.96
April 7,	226,423	15703	14.43
April 14,	226,062	16231	13.91
April 21,	235,367	16935	13.89
April 28,	243,231	17804	13.67
May 5,	246,615	18425	13.40
May 12,	254,006	19019	13.38
May 19,	259,380	19289	13.43
May 26,	263,137	19624	13.40

Prepared by H. E. Cobb,
Production Dept.

This information was collected and available within a week after the operations were performed,—long before the final accounting charges of all operations (about 3,000 per rifle) were made up by the accounting department, in the regular way; hence they were of immediate use to the operating management. At the same time, the efficiency by departments was figured out in a similar manner, on form RAB918 (Exhibit No. 19,) and copies were distributed to department superintendents. This acted as a spur to increased production at lower labor costs. The patent fact that departments with high percentages of Piece Work were lowest in labor costs, led all supervisors to planning and providing for CONTINUOUS piece work and they practically eliminated day work. The final result, with continuous piece work in May 1917 as compared to the conditions prevailing nine months previously,—before the Cost System had been installed,—was a labor cost of less than half the former cost. Until the Cost System began to place before the superintendents the facts and figures in this manner, they had been in the dark as to how they were progressing, and had no yardstick by which to measure their results and compare their efficiency with that of the other superintendents in the factory, or their costs with standard or possible costs.

No attempt will be made to describe the material, production and cost control system,—which was always subject to improvement,—but in order to show the method of charging labor and material to the various accounts which were finally brought together in the weekly cost and efficiency reports,—the charge symbols for the "Expense Accounts" are exhibited

20

CARD "A"

2ND REVISION EFFECTIVE, APRIL 30TH, 1917

EXPENSE ACCOUNTS

	DEPARTMENT AND FLOOR	Supervision and Indirect Labor 1	Miscellaneous Supplies (No Labor) 2	Repairs to Machines 3	Repairs to Fixtures, Jigs, Arbors Etc. 4	Repairs and Replacement to Tools Drills Cutters 5	Repairs to Gages 6	Repairs to Work in Process 7	Condemned Work 8
010	Vice President and Works Manager	0101	0102	0103	0104	0105	0106	0107	0108
011	A-2-E-B (Bookkeeping)	0111	0112	0113	0114	0115	0116	0117	0118
012	A-2-E-C (Cost)	0121	0122	0123	0124	0125	0126	0127	0128
013	A-2-E-T (Time)	0131	0132	0133	0134	0135	0136	0137	0138
014	A-2-W-P (Purchasing)	0141	0142	0143	0144	0145	0146	0147	0148
015	16 (General Stores)	0151	0152	0153	0154	0155	0156	0157	0158
020	Production	0201	0202	0203	0204	0205	0206	0207	0208
021	A-3-T (Records and Costs)	0211	0212	0213	0214	0215	0216	0217	0218
022	A-3-S (Shop Clerks)	0221	0222	0223	0224	0225	0226	0227	0228
023	28 (Shop Stores)	0231	0232	0233	0234	0235	0236	0237	0238
025	B-3-P (Print Shop)	0251	0252	0253	0254	0255	0256	0257	0258
030	Inspection	0301	0302	0303	0304	0305	0306	0307	0308
031	Laboratory Office	0311	0312	0313	0314	0315	0316	0317	0318
032	Chemical Laboratory	0321	0322	0323	0324	0325	0326	0327	0328
033	Metallurgical Laboratory	0331	0332	0333	0334	0335	0336	0337	0338
034	Physical Laboratory	0341	0342	0343	0344	0345	0346	0347	0348
035	Tool Inspection	0351	0352	0353	0354	0355	0356	0357	0358
040	Toolmaking	0401	0402	0403	0404	0405	0406	0407	0408
041	F-1	0411	0412	0413	0414	0415	0416	0417	0418
042	F-2	0421	0422	0423	0424	0425	0426	0427	0428
043	G-2	0431	0432	0433	0434	0435	0436	0437	0438
044	H-2	0441	0442	0443	0444	0445	0446	0447	0448
045	J-2	0451	0452	0453	0454	0455	0456	0457	0458
046	K-2	0461	0462	0463	0464	0465	0466	0467	0468
047	H-1	0471	0472	0473	0474	0475	0476	0477	0478
048	A4E—B1WS—B4S—D2S—F3S—F4S	0481	0482	0483	0484	0485	0486	0487	0488
	G4S—H5S—M2S—K1S—D1E								
049	D1F—H3F—R1—R2	0491	0492	0493	0494	0495	0496	0497	0498
050	Works Office Division	0501	0502	0503	0504	0505	0506	0507	0508
051	A-2-W-E (Executive)	0511	0512	0513	0514	0515	0516	0517	0518
052	37 (Watchman)	0521	0522	0523	0524	0525	0526	0527	0528
053	37-B (Barracks)	0531	0532	0533	0534	0535	0536	0537	0538
054	39 (Manuf. Supt.)	0541	0542	0543	0544	0545	0548	1547	0548
055	H-O-S (Hospital)	0551	0552	0553	0554	0555	0556	0557	0558
056	E-M-P (Employment)	0561	0562	0563	0564	0565	0566	0567	0568
060	Engineering	0601	0602	0603	0604	0605	0606	0607	0608
061	A-3-W (Executive Force)	0611	0612	0613	0614	0615	0616	0617	0618
062	A-3-D (Drafting)	0621	0622	0623	0624	0625	0526	0627	0628
063	A-3-P (Process)	0631	0632	0633	0634	0635	0636	0637	0638
064	B-3-E-A (Apprentices)	0641	0642	0543	0644	0645	0646	0637	0638
065	P-O (Power House)	0651	0652	0653	0654	0655	0656	0657	0658
066	U-C (Cutter Hardening)	0661	0662	0663	0664	0665	0666	0667	0668
070	Works Engineering—B-3-W-E	0701	0702	0703	0704	0706	0706	0707	0718
071	29 (Fire Department)	0711	0712	0713	0714	0715	0716	0717	0718
072	30 (Transportation)	0721	0722	0723	0724	0725	0726	0727	0728
073	31 (Yard)	0731	0732	0733	0734	0735	0736	0737	0738
074	32 (Bl'd'g Trades)	0741	0742	0743	0744	0745	0746	0747	0748
075	33 (Service)	0751	0752	0753	0754	0755	0756	0757	0758
076	34 (Cleaning)	0761	0782	0763	0764	0765	0766	0767	0768
077	35 (Salvage)	0771	0772	0773	0774	0775	0776	0777	0778
078	36 (Mech. Maint.)	0781	0782	0783	0784	0785	0786	0787	0788
079	38 (Elect. Maint.)	0791	0792	0793	0704	0795	0796	0797	0798

855-040

#16

(Exhibits 15, 16 & 17). It will be noted that the principle of the Dewey Decimal System is used,—which lends itself readily to the use of the tabulating machines. I was associated in this work with Mr. George S. Radford, later Contract Manager of the Emergency Fleet Corporation. The details of this charge system were worked out by Mr. Henry A. Thayer, now Lieut. Commander, U. S. Navy, Cost Inspector for the Navy at the Ford Eagle Plant, Detroit. He also had charge of the operation of the system, under my supervision, including all material control, production scheduling, production records and timekeeping,—up to the time he entered the Naval Service, when he was succeeded by Mr. J. G. Ennes and Mr. H. E. Cobb. In passing, I may say that Mr. Thayer had previously assisted me very materially in designing the present cost system for Navy Yards,in which work I was engaged for about a year, in conjunction with Paymasters Chadwick and Auld of the Navy. They represented the financial "Accounting" side,—all of us under the direction of the Paymaster General of the Navy, Admiral Samuel McGowan,—who laid down the principle that the cost system was to be for the use and benefit of the operating executives.

Three charts are shown (Exhibits 20, 21 and 22) which kept the manager of the rifle factory posted weekly as to general progress,—number of employees, (both direct and indirect labor,) average hourly wages, "equivilent" production, finished production, and total shop efficiency. Similar charts were issued weekly by "Departments" to the various superintendents of these departments.

Conclusion

The parallel between comparisons of actual labor costs with STANDARD labor costs, and similar analysis of indirect expenses by departments under a well developed "Budget" system, is very easily recognized.

In conclusion, it seems to me that a good cost system is very much like an education,—if you have it, you never think much about it, but if you haven't it, you appreciate what a wonderful advantage it must be!

CARD "B" — 2ND REVISION EFFECTIVE, APRIL 30TH, 1917 19

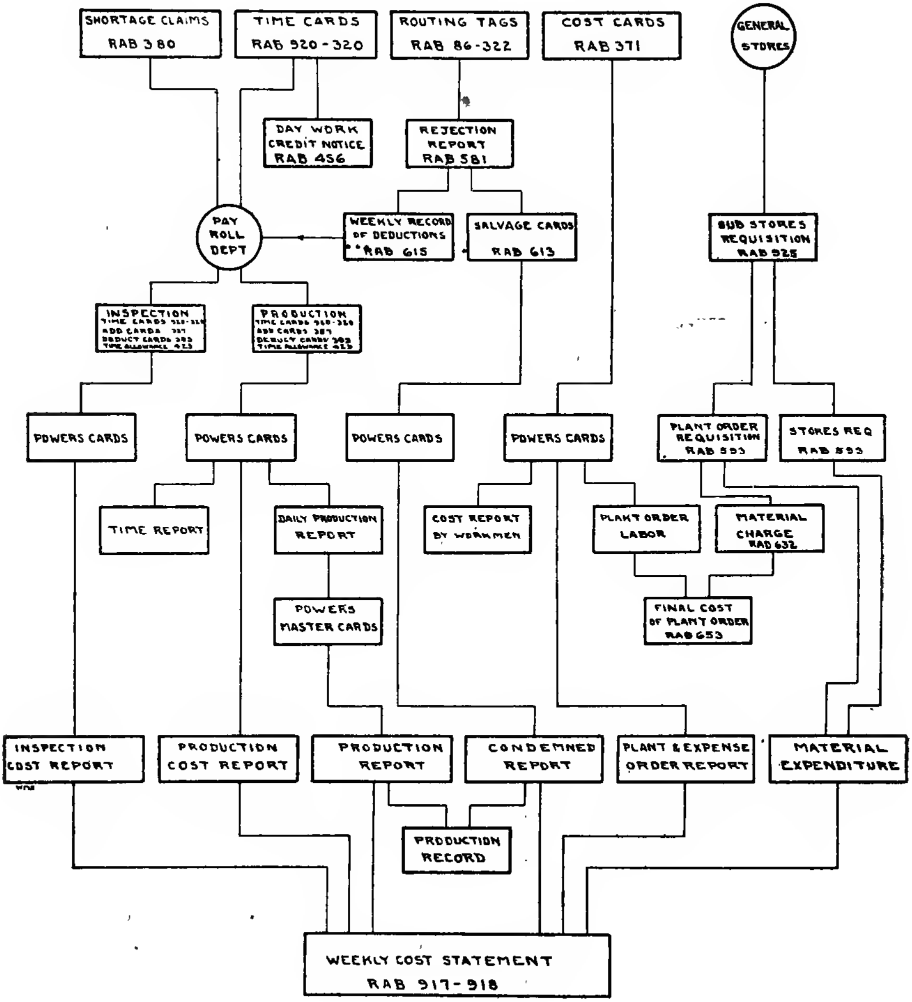
EXPENSE ACCOUNTS

	DEPARTMENT AND FLOOR		Supervision and Indirect Labor 1	Miscellaneous Supplies (No Labor) 2	Repairs to Machines 3	Repairs to Fixtures, Jigs, Arbors Etc. 4	Repairs and Replacement to Tools Drills Cutters 5	Repairs to Gages 6	Repairs to Work in Process 7	Condemned Work 8
100	DROP FORGE		1001	1002	1003	1004	1005	1006	1007	1008
110		S-F (270)	1101	1102	1103	1104	1105	1106	1107	1108
120		T (271)	1201	1202	1203	1204	1205	1206	1207	1208
130		U (272)	1301	1302	1303	1304	1305	1306	1307	1308
140		V (273)	1401	1402	1403	1404	1405	1406	1407	1408
150		G-1-W	1501	1502	1503	1504	1505	1506	1507	1508
160	Heat Treat									
161		S.H.T. (270)	1611	1612	1613	1614	1615	1616	1617	1618
162		T.H.T. (271)	1621	1622	1623	1624	1625	1626	1627	1628
163		U.H.T. (272)	1631	1632	1633	1634	1635	1636	1637	1638
164		V.H.T. (273)	1641	1642	1643	1644	1645	1646	1647	1648
200	BRITISH BAYONET		2001	2002	2003	2004	2005	2006	2007	2008
201		B-3 (Packing)	2011	2012	2013	2014	2015	2016	2017	2018
210		A-1	2101	2102	2103	2104	2105	2106	2107	2108
220		B-1-E	2201	2202	2203	2204	2205	2206	2207	2208
221		B-1-W	2211	2212	2213	2214	2215	2216	2217	2218
230		C-1-E	2301	2302	2303	2304	2305	2306	2307	2308
231		C-2-E	2311	2312	2313	2314	2315	2316	2317	2318
232		C-1-W	2321	2322	2323	2324	2325	2326	2327	2328
240		S-B (270)	2401	2402	2403	2404	2405	2406	2407	2408
250	SCREW MACHINE		2501	2502	2503	2504	2505	2506	2507	2508
251		B-4	2511	2512	2513	2514	2515	2516	2517	2518
252		C-4	2521	2522	2523	2524	2525	2526	2527	2528
300	BARREL		3001	3002	3003	3004	3005	3006	3007	3008
310		D-1	3101	3102	3103	3104	3105	3106	3107	3108
320		D-2	3201	3202	3203	3204	3205	3206	3207	3208
330		D-4	3301	3302	3303	3304	3305	3306	3307	3308
340		D-3	3401	3402	3403	3404	3405	3406	3407	3408
360		A-5	3601	3602	3603	3604	3605	3606	3607	3608
370		B-5	3701	3702	3703	3704	3705	3706	3707	3708
380		C-5	3801	3802	3803	3804	3805	3806	3807	3808
390		D-5	3901	3902	3903	3904	3905	3906	3907	3908
400	RECEIVER		4001	4002	4003	4004	4005	4006	4007	4008
410		E-2	4101	4102	4103	4104	4105	4106	4107	4108
420		E-3	4201	4202	4203	4204	4205	4206	4207	4208
430		F-3	4301	4302	4303	4304	4305	4306	4307	4308
440		G-3-E	4401	4402	4403	4404	4405	4406	4407	4408
450	BOLT		4501	4502	4503	4504	4505	4506	4507	4508
452		E-4	4521	4522	4523	4524	4525	4526	4527	4528
453		F-4	4531	4532	4533	4534	4535	4536	4537	4538
500	RUSSIAN BAYONET		5001	5002	5003	5004	5005	5006	5007	5008
510		G-1-E	5101	5102	5103	5104	5105	5106	5107	5108
520		J-1	5201	5202	5203	5204	5205	5206	5207	5208
530		K-1	5301	5302	5303	5304	5305	5306	5307	5308
550	MAGAZINE		5501	5502	5503	5504	5505	5506	5507	5508
551		G-4	5511	5512	5513	5514	5515	5516	5517	5518
571	SMALL PARTS —H-5		5711	5712	5713	5714	5715	5716	5717	5718
572	SMALL PARTS —J-5		5721	5722	5723	5724	5725	5726	5727	5728
573	SMALL PARTS —K-5		5731	5732	5733	5734	5735	5736	5737	5738
574	SALVAGE REPAIRS—G-5		5741	5742	5743	5744	5745	5746	5747	5748
700	POLISH AND BROWN		7001	7002	7003	7004	7005	7006	7007	7008
710		B-2	7101	7102	7103	7104	7105	7106	7107	7108
720		C-3	7201	7202	7203	7204	7205	7206	7207	7208
730		C-2-W	7301	7302	7303	7304	7305	7306	7307	7308
740		E-5	7401	7402	7403	7404	7405	7406	7407	7408
800	STOCKING		8001	8002	8003	8004	8005	8006	8007	8008
810		M-2	8101	8102	8103	8104	8105	8106	8107	8108
820		M-3	8201	8202	8203	8204	8205	8206	8207	8208
830		M-4	8301	8302	8303	8304	8305	8306	8307	8308
840		M-5	8401	8402	8403	8404	8405	8406	8407	8408
850		N-3	8501	8502	8503	8504	8505	8506	8507	8508
860		N-4	8601	8602	8603	8604	8605	8606	8607	8608
870		N-5	8701	8702	8703	8704	8705	8706	8707	8708
900	ASSEMBLING		9001	9002	9003	9004	9005	9006	9007	9008
920		L-3	9201	9202	9203	9204	9205	9206	9207	9208
930		L-5	9301	9302	9303	9304	9305	9306	9307	9308
940		K-3	9401	9402	9403	9404	9405	9406	9407	9408
950		J-3	9501	9502	9503	9504	9505	9506	9507	9508

#17 RAB-990

SEE DEFINITIONS OF CLASSES ON BACK.

