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MAXIMUM PRODUCTION

IN

MACHINE-SHOP AND FOUNDRY

By

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PREFACE

The material on which the present book is based was most of it contained in three series of articles published originally in The Engineering Magazine at various times from October, 1908, to May, 1911. It was all written in the very atmosphere of the busy manufacturing plant and under the influence of daily contact with the problems and methods discussed. Everything in it represents some phase or period of the author's personal experience. As here gathered in volume form, however, the material is all resurveyed, rearranged, largely recast, from the viewpoint of a larger experience and a maturer study of the mechanical industries and more advanced principles and methods of management. The result is a logical, well-proportioned and well-balanced development of the subject from beginning to end, by which the relations of all its elements will be much more clearly understood. The discussion will be followed again with new and increased interest and reward, even by those who read the articles as they appeared in sequence in The Engineering Magazine.

The machine-shop and foundry in Mr. Knoeppel's book are considered as twin factors in production, so closely related throughout a vast range of metal manufacturing that their problems can best be studied together. Therefore after laying down the principles of organization and management common to efficient operation and maximum success in both kinds of establishments, the author follows special applications of the same ideas first in the shop and then in the foundry. To this latter he gives the larger and closer attention, because it has heretofore been less thoroughly studied by systematic methods, and it yet offers immense possibilities of profitable improvement since it lies at the foundation of so many mechanical industries.

Mr. Knoeppel has the intimate knowledge of shop and foundry conditions and workers that is gained only by being brought up "on the floor." He has the grasp of principles and methods that characterizes the unusually successful manager. He has the wide viewpoint gained by association (as specialist in betterment work) with many well-known plants, having been formerly associated with Harrington Emerson and later a member of the organization of Suffern & Son, and to this wealth of equipment and experience he brings unusual power of analysis and clear interpretation, completed by close study and practice under one of the greatest of efficiency engineers.

THE EDITOR.

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Chapter I

THE TWO GREAT FORCES IN MANUFACTURING

It is extremely doubtful if the accountant of a hundred years ago would recognize present-day accounting practice. He certainly would be in no position to appreciate immediately the progress that has been made since his day, owing to the fact that he would be lost in the maze of bound books, loose-leaf devices, card systems, mechanical aids, controlling accounts, short cuts, special rulings, billing machines, and a hundred and one other things which go to make our Twentieth Century accounting practice. He would admit, after he became familiar with the methods used, that wonderful progress had been made since his time; but he would also be impressed with the fact that many accounting schemes, considered excellent, seriously approach the "worth next to nothing" point.

There are a number of reasons for this. In many cases, the accounting is a mere jumble of figures, which have little or no value as a guide to the executive. In others, vital information is compiled only *once a year,* or if any attempt is made to furnish monthly statements, they are furnished so long after the close of a month that the information contained in them represents so much waste effort—they are furnished too late to enable the executive to point out the reasons for certain inefficiencies. Then again, accounting schemes may furnish information without regard to the requirements of the business in question; or they may be changed materially from time to time, elaborated upon, "boiled down," new features added, others cut out—each new bookkeeper introducing a few "stunts" of his own, until he gets things to run his own way. Between all this and accounting schemes sold in "chunks," and further the willingness of each auditor or accountant that comes along to point out where the accounting fails to furnish the required data —where it violates the rules of standard accounting practice—the scheme in a short time becomes hopelessly confused, rendering intelligent comparison absolutely out of the question. Is it any wonder that a manufacturer, after going through such an experience, is far from being in a receptive attitude when "accounting system" is mentioned to him?

To present the right kind of information in the wrong manner is confusing and unsatisfactory. To present the wrong kind of information in the right manner is misleading and dangerous. It would be far better for many simply to keep track of the cash on hand and what is due and owing, than to maintain an elaborate accounting arrangement which does not result in an accounting that can be used in bettering the business. A scratch pad, a pencil, and a good guess would be just as efficient. The *right* kind of information, *rightly* presented, is therefore the problem.

As a declaration of principles, let us decide at the outset that an accounting scheme to be efficient must first of all consider the needs of the business in question; that it must be comprehensive, proceeding on the broad assumption that information should be given an opportunity of working for the executive—not a burial which may have no resurrection; that it must be designed to anticipate the needs of the executive in every possible way; that it must be planned not only to make possible a rapid comparison and analysis of the various elements, but to serve as a statistical bureau as well; that the accounting *must be simple* to admit of its being easily understood and quickly operated, in order that there may be no delay in getting the pertinent facts to the executive promptly; that it must be arranged so that unnecessary work and entries will be done away with, and in addition should be designed to furnish information *during* the month—a point of importance to every manager. At any rate, an accounting scheme which measures up to the above standard is entitled to consideration, for one of the possibilities in the right kind of accounting methods is *better and more complete information in quicker time and at less cost than is usually found.*

There can be no question, however, if one stops to review the past, that there has been and is now, on the part of a great many, altogether too much dependence placed in mere cost records and figures; for while they are necessary and of the utmost importance, they *must not be considered as being the only means to a desired end.* A great many are satisfied when their cost figures inform them regarding the disposition of their money, and in addition may be used as a check on their selling prices. Others go a step further and use their information as a basis for comparison between operation and operation, or of completed unit with completed unit, in order to detect fluctuations in an endeavor to keep costs down. Others use their figures for carefully checking up the departments, foremen, machines, operations, men, etc., in order to reach some conclusion, even if not altogether accurate, as to the efficiency of their plant. Still others have definite estimates or standards against which the actual performances are checked. How many are there, however, who use their facts and figures for all the purposes mentioned? If all were using all of them, they would be bringing into play what I would term an "analytical force"—a process enabling them to apply remedies when their information developed the fact that certain places needed prompt attention.

An equally important force can be employed with as great if not greater results—one which can be fittingly termed a "constructive force," a building up process—which acting in harmony with the force just mentioned, finds ways and means to *anticipate* as far as is possible the leaks and faulty conditions. One force is as vital and necessary as the other, although it is true, and unfortunately so, that very few get all the good possible out of both of them. Whether employed separately or together, they are made up of the following steps:—

1.—Securing data.
2.—Recording the data secured.
3.—Compiling the data in convenient shape for reference and study.
4.—Reasoning applied to the compilations.
5.—Conclusions based on the reasoning.
6.—Action in some definite direction.
7.—Results.

The principal difference is that the analytical force is concerned with figures and statistics showing *what has been accomplished, as a guide to future action and re-*

sults, while the constructive force is concerned with facts and information as to equipment, conditions, operations, men, etc., showing *what should be accomplished in order to secure results.* One force will of course do a great deal of good without the other, perhaps because of the fact that there remains, in modern manufacturing practice, a great deal to be done, but it should be seen that the two forces mentioned, working harmoniously along widely different lines with the same goal in view, will accomplish more in the way of results than either of the forces working independently.

Mention was just made of the fact that a great deal remains to be done. How true this is no one knows better than those whose profession it is to assist in getting all that is possible out of men, equipment, and materials, and who are in a position to see, through close observation, where the faults lie and what will eliminate them. There is a task ahead of this great nation—a task of such magnitude as to warrant wise executives giving it earnest and careful consideration, as well as to attract the attention of those who are in a position through training and natural ability to assist in solving its many problems—*that of increasing the efficiency of all human endeavor.*

We have graft and investigations of one kind or another until it would seem that there remained no such thing as civic pride; we hear on all sides constant reference to "high cost of living" with innumerable reasons therefor; we hear that railroads must raise their rates in order to protect themselves, to which the shipper strenuously objects as any such increase affects cost of production which would mean still higher prices; we see sufficient evidence of a far from diminishing dissatisfaction among the laboring classes resulting in constant strife between capital and labor. These and many other conditions which could be mentioned furnish sufficient evidence that something is decidedly wrong—that we are face to face with conditions which cannot exist continuously without disastrous results.

This condition of affairs has been most excellently described by H. L. Gantt:*

With increase of prices comes higher cost of living; with higher cost of living comes demand for higher wages; with higher wages comes higher cost of pro-

*See "Work, Wages and Profits," by H. L. Gantt, The Engineering Magazine, New York.

duction. Then to maintain the same profit under the new conditions, we must again increase our selling prices and the cycle repeats itself.

This vicious cycle is illustrated graphically by the chart below.

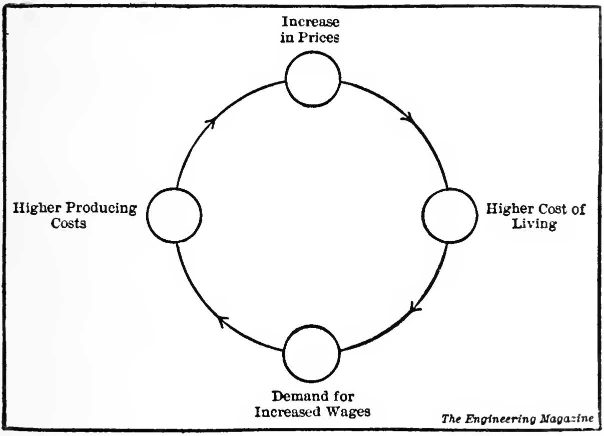

FIG. 1. THE VICIOUS CYCLE OF INCREASING PRICES AND COSTS.

What is the trouble? To me, two great faults seem to be responsible: first, *extravagance* and, second, *impatience.* The widespreading movement for the conservation of our natural resources is sufficient evidence that as a people we are extravagant, and no one, after due consideration, will deny the fact that in our hurry to get things done—to see results—to turn time and material into cash—impatience is largely responsible, both faults being the result of our present system of organization and management, as will be evident to anyone who will take the time to read carefully Harrington Emerson's "The Twelve Principles of Efficiency."*

As a people we have come to the realization of the importance of conserving our natural resources, and as a result we now have this matter as one of our lively issues, forcing the attention of our able men. What we need, however, and *at once*, is a movement for the conservation of our resources other than water power, minerals, timber, etc., which would mean decided benefits. This would involve:

1.—Increased production.
2.—Lower production costs.
3.—Decrease in prices.
4.—Lower cost of living.

} as an offset to the condition pictured in the chart.

We need most of all to hear more about *inefficiency* and less about efficiency. We like the latter word so well that we use it without much thought as to its real mean-

*Published by The Engineering Magazine, New York.

ing. If we talk about the inefficiencies more, our efforts towards eliminating them will be increased, and efficiency, as a natural result, takes care of itself. Inefficiency is an unhealthy state of affairs—a disease in other words—just as susceptible to diagnosis and treatment as any unhealthy condition. If diagnosis and treatment are withheld, however, *decay and death is the result*—a law which is no different in its relation to the industrial body than to the physical body.

Efficiency in the best acceptance of the term means more than simply doing things well—I might say, *thinking* or *guessing* that they have been done well; it is the *positive relation or ratio* between a possible accomplishment—an ideal, a standard—and the actual attainment. We have had altogether too much imagined efficiency and not enough of the cold, mathematical, relative determination. The great trouble has been that standards have not been properly set, or if set no consistent effort is made to assist those responsible for results in attaining them. Consequently we have accomplishments that are not what they should be, which if reduced to a relative basis would show that inefficiencies are still "on the job." For this the management of the enterprise is largely to blame. Instead of beginning at the *bottom* and setting standards for each and every part of the work—whether it be operation or condition—entering into making a business successful, they begin at the *top* and fix in their own minds a final standard as regards what they *want* accomplished, after which they promptly proceed to unload all responsibility onto the shoulders of others—everyone all along the line, down to the workers themselves, having a hazy idea as regards what is really expected of them; and as "anybody's task is nobody's work" it stands to reason that the final attainment cannot measure up to the expectation. This however does not seem to relieve those who have failed to accomplish what was wanted from their share in the session "behind closed doors."