CHART SHOWING SYSTEM OF OBTAINING COST AND PRODUCTION RECORDS.



WEEKLY FACTORY EXPENDITURE

FAB. 817

REMINGTON BRIDGEPORT WORKS

NON PRODUCTIVE DIVISION

WEEK ENDING ____________

DEPARTMENT	LABOR DISTRIBUTION — NON PRODUCTIVE LABOR: SUPERVISION IND. LABOR	EQUIPMENT REPAIRS	REPAIRS TO WORK	CONDEMNED WORK	TOTAL	$ INC.	$ DEC.	PRODUCTIVE LABOR: PIECE WORK	DAY WORK	TOTAL	$ INC.	$ DEC.	GRAND TOTAL	MATERIAL USED — NON PRODUCTIVE: OPERATING SUPPLIES	SMALL TOOLS EQUIP. REP.	TOTAL	DIRECT MATERIALS AND CONDEMNED	GRAND TOTAL	TOTAL LABOR & MATERIAL COST	ACTUAL PRODUCTION EQUIVALENT RIFLE PARTS	STANDARD PRODUCTION	EFF'Y	% INC.	% DEC.
V. P. & WORKS MGR.																								
WORKS OFFICE DIV'N.																								
MAINTENANCE																								
ENGINEERING																								
INSPECTING																								
PRODUCTION																								
SUB TOTAL																								
PRODUCTIVE DIVISION																								
FORGE																								
HEAT TREAT																								
BRITISH BAYONET																								
SCREW MACHINE																								
BARREL																								
RECEIVER																								
BOLT																								
RUSSIAN BAYONET																								
MAGAZINE																								
SMALL PARTS																								
POLISH AND BROWN																								
STOCKING																								
ASSEMBLING																								
SALVAGE G-6																								
SUB TOTAL																								
GRAND TOTAL																								
% OF TOTALS																								
$ INCREASE																								
$ DECREASE																								

April 30th, 1917

DEFINITION OF EXPENSE ACCOUNTS.

1. Supervision and Indirect Labor.
This class includes the pay of supervisors, foremen, cleaners, adjusters and all employees whose labor is not changeable directly to a production operation or to classes 2, 3, 4, 5, 6 or 7.

2. Miscellaneous Supplies.
Material only, (no labor) is chargeable to this account which covers consumable supplies used by the various departments. For example;—oils, waste, soda, broom, emery cloth and sand paper.

3. Repairs to Machines.
This class covers all labor and material used in repairs to machines. Charges will be located to the department using the machine.

4. Repairs to Fixtures, Jigs, Arbors, etc.
This class includes all labor and material used in repairs to the above. Charges will be located to the department using.

5. Repairs to and Replacement of Cutters, Drills, etc.
Charge this class with pay of tool grinders when grinding tools and with the new cutters and drills drawn from stores. Locate to the department using.

6. Repairs to Gages.
Charge all labor and material used for repairs to gages, locating the charges to the department using.

7. Repairs to Work in Process.
Charge this class with labor used in repairs to work in process. This number with the number of the department which performed the faulty operation will make up the charge number which will appear on the Repair Tag. All work necessary will then be charged to this number until the part has reached the first operation after the one at which rejection took place.

8. Condemned Work.
This is a book-keeping account only, and no charges will be made in the factory.

THE CHAIRMAN: I think we will agree that Mr. Ferguson has launched his paper with the same success that he launches his ships.

The discussion of Mr. Ferguson's paper will be lead by Mr. Hasbrouck Haynes, Industrial Engineer, President of Hasbrouck Haynes Corporation, Chicago.

MR. HAYNES: I shall confine my remarks to some of the theoretical phases of the subject and to the application.

"HOW THE COST SYSTEM ASSISTS THE MANAGEMENT IN THE REDUCTION OF OPERATING COSTS."

HASBROUCK HAYNES

President, Hasbrouck Haynes Corp., Chicago

In order that we may more clearly visualize the value of the cost system to the industrial manager as an aid to reducing the cost of production, let us first consider the elements of cost, and all possible means by which costs can be cut down. Then we can better judge the relation of the cost system to the many varied ways for lowering costs.

For this purpose we can advantageously take as a basis for analysis the three accepted elements of factory costs; material, labor and factory overhead. Then we should determine what might reduce these three elements in any one case. In this connection we must consider both the price paid for these elements, as well as the use to which they are afterward put, as both considerations affect the final cost.

Means for Reducing Costs:

We can state, as a general case, that any increased economy in the purchase, or greater efficiency in the use of the factory labor, material, or appropriation for overhead expense, will serve as a means of reducing the cost of the finished product.

Keeping in mind this broad statement of what is necessary to reduce costs, let us now consider some of the specific ways for accomplishing this result. By so doing we will be able to see just what effect the cost system itself has on the task of cost reduction, and in this connection neither overestimate nor under-estimate its value.

Naturally to reduce costs a change in conditions or methods is necessary. Either a change in the market price of the material, labor or expense must take place or some alteration is necessary in the manufacturing methods employed, such as changing from hand work to machine work, from intermittent assembling to assembling by means of conveyors, or from day work to piece work. If there were no change in the conditions there could be no change in the cost, so logically it follows that a reduction in costs must be preceded by some change in conditions or methods; or in other words, some action must take place.

The drop in the market price of material or labor resulting in a lowering of costs might be classed as a changed condition almost beyond the control of the management. But in this discussion we are, of course, interested only in those factors affecting cost reduction within the power and jurisdiction of the management and which, as mentioned before are brought about by changes in method.

Complete Machinery for Reducing Costs:

The machinery used by the management to effect changes in method that might increase the output or reduce costs can be divided into three headings as follows:

(1) **The System**—including all the accounting, cost, production, pay and other control methods and forms;

(2) **The Equipment**—including the buildings, machinery, tools and other facilities;

(3) **The Personnel**—including the line and staff, and the rank and file.

Some of the actual ways labor costs can be reduced are by means of:

(a) Labor incentives such as piecework and bonuses;

(b) Labor saving machinery and tools;

(c) Direct routing of material and automatic conveyor manufacturing methods;

(d) Labor training, including standard working instructions.

(e) Scheduling and dispatching work;

(f) Reducing labor turnover.

Among other ways material costs can be reduced by:

(a) Waste elimination by means of bonuses;

(b) Improved machinery and processes;

(c) Foresighted purchasing and close stock balancing methods;

(d) Thorough inspection methods.

Among other ways overhead costs can be reduced by:

(a) Elimination of unnecessary indirect labor thru better planning;

(b) Prompt repairs to machinery and tools (a stitch in time saves nine);

(c) Watching leaks in supplies, power and other expense items.

A casual analysis of these typical ways of reducing costs will emphasize the fact that the cost system independently is not the direct cause of reducing any of the three elements of cost.

The Function of a Cost System as part of the Cost Reducing Machinery:

The cost system promptly places before the management complete and comprehensive information as to the results of factory transactions. This information when compared with former performances, or with the performances of manufacturers in similar lines, brings to light any conditions or results which may be below standard. It is then the duty and function of the organization to act upon this information by studying the situation and by installing improved equipment or methods, such as just mentioned, to correct the conditions and bring the results up to standard.

It is to be noted, however, that the actual reduction in costs is the result of action taken by the organization. It is the combination of these three factors,—the system, the equipment, and the personnel—that finally brings about the improved condition; not any one of them acting independently.

Successful managers today control largely by means of what might be called "the exception principle." Napoleon is quoted as saying, "Tell me the bad news first." He realized that good news would take care of itself. So in manufacturing it is the unsatisfactory conditions as revealed by the cost records that the factory manager is interested in knowing first.

A cost system is to the factory manager very much what the accounting system is to the general manager. It is like the nerve system of the human body which transmits to the mind the conditions throughout the entire anatomy. It is like the intelligence department of the army which collects bits of information here and there and transmits them to headquarters from which the complete movements of the enemy troops can be detected.

A doctor with his X-ray pictures may be able to disclose an inflamed internal condition, but the X-ray is not the means of curing the disease. Still by means of the X-ray many useless and dangerous operations are avoided. But should the condition be serious it shows the surgeon where to look for the trouble. In the same way the cost system shows the industrial manager where congestion, disorder or slackness exist in his plant. While of itself it does not remedy the condition yet it does furnish the manager with information to help him correct the difficulty before it has become serious.

Advantage of Time Standards over Cost Standards:

With fluctuating labor and material markets cost standards are very difficult to attain. It is hard to compare, under present conditions, the operating efficiency of today with the operating efficiency of yesterday from cost records alone. It is almost impossible to tell whether any change in cost is due to a rise or fall in the market price of labor or material, or due to increased or decreased production efficiency. This objection to cost records is not so serious in normal market times, but it is objectionable in these abnormal times.

Much the same difficulty is now being experienced by manufacturers with their piece rates. Where many rates are necessary it is found extremely difficult to keep them constantly in step with the changes that are being made from time to time in the base rates due to the general rise in the labor market. As a result, in many cases manufacturers are changing their piece rate systems to bonus systems where standard times instead of money rates are established as a basis for wage calculations.

In this connection, as a basis for measuring the production of efficiency of the individual, the department, or the plant as a whole, an operation-time record, such as required by production bonus systems, is a more satisfactory standard than an operative cost record. This does not mean that the cost system may be abolished, but it does mean that as a means for measuring labor efficiency it is inferior.

Where only a cost system is available as an index of the efficiency of operation it is well, particularly in these days of fluctuating material and labor prices, to compare the costs of one plant with those of another plant of similar character, at the same date. A small but growing number of manufacturing associations have recognized this fact and serve as clearing houses for the exchange of such cost information for comparison among their members.

It is an advantage that a cost system does absorb all contributing costs. Because when tied into the general accounting records it becomes a basis for determining the monthly profits or losses of the entire business. This is, of course, extremely important information to the general management in directing the affairs as a whole.

Cost Estimates and Expense Budgets:

In many jobbing or contract-work plants, and in lines of manufacturing producing large expensive units, such as railroad cars, steamships, or large special machinery, it is particularly important to watch continually the progress of an order throughout the period of construction. It is not sufficient to wait until the work is completed to know what it has cost. A careful watch must be kept on the costs as the work progresses, comparing it with earlier estimates on sections of the work.

In such lines of manufacturing the conditions are somewhat different from those in a factory making a stock article. The selling price of stock products can usually be adjusted to correspond with their actual, or anticipated future cost.

In comparing performance with estimate, as a rule the material and overhead cost may be neglected. In such cases it is merely necessary to watch the accumulation of the labor cost to be able to keep within the lump estimate. This point is more important than might appear at first, as by so doing it greatly simplifies the cost-keeping during the period of construction.

It is difficult to control factory expense thru a budget system. The amount of non-productive labor and the quantity of supplies required is dependent largely upon the volume of production, and as this fluctuates any predetermined budgets are upset.

The percentage basis for comparison, such as the ratio of the overhead expense to the productive labor is the commonest off hand index for contrasting departments, plants or periods; but even here it is obvious that the volume of outputs must be taken into consideration to make the comparison fair.

Control of Factory Overhead thru Bonuses on Manufacturing Profits:

A practical basis for controlling manufacturing expense is to establish a monthly manufacturing profit and a monthly sales profit in connection with the accounting records. This can be done by theoretically selling the output of the factory to the sales department at a figure based upon the list price less an arbitrary discount. This discount to cover the selling expenses and sales profit.

The factory profit will be the difference between the factory selling price to the sales department and the factory cost of producing, including the material, labor and factory overhead. The plan, of course, necessitates the prorating of the administrative, accounting and general office expense to the sales and manufacturing departments on some equitable basis.

Such an accounting arrangement serves as a very satisfactory basis for paying bonuses to the factory executives and department heads, calculated from the manufacturing profits. Combining these bonuses on manufacturing profits with the regular production bonuses for increased efficiency in the shop furnishes ample incentive to both economy and efficiency in operation.

At the same time this system of manufacturing and sales profits puts the sales department on its own feet and furnishes a basis for bonuses to heads of that department, calculated on much the same basis.

Volume Justifies High Overhead:

As we all know volume is the secret of large profits, and to obtain volume economically requires the standardization of conditions and a functional type of organization. This standardization and organization increases the overhead expenses at the outset and it may take some time before the volume will reach a point which appears to justify the expenditure. Even if the limit of overhead cost is never reduced to the former figure, which is apt to be the case when a small factory grows to a large organization, nevertheless, the margin of profit and the faster turnover should justify this additional increase in expense. So we see that a policy of too close a tightening up of expenses might tend to retard expansion and the element of foresight and judgment must, therefore, enter into the fair analysis and criticism of all cost records.

Some of the By-Products of a Cost System:

While the direct advantages of a cost system to a factory manager result from the information it reveals, nevertheless, there are some highly important by-products to be derived from its use. The fact that the men working under a cost system have to account accurately for both their time and material tends to make them more sparing and more orderly in the use and distribution of these cost factors. This feeling of responsibility, which applies to foremen and supervisors, as well as to the rank and file, has a material effect in keeping costs down. It is somewhat similar to the moral influence of a cash register in a retail store. It may not absolutely prevent leaks but does tend to stop them.

A cost system has much the value of an accounting system in that it keeps track of the final distribution of all transactions. When you ship goods to a customer you bill him on your accounting records until his account, which remains open and serves as a reminder until payment closes the transaction. In the same manner a cost system keeps a record of each work order in process and serves as a reminder of the continuance of this order until it is finally disposed of by returning to stock, by blending with another order, or by shipment. This principle is an argument in favor of a double-entry cost system, which like a double-entry accounting system, serves as a check on the final disposition of all material and labor.

For the plant which has reached its normal growth increased profits are possible only thru higher selling prices or lower costs. We are fast approching the condition where further price raising will be impossible and profits from production will be the only opportunity for greater profits. In this connection, as a basis for investigating the possible ways of reducing costs, a cost system is indispensable.

However, the man who looks upon a cost system as merely a means for reducing costs loses sight of its possible greatest value to the business as a whole. As a basis for equitably establishing list-prices a cost system is in some cases invaluable; and when, as before mentioned, the cost records are tied into the accounting books to furnish a monthly profit and loss statement, we then have the cost and revenue comparison of the month's output as a whole, which in the last analysis is the final objective of the entire cost keeping plan. Where costs and expenses fluctuate rapidly, or where a manufacturer is working on a close margin, it is particularly important to know each month of the year exactly where he stands.

Conclusions Reached from this Discussion:

The relative value of a cost system as an aid to the management in the reduction of operating costs may be summarized as follows:

(a) A method of cost finding is an all extensive intelligence system for indicating to the management where costs might be reduced.

(b) Changes in system, plant equipment, and personnel are necessary factors in the reduction of operating costs.

(c) Where cost standards are to be used as a measure of efficiency, comparisons should be made between plants in the same industry at the same date.

(d) Operation-time records are more reliable standards than cost-records as a basis for measuring production efficiency.

(e) In many classes of work performances can be kept within estimates by watching the accumulation of the labor cost alone.

(f) A high overhead cost, to provide the necessary organization and system for the expansion of business, may be shown as justifiable.

(g) Where production incentives might tend to unduly increase the factory expenses, these expenses can be kept down by means of manufacturing profit bonuses to executives and department heads determined by the aid of the cost system.

(h) A cost system like a cash register, tends to check wastes of material and labor.

(i) A double-entry cost system in particular serves as a means for preventing the possible oversight of any factory expenditure, direct or overhead.

(j) Where it is impracticable to raise prices a cost system is a great aid in increasing profits from production.

(k) Under some conditions the major value of a cost system is in aiding the reduction of costs.

Under some conditions, it is the insurance of safety in fixing selling prices.

Under some conditions it is the furnishing of a monthly profit and loss statement.

Under other conditions any two or all three of these advantages may have equal importance.

THE CHAIRMAN: I am not going to call for an open discussion on the paper just now. The speakers and discussers have agreed to a sort of a daylight saving schedule for this afternoon and we will go along as well as we can, and if we are ahead of the game at the end of the papers, then we will devote the balance of time to open discussion.

I don't think Mr. Polakov needs very many words of introduction. Like other good engineers, he has managed to get his message across to the non-engineer in a very human way so that laymen are getting to be educated up to the point of looking to the engineer for the same human message that one has been accustomed to get from the pulpit, from social settlement work, or other humanitarian efforts. Mr. Walter N. Polakov is the President of Walter N. Polakov & Co., Inc., New York, and will speak to us on "Saving the Man by Wearing out the Machine."