In recent years, a great deal of attention has been devoted to "waste products"—a number of establishments having their own corps of experts, who do nothing but analyze and study the wastes previously considered as possessing little or no value, with the result that the markets today are filled with "by-products" of every kind and description producing a revenue which pays excellent dividends on the cost of their marketing.

In all industrial pursuits, there are many wastes which can be made to yield satisfactory returns. Careful investigation in the majority of institutions will soon disclose the fact that the chief wastes are due to time losses, wasted materials, too much equipment, lack of intelligent planning, poor and insufficient facilities, equipment improperly maintained, etc. A costly bridge is erected, not because it was impossible to cross before, but because crossing is facilitated and made easier with the bridge than without it, and as a result all share in the benefits. If, then, we place a force at work which will turn the wastes into products, we erect a structure which enables the consumer as well as the maker of the products to share in the benefits that always accrue through turning out more in less time.

A successful organization is one which considers the fact that the "constructive force" is a building force, and as it takes time to erect any structure, results must not be expected in a minute; that it should be composed of men who can give their time and attention to the careful study of the wastes, or be assisted by men who are expert in analyzing and bringing up for attention the weaknesses of the industrial body; that the hearty coöperation of the ones who own and operate the business is vital and necessary, in carrying to a successful issue the proposed ways to greater results. It should first see that the working conditions are what they should be; that the equipment is placed in the best possible shape for maximum production; that the men are furnished with the best facilities in order to enable them to take every advantage of the improved conditions and equipment; that the work, in its various details, is planned ahead and scheduled so that delays and annoyances can be eliminated; that careful observation is made as to time and materials consumed in order that suitable standards may be arrived at, against which accomplishment may be measured; that advice and instructions are given in order to assist the various persons interested in attaining the standards set; that suitable records are maintained in order that the management may know exactly what is being accomplished; that those who measure up to the expectations are rewarded in proportion as they assist in converting "waste products" into "by-products."

As will be easily seen, the above is not the usual procedure in the majority of enterprises. The usual course is to engage a manager; to allow him a limited time in which to get acquainted with the conditions and the product, and after that to tell him to go ahead and get results. His time is devoted to securing business; pushing the work through the shops—many times regardless of the cost; running a "diplomacy bureau" for the benefit of the customers; worrying about finances and getting customers to pay their bills; listening to complaints from his men; settling disputes and quarrels, and a thousand and one other things that an executive is called upon to do in the course of seven or eight hours daily. While so busily engaged, in spite of the fact that he may have facts and figures in abundance regarding what has been and is being done (which he uses as best he can when he has a little time), it is easy to appreciate how it is possible, in the absence of a well-organized attempt to convert wastes into cash, for time to be lost, money thrown away, materials scrapped, etc., all because industrial endeavor seems to be conducted on the assumption that the more detail a man can look after in the course of a day, the greater he is as an executive and the more he should be able to accomplish. As a matter of fact there is a limit to the amount of detail a man can handle, *but practically no limit to the supervision that he can exercise.*

Supply the executive with proper records and a staff of men who can assist him in locating and eliminating wastes and inefficiencies; make him a supervising agent, not a drudge; furnish him two good strong arms with which to work—one the "analytical force" with which he can study the past and present as a guide to the future—the other the "constructive force" with which he can improve and build new structures, and the "By-Products Department" will pay dividends far in excess of the cost involved. Unless this is generally conceded to be the proper scheme of management—and not only conceded but *generally adopted—we are going to have with us, as a destructive factor, the condition of affairs so clearly pictured in the chart.*

CHAPTER II

IMPORTANCE OF EFFICIENT ORGANIZATION

IF consideration is given to the analogy between the business machine (the manufacturing enterprise) and the fighting machine (the company of soldiers) the importance of "Organization" is at once apparent. A company of soldiers will accomplish results in the surest and swiftest way simply because they are well organized and properly supervised. From the captain to the privates, through the lieutenants, the sergeants, and the corporals, the orders are given and executed methodically without confusion, delay, and misinterpretation; and in the manufacturing enterprise, the orders can be given and executed methodically without confusion, delay and misinterpretation—if, in the growth of the business, in its evolution from the old order of things to the new, proper consideration has been given to the importance of a well trained and efficient organization. I do not maintain that it is possible for the manufacturing enterprise to attain that high degree of efficiency enjoyed by the army company, but I do most emphatically maintain that it would be possible for more manufacturers to be more successful than they are if they would inject some sort of organization and supervision into their business, instead of conducting it in the hap-hazard, disjointed, hit or miss, aim-at-the-ground-hope-to-hit-the-stars way of which so many are guilty. To this class the mere mention of the word "organization" elicits the cry "red tape," although if one of them would once consent to have some of this kind of tape wound around his business, the results would be so startling as to win him to the side of those who had attained success through a well systematized organization and from whom he could learn how to conduct his own business properly if he would but once get away from his habit of jumping over dollars in an endeavor to save pennies.

If space permitted, we might go into the details regarding the evolution of business in general, from the primitive stage of barter to its present immense propositions. In its early stages business was most simple.

If a man had something his neighbor needed and he needed something his neighbor had, a trade was effected; or if a man had several things of like nature, he sold them to others for whatever suited his requirements. As the demand for various articles increased, however, it was found necessary to specialize in a small way, but in a way which enabled a man to devote his entire time and attention to the manufacture of one thing. During this stage of business development, it was an easy matter for the proprietor of the little establishment to give his attention to the various details; in fact, we can safely say that he carried his office "under his hat." As we approach the next stage, we find that conditions, becoming a trifle more complex, necessitated a radical departure, and that instead of one man looking after every detail, the work has been rearranged so that at least two men divide the responsibility. Tracing still further, we will find that as the volume of business expanded, the amount of detail work necessary to accomplish results assumed such proportions as to make it utterly impossible for a few men to manage a business properly. At this stage segregation was an absolute necessity, and today manufacturing enterprises, while still a unit, are divided into two distinct branches—the commercial and engineering—these branches being again divided into departments and sub-departments.

While business as it is now conducted is not as simple as it was in the barter days, it must not be inferred that this segregation of authority is synonymous with complexity, for its very purpose has been to simplify and this is what it has accomplished. It is only where this segregation has been the result of lack of thought and proper attention that we find a complex and unsatisfactory condition of affairs. In fact, there is all about us sufficient evidence that many commercial enterprises are being conducted along lines that, as far as evolutionary development is concerned, are several stages behind the times.

Let us suppose a case, which will apply in a greater or less degree to the majority. In the earlier development, we will say that the founder of the business was able, on account of its small size, to make what sketches he needed, solicit orders, see that they were filled, perhaps take a hand at the making if occasion required, see to the shipments, and attend to the collections and the keeping of his few accounts. He finds that business grows, and eventually places a man in charge of certain branches while he looks after others. The accounts eventually require more attention than he can give them so he engages a bookkeeper in order that he may be relieved of this work. He finds that the quantity of materials received and shipped amount to enough to warrant a receiving clerk as well as a shipping clerk, and to handle this material from its inception to shipment he conceives the idea of placing a man in charge as stock clerk. He then adds a purchasing agent, in order that he may be relieved of the detail and that the purchases may be made most economically; a man is placed in charge of the orders—foremen are placed in charge of certain men in the shops —the details connected with making plans, drawings, estimates, etc., are taken over by a practical man—his manager is given a person to look after the shops or engineering branch, while the commercial branch with its many details is placed in the hands of another. As the evolution continues, the selling function is assumed by one man—cost details are looked after by another—a chief inspector is added in order that all work may be shipped according to specifications—the engineer, who before had been a sort of jack of all trades, is placed in charge of certain work while an electrician is engaged to look after this particular work—and so this segregation continues with the development of the business.

Perhaps it is not to be wondered at that the founder, in looking backward, is inclined to pat himself on the back when, in a reminiscent mood, he considers what he terms "remarkable progress." He considers that he has been wonderfully successful in building up a business which at the beginning was so small as to admit of his supervising every detail, while today he employs a dozen men to do the work he once did. There is no getting away from the fact that it is this feeling of self-satisfaction that is responsible for a large number of faulty organizations, for if we should tell this manufacturer that his business is far from being as successful as it is possible for it to be he would be very much surprised and perhaps angered—in fact, he would vigorously resent any such accusation; but it is not the success it should be for the very reason that the development has been allowed to take care of itself. New men were added, new offices created, only when absolutely necessary, each newcomer being given a general idea of what was expected of him; and not knowing, not thinking, or perhaps not having the time to give more than passing attention to the matter, the proprietor did not consider the fact that his business was a unit, with each worker a part, having a distinct relation with every other worker. Hence as the efficiency of any organization is directly in proportion to the care with which these relations are considered and treated, this organization naturally fails to attain that degree of efficiency obtainable, and for this condition he and he only is responsible. As a result, we find in his establishment a condition of affairs that, shown graphically on paper, looks like Figure 2. We have here an organization composed of managers and heads of departments, but we also have a confused organization in that no one really knows where his authority begins or ends. Consequently, there is no sequence, order, or harmony, and without these it is impossible to obtain maximum results.

If, on the other hand, the proprietor had

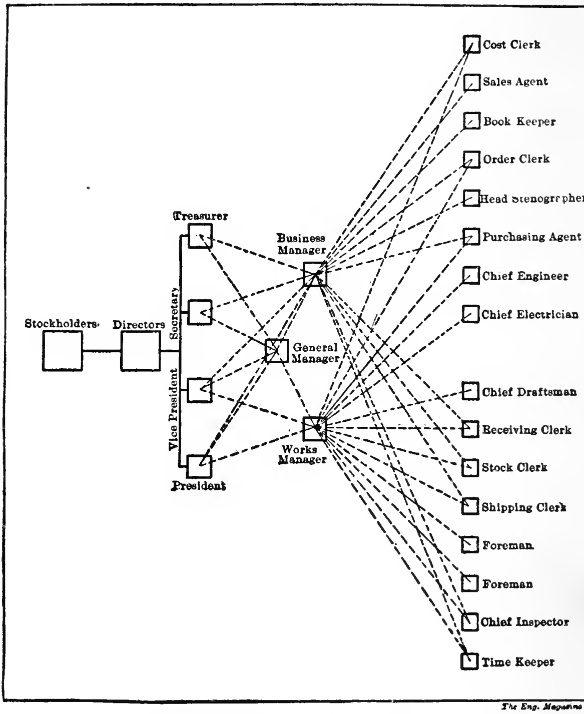

FIG. 2. AN ILLUSTRATION OF POOR ORGANIZATION.

given due consideration, during the growth of his business, to the importance of a well regulated organization—if he had realized that more could be accomplished through an intelligent supervision than through a supervision where one authority conflicts with another—his organization could then be graphically shown by Figure 3. Compare these two charts, and the difference between