MR. POLAKOV: Not being a member of this Society, I am grateful and thankful for the opportunity of speaking to you today, bringing to your attention one of the subjects relating to our industrial relations, which, at least to my mind, appears to be one of the most important today.

"SAVING THE MAN BY WEARING OUT THE MACHINE"

WALTER N. POLAKOV
President, Walter N. Polakov & Co., Inc., New York

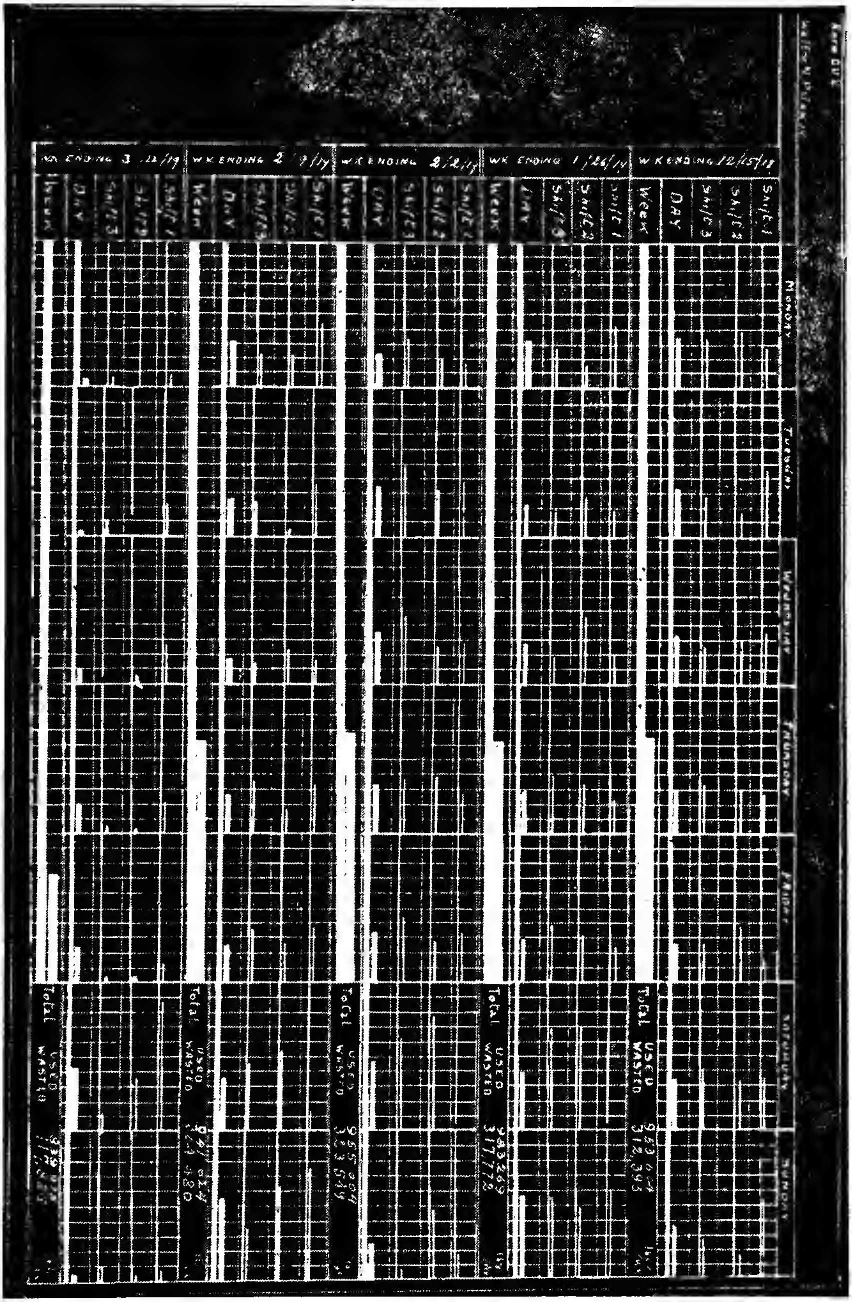
In his quest for harmonizing the industrial relations, Dr. Fred W. Taylor laid greatest emphasis on the "elimination of soldiering" which would lower the cost of production, insure higher wages and make shorter working hours and better working and home conditions possible. Maximum prosperity for both parties of controversy in his opinion can exist only as the result of the determined effort of each workmen to turn out each day his largest possible day's work.

After twenty years of determined efforts on the part of a large number of industrial engineers of all description and nearly in every country of the world, neither the expected prosperity nor consequent industrial peace makes itself manifest. Reasons for this failure can be ascribed neither to opposition of some labor groups to the use of stop watch nor to the lack of appreciation on the part of employers of advantages existing in the so called scientific management. Indeed there is a fairly large number of industrial establishments today that practice Taylor System, yet the reason why our industries as a whole did not get anywhere toward solving the problem of industrial relation is that it was sought in the wrong direction. One wonders that for over twenty years the forest was not seen behind trees.

The trouble was hinted at by Mr. H. R. Towne who naively said "The dollar is the final term in almost every direction which arises in the practice of engineering in any of its branches, except qualifiedly as to military or naval engineering, where in some cases cost may be ignored." (x) and also: "industrial engineering, of which shop management is an integral and vital part, implies not merely the making of a given product, but the making of that product at the lower cost consistent with the maintenance of the intended standard of quality."

Dollars and cost thus obscured and subjected all other considerations as to service to the society, welfare of the community, maintenance of standard of living, education and decency—the only qualifier being quality of the product and the only exception—military necessity—the disintegration of productive forces within a society was neglected for the sake of a dollar. Mr. H. L. Gantt summed up the situation in these terse words: "The aim of our efficiency has not been to produce goods, but to harvest

(x) Speech at Purdue University 1906.
(x) Foreword of F. E. Taylor's Shop Management, Harper Bros. 1912.



dollars. If we could harvest more dollars by producing fewer goods, we produced fewer goods." (xx)

So long as our industry is conducted individually and on competitive basis the success in business means securing larger profits. Increased production, by supplying more than the limited ability of population can consume, tends to lower the profits. Hence the increased productivity is avoided and whenever apparent is "corrected" by witholding the goods from the market by means of so called "cornering," hoarding or even direct limitation of output and refusal to book orders at less attractive prices.

Under such economic regime a peculiar inconsistency developed in treatment of idle producers and idle means of production.

If a worker is "soldiering" the management of "initiative and incentive" as well as the "Task management" exert their efforts to stimulate the productivity of individual worker until it measures up to their expectations. It creates therefore an alternative before a worker either to increase individual efficiency and make a fellow worker superfluous or to be laid off himself. The manufacturer, on the other hand is benefitted by increased production of men in his employ provided the productivity of his competitors and of the whole industry does not increase faster than the prices may be adjusted to safeguard his profits. If under the circumstances he finds it more profitable to limit his own production he lays off excessive workers still demanding high productivity from the remaining men.

The laid off men receive no wages and are no longer a direct concern to former employer; the laid off machines however, continue to draw the payments for rent of space they occupy, for interest, depreciation, insurance, etc.

While in this manner idle men are not burden to manufacturers, idle machines cause a material burden. This expense of maintaining idle plant is in turn unloaded by manufacturer on the shoulder of consumers inasmuch as the idle overhead is prorated over limited output of part of plant remaining in operation. In my paper before A. S. M. E. in 1916 on "Valuation of Industrial Methods" I said: "Present practice manifestly tends to charge against the cost of a product the cost of overequipment and mismanagement, thus imposing on society the penalty for tolerating these conditions in the industries."

(xx) H. L. Gantt, Organized for Work. Harcourt, Brace & Howe 1919.

In nearly every industry the overhead charges are higher than payroll; fixed charges on a $10,000 machine are twice as large as wages of its attendant; the blast furnaces overhead is over $90,000,000 while wages were $22,780,000; in steel mills overhead exceed $250,000,000 while wages paid were $188,142,000; in central station practice the overhead of $440,000,000 corresponded to only $36,800,000 paid in wages (above data from the last U. S. Census.

The importance of having the equipment to perform its productive work is far greater than further increasing the efficiency of individual workers.

The significance of the burden imposed on the society and a drain on economic resources of the country by neglect of using the existing productive capacity may be illustrated by a few typical cases.

1—In the coal industry 50% of productive capacity of mines remains constantly idle.

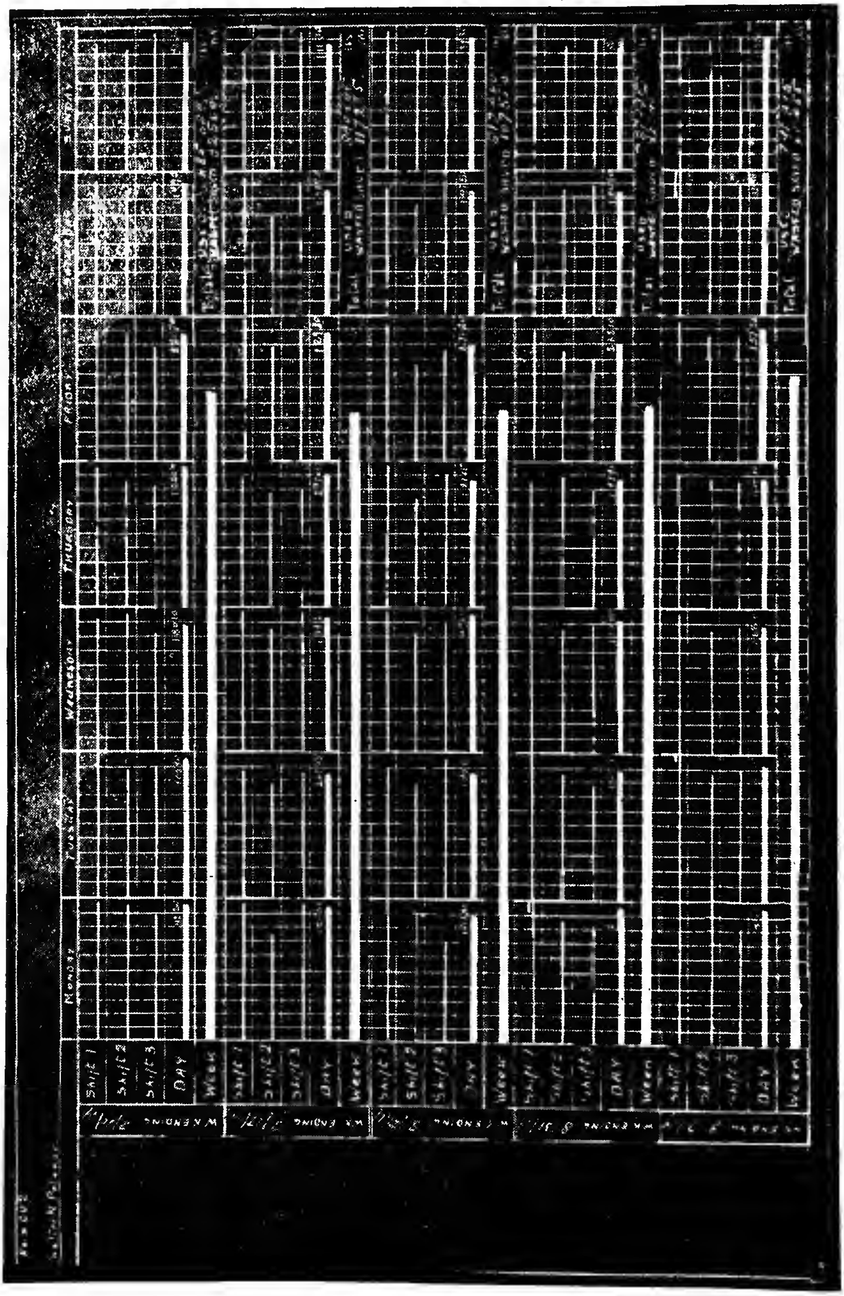
2—In the Blast Furnace industry 40% of productive capacity was idle during 11 years at an average annual expense of $79,200,000 of which $49,500,000 were avoidable i. e. not caused by repairs, relinings, etc., but by restriction of output.

3—In a typical central station supplying electric power to a railroad, annual idle expense averaged $123,980.00.

An instructive comparison of losses caused by the recent steel strike with those constantly inflicted by the policy of steel companies to the country illustrates the point. The loss of ingot production during period Sept.—Dec. 1919 was estimated at 2,500,000 tons equivalent to $23,750,000; this sum was recovered by the steel companies by imposing on the country the increased price of $9.50 per ton (Sept. $38.50) (Dec. $48.00.) If such was the expense of 3 months warfare against Labor Unions, the average annual idleness of capital is more costly to the country than 3 months strike repeated every year.

The organized labor today does not object to the increase of productivity; it indeed declares that; "Labor is anxious to work out better methods for industry, and demands that it be assured that increased productivity will be used for service and not alone for profits." (Declaration of 115 Labor Unions, Dec. 1919.) If now, on the basis of equity we adopt the **principle that the idle capital represented in idle plant and equipment is not entitled to any return or reward, same as idle labor** we will establish thereby a principle of fair play. This practice will put a stop to rewarding the idleness and will stimulate the industry to render to the country the most needed service.

Analyzing the causes of high cost of living the experts of National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Shift 2
Shift 3
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Week

Council of Defence said in a report: "In contemplating the Legislation of American business to adjust promptly the matter of production. . . . to meet peace time requirements, question arises as to how those requirements could have been accurately estimated and prospective prices better foreseen."

The problem has been successfully approached during the war time in so far as production and importation of necessary commodities were scheduled. The quantity of each was estimated and the time of delivery determined. The graphic chart was then kept to scale at once to time and percentage of quantity produced. Any shortage or excess was at once apparent and activities coordinated accordingly. This method as tried out with gratifying results, was used by Aircraft Production, Emergency Fleet Corp., U. S. Shipping Board; Ordnance Dept. and a number of private concerns.

Similar scheduling of peace-time requirements will eliminate uncertainty of guessing the demand from the price fluctuations, will reduce idleness, stimulate productive use of equipment and establish a competition on a basis of lowering the cost of production instead of by limiting the productivity in order to inflate prices sufficiently above the cost of idleness and mismanagement.

MR. POLAKOV: Because of the daylight saving schedule, by request of this Society, I will show my charts this evening. (Applause)

THE CHAIRMAN: Mr. Polakov's paper will be discussed by Mr. George T. Trundle, Jr., Consulting Engineer, Cleveland, Ohio.

MR. TRUNDLE: I am not going to prolong my discussion of Mr. Polakov's paper, because it is my opinion that we have not had enough general discussion on the various papers at this convention. Mr. Polakov has presented a paper which every man here should have an opportunity to discuss.

Wearing out the machine hardly seems to be the right subject. We are no more anxious to wear out the machine than we are to wear out a man. What we really want and must get. is the maximum production from the machine, with the least amount of repairs. You can readily understand that an overworked machine will necessarily have to be shut down for repairs which may not only affect production at that point but all the way through the plant to the shipping room.

We are spending thousands of dollars each day to increase the efficiency of man. We must do the same thing to increase the efficiency of the machine equipment. In increasing the efficiency of man, we follow the process of elimination. In other words, we unconsciously apply the system of eliminating fatigue, cutting out all lost motion. The machine is very similar to man. Mr. Knoeppel very ably proved to us that the functioning of the various mechanisms of our body could be used as an example of how an industrial organization should operate.

A machine needs the same careful, intelligent study as does labor. We must use the process of elimination not of parts of the machine, but elimination of trouble. A machine may be making automatically or semi-automatically an article at the rate of sixty parts per minute or hour. Why won't it produce seventy or even a hundred? We must find the reason. A machine may be making paper bags at an increased speed, but it may fail to do a good job of glueing. A slight change in the construction of the glue roll may eliminate this difficulty and permit an increased production of possibly fifty percent. The next trouble may be the stacking of the finished bag. This might be eliminated and another increase production made possible, and so on down the line, until the engineer has decided that any further increase would cause undue wear and tear on the machine and spoil the work.

The selection of equipment to manufacture any article is more important than the selection of men. We often choose a universal machine that is more suitable for a thousand other jobs than the one at hand, because it has a better selling value as a quick asset than a one-purpose machine. I discourage my clients on this point, in following this system, with the argument that we are not buying a machine—we are buying what it will do. Wherever the production is of sufficient quantity so that a special machine designed and built to perform a given operation will produce enough parts in excess of a standard machine, paying for itself in a reasonable lenght of time, we should by all means get the special machine.

The foremost thought in our minds today should be to conserve man-power by labor saving machinery and tools. There is a place in your plant for every level-headed, up-and-doing workman, but that place is not making something by hand that a labor-saving machine and tool will do faster, and in most cases, better. True regard for an employee's interest means putting him where his intelligence and responsibility counts, not in competing with a piece of inert machinery. When you have machines for the machine-job, you have more men available for the man-job.

In an article by James Burnley in the Romance of Invention, we find that there was something of an accident in the invention which Humphrey Potter, the lazy cock boy, brought about at a subsequent period—in 1705. The regulating and condensing valves had, in those days, to be opened and shut by a boy for that purpose. Humphrey, however, cared more for play than work, and one day, in order to escape his task and get away into the field, he conceived the idea of connecting the levers which governed the cocks with the beam by a piece of string. This idea he carried into effect and then off he scampered. His absense was discovered, and so, also, was his ingenious contrivance. No doubt he was freely forgiven and promoted, though we do not hear anything of him after that. For once idleness had done a great service to mechanical science—the principle of Humphrey Potter's labor saving invention being ever after adopted in the working of the steam engine which this improvement rendered completely automatic.

Mr. Polakov has shown that idle machinery is an expense. Therefore, we must get the greatest efficiency from every machine, thereby reducing the number of machines necessary for a given production. To get the greatest good out of Mr. Polakov's statement, we must have a free discussion. Let us apply efficiency in eliminating the law of time between speakers.

Before closing, I should like to start a discussion on the training of our mechanics to build these machines. All of you know that prior to the war we got our high-skilled mechanics—not all of them, but most of them—from Europe. Those men have been killed in the war and are not coming into our country any more. We must depend on our apprenticeship training in the United States. It is not being done, and unless something is done almost immediately—within the next ten years—we are going to find it difficult to build high-grade machine tools. Understand that I am not talking about the one-purpose man in the manufacturing department, but I am talking about the high-grade machinist and the tool maker. We are asleep at the switch and something must be done to train these men for ten years hence. (Applause)

THE CHAIRMAN: We will now have ten minutes for questions or discussion with regard to Mr. Ferguson's and Mr. Polakov's papers.

MR. PETTINGILL (Chicago): I think that our lack of discussion is somewhat due to lack of organization, with no criticism to our President. I think that a good many men here have the same difficulty in their meetings of foremen, getting the discussion started. I think the most successful plan which was adopted was to have men in various parts of the room ask questions which may have been foolish but which were intelligently answered, and which usually evoked a lot of discussion. I think most of us, because we have not read the papers and for fear of our questions appearing foolish, are prone to keep our seats.

Mr. Ferguson made the statement that a cost system was an aid to fair treatment of men. I want to ask him if this is through the setting up of a standard performance for the man to live up to, or, if not, in what way a cost system is an aid to fair treatment of men.

MR. FERGUSON: I stated that in a properly designed cost system there would naturally be included not only the cost in money but records of production of individuals, which compare with a proper standard or guide to give the relative ability or efficiency of employees. That would be applied either to the department heads or supervisors or workmen, and that, of course, presupposes that the standard with which you compare your actual production is properly set.

I didn't attempt to go into the method of setting it up in my paper, but the standards should be properly set and arranged so that all your records can be compared. In the description of the system which I gave, we had records which were taken over a long period and which were the result of very careful study and analysis, and they were always comparable and that was my intention—to bring out that particular phase of the subject.

MR. WALLACE: I might reply to Mr. Pettingill's reference to the lack of discussion by stating that the President not being a politician is not on to their ways. (Laughter)

THE CHAIRMAN: I think somebody must carry a way a hint from what has been contributed, and see to it that a complete discussion plan is organized so that a discussion man will always be prepared with standard questions for upsetting the speakers or starting the ball rolling.

MR. POLAKOV: I would like to say, regarding the official discussion by Mr. Trundle, that it seemed to me not to be a discussion of my paper. At least, I failed to find any connection between my paper and his discussion. He was talking about automatic machinery. Thinking over what he said, I agree with him absolutely, and I can probably find point in common and that is the more automatic, the more elaborate, the more complete the piece of productive mechanism is, the more dangerous is the neglect of scheduling, using it properly and using it all the time. First, because it costs a lot of money, those things must be taken into consideration, and if you are not using expensive mechanism, its the same as having an expensive car in the garage twelve months of the year, and you know what happens to your bill. Consequently, the more mechanical engineers work to develop the perfect mechanism for helping human labor, the more grave will be the responsibilty of industrial managers to see that this drag on the society, which is penalized for having productive equipment idle.

MR. TRUNDLE: I tried to show that our machinery was not being used efficiently. We often buy machinery not suited for the job we have and therefore its idle most of the time and its an expense because it isn't producing fast enough. Often times we buy machinery and find it useless, and then, instead of selling it and getting it off the books, it is charged off in the regular way over a given number of years and allowed to rust. Put it in profit or loss, or any where you wish. In my mind, incorrectly placed machinery is just as much a burden to the public as machinery not being used at all, because of the curtailing of production on the part of the manufacturers.

Copper, for instance—today the production of copper is being curtailed because barely enough is mined to meet the demand; the price is bound to come down, but with a curtailment of production, there is necessarily a shortage and it keeps the price up.

That same thing happens in idle equipment and Mr. Polakov hit on that part of the subject and I took as my subject my other understanding of the subject for discussion.

MR. NEUSTADT (Philadelphia): My only criticism of Mr. Polakov's paper is that it wasn't long enough. I suggest that we go on with that point of idleness of capital rather than idleness of labor which causes not only industrial unrest but also the high cost of living. I should like to have Mr. Polakov expand on that.

MR. POLAKOV: I couldn't expand on that in a few moments and I wouldn't attempt to do it. I even accepted the invitation to speak on such an enormous subject in twenty minutes with great reluctance, because such a subject cannot be properly discussed in twenty years, and the more questions will arise in your heads, the more I will be gratified that I stirred up something.

The whole subject of this paper was merely to bring up questions rather than to attempt to answer them within one afternoon with three speakers on the program.

MAJOR PORTER: I would like to have Mr. Polakov give us his ideas on this subject which we rather looked for him to bring out. A few years ago, when a good deal of expensive study was being made on the subject of getting the most of the machine, we heard a lot of talk about operating continuously, even in industries that didn't necessitate that type of operation. I, myself, came to believe that that was the thing to do and I was very much interested to find out a couple of years ago that Ford was deliberately enlarging his plant and was going from a three-shift basis back to a two-shift basis, and from twenty-four hours to sixteen hours, because he found that one of those shifts were not producing.

MR. POLAKOV: I was up against the same problem in my private practice and I found that three shifts, as a rule, were very economical from the viewpoint of dollars but not from the viewpoint of human expenditure of vitality. Therefore, it is national economy, so to speak, to eliminate the rotation of three shifts and increase the vitality of workmen, and that is a great deal more important than a few dollars.

As an example of that, I have under my direction a mine in which extensive studies have been made to find out whether the third shift is a good proposition from the broader standpoint or not, and it has been fairly conclusive (fairly because we haven't arrived at the final results) that we will commit social crime by installing the third shaft in that case. In other words, as I said in the beginning of my paper, there are two distinct viewpoints in industrial problems, one from the viewpoint of the dollars made by individual effort, and the other of the benefit that our country derives from the industrial productivity. Whenever they can be reconciled, the answer is the same. Whenever they are not reconcilable, and in many cases they are not, its a moral question and I, as an engineer, wouldn't answer it now. (Applause)

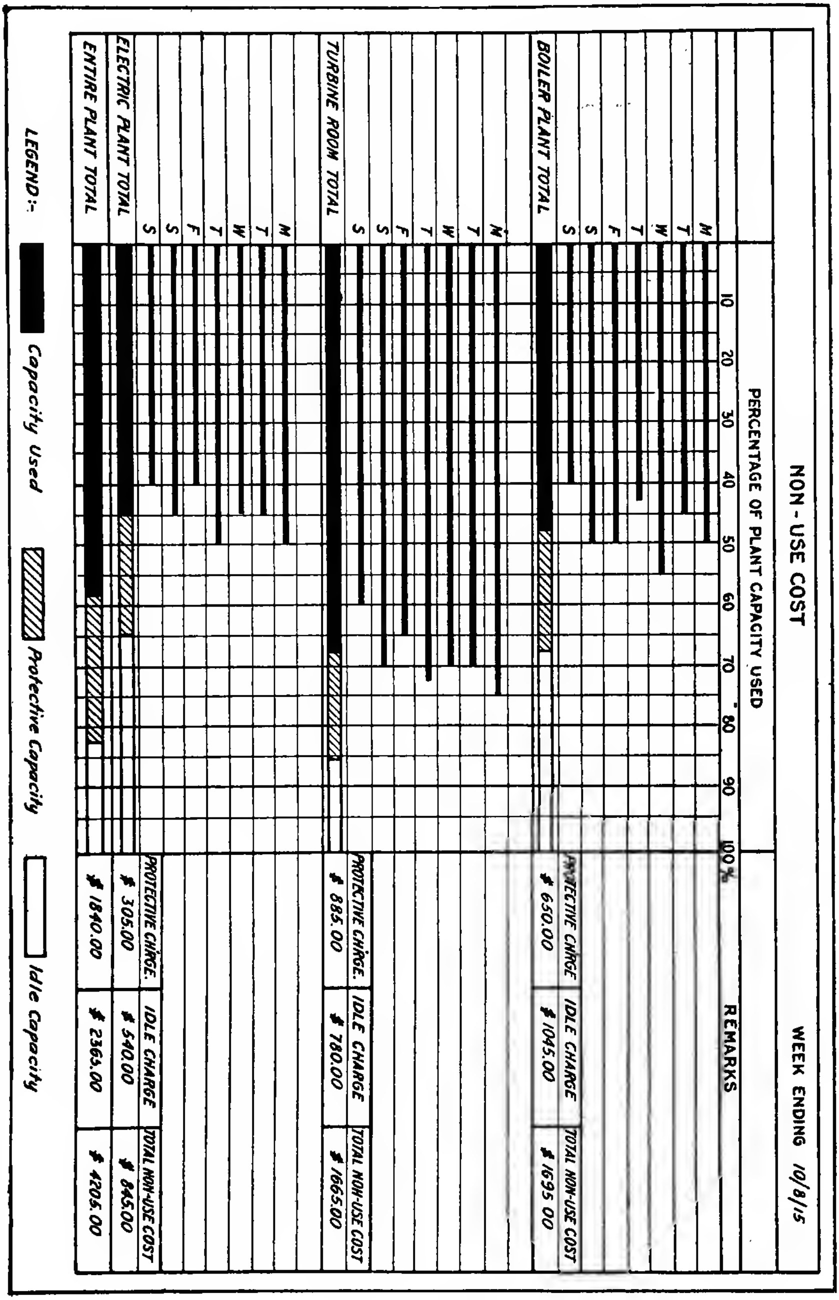
MR. M. POROSKY (Boston): I would suggest that Mr. Polakov indicate the connection between idle machinery and the law of supply and demand.

MR. POLAKOV: Now my neighbor tries to drag me into political economy, and I am not an economist so I will evade the answer.

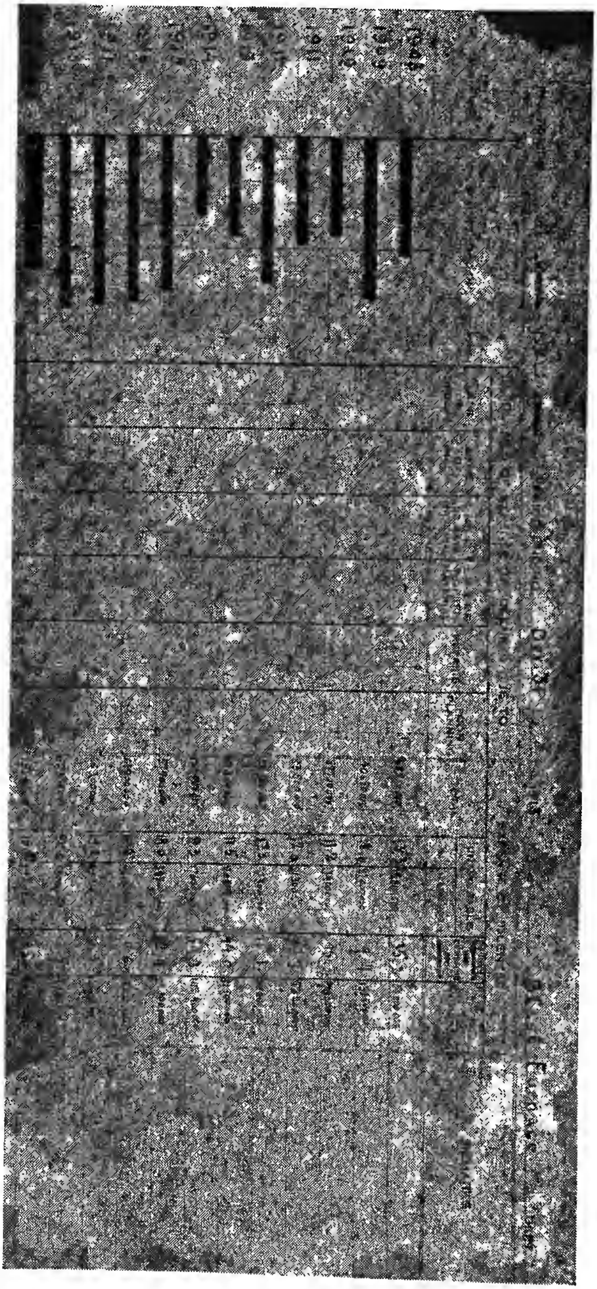
I will say, however, that I don't know that there is such a law as supply and demand in existence. I never observed that law in my life. We call something by that name but it is neither the law, nor has it anything to do with supply or demand. It is curtailment of the market and if we can sell at higher prices by reducing the output, we do so. If we are not manufacturing enough shoes, we can enhance the prices from $4.00 to $12.00. We used to do that, but that has nothing to do with supply and demand—it has something to do with the pavement upon which we cannot go very comfortably barefooted. (Laughter)

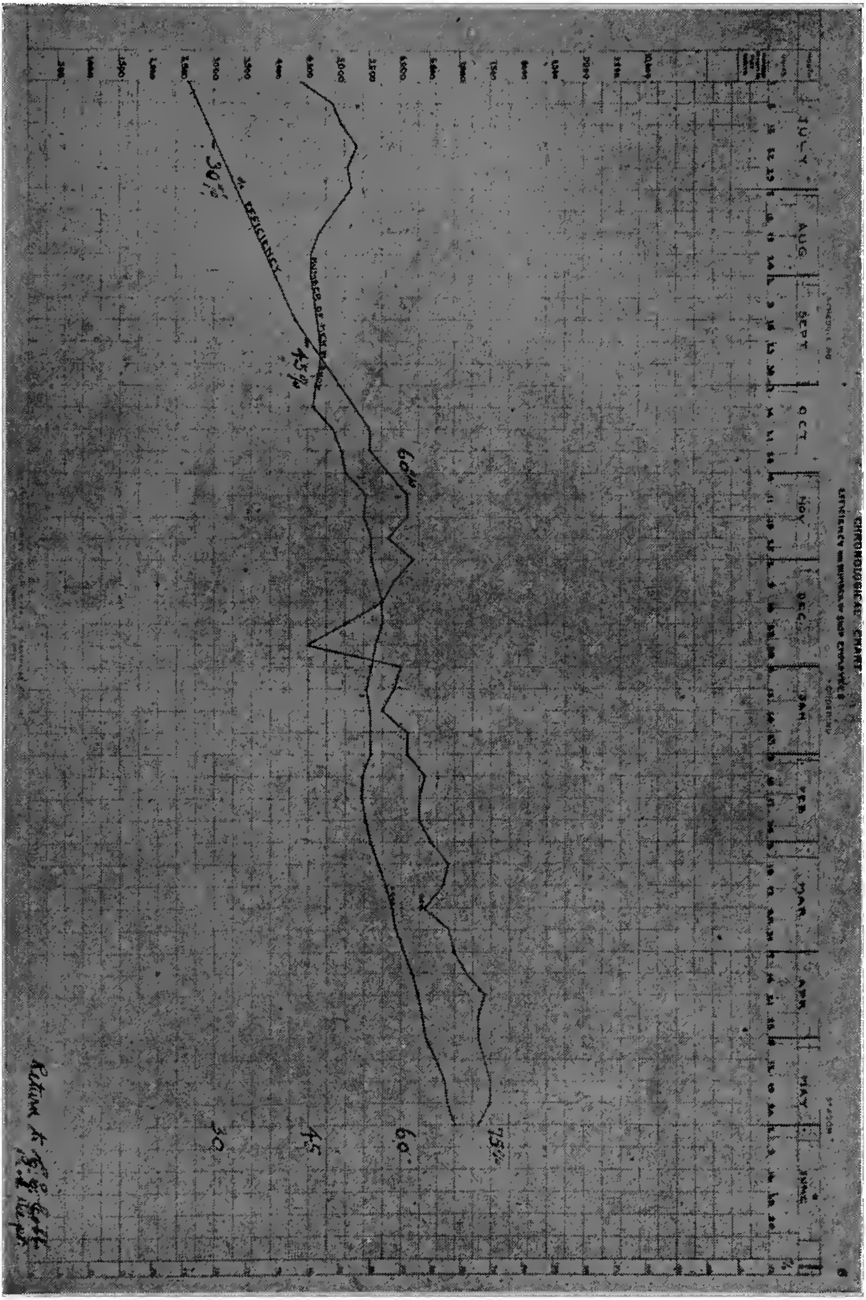
In other words, its taking advantage of the necessity. Furthermore, in case of so-called over-production, there is often heard a statement that there is an over-supply but we all know there isn't, and I remember a page from a magnificent book by Harrington Emerson where he calls attention to the breadline at the same time as we apparently have over-production of all things in the country. Apparently, there is no law of supply and demand in his case either. The cases somewhat differ.