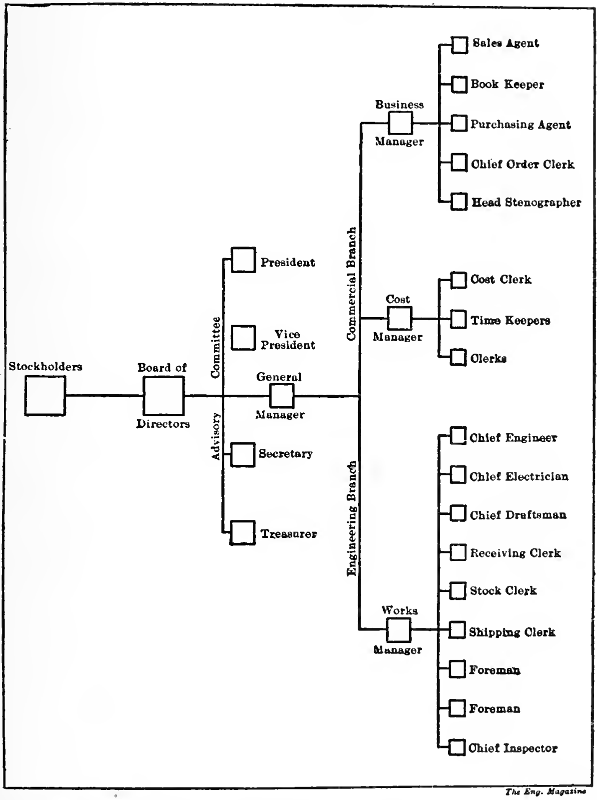

FIG. 3. DIAGRAM SUGGESTING AN ORDERLY AND EFFICIENT ORGANIZATION.

an enterprise well organized and properly supervised and an enterprise in which the opposite is the case will be apparent without further argument. Enterprises like the one shown in Figure 2 fail to appreciate the importance of classifying work and duties under their proper authorities, and naturally the result cannot help but be confusion, conflicting orders, arguments, etc.; while the value of an organization like the one shown in Figure 3 lies in the fact that work and duties have been properly classified and placed under authorities most competent to handle them, the effect of which is to reduce to a minimum the friction between the different workers, as well as to enable them to accomplish a maximum amount of work in the shortest time possible.

It is not the purpose of this chapter to go into details as to work, duties, responsibilities, or authorities. Each establishment has its own peculiar conditions—its own special needs—and the introduction of methods or systems must be made only after careful thought and application. The fact remains however that no matter how complex the existing conditions in any enterprise may be, the matter of properly organizing it is not as difficult as might be imagined, and if the work is started and carried on in the right way it can be accomplished within a short time with gratifying results.

A man is hired and receives wages or a salary, as the case may be, for a distinct purpose—to perform certain duties, and upon the thoroughness with which he performs these duties depends his success; but he depends in turn upon the clearness with which these duties are defined—upon full knowledge as to whom to look to and who are to look to him; yet this part of the contract never receives any consideration at all from many manufacturers. It is therefore of primary importance, in organizing a business, that a complete list of work and duties be compiled. Provision should then be made for placing these duties in charge of those most competent to handle them, after which it should be decided who shall direct and supervise. It is then an easy matter to classify the details under the proper authorities and we can then draw up an organization chart along the lines shown in Figure 3.

The list shown on page 28 was designed to provide a means of enabling a manufacturer to compile duties and then designate the ones

LIST OF DUTIES AND OFFICERS TO WHOM THEY ARE ASSIGNED.

Work and Duties.	Under the Direction of	Under the Supervision of
The figuring of depreciations.....	Business Manager	General Manager
Purchase of special machinery..	General Manager	Advisory Com.
Purchase of materials and supplies	Purchasing Agent	Business Manager
Banking arrangements.........	General Manager	Advisory Com.
The checking of invoices with materials received...........	Receiving Clerk	Works Manager
Checking invoices for payment..	Book Keeper	Business Manager
Notes......................	Book Keeper	Business Manager
Fire protection................	Works Manager	General Manager
Appointment of those under commercial authority...........	Business Manager	General Manager
Appointment of those under manufacturing authority.....	Works Manager	General Manager
Compilation of sales prices......	Sales Agent	Business Manager
Passing on requisitions for materials and supplies:		
Engineering branch........	Works Manager	General Manager
Commercial branch........	Business Manager	General Manager
The following of purchase orders...	Purchasing Agent	Business Manager
The issuing of all shipping orders.	Chief Order Clerk	Business Manager
Billing materials shipped.........	Book Keeper	Business Manager
Experimental work............	Works Manager	General Manager
All issuing of materials on written requisition.................	Stock Clerk	Works Manager
Maintenance and operation of power units................	Chief Engineer	Works Manager
The inspection of all work.......	Chief Inspector	Works Manager
New designs and changes......	Chief Draftsman	Works Manager
Statements..................	Book Keeper	Business Manager
Payment of all bills............	Business Manager	General Manager
Collections up to the point of suit.	Book Keeper	Business Manager
Collections from the point of suit.	Business Manager	General Manager
Ordering of new parts to replace	Chief Order Clerk	Business Manager
Creation of systems...........	General Manager	Advisory Com.
Issuing manufacturing orders...	Chief Order Clerk	Business Manager
All filing....................	Hd. Stenographer	Business Manager
Handling materials for shipment.	Shipping Clerk	Works Manager
The maintenance of proper stock margins...................	Stock Clerk	Works Manager
The determining of proper stock margins...................	Works Manager	General Manager
Execution of shipments from written orders..............	Shipping Clerk	Works Manager
Sanitary and plumbing arrangements.....................	Works Manager	General Manager
Transportation...............	Shipping Clerk	Works Manager
Advertising contracts..........	Sales Agent	Business Manager
Passing on credits.............	Book Keeper	Business Manager
Maintenance and operation of electrical equipment.........	Chief Electrician	Works Manager
Execution of work on time:		
In charge of committee comprising................	Works Manager Chief Order Clerk Stock Clerk Shipping Clerk	General Manager
The tracing of all shipments.....	Chief Order Clerk	Business Manager

to look after and supervise them. The entries shown have been selected at random—the list has been purposely made incomplete on account of lack of space, and is simply suggestive in nature. After a complete list has been made, the work of classifying under proper headings is a simple matter but one of great importance, as the following will show:—

BOOK KEEPER, under the supervision of BUSINESS MANAGER, final authority GENERAL MANAGER—shall have full charge of all bookkeeping, the giving of all notes, the issuing of statements, the billing of all materials shipped, the handling of all invoices received—their checking and passing for payment, cash, the disbursing of money when advised to do so by the Business Manager, pay rolls, time accounts, passing on credits, the enforcing of all collections up to the point where legal assistance is necessary, the hiring, paying, and full charge of assistant bookkeepers, bill clerks or whomever it may be necessary for him to engage in order to manage his department properly; the arrangement, classification, and handling of his accounts, the right to employ whatever methods he may elect without changing the general scheme of the accounting; and while possessing no authority outside of his own department, he shall have the right to collect such data as are or will be necessary for him properly to compile statements as to the general or detailed conditions of the business.

After this task is completed, the chart of organization can be quickly made, and we then have the proper foundation for an efficient organization. By following the suggestions outlined, a means is provided whereby conflict of authority would be almost entirely eliminated with friction greatly lessened, as we have supplied a lubricant; and as we have succeeded in arranging the various forces in the most logical way, as well as provided for their care in the most careful manner, it is well within the range of reason to expect a maximum production through this factor—"Effective Organization."

Chapter III

THE ELEMENTS OF ACCOUNTING AND MANAGEMENT

"RESULTS of action vary as knowledge increases or decreases," the moral of which is—*know what is going on.* Any industrial undertaking is operated for profit, by men who do not start out with the definite intention of having the venture eventually prove a failure. They expect to be successful and to make money for themselves and for those who may be associated with them in the business. Theoretically, then, there should be no such thing as failures; but the mere fact that each year adds its number of industrial wrecks to the large number that have preceded them, simply emphasizes the fact that action has been the result of a lack of, or the wrong kind of, knowledge.

The simple elements of any business, if analyzed and studied, will show how necessary it is, if success and profit is to be attained, to have the *right* kind of knowledge, furnished in the *right* manner, at the *right* time.

Elements must always be recognized before knowledge can be complete. Mathematics would not be mastered in a thousand years if calculus was the starting point, yet it is possible to go into plant after plant and find a most hazy idea as regards what constitutes the elements of the business; and where an element is recognized, a great diversity of opinion as to its correct definition is likely to be met with. The purpose of this chapter is therefore to pick out, to define, and to attempt as far as possible to reduce to some sort of standard practice, the principal elements entering into the successful operation and management of a business, in order that the many possibilities in the two forces discussed in the opening chapter—the "analytical" and the "constructive"—may be used to advantage by the executive.

The purpose of any business is to make a salable commodity, and the elements which go to make its output or production are:—

1. Articles made for sale to the trade or to the company of which it is a part, or to both, which we will term "Commercial Production."

2. Articles made for the use of the plant itself, which we will term "Shop-Use Production."

If we attempt to analyze these elements, we shall find that the first is one that is easily understood, as it includes only such items as will produce a direct revenue on which a profit or loss is made. The second is made up of several other elements which can be picked out and defined, if consideration is given to the following:

While the definite aim of the management is to make and to sell as much as possible, every executive is confronted with the necessity of periodically replacing or renewing or repairing certain parts of his plant and its equipment, which leads us to the statement; in order to produce to advantage, we must *maintain* that which makes our production possible. We have still another consideration. The ambition of every manager is constantly to increase his volume of production, and depending upon his success in realizing his ambition, we find that he is forced to add new equipment, to build additions, and in other ways to place himself in position to supply his trade with their requirements. This gives us the thought—to expand so as to produce more, it is necessary to *construct* that which will make a greater production and an increased volume of sales possible. This construction is of two kinds, although this fact is not generally recognized, the distinction being determined by the consideration whether the construction is something *altogether new* or simply *the changing of something that has already existed.* We will term these two kinds, A—New Construction, and B—Reconstruction.

In every plant it is necessary to do special work for customers, for which a price is charged—another element which we must consider. Still another is made up of such items as cannot be classed with any of the elements which have just been pointed out, and as consideration will show that such an element could not be classed as a revenue-producing or an asset element, it must be classified as expense. Our division of endeavor, common to all industries, would therefore be as follows:—

1. Commercial Production.
2. Maintenance.
3. Construction—
    - A New Construction.
    - B Reconstruction.

(Elements of Production, Continued)

4. Special Work Chargeable to Customers.
5. Expense.

After the principal elements have been pointed out, the task of next importance is to have them intelligently control the numberless details that are met with, which must be switched onto one or more of the five main tracks mentioned. In the South Terminal Station in Boston, there are twenty-eight tracks which are connected with the outer network of tracks by switches, and upon the correctness with which these switches are manipulated by the operators depends the safety of hundreds of passenger trains which enter and leave this station daily. There would be absolutely no excuse for an operator to make the statement that he was not sure which one of the twenty-eight tracks a certain train was to enter upon. Likewise, it is just as necessary, in order to prevent costly mistakes, false impressions, dangerous conclusions, etc., to switch the details that are met with daily onto the right tracks. How little attention has been given to this particular consideration of the subject, however, would be evident to anyone who could have the opportunity of placing together, for comparison, the handling of the details in a hundred plants. It is safe to say that the variety would be most surprising and would be one means of showing why the average enterprise is so inefficient.

The much discussed topic "depreciation" plays such an important part in the proper understanding of the elementary factors of a manufacturing business that it was deemed advisable to take up the discussion of this subject somewhat in detail.

Keister, an authority on corporation accounting, defines depreciation as:—

> The actual loss upon assets which are diminishing in value, or an estimated sum charged against gross revenue, which amount is considered sufficient to replace the capital used up or reduced by wear and tear.

L. S. Randolph, in a recent paper in The Engineering Magazine,* defines it as follows:—

> The fall in value from any cause whatever, the essential element being that the machine or structure becomes obsolete.