If the people in this country did not have the money with which to buy the things they were sorely in need of, or if their earning capacity was reduced by mismanagement while the prices of commodities were increased by financing, I don't call that political economy—I call it common sense. (Applause.)



Plant operating Electric Railway.
Note excess of boiler room capacity, causing large portion of boiler room to stay idle

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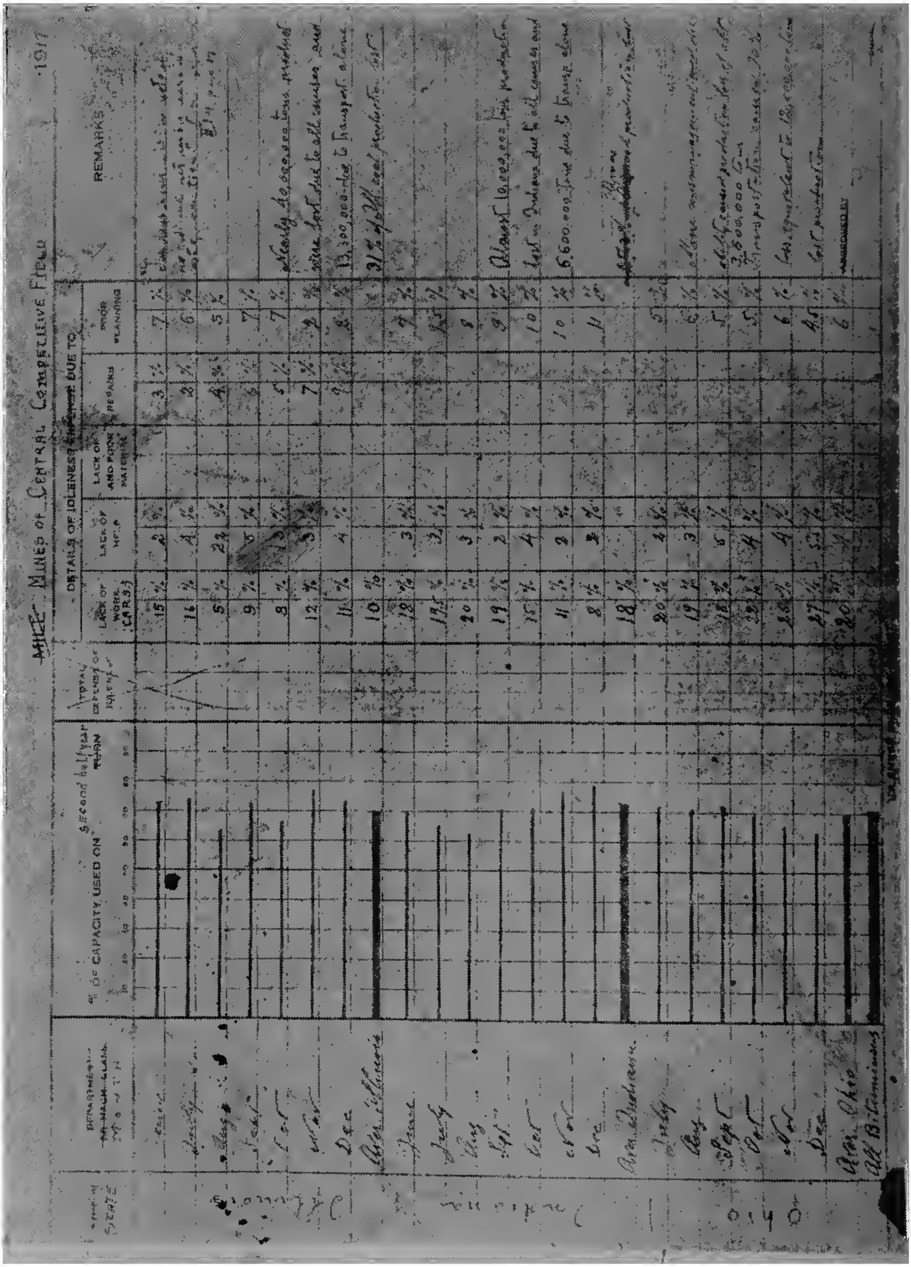
MINES OF CENTRAL COMPETITIVE FIELD
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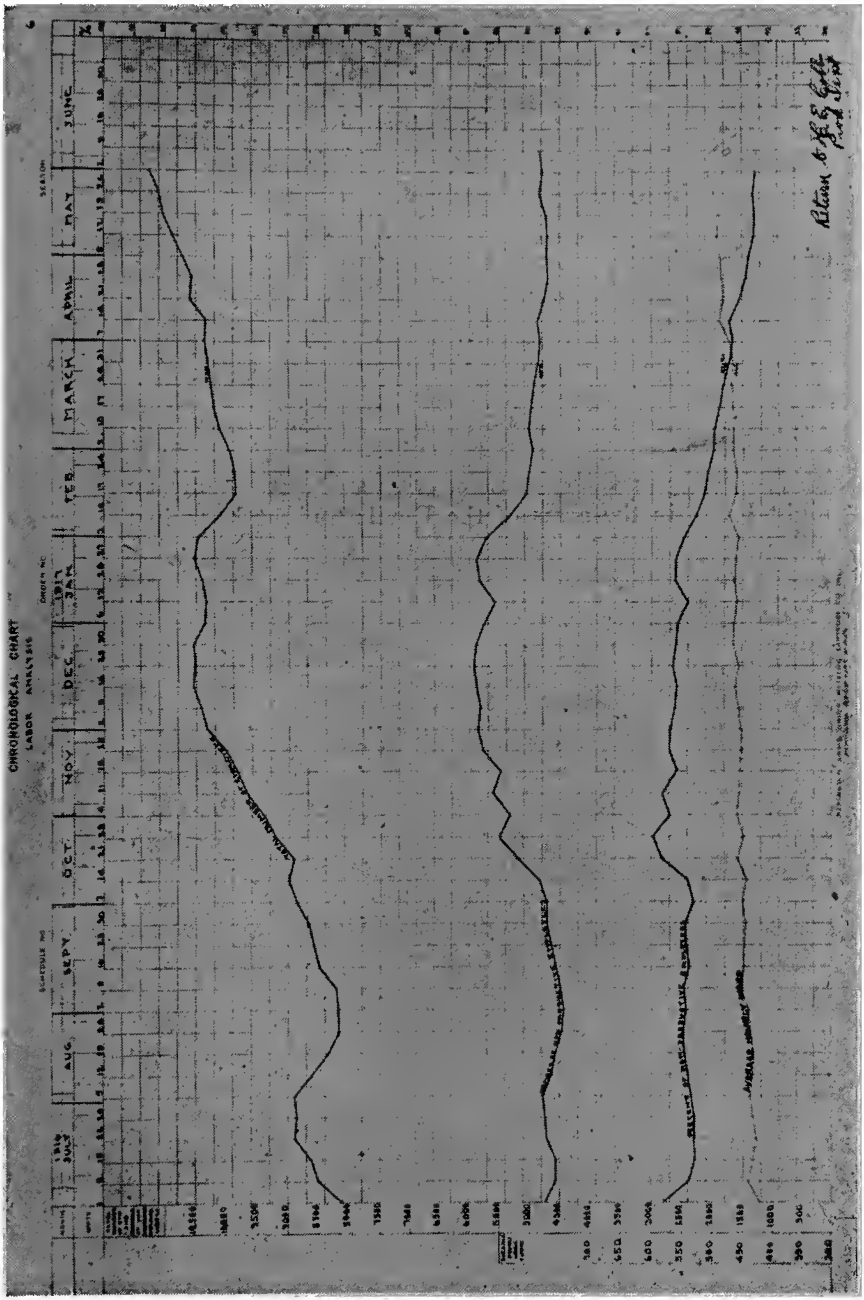
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THE CHAIRMAN: It gives me great pleasure to present to you Mr. Alford, The editor of "Industrial Management," who has as much right as any human being I know of, to voice his views on "The Value of Team Work Among Engineers."

MR. ALFORD: In taking this topic—"The Value of Team Work Among Engineers" it is evident that I must take one or two viewpoints, that either you engineers are doing team work from the results that are pointed out, or else you are not doing it, and its up to me to show what you might have done.

I venture to take the second attitude and very frankly quarrel in a good natured way and point out many things that you engineers do or do not do. Perhaps I ought to think of what's going to happen to me, and it reminds me of a story that was credited to a doughboy in France. At a Salvation Army meeting in France, there was an attractive little French girl working around the hut, and who had found religion. In keeping with the Salvation Army practice, she was giving her testimony and she said, "Last night I was in the arms of the Devil; tonight I am in the arms of the Lord," and a doughboy yelled out, "How about tomorrow night?" (Laughter) So I suppose its for me to watch for the comeback after you have listened to what I have to say.

We are all familiar with the saying that the children of the shoemaker go barefooted; that the wife of the miller has no meal, and you gentlemen are organizers but you yourself are unorganized. Do you ask for proof? One of the publications in New York City, a technical paper, issues a list each year of the technical and engineering societies. The list dated 1920 lists 271 organizations, national, state, district and local. Of these, about 200 could be classed as engineering and technical societies, and the others having some flavor of manufacturing or trade organizations, although they all have some bearing upon engineering. That is, you have organized in some two or three hundred small organizations and you have no single over-spreading organization. You are literally unorganized.

VALUE OF TEAM WORK AMONG ENGINEERS

L. P. ALFORD

Editor, Industrial Management

Engineers are aloof, self-centered specialists caring for little or nothing but their narrow professional aims. Engineering is a disorganized profession broken into fragments. What an amazing inconsistency! Engineers are continually advocating team work, unity of purpose, cooperation, combined effort, organization; and you, gentlemen, who deal with the major problems of industry are unceasingly putting these principles into the plants of your clients. But as a profession you do not practice what you preach; you do not take your own medicine. You have organized among yourselves only to bring confusion and greater disorganization.'

Do you ask proof?

It is estimated that the professional engineers of this country pay more than $1,000,000 per year in dues into some 200 national, state, district and local engineering and technical societies. Some estimates place this number of organizations much higher, reaching a total of over 600 when there are included the various engineering trade associations of which many exist. Either total is sufficient to prove the charge that engineering is a disorganized profession, for there is no nation-wide, over-spreading, all-embracing society expressive of the ideals, purposes and work of all engineers.

Furthermore, the charge of waste stands proved in the upkeep of the secretarial organizations of all these societies, a duplication of expense and effort for which engineers should be heartily ashamed. They have applied the industrial principles of sub-division and specialization to such an extreme that all of the major advantages of team work have been lost.

That others see us in this impossible situation is proved by the comment of an American statesman and politician, in the best sense of the word, a keen observer of people. Talking with Mr. M. O. Leighton in regard to the effort now going forward sponsored by engineers to establish a national department of public works this great man said:

> "Your task is appalling. You have been elected to lead engineers into political reform. They are the most unresponsive citizens that we have. Your organization has a praise-worthy purpose but if it were sponsored by almost any other group of reputable men than engineers there would be more promise of success. If your organization succeeds I believe you will find

> that it will not be the engineers who have carried through. Their aloofness and indifference in all matters outside of their own professional sphere are among the unexplainable things in our political life."

That opinion from the outside cuts deeply, it hurts. Every engineer must feel a twinge of shame for his own profession when he realizes that a public man speaks of us as "the most unresponsive citizens that we have" and looks upon our aloofness and indifference as one of the "unexplainable things in our political life." Unresponsive citizens, unexplainable political units—indeed we are guilty of failing in team work among ourselves!

I have mentioned the application to extreme limits of the principle of specialization as striking proof of the great failure of engineers. Practically speaking an engineer joins only one of the national engineering societies, thus showing how far he specialized in his personal affiliations. Mr. W. E. Bullock, Assistant Secretary of the American Society of Mechanical Engineers, presents the following facts in regard to the duplication of membership between the four national societies, those of the mechanical, civil, mining and electrical engineers.

> In the metropolitan district, the largest local center of the four "national" engineering societies of mechanical, civil, mining and electrical engineers, there are four men who hold membership in all four societies. This district contains about one-fifth of the total membership of the same four societies, so that in the whole country there are probably on the order of twenty men who hold all four memberships.
>
> Of course, there is a larger number who hold membership in three of these societies, and a still larger number who belong to two. In the metropolitan district the total number of "duplications"—two or more societies—is under 300 and is well within 5 per cent of the total number of memberships. This figure is obtained by actual count and could be substantiated for the whole country without difficulty. It is safe to say, however, that there are not more than 1500 duplications in the total number of memberships approximating 40,000.
>
> This figure is of significance in discussing the question of engineering organization.

So the charge that engineers fail in team work is proved from the viewpoint of engineering organization. In this respect there is wide departure from true American ideals.

Team work implies **united effort.** The powerful concept that these two words convey, one that meant so much to our forefathers of Revolutionary days, has been weakened and in its place we too often speak of cooperation. Let us return to the idea and principle of union, that great fundamental which built this nation. Have you forgotten such familiar maxims as these:

"United we stand, divided we fall."
"In Union their is strength."
"We must hang together, or it is certain we will hang separately."

And the motto spread upon the shield of the United States of America, "E Pluribus Unum"—one from many—a great rallying cry of all true Americans.

How different might be the power and influence of engineers today if in their professional affairs there had been no departure from the Ameri-ism of our fathers which they expressed in the word **union**.

In applying this great American ideal in the engineering profession there are three aspects of the team work that should be made effective.

1. There should be the closest union of essential purpose among the recognized leaders of the profession. No element of jealousy should be permitted to exist; prejudice, belittling of the attainments of another, or questionings of the capabilities of another's organization should disappear; the highest code of professional ethics should be respected and lived up to by those recognized as our professional leaders for they are setting the example for all others.

If I may be permitted to speak quite plainly to industrial engineers, as one who is of you and yet at the same moment who stands a bit apart from your professional activity, I must say this: The profession of industrial engineering has suffered, from the time of its beginnings in the minds and hands of such men as Fred W. Taylor, H. L. Gantt and Harrington Emerson, because of the debasing efforts of fakers and charlatans. You all recall with a shudder the extravagant statements of a dozen years ago, made by alleged efficiency engineers who guaranteed impossible improvements in production, factory organization and management. Many of these men were actually retained by clients, attempted to do work which failed to the discredit of themselves and, worse, to the discredit of the profession as a whole. I wish it could be said that all of these men had sought other fields of endeavor, such as selling stock in oil companies, or wildcat mines, or something like that. But the truth remains that they are still with us. Their efforts can only be neutralized by setting up and adhering to a code of ethics by all honest engineers—a code that will be respected by clients everywhere and will stand as a measure between the men who are worthy and the ones who are unworthy. The value of this form of team work cannot be measured. It is the bed rock of the future of the profession of industrial engineering.

2. While ideals and codes of action must spring from individuals they can be adopted by a society and through the lines of influence that the society exerts can be made more potent in business and industrial affairs. An engineering society expresses itself to outsiders in three ways: Through the personality and professional attainments of its members and officers; through official acts, such as resolutions and declarations adopted by the body as a whole or by its board of directors; through the engineering literature that it brings into being and disseminates under its authority and emblem.

These expressions can only come into being in true force through the team work of every member of the society. And herein lies a great advantage of an organization like The Society of Industrial Engineers, which promotes the welfare of the profession as a whole and of its members in particular.

3. The great ideal of industry that is being set before us by leaders of our own profession has been splendidly stated in recent months by two of our number.

Mr. H. L. Gantt in his last book, "Organizing for Work" published just before his death said:

> "In other words, 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."

In a current magazine article Mr. C. E. Knoeppel, who is with us at this convention, drives home the same thought in this manner:

> "In the last analysis all business and industrial activities are for public service. All products of industry are for the direct or indirect use of the people of the country. Service to the community is no less an obligation on the part of labor than on the part of management and capital. Service at a profit, not mere profit alone, is to be the motive in the new order of things."