In other words, the common understand-

* August, 1910. Ethical Aspects of the Allowance for Depreciation.

ing of the subject seems to be that depreciation is:—

> The provision made to maintain the book value of an item on a level with the diminishing value of the item, due to its usage or other reasons.

It must be an intensely optimistic mind that can see no depreciation in what he possesses. Such minds do exist, for the author was once told by a shrewd manager that there was no such thing as depreciation; that as long as he kept whatever he had in good condition, it was as good as the day he purchased it and therefore worth what had been expended for it. A foundryman, citing the tumbling barrels in his cleaning room as an example, stated that he considered that there was no wear out to them, for whenever staves were broken, he promptly replaced them, which made the barrels as serviceable as ever. Excellent viewpoints, both of them, but in error just the same.

Let us outline a case which will serve as an illustration. Assume for instance that a horse had been purchased for $350 and for a period of years did all that any horse could do, during which time it was fed regularly, shod when necessary, occasionally received a "doctoring up." Eventually, however, on account of the age of the horse, disease, or other reasons, it has to be sold, $50 being all that it will bring, and to take its place another horse has to be purchased, for which a price of $250 is paid. Assuming the consideration had been that the value of the horse did not diminish, in which case no depreciation charge was ever entered, and we find in our assets an item of $350 year in and year out. Finally, when the horse is sold and the new one purchased, we credit the assets for the salvage of $50, but charge it with the $250 expended for the new horse, so that the account stands—

Old horse	$350.00
New horse	250.00
Total	$600.00
Received for old horse	50.00
Balance in account	$550.00
Value of new horse	250.00
Difference	$300.00

Here we have $300 in the assets account for which there is no value whatever. The only thing to do is to write the amount into profit and loss and the executive can say to his stockholders:

Gentlemen: I had to sell our old horse and purchase a new one. After just paying $250 for the new horse, I find the value of the old horse still in our assets, so will have to carry it into profit and loss—hence you will have to go into your own pockets this year to pay for the new horse and in addition stand the difference between the value of the old horse less the salvage and the value of the new horse.

Such an explanation would certainly not appeal to the stockholders, in fact their reply would probably be:

You should not have allowed this replacement and loss to come out of this year. If the decreasing value of the horse had been offset by a depreciation charge and this amount absorbed yearly by our cost of production, our customers would have paid for it the same as they pay for the labor and material which enters into their product. If this had been done, not only would our profit have been about the same during the years we have had the horse, but when the time came to purchase the new one, there would have been enough in reserve to take care of the purchase without calling upon us to do so.

From this statement, two conclusions are forthcoming:—

1. The customers, not the stockholders, should have paid for the horse.

2. By making "cost of production" absorb the cost of the old horse, less the salvage, the expenditure would have been returned to the business.

A study of this leads to the conviction that one phase of the subject which has never received the proper amount of consideration is the fact that *regardless of all questions of replacements, diminishing values, wear and tear and reserves, whatever is produced for commercial use should absorb all that enters into making that production possible,* whether it is the wages paid to the workmen or the cost of the machinery; expenditures for materials used, or what has been spent for erecting buildings. In other words, whatever is produced uses, in some form or other, the various items in the list of assets and should be assessed with its proportion of the cost of these items. The wages paid the driver of the horse we were just discussing is entered every month against the production of the month. Why not some part of the cost of the horse? If the $65 per month paid to the driver should be left out of the consideration, through an error, what a stir would be raised because of the carelessness of some clerk! But what is said if the cost of the horse stays buried in the assets month in and month out?

A foundryman purchases a moulding machine for $1,000, which he promptly proceeds to charge to his assets. He engages a moulder to operate this machine, and immediately the machine and man become a unit in turning out production. The foundryman charges the wages paid the moulder against the production of the machine, being very careful that the distribution of the labor is as correct as possible. He may be of the opinion, as many foundrymen are, that there is very little depreciation in a foundry—he may believe there is none at all; and as a result, a very small charge for depreciation is entered against the production of man and machine—perhaps nothing. If it is logical to charge wages against the production, it is just as logical to make this production bear its share of the cost of the machine. The only difference existing is the fact that the workman receives his wages weekly at so much per day while *the machine is paid for in advance.*

The analogy existing between man and machine is worthy of mention. Assuming for purposes of comparison that a man contracts, with a concern or its successors, to give it his services for a period of ten years, at $1,500 per year, the entire sum to be paid upon signing the contract, which provides that in case the man is able to continue on for an additional five years, he is to do so for no extra compensation, the man in turn being guaranteed against deductions for sickness, vacations, etc., the concern to waive all claim to any part of the $15,000 in case of the death of the man. What difference is there in the condition when a machine tool is purchased? The builders of the tool contract with the concern wanting the tool, to give it the service of the machine for $15,000, their estimate being that the machine will last ten years with ordinary usage. If the machine lasts fifteen years, no extra amount is forthcoming to the tool builder. If the tool is out of commission for repairs or because there is no work, the concern gets nothing from the tool builder. If the machine wears out before the stipulated ten years, the concern loses, although there would be some salvage in the disposition of the discarded machine, which would not be the case should the workman die—the only point where the comparison does not hold.

The concern might feel justified in taking the stand that there was little or no depreciation as far as the machine was concerned, but what a difference there would be as regards the man. Not one of the 120 months would pass without a charge of $125 being assessed against the business for the month. If the nature of the work was such as to admit of its being distributed to some specific line of production, this would be done; if this were not possible, then it would go into the general expense of conducting the business, but it would be included without question, for would not the contention be that the amount expended for the man is a part of the direct or indirect cost of production? Most assuredly it would, and rightly so.

Three things could happen to the man—

1.—He might be off sick from time to time, occasionally going away on a vacation (corresponding to a machine being down for repairs or not in operation because of lack of work).

2.—He might die before the ten years are up (corresponding to a machine being discarded before it has given its full measure of usefulness).

3.—He might work for the ten years and then continue for a few years longer (corresponding to the machine lasting longer than anticipated).