There is no way in which this great ideal of essential service to society as a whole can be realized by the engineer—the man of all men who stands between capital and labor and enters upon a consideration of problems without prejudice—except by combined effort, by the union of plans and energy, by team work.

So the value of team work among engineers will find its greatest expression in its service in national affairs. The united work by a small number of individuals, or through the membership of the society as a whole, is but the foundation for greater things, and among these stands the possibility of taking our present problems of capital and labor out of politics and determining them on a matter-of-fact basis. Here is where the value of team work shows to the greatest possible degree.

It would be unfair seemingly to charge the engineering profession of the United States with an utter failure of team work. Broadly speaking the charge stands, but here and there have been flashes of united effort which must be mentioned to present a true picture of what has been done, and especially to lay emphasis on what can be done.

The four national engineering societies of the mechanical, civil, mining and electrical engineers, created an Engineering Council to provide for consideration of matters of common concern to engineers, as well as those of public welfare in order that united action might be made possible. The first meeting of this joint body was held June 17, 1917. Among its important acts up to the present are the following:

> "As parts of its war services, Engineering Council furnished to governmental departments, 4000 names of engineers for technical duties; aided the Naval Consulting Board and the Army General Staff in examining 135,000 suggestions and inventions for war devices, and cooperated with the Fuel Administrator in conserving coal.
>
> Council organized Engineering Societies Employment Bureau in November, 1918, which since the armistice has registered 5500 engineers and assistants (mostly returned soldiers and naval men) and has aided thousands to positions, without charge.
>
> Council established the office in Washington under the general direction of a National Service Committee. Through this office engineers have been put into contact with the Federal Government as never before: individuals, companies and societies have been furnished information about the activities of Congress and the departments of Government, and useful services have been rendered to the Government.
>
> For the promotion of a Department of Public Works in the Federal Government, representatives of seventy-four technical societies, having 105,000 members, were assembled at the invitation of Council in Chicago, April 1919, and Engineers', Architects, and Contractors' Conference created to support the enterprise, Engineers throughout the country have been organized

and the cooperation of the Chamber of Commerce, U. S. A., and other business organizations sought. The National Chamber, at the request of Engineering Council, has appointed a special committee to consider the advisability of submitting a referendum on this subject to all local chambers. A second conference of 124 societies was held in Washington, January 13-14, 1920.

Through direct appeal to President Wilson, Council brought about a conference of the fourteen Government offices engaged in map-making, with the prospect of greatly accelerating the completion of the topographical map of the United States. It is now hoped to have the whole country mapped in a decade and one-half; at the former rate the country would have been finished before the map. A joint organization of the 14 offices has been set up.

By the generous services of an able committee, Council has well advanced a comprehensive, carefully considered scheme for the classification of engineers, with suggestive schedules for compensations. Working in three sections, this committee has dealt especially with engineers on the staffs of the railroads, of the Federal Government, and of cities and states, believing that a suitable scheme for these great groups would be acceptable to most other groups. Preliminary reports of this committee have attracted serious attention throughout the United States and in Canada and are constantly in demand.

Engineering Council has drafted a typical general law for the registration of engineers, architects and land surveyors, the result of fourteen months' work by a committee representing all parts of the country and the various important branches of the profession.

Council assisted the State of New York in preparing a scheme for reorganization of the State Government, through an advisory committee made up of eminent local engineers.

Council aided in securing increases of pay for some of the railway technical engineers and certain municipal engineers.

In favor of a National Budget, on invitation of the Select Committee of the House of Representatives, Council sent delegates to Washington to present testimony before the committee.

Recently Council has established committees on Types of Government Contracts on Military Affairs, and on Cooperation with the American Institute of Architects.

Among the foregoing activities of the Engineering Council are mentioned the protection of the effort to establish a Department of Public Works of the Federal Government.

That work has since been taken over by the National Public Works Department Association which has organizations in practically every state in the union with headquarters in Washington, D. C. It is carrying on active propaganda for the passage of the Jones-Reavis bill to do away with the Department of the Interior and set up in its place a Department of Public Works as a division of the executive government in Washington with its secretary, a full cabinet officer.

A third effort where engineers have united is in forming the joint conference committee of the mechanical, civil, mining and electrical engineers to formulate a plan for a national engineering organization. That report has been presented with the expectation that it will be accepted by each of the societies interested and that a national conference will be convened next month embracing accredited delegates from local, district, state and national engineering and technical societies to bring into being the national engineering society.

These three examples of united effort forecast imperfectly what engineers will do if they unite and do team work. They emphasize again the value of such team work on the most comprehensive, nation-wide scale. I am sure that The Society of Industrial Engineers will do its full duty in entering in spirit and with full activity into all these efforts which require team work among engineers.

Lest any one believe that there is little opportunity for great things let me briefly suggest these three:

We know nothing about conditions in Russia except that revolution has taken place, a new government has been installed and an attempt made to put into practice the most astounding, untested, economic principles. What results have come from these attempts? What is the condition of industry operating under these principles? What does their application promise? I am ready to declare that no one is qualified to evaluate the economic and industrial results that are taking place in Russia except industrial engineers. What an opportunity for team work this presents! I wish this society might have the honor of sending an accredited commission of engineers to Russia to study the economic and industrial principles that are being tried out and make a matter-of-fact engineering report.

Perhaps the engineer is a bit unfortunate in lacking something of the spirit of the ancient explorers and pioneers. How strong was the appeal of adventure to these men, how gladly they searched for unknown lands, or sought for new rivers or great chains of mountains, rumors of whose existence came to them through savage inhabitants. In our day the physical characteristics of the earth have been so fully explored that this type of adventure has nearly passed. But is there not something of the same appeal in the thought of going to a great nation like Russia, which has embarked upon such a tremendous experiment in economics and industry, and ascertain the true facts of what has been done and is promised. Should this Society select a commission of this kind the members should go forth with the thought that they are partaking of the spirit of the explorer, or the discoveries, for they will be searching for knowledge and truth of one of the great, unknown, social efforts of mankind.

An entirely different opportunity presents itself in the thought that we should have a great engineering and industrial center in Washington, D. C., where the engineering and technical societies of this country would have headquarters or offices, where there would be gathered together information in regard to engineering and industry the like of which does not exist. Why should not the engineers of this country join together in team work and raise an endowment of, say, $20,000,000 to found this center? Is it not possible that the public and the great industries would be quite willing to contribute to such a fund, provided assurance was given that the engineers would abandon their traditional habits of aloofness and unite in team work?

A third opportunity is presented in the often made, but hitherto never acted upon, propospal to found a group of national museums of industry. It should be a combined record of invention and progress, with educational facilities for a survey and study of every industrial art and even applied science. Only engineers can make this suggestion a reality, and to do it they must work together.

Perhaps the "value of team work by engineers" can be summed up in no better way than to say, that all of the advantages that came to our forefathers in uniting themselves together to found this nation, will come to engineers in their professional life if they will but unite and do team work.

Why do we permit organized labor to have headquarters—permanent headquarters in Washington? These men are conferred with by legislators. Why should not the engineers have headquarters of their own down there? Why shouldn't they have headquarters in Washington where they could assemble the essential factors in order to have information available for the benefit of the Legislative, and be in position to advise in regard to the legislature of the bills upon which technical knowledge can be brought to bear on the subject? (Applause)

THE CHAIRMAN: I hope that will push a committee of technical engineers to make just such an investigation, as suggested by Mr. Alford, in Russia, but I would suggest that in view of the still unsettled conditions in Russia, no prospective member of such committee throw away his safety razor just now, and such committee might well be instructed to go to Germany and to other centers where new forms of control are being tried out.

Mr. Irving A. Berndt, Vice President of C. E. Knoeppel & Co., Inc., New York, will discuss Mr. Alford's paper.

MR. BERNDT: I discovered this afternoon that it was quite dangerous to discuss papers. (Laughter) But I think because I had an opportunity quite some time ago to read Mr. Alford's paper, I can stay with the point.

"VALUE OF TEAM WORK AMONG ENGINEERS"

Discussion by

IRVING A. BERNDT

Vice President C. E. Knoeppel & Co., Inc. New York City

It was with a great deal of interest that I read Mr. Alford's decidedly instructive paper. I suppose that I had all the reactions he intended us all to have. I felt a good deal like I did one time when after taking for the first time some very violent exercise, I felt lame, rather shot to pieces —but very much better for it.

We are fortunate indeed to hear Mr. Alford present this critical review. No one else in this country would dare be so frank in his criticism. But above all there is no one so entirely qualified to do so. We must recognize that he speaks with much authority. Then too Mr. Alford is personally a man who can call us names with a smile on his face and make us like it. So let us take our medicine and derive the greatest benefits possible from it.

Is there anything in Mr. Alford's accusations which can be denied? Nothing! Is there much which can be excused or explained? Probably—some—but why devote ourselves to anything but the constructive side of the discussion.

Taking this as my cue, and since there is very little that can be added to Mr. Alford's constructive programme, may I be permitted to try to bring all this home to us, closer to us individually and as a group of industrial engineers.

Mr. Alford tells the engineer first that there must be the closest union of essential purposes among them. No group of engineers needs this advice so much as we do. Other sections of the engineering profession have two advantages in this direction, it would seem. First—they deal for the most part with more tangible, definite and clear-cut factors, which in themselves tend to express the unified purpose, and second—they are older, well established and have much of this work well organized.

We are by no means agreed among ourselves as to the scope, status and purpose of our profession. To my knowledge it has only been in the last year that any attempts have been made toward this. If there is in existence even a vague unified purpose, we certainly have not sold it to the industrial world as yet. We have not put it across. We have not secured its recognition.

We are still suffering from all the disturbing elements, the retarding influences, the handicapping factors which Mr. Alford told us interferred with our progress. The faker is still on the job. The extravagant promiser is still guaranteeing impossible results. The inexperienced, egotistical yet sincere practitioner, probably one of the most difficult types to deal with, still hangs his sign out ever so often. There are no standards which any of them have to abide by. There are no regulations of any kind which protect our profession from their influence. Shall we ever be compelled to establish civic examinations such as those passed by Certified Public Accountants? There are disadvantages in this. My mind is still open on this point.

If you think that we have even begun to overcome any of the popular misconceptions, misapprehensions and misunderstandings which have arisen from our errors in the past, let me read to you a clipped article from one of Cleveland's leading daily papers, wherein a very clever humorist, whose writings are recognized as giving expression to popular sentiment under the cloak of ridicule and humor, gives his idea of the public sentiment regarding the industrial engineers or the efficiency experts as he calls them:

> **"Efficiency Experts."**
>
> "The right way to end all wars is to put 'em in charge of efficiency experts. Nothing that an effish bird has charge of lasts very long. Everything on earth has a use and a place, but you'd have to drive three Weejee Boards tandem to discover the answer to this cuckoo. Efficiency is a new rash that has broken out in big business.
>
> "If a merchant prince is annoyed by his business, he puts the works in charge of an effish hound. In a week, there ain't no business to annoy him. The first thing that the effish duke does when he wheels into an office is to fire everybody who looks as if he has authority enough to fire the effish gent.
>
> "He cuts down the overhead expenses by the same method that the Indians cured the pioneers of dandruff. By scalping. Turn an expert loose in a Chinese laundry and he immediately fires all the Chinese. He pulls the spokes out of wheels, the cogs out of gears and breaks the teeth from saws. When there ain't anybody left to fire, the expert hires new sapps who can do one-third of the work at one-half the salary. He cuts down the expenses by eliminating the receipts. After he is through with the outfit, the brass knob on the front door will last forever, and the 'Welcome' on the doormat doesn't mean a thing. Then he goes home and plays horsey with his fair-haired baby with a conscience as clear as ocean water and just as salty. Wood alcohol is a tonic for that guy.

"Every office is about the same. There is the office boy who can answer one question wrong twice. Youth is the only thing that bars him from the Senate. Then there is the blonde stenographer who chews gum in three speeds and reverses without stripping the gears. She wears $11 shoes, but is good to her mother. She can take dictation backward and typewrites it the same way. Three or four clerks who think that a loose-leaf ledger is the Third Testament, and the boss make up the rest of the gang.

"The old boat has been sailing along for centuries, everybody drinking out of one Lilly cup without getting more than their pro rata share of the 'flu and wages. The boss inherited the works from his father, whose father had wished it on him. Saturday afternoons off and two weeks vacation in the summer. All legal holidays including Washington's birthday and gum boils. When the clerks hitched up with the A. E. F. the boss paid their salaries for the duration of the fighting in Europe but balked at the scrapping in Congress. Nobody ever stole another guy's umbrella, showing that it was an innocent outfit, on rainy days, anyway.

"During a lull in common sense the boss paged an efficiency expert and the panic was on. When he got through with the office it would have made a fine bowling alley. There ain't any clerks left to eat up wages. There's no correspondence to chew up valuable ink, and no safe for a burglar to rifle. The spiders have another nest. The expert experted plenty. The wood-print on the wall, dated 1859, and showing the home factory when it was a mere ash barrel, is right up-to-date.

"But the boss is cheery, oh, as the effish expert has promised to get him another job.

"It was a fortunate thing that the Ten Commandments were written before some efficiency bandit had a chance to cut 'em down to about two or three."

I wish that I could believe that this was just fun, but I am convinced that it was only an exaggerated description of the acceptance of our work received at the hands of an altogether too large a portion of the industrial public.

A code of ethics is suggested. The Society has one, but is it followed, used or emphasized? A code of ethics is a worthless thing without the team spirit back of it, without every man of us following it, practicing it, preaching it.

I would like to see our Society appoint a committee to go over this code of ethics, assure ourselves that it is as satisfactory as it was when it was originally formulated. Then I would like to see as a definite part of our educational work a movement to secure the individual acceptance of each and every member to it, thru local chapters and otherwise until we were back of it to a man, until we were as ready to protect it and defend it as we would our Christian Creed. This is work for our Educational Committee but as well for each and every one of us.

It is true that our constitution is probably the only existing attempt to express the unified purpose but is it understood and accepted? I have spoken with members who have not even read it.

It is also true that our application blank shows membership qualifications which are probably the only existing standards by which to measure the status of individuals and their right to participate in this work. Are they good enough to be accepted as a national, official standard which can be used to safeguard the profession and the industrial public? If they are not, let us make them so. Let us set up standards of membership which will without question establish the profession including every branch of membership and secure its proper recognition.

If I may, I would like to sound a warning to members of our Society and others who are expecting and urging large rapid growth in membership and particularly a rapid establishment of many local branches and chapters.

I think back of Mr. Alford's suggestions regarding the work constructive, educational work, we can do, is the thought that a society of engineers will grow in numbers and become effective, not in proportion to its definite efforts to increase its membership but rather by the good work, its members no matter how few in number are doing.

Divisions of our group into many smaller branches will merely tend to decentralize our work, lose the effect of team spirt, scatter our shot and divide our responsibility.

Let us grow slowly in numbers but effectively in good work performed.

Mr. Alford has suggested many important pieces of work for the engineers as a whole and for our organization in particular to do. Do not let these suggestions merely become a printed plan. Let us get back of them and develop the thought and put it across. I wish to charge our President with the responsibility for leadership in carrying this out.

And now what can we do definitely? To those who are not members of our organization, but who are interested and have proper qualifications for membership. I say join our team and when you do, above all work. To those who cannot join I say, we want your moral support, your continued interest, your suggestions, your advice.

To our own present members I say, work! Get behind our code of ethics. Get behind our statement of scope and keep perfect and develop our status. Sincere work to overcome any misconceptions as to our purpose.

Get behind Mr. Farnham's educational committee and work. The development of a standard course of education in industrial engineering is a splendid ideal. Help him. Get behind Mr. Roe's research work. The research committee needs all kinds of co-operation from all sources in its efforts to coordinate the literature of the profession.

Help in the development of definition of terms. We need this.

Help in the Fatigue Elimination work. Here is a big opportunity for service.

If you don't agree with the plans or objects of any of these pieces of work, get in and say so, and why. Say what you do believe. Constructive criticism is a great necessity. We are naturally enthusiasts. We all need counsel.

Summing up the lessons I got from Mr. Alford's paper and which I am hoping can be brought to us all. I am reminded of a popular slogan used thru the war. Let's go! By adding another word we can make it—

Let's go—together.

THE CHAIRMAN: As I was listening to Mr. Alford's indictment as to the engineers falling down in matters of government statecraft, I thought I could hear the brain cells of the engineers in this audience (and we in Boston are great for hearing brain cells at work and mind reading) and I thought that I could hear many an engineering brain retort that we do not fall down in statecraft. Wait until the next presidential election and we'll show you what an engineer can do. I mean nothing personal. (Laughter)

I am instructed to have you practice all the motion study you know in clearing this room now so arrangements may be made for the banquet tonight.

Adjournment.

SIXTH AND CLOSING SESSION

Friday Evening, March 26, 1920

BANQUET

L. W. WALLACE: Toastmaster

THE TOASTMASTER: Many of you will doubtless recall that unique definition of a pessimist that Mr. Cattell gave to us at the opening session. I think it was so unique and forceful that it can be repeated with good results. Mr. Cattel said that a pessimist was likened to a blind man who went into a dark room, where there were no lights, endeavoring to find a black cat that was not there. I feel that The Society of Industrial Engineers during these three days has dispelled a large part of the pessimism as to its usefulness and as to the value of the program that it endeavored to give you.

I have no pessimism in my makeup at any time and I want to assure you that I have none whatever tonight with reference to this Convention because I have watched with a great deal of interest every session and there has been at all times an evidence of intense interest and appreciation of what was being said and of the discussions that followed. So I indeed feel that the Society can congratulate itself—if the President may be so immodest to say that—upon this convention. I am immodest enough to say that because we are not holding these conventions and we are not carrying on this work for a selfish purpose. We are not doing this to promulgate the interest of any individual or group of individulas, but fundamentally, we are constantly doing this because we hope it will be beneficial to American industry, and as we may, through our activities, be beneficial to American industry, we are thereby rendering a public service which should be the motive prompting the activities of any individual or group of individuals at all times.

So I feel gratified with this convention just coming to an end because I feel that we have done some good educational work. We have stimulated thought along new avenues of activity that will unquestionably rebound to the good of American industry, and if so, the time and the efforts spent here the last few days have been well worth while.

May I, at this moment, express the sincere appreciation on the part of the officers of the Society to all of those who have in any way assisted us in carrying out the program this week—those who have been on our program; those who have prepared papers and discussion, and I would mention, especially, some of the committee men who have done that thankless task of registration and such other laborious work. Often times we forget how important that kind of work really is, but after all, we could not have a successful meeting unless there were willing men to sit at the desk and write other people's names and tell them when to buy banquet tickets and such like. I wish to commend the Reception Committee and all other committeemen who have in any way assisted and we are very grateful, indeed, for the hospitality extended to us by the residents of Philadelphia.

I wish to read to you a paragraph from a letter written to Mr. Knoeppel by Major General Wood, in answer to Mr. Knoeppel's invitation for him to attend this banquet. General Wood said, "The industrial engineer holds the most important position in the development of our industries. I have always appreciated the importance of the engineer and his work, and have felt that the United States should have a department of public works of the government. I feel that the establishment of such a department would tend to great efficiency."

We also have a letter from Mr. Hoover, in which he says, "I do not think that too much emphasis can possibly be laid upon the necessity of engineers taking an active interest in public affairs. There is an education and experience in quanitative thinking and acting and our country greatly needs quanitative as distinguished from qualitative thinking in its great industrial and business problems."

I am sure we appreciate these approvals from men of such prominence. My friend, Mrs. Emerson, whether she intended it as a suggestion or not, I do not know, just remarked in the course of conversation that she did not like a toastmaster who told all about the history of the speakers he introduced, so I am going to take her suggestion and not attempt to give the history of the speakers this evening. I shall not do so, because in the first place, I quite agree with Mrs. Emerson's philosophy, and in the second place, which is more important, the men who speak to us this evening are of such prominence and have been so well known for so many years, that it is not necessary to narrate their life's history.

In recent months I have had two very delightful visits from Mr. Harrington Emerson. One Sunday evening he came out to our place and we sat there almost until Monday morning. I think we would have been there until Monday morning if it had not been necessary for me to take a one o'clock train to New York, but it was a delightful visit. Those of you who have had those little intimate contacts with Mr. Emerson, know what it means to be able to sit down in a quiet way and talk of many things of mutual interest and concern, and I assure you that Mr. Emerson is just as interesting and pleasant a visitor in your office or home as he is a successful engineer and an entertaining and instructive speaker. It has been my pleasure and privilege to come in contact with him in these several phases, therefore it is with confidence that I assure you that you will enjoy hearing from Mr. Emerson, our friend, from New York City. (Applause)

MR. EMERSON: Last winter I was reading some of the old copies of a magazine printed during the reign of Queen Anne, who ascended the throne in 1702 and who died in 1714, and what most interested me was the fact that at that time the death rate in London was two hundred per thousand, and it was said that the cities, the great cities, were the graveyards of the country; that they were constantly replenished by people that came from the country and died in the city. Queen Anne, herself, was the mother of seventeen children and she was succeeded by her Aunt's grandson because not one of those seventeen children lived to maturity.

At the present time, the death rate in our best American cities is somewhere between twelve and fifteen per thousand and in one of the cities in the west, it is even under ten. It has taken two hundred years for medicine and hygiene to bring the death rate down from two hundred in the thousand to less than twenty, and we similarly can look at this older activity, this older morality of hygiene and imitate some of its methods and principles and endeavor, also, to bring down industrial engineering incompetency, in the same way as during the last two hundred years hygienists have slowly reduced the death rate. They have done it not by bottles and pills of this kind or lozenges of that kind, but by establishing certain principles of hygiene and very, very slowly persuading the people to adopt these principles, and when the principles were adopted, the death rate declined until it has reached its present status.

"HOW THE INDUSTRIAL ENGINEER INCREASES THE EARNING POWER OF INDUSTRY"

HARRINGTON EMERSON

Director The Emerson Engineers, New York

When a civil engineer is given the problem of building through a new country road the first two questions to solve are what is the country like and what kind of a road should it be.

To find out the nature of the country a survey is made and then the details of the road are decided on, the larger decisions first, shall it be a footpath, a pack trail, a wagon road or a railroad?

Then the minor but scarcely less important details are considered, details of construction.

Similarly I survey the whole problem. What is industry? What is its earning power? What is the function of the Industrial Engineer?

Industry is all human activity that is not parasitical or recreational. Each human being's life consists of a definite number of hours. If a man dies at full age he is entitled roughly to one fifth to one quarter of his life in parasitism, the remainder can be roughly divided into one-third for sleep, one third for recreation and one-third for usefulness.

It is evident that if he dies young the part that is parasitical rises from a fifth and nearly reaches the whole.

Similarly if he is otherwise physically, or if he is morally or mentally defective, parasitism increases.

Industry is not responsibly concerned with normal parasitism or normal recreations. It is concerned when either parasitism or recreation enroach on the hours properly alloted to useful and productive activity.

Earning power is curtailed both actually and potentially. When a man is below production standard between the years 20 to 21 or any others the earning power of industry is actually curtailed. When by burning the instead of living to 80 the earning power of industry is potentially curtailed.

When we burn 6 pounds of coal per horsepower hour instead of one the earning power of industry is actually curtailed.When by burning the raw coal we lose all the priceless coal tar products, the earning power of industry is potentially curtailed.

When we raise from an acre 30 bushels of corn intsead of 120 the earning power of industry is actually curtailed. If great acreage lies unused the earning power is potentially curtailed.

What curtails both actually and potentially the earning power of industry. Solely the failure to apply certain well defined and elementary moralities.

Classification is a splendid aid for analysis, understanding and control.

The sound S and the sound O are very different. We attempt to classify all sounds by means of the alphabet.

The different substances of the earth are billions, we resolve them into about 70 elements and then begin both analytic and synthetic constructions.

There are millions of diverse living creatures on earth. Yet they are easily classified first of all into plants and animals, the animals into vertebrates and invertebrates, the vertebrates into turtles, fish, reptiles, birds, mammals.

Similarly we classify all moralities under seven heads in order better to understand them, control them, improve them.

Each of these moralities has its influence on parasitism, on recreation as well as on utility.

The Industrial Engineer is primarily concerned with only one of these moralities and not with its universal application to all life but with its limited application to the earning power of industry.

The morality with which the Industrial Engineer is authoritatively concerned is that of Industrial Competence.

If men and institutions are industrially competent the earning power of industry is increased.

It is also increased by each of the other six fundamental moralities.

The Industrial Engineer is like a letter in a word, like an element in a chemical combination. He is essential but he is not everything, he is coordinate with the others. He must work with and for them yet be distinct from them.

There is a great danger that the letter will think itself the whole word, that the oxygen in the automobile gas will forget that hydrogen, carbon and nitrogen are equally important, that power could be generated without oxygen but not so conveniently.

There is also great danger that the Industrial Engineer, in his intense and general interest will assume jurisdiction in fields that do not belong to him.

Attempts of this kind remind me of the comic printing occasionally perpetrated when the printer had no s and used instead f. It worked, f for s was better than nothing but nevertheless only a substitute.

"The fun fank to itf fetting in the weft over the fmiling fea."

The other six fundamental moralities are:

Aptitude
Coordination, Cooperation.
Hygiene.

The Joy of Life.
Righteousness towards others and towards self.
Education, the development of latent capacity and the acquirement of special skill.

The neglect, the inadequate application of all these moralities causes a daily preventable loss of $250,000,000.

To prevent this loss it is not necessary to encroach on those portions of life properly devoted to dependency and to recreation.

There is no need of crossing honey bees with fire flies so that the hybrid can work night and day.

There are, however, combination of moralities that are immensely more effective than either alone. The man who is equipped with two of the moralities is not twice as strong, he is probably four times as strong as if he had only one.

The man who is equipped with three is probably nine times as strong, the man who is equipped with all seven is perhaps 49 times as strong and this seems to be a very great underestimation.

I may briefly suggest the magnitude of the losses and their apportionment to the different moralities for alleviation, correction.

Aptitude. To what extent are men engaged in activities for which they have inferior aptitude (actual loss?) To what extent would the earning power of industry increase if each worker brought aptitude to his work?

Fritz Kreisler was sent to the Austrian front during the war as a trench digger, work that could have been better performed by a Chinese coolie, Fritz Kreisler can earn $5,000 a night by playing at Carnegie Hall.

Is it too much to estimate that faulty aptitude impairs average earning power to the extent of 20 per cent?

The total production of the United States in 1919 was about $73,000,000,000,—$200,000,000 a day, of which 20 per cent is $40,000,000.

Coordination. The war with its direct expense to us of $35,000,000 daily, not counting the aftermath and the curtailments. The war was a single instance of failure to coordinate. So is every strike. So is every law suit. So are all forms of injurious competition.

Hygiene. The duration of life should be 80 years. It is 50. There is here a loss of 30 years. The loss estimated at $1.00 a day amounts to nearly $1,000,000,000 daily. The hookworm disease alone causes an annual potential loss of $20,000,000,000, only a small part in the United States. There is in hygiene the immense potentiality of eugenics, of converting us into a thoroughbred people from a nation of mongrels.

The Joy of Life. If this were brought into our working hours the output could easily be increased $1,000,000,000 daily yet we would have fifty per cent more time given to enjoyment.

Righteousness. The war was primarily caused by unrighteousness. All armies, navies, policies, much of government, all our prisons, many of our fires, the necessity for locks and bolts are due to unrighteousness.

Education. What is the average earning of the illiterate compared to those whose have gone through grammar school, what is the average earning of the high school graduates compared to those who stop at the grammar school, what is the average earning of the technically educated compared to those who stop with the high school?

Just now as an aftermath of the war an illiterate milk driver may earn more than some lawyer but this cannot be permanent. If one assumes that the well-educated and trained and skilled man or woman is worth two dollars a day more the gain would not be less than $60,000,000 a day.

Industrial Competence. This is the peculiar avocation of the Industrial Engineer. I have naturally better opportunities of establishing closely the losses due to industrial incompetence.

During the last 20 years I have been checking up actual industrial losses due to incompetent use and combination of materials, of men and of equipment.

Taking materials in dependent sequence from start to finish, coal for instance from mine seam to final combustion, wood, from forest tree to final use, etc., etc., the average efficiency is not above 60 per cent.

The average efficiency of all men owing to neglect of all the moralities is not over 50 per cent, the average man's industrial competence is not over 50 per cent. This we learned by checking up over 12,000 selected skilled workers in 20 different trades over a period of three years.

The average efficiency of all equipment is very low. The largest single business in the United States is the railroads.

The average use of running track does not exceed 1 per cent, a locomotive during its life does not haul freight more than 10 per cent of the time and a freight car works 8 per cent of the time.

Our national equipment as a whole does not work over 20 per cent of the practical (not absolute) time.

Great quantities of expensive equipment, for instance the bath tub in a hotel room, is not used any more than main line rails, perhaps 10 minutes a day.

It is the function of the Industrial Engineer to lessen this industrial incompetence. He must coordinate with the other six related moralists. They also are vibrating strings in the same instrument. However much he vibrates himself he must not interfere with their vibrations (whether he strikes the highest treble or bows the deepest base.)

The Industrial Engineer must speak and counsel with moral authority. The morality of the profession is paramount; the commercial is subordinate. This is true of all the moralities, it is not true of the purely commercial professions.

There were certain Quaker manufacturers of boiler plates. They would neither make them nor sell them for war vessels or for distilleries. All business would stop if all were so conscientious, if no coal operator would mine coal, or railroad transport it unless the ultimate destination were known.

Moreover the conscientious Quaker firm probably did not refuse to make boiler plate for a locomotive ultimately sold for work in a distillery plant.

The commercial profession produces for money. The ethical profession's chief aim is ethics. The chief function of the Industrial Engineer is ethical. He is the moral arbiter as to industrial competence between capital and labor, between employer and employe, between society and production. He cannot sell his moral product to the highest bidder.

The commerical purveyor sells, he does not say either thou shalt or thou shalt not. It is the ethical quality and solely the ethical quality that gives authority or excuse for existing.

The Industrial Engineer therefore increases the earning power of industry by condemning immoralties or wastes, by advocating industrial morality.

Because he is a moralist he sets up moral standards. Because he is a moralist he measures actuality against moral standards. Because he is a moralist he insists on the attainment of moral standards.

That many of his moral standards are accepted and striven for without consulting him is so much the better. In a perfect world he would be superfluous as would also be the preacher and the physician.

What moral standards does he set up? Those that prevent industrial waste. Because the standards are moral standards they are more concerned with quality than with quantity. Good quality lessens waste. As quality improves, quantity required decreases and this lessens waste.

In the universal formula of Production Cost: QP plus TW plus tR equals Value.

The symbol for materials is QP in which Q is quantity of units and P price per unit.

The symbol of pay is TW in which T is hours used and W is wage rate per hour.

When P, W R increase Q, T and t decrease faster.

There is a condition when QP, TW and tR are for a given volume a minimum. The Industrial Engineer wants P, W and R to be as high as possible provided T and t are so low as to make the result a minimum.

It will be one of his greatest difficulties to persuade his clients to increase P. W and R in order to reduce Q, T and t.

Twenty years ago when I recommended the use of the best quality of belting I was suspected of having been bribed by the belting manufacturers, yet in consequence of the improved quality we used only one-tenth as much.

The $100,000 a year man is generally the cheapest man in any organization yet some industrial managers want to hire convicts.

A bicycle will carry a man easily 100 miles in a day and he can also load on it another 100 lbs. A sodier finds it real tiresome to carry 75 lbs. 10 miles.

The Industrial Engineer increases the earning power of industry by insisting on the lessening of the quantity elements by the increase of the quality elements.

As to all quantity and quality elements there are subsidiary standard efficiencies. There is the efficiency of supply, the efficiency of use, the efficiency of allotment the efficiency of cost and the efficiency of volume.

While it is a general truth that quantity decreases as quality improves it is a particular fact that usually even if QP, TW, and tR are ideal more Q, more T and more t are used than are necessary. The best material, the hours of the best men and of the best equipment may be superabundantly at hand.

The efficiency of use refers to the acutal utilization when working. The best materials, the hours of the best men and of the best equipment may be used at low intensity thus offsetting the gain of improved quality.

The skilled man producing 4 pieces a day is not worth as much as the unskilled worker producing 8 pieces.

The efficiency of assignment is illustrated by the fact that a babbitt made of platinum, gold and silver even if of superior quality, is not as efficient as a bearing metal made of antimony and lead. Platinum, gold and silver can be used to better advantage for other purposes than babbitting. It does not pay for the president of an industrial plant to write his own letters or keep his own books. He ought to better employed.

The efficiency of cost means that if all else is standard it is inefficient to pay more than the market price. Simply because he likes the color no man is commercially justified in paying more than $20 an ounce for pure gold to be melted up, nor is he commercially justified in paying a high salary to an incompetent relative.

Efficiency of volume is peculiarly an American development. If 1 costs $1,000, then 1,000 may only cost $1.00 each. Just as we began to use automatics on watch parts we have extended their use to automobiles, to tractors and Ford extended them to ships. We are now building ships of standardized parts. This was the earlier phase. The later phase is that an enormous volume of completed units, even if every unit and every part of each unit should be different permits immense economies. Scarcely anything could be more different than the aggregates and the units making up the lunchers noonday meal, yet on account of the vast number served, the indirect expenses drop.

The combination of standardized parts of a standardized unit sold in immense quantities is the hope of American industry and it is peculiarly the function of the Industrial Engineer to counsel along these lines.

Finally, because all modern industry is a dependent sequence, since even slight inefficiencies in each term of a long sequence results in a very low end efficiency of the final result, and because the adding of terms necessitated increased supervision both in quantity and quality between each term, which was not provided, it follows that because of undersupervision all modern industry is over equipped and the result is decreased earning power.

One of the special functions of the Industrial Engineer is to analyse dependent sequences and improve the efficiency of each term.

To sum up, the Industrial Engineer increases the earning power of industry by insisting:

(1) That all other six moralities shall be in tune so that he will not be playing against a universal discord.

(2) That he shall be worthy to exercise authority and set up standards as to the morality of industrial competence.

(3) That he shall lessen the terms if possible, but in any case increase the efficiency of each term of the dependent sequence.

(4) That he shall do so by improving the quality elements in the universal cost formula.

(5) That he shall apply the five standards of supply, of use, of cost, of assignment and of volume to each element of Material, of Personnel, and of Equipment for both quantity and quality in each term of the sequence.

It is comparatively unimportant to make even 1,000,000 automobiles a year, it is an item, a detail in industry. It is not unimportant to try to make a nation of 110,000,000 competent, to try to eliminate $50,000,000 of daily losses.

It is most important of all to work closely in harmony with the other six groups of moralists, moralists whose practical function today is to eliminate $250,000,000 of daily losses of industrial wastes in the United States alone.

THE TOASTMASTER: I am sure that we appreciate this very instructive address of Mr. Emerson's.

Personally, I feel that we are greatly indebted to our next speaker because of the effort that he has made to be with us tonight. He has been traveling a great deal of late, and he has been very, very active because of assuming some new and heavy responsibilities consequently I know that he has made a physical sacrifice to be here tonight. But we are always charmed with his addresses and his delightful personality, and I am sure his being here is a great treat to us and I hope our appreciation will in some small way repay him for the effort that he has made to be here. I take pleasure in presenting to you Dean Dexter S. Kimball of Cornell University. (Applause)

"HOW INDUSTRY CAN ASSIST THE EDUCATOR"

DEXTER S. KIMBALL

Dean Engineering Schools, Cornell University

I was quite interested in Mr. Emerson's suggestion about reading some ancient history. I was reminded that I too was looking through some ancient history recently and I found in my reading, a delightful account of how the wife of the squire made two hogsheads of beer; he complimented the wife on her industry and efficiency in getting out the beer so cheaply. (Laughter). I take it that the college men may find a lot of good reading in ancient history.

I had no choice in the subject assigned to me and if I had my way, I would dispose of it rather quickly. I think if industry would see to it that education was well supplied with financial backing, education would care for itself. But I know that wouldn't do for a reason that perhaps you have not thought of yourself. There are two subjects—education and politics, on which every man feels entitled to speak. A shoemaker would resent the parson coming down and telling him how to make shoes, and the engineer would resent the doctor coming in and telling him how to run the plant.

But somehow or other, in politics we all expect to speak as oracles, and in matters of education, this is true also. So it would not do to dismiss the matter in this way—I will have to argue it with you.

In viewing the matter of education from the other side of the fence, and in thinking over the many suggestions, discussions and criticisms that come to us in educational work, I am reminded that if sometimes we would stop to think and analyze how little we know of education, we would hesitate to offer an opinion.

What is this problem of education then from the standpoint of the university professor? Every year we have groups of young men come to the colleges, as varied as the grass in the field, running all the way from intense men whose minds are hung like the hair spring of a watch, inventors who by nature are not interested in anything except highly technical matters, with absolutely no interest in the humanistic things, men who hardly look at the other fellow except in an offhand way, to happy, harum-scarum fellows who arrive with no care whatsoever, intensely interested in humanity and happy as the day is long. In between come all gradations of men—and what is the educator to do? He is expected to give every student a good grounding in chemistry, mathematics, mechanics, something of general mechancal engineering and at least some knowledge of some particular specialty. And then he is also expected to correct his English because his English is something awful. I am speaking from long experience. His English is really something awful—it's the English of the street, or it may be the English of his home which is far more difficult to correct. We also must inspire in the boy the desire for a knowledge of the classics. He ought to have some oratory, some political science, and last of all, we must in some way eradicate all the devilishness that has come from his mother's side of the house—the father is always all right. (Laughter.) There are a lot of things to be taken out of the boy and many to be put into him before he is sent out into the world as an engineer. Quite an undertaking, you will admit.

The time allotted for this small piece of work—it must be easy because everybody knows how to do it—is usually four years. Of course we hear of talk of five and six year courses but the time allotted is usually from the age of eighteen to twenty-two years. Few boys arrive before seventeen, and nineteen would be better. Few stay longer than twenty-three. If they stay much longer they are likely to lose some of their flexibility.

As I said before, everybody seems to know something about this problem and at this particular time, the United States is filled with people who have what I call "happy thoughts," particularly in the line of education. I have a great pile of material on my desk containing demands for courses in several kinds of aviation; the Government wants a course in ordnance; another man wants a course so that the bankers can use our men in some way; someone wants a course in human engineering, and we have had to supply men for the ministry. I am speaking seriously. Some years ago a bishop in foreign missionary work wanted an industrial missionary, a man who was particularly well trained in engineering and of a good appearance. He had to be theologically correct as he had to be examined for orthodoxy. The man passed that test, strange to say. He went to Siam and I have heard he is doing very well. He organized industrial schools and that sort of thing is all right—there is no end to a good work of that kind.

The Society of Industrial Engineers is now making a program to present to the colleges to use in turning out industrial engineers. Why not? Happy thought! I have no fault to find with these suggestions—they are good for the colleges. No thinking man would hold that the colleges are all right; no human institution is all right! I have an idea that something is wrong with The Society of Industrial Engineers also.

These suggestions are good but the point I want to make is this—Most of these suggestions aim at starting the boy, perhaps in the sophomore year, when he is about nineteen or twenty, along one of these lines, so that by the time he is twenty-two, he is an industrial or some other kind of an engineer.

Go back to the time you were twenty-two and make an estimate of what the average boy's mind is at that age—the average boy, not the high-type boy, because the keen-minded fellow is going to get along without your help. All these courses start out with the hypothesis that the college training so shapes the boy that by the time he arrives at the senior year, the industrial leader will say, "This man will just suit my ideas."

What's all this about? What is there in the engineering training that makes him so very, very valuable? If there are so many things wrong with the colleges, how is it that their graduates get along so well? It is not unusual that some months before the graduating year, we have repre-senatives of twenty-five or more industrial concerns looking over the senior class to find the kind of man they require in their work, and Cornell is not a solitary example of an incident of this kind.

How does it come that these men are so very, very valuable to so many kinds of industrial executives? The answer is simply this—the engineer is so very valuable to all kinds of industries, not because of some special knowledge—it is because of the way he has been trained to think. As near as I can explain it to you, its this—its the way all men think who have had sound training in pure and applied science.

A story is told of a group of philosophers who had a long argument as to how many angels could stand on the point of a needle. The argument lasted all night and finally the question was asked, "Are there any angels?" and that brought the proceedings to a halt. They weren't quite sure there were any angels. Now, an engineer proceeds in a different way. He would have said "Show me an angel—how big, how high is he, how big are his feet—get a blueprint. Show me your needle. Let's get to facts and then I will tell you how many angels you can get around the point of a needle." The engineer thinks of these things in a different way. He thinks straight to the point and that is largely due to the fundamental training he has received. Its the long, hard drill in descriptive geometry, mathematics and other fundamental subjects that stretch his mind and keep stretching it, and by and by he attains a certain method of attack which is only to be found in men with that kind of training and it is not to be found in other types of men.

I was waited on lately by a man from New York who represented some large capitalistic interests. This man wanted us to introduce one of these special courses in human engineering, beginning in the freshman year. There was plenty of argument—another one of those happy thoughts—and I let him talk until he was exhausted. I then laid before him just what I am laying before you and I said, "If we sent such men to you, after having cut out a great slice of the fundamental training which makes these men what they are, you wouldn't have engineers at all, but common ordinary people." He thought for awhile and he said, "I think you are right," and he took that message back to his people.

Now these things are worth your thought because they concern your own boy. The one thing that makes the engineer valuable is not some particular educational content, nor is it the way in which he can draw to a particular scale, but its the kind of mental training he has received. He has been put through a drill that makes him valuable to all these people who are anxious to secure his services. Now that they have him, they want to change the methods which have made the man what he is, and when they do that, they change the man.

So far as the training at the university is concerned, keep on sending in these suggestions, but don't expect educators who are thinking carefully, to adopt all these various kinds of curricula leading to all kinds of degrees, because it isn't possible. There are too many of them and if all were incorporated, it would make engineering education impractical.

Here is another important point, I think. In all these demands coming coming from industry, we hear demands for men of character, ability, energy, tact, etc. We hear very little of something which we are likely to overlook. Very few of these men ask us this question—has the man ideals? We don't think enough of high ideals or of ideals at all. What is an ideal? Most people think ideals are much the same as ideas. They are two distinct things. A man may have an idea that its a fine thing to raise hens, but when he gets to the point where he must depend upon poultry-raising for his salvation, then it becomes a thing to be desired above all things; then its an ideal.

What has that to do with the world in general? Ideals move the world. Charts, machinery, etc., are all secondary things—ideals move the world. This has been proven to you lately in no uncertain manner. About the time you learned to play marbles, there appeared in a certain university in Germany a man by the name of Nietsche who began to preach ideals, old pagan ideals—not new at all. Many people and many peoples have had them in their mind but he and a group of men put those ideals before the German people in such a way that they were keen to find out what was meant; and these ideals became things to be desired above all else. There hasn't been in your time such a proof of the influence of the teacher. That was the beginning of trouble in Germany. It all started in Nietsche's day and has brought Germany almost to destruction, and very nearly carried the world down with it.

Every now and then we hear people say that the universities are not in touch with industry and the world. John Hays Hammond is quoted as saying that if he were running a university, he would put a business man at the head of it. That again is a difference in ideals.

Last week a committee of the Board of Trustees, all of whom are business men, met to consider the matter of a new president for a great American University. This university has a rather progressive place in industrial and technical matters. It is known by its technical work more than by any other kind of education. As a platform to start with, these men agreed that the next president at this university should be an educator, drawn from the educational class. That's the difference in the point of view of this group of men and Mr. John Hays Hammond, and the difference in the point of view of men who are thinking along modern educational lines and men who are thinking of something else.

If the universities are somewhat out of touch with industry, still we have something to be thankful for. I hope there will always remain in this country some place and some group of men that are not dominated by any industrial methods or other things that prevent them from keeping intact the ideals we have inherited, and from forming ideals to guide us through the troubled years to come. When the universities begin to send out men who hold before them strong ideals of service, ideals that will look to the betterment of industry, just as the knights of old went forth to seek the Holy Grail, then there will be no trouble over the high cost of living nor will there be any labor troubles.

What we need is men of high ideals—men who can formulate ideals of industry better and higher than those we now have. If we can hold the right spirit in our colleges and universities, the right kind of teachers—and you have to pay for them—then you are going to send out men who will have such ideals, and they will have just as much influence on this country of ours as Nietsche's ideals had on Germany. Just as soon as this country, on the other hand, comes to the point where we think of universities as an adjunct to industry simply to make tinsmiths, plumbers, carpenters, and so on, just that minute do the light and the liberty of this country begin to go down, and just that minute do the people begin to go down. (Applause)

THE TOASTMASTER: May we not express our appreciation of the addresses of Mr. Emerson and Mr. Kimball by rising to our feet.

A rising vote of thanks was extended to Mr. Emerson and Mr. Kimball.

THE TOASTMASTER: We received a telegram yesterday from Major General C. C. Williams, stating that it would be impossible for him to speak to us tonight. We have taken occasion to fill in a few minutes of that time by giving Mr. Polakov an opportunity to show some lantern slides illustrating his talk of this afternoon, which will occupy some ten or fifteen minutes.

MR. WALTER N. POLAKOV: In my paper this afternoon I emphasized the evils resulting from neglect to utilize to the full extent our productive capacity. This statement aroused many questions, the two outstanding ones are **"what is the cause"** and **"what are the consequences."**

Mr. Emerson ably answered the first: it is due chiefly to the industrial incompetency of leaders. I may illustrate this point by a few pictures.

Diagram 1 represents the well known fact of restricting the output of our soft coal mines. Not over 70% of their capacity are used according to U. S. Geological Survey Statistics.

Diagram 2 shows less known fact that during the past 11 years the blast furnaces of this country produced but 60% of their capacity of pig-iron according to the American Iron and Steel Institute's data.

Diagram 3 represents a typical electric railway power plant over-equipped so that over 30% of boiler plant is never used and about 20% kept for protection only.

Diagram 4 shows that less than 25% of our dock facilities are serving any useful purpose and this was at the times when safety and welfare of our country depended on prompt shipments.

The responsibility is clearly at the door of leaders for in a case represented on diagram 5 jobs shown by solid line are those about which management knew how to do it and how long it shall take while those shown in broken line indicates the ignorance of management as to method and time needed.

Diagrams 6 and 6a show the relation of work done to the expected output of 10 pieces per day. Note the remarkable improvement accomplished by a competent leader on chart 6a as against similar work done at the same time under incompetent direction, shown on chart No. 6.

Diagrams 7 and 7a present convincing example how fuel is wasted under incompetent management in a typical power house. Over 30% of fuel was wasted steadily due to ignorance while under competent direction the same plant with the same men shows 40% improvement on the chart 7a taken only about half year later.

The answer as to consequences is thus obvious: incompetent production materially increases cost of living, needlessly wears out men and criminally destroys our natural resources.

Some of you probably did not forget what I had to say this afternoon regarding a fundamental trouble in our industry, or, using Mr. Emerson's words, lack of morality in our industries, where we are failing to use competently what we have, failing to use it for the benefit of society. Maybe some of the manufacturers are using that for their private profits, but that is not the standpoint from which I am showing these horrid illustrations of how our national wealth and our productive capacity is dissipated due to the lack of this moral responsibility that the industry shall be controlled by those who know what to do and how to do it.

That is all I care to say as an illustration of my talk this afternoon, and I believe Mr. Emerson wouldn't have anything against me if I said it just as well serves to illustrate some of the principles of morality of which he spoke this evening. (Applause)

THE TOASTMASTER: This brings us to the close of our convention and as it is early, I hope you will take the occasion to visit and become acquainted with each other so that when we meet at our next convention we will not start in as strange to each other as we did here. (Applause)

Final Adjournment.

Exhibitors of Equipment

The Society of Industrial Engineers expresses its sincere thanks to the manufacturers who displayed equipment, devices, photographs, etc., and thus furnished one of the interesting features of the convention

ADDRESSOGRAPH COMPANY
Equipment for addressing envelopes, pay checks, etc.

AUTOCALL COMPANY
Electric code signalling and calling device

BARRETT-CRAVENS COMPANY
Lift-trucks for Internal transportation

EDUCATIONAL EXHIBITION COMPANY
Material for making, displaying and marking charts

ELLIOTT SERVICE
Illustrated bulletin board service

FELT AND TARRANT MANUFACTURING COMPANY
Adding and calculating machines

GRAVES TIMING DEVICE COMPANY
Device for timing telephone calls, etc.

LAKEWOOD ENGINEERING COMPANY
Electric tractors and tiering machines

LAMSON COMPANY
Conveying systems for offices, retail stores, factories, mills, etc.

LANSTON MONOTYPE MACHINE COMPANY
Chairs designed to reduce fatigue

LINEATIME MANUFACTURING COMPANY
The Line-a-time reduces fatigue of typists

LOUDEN MACHINERY COMPANY
Over head conveying systems

MODERN MERCHANDISING COMPANY
Merchandise for industrial employees at wholesale prices

McCASKEY REGISTER COMPANY
Cabinets for factory records. Perpetual inventory system. Boards for planning, production, etc.

MONROE CALCULATING MACHINE COMPANY
Adding and calculating machines

MULTICOLOR PRESS COMPANY
Printing equipment for office stationery, form letters, factory blanks etc.

RAND COMPANY
Visible index equipment

ROESLER & COMPANY
Envelope sealing machines, postage machines, etc.

EXHIBITORS OF EQUIPMENT

(continued)

TELAUTOGRAPH CORPORATION
Instantaneous transmission of written messages in original hand writing

UNITED STATES RUBBER COMPANY
Rubber heels for shoes

A. C. WARNER COMPANY
Cowan transveyors—platform elevating trucks, etc.

WESTINGHOUSE LAMP COMPANY
Electric Lighting equipment for offices, factories and stores

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OF

The Society of Industrial Engineers

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Convention Headquarters at the Hotel Schenley

Major Subject

"Industrial Education"