As regards No. 1, it is evident that the charge must be made against general expense. In the case No. 2, if the man dies before the stipulated time, there are only two courses open to the concern.

A.—Write the undistributed portion into profit and loss, thereby closing the transaction.

B.—Allow the undistributed portion to be absorbed, year by year, according to the schedule originally mapped out.

In case No. 3, we have the opposite of case No. 2—the man working longer than was expected. As the $15,000 has already been absorbed by the ten years during which he worked, there remains nothing further to absorb, consequently the services of the man from the ten years until he stops are a clear gain to the company.

Substituting buildings, machinery, and general equipment for the man cited in the illustration, we are bound to reach the same conclusions, and, while the comparison is contrary to all reason, it was used because a person interested would see, in comparing man with machine, that the machine would have to be handled in the same manner as the man.

An opposite viewpoint is equally interesting. If the concern could contract for the buildings, all machinery and equipment, etc., on the basis of monthly payments, for the period of years corresponding to the life of the items (assets on a man basis), it is obvious that *there would be no assets at all, for the concern would own nothing until full payments had been made.* The procedure would be most simple. The cost of production of each month would absorb the monthly payments on plant, the same as it would absorb wages, cost of material, and the general expenses. When all payments had been made and the concern owned everything free and clear, it would be found that the production had paid for everything. If the concern had started out with capital to purchase their plant but had contracted as above outlined, it would also be found that the original capital was intact, as during the years, assuming the business to be profitable, the customers would have paid enough to take care of the cost of the production including *charges for plant, plus a profit for the stockholders.*

From these two illustrations—opposite in their nature—it is evident that there is such a thing as depreciation, and that, as the cases cited made no reference to reserve for replacements, diminishing values, etc., it would seem logical to make the assertion that these considerations are, after all, *only side issues* instead of *principal elements* of the subject that have so long been considered as being the reasons why it was necessary to figure depreciation.

I get my friends to advance me enough money to buy land, erect buildings, install machinery, with the view of conducting a manufacturing business. I solicit business, get orders which I proceed to fill, charging labor, material, expenses against my monthly productions. My friends may know nothing of the particular business I am engaging in; they may know little about depreciation, diminishing values, reserve for replacements, etc., *but they do know that they want the business to earn what was invested;* and how can a business earn the investment if a proportionate amount is not a part of my production costs? If I fail to do this, I give my customers the benefit of money invested in my business which they are not entitled to, for when the time comes for buildings to be replaced, new machinery installed in place of that which has worn out, etc., I find no funds on hand to do the work with, without going to my friends to "stake" me a second time. If I sell my plant, it would not, on account of its run-down condition, bring anything like what was put into it originally, hence my friends would lose their investment, or at least the greater part of it. If, however, I had added a proportionate amount of my friends' investment to my cost of production, for which my customers would have paid, I would have invested in good securities funds with which to do my replacing; or I could sell out, and return to my friends the money they invested *plus* their share of the sale of the plant.

My theory of depreciation is therefore:—

"The absorption by production of all capital investments, in proportion to the use of this investment entering into making this production possible, and the consequent insurance of a return to the business of the initial expenditure."

This can easily be seen to take care of wear and tear due to usage, diminished value which is the undistributed portion of the costs assessable to future production, reserve for replacements which is the returning to the business what originally was a capital outlay.

In determining the method of figuring depreciation, consideration should be given to the following:—

1.—The estimated life of the unit must be established.

2.—The units must be classified according to those which can be assessed—

A.—Against specific production, as for instance a moulding machine, a lathe, or a boiler.

B.—Against classes of production, as for instance a building for a certain class of production or the crane in this building.

C.—Against total production, as for instance a crane serving the whole shop or the cupola, fan, charging appliances, etc.

3.—For 2A, a rate per hour should be ascertained which can be charged to specific production when the unit is in use, or to general expense when idle. For 2B and 2C, a rate per month can be established which can be assessed according to the facts in the case.

In establishing these rates we can proceed as follows:—Let

M=Estimated life of the unit in months.

H=Estimated life of the unit in hours.

C=Cost of the unit.

I=Costs of installing the unit.

I_1=Interest on the cost of the unit.

S=Possible salvage upon being declared obsolete.

RH=Rate of depreciation per hour.

RM=Rate of depreciation per month.

Using these symbols, we may then formulate the monthly and hourly depreciation rates thus:

Rule 1.

$$\frac{(C + I + I_1) - S}{M} = RM$$

Rule 2.

$$\frac{(C + I + I_1) - S}{H} = RH$$

Regarding the recording of depreciation charges, a first thought would be that the clerical labor involved in keeping an accurate record of depreciation renders a careful accounting impracticable. To keep properly informed as to existing conditions, to have production costs absorb capital charges equitably, it is necessary to keep some track of the items; and while the work may seem unnecessary and like too much "red tape," it will be found profitable. The card illustrated on this page (Figure 4) would serve as an excellent means of keeping track of values, the reverse side being ruled to show the maintenance cost, date, order number, and the value of repairs. Reserve accounts should be opened for depreciation charges,

Department						Account				
No.		Name of Unit					Estimated Life			
Made by Purchased from			Date			Order No.		Rate of Depreciation		
Date Installed		Original Cost			Interest		Installation		Total Cost	
Betterments					Depreciation					
Date	Order No.	Item	Value	Total	Date	Amount	Balance	Date	Amount	Balance

FIG. 4. FORM FOR RECORD OF DEPRECIATION.

which should be properly classified, to which should be credited the amounts charged expense for the depreciation, as shown by a recapitulation of the cards illustrated. In this manner the original values of the asset items are left intact, being offset by these credits to the reserve accounts.

In closing this chapter, a few words should be said with further reference to a procedure for asset items declared obsolete before their estimated life, or lasting longer than anticipated. As was stated, two courses are open: either to close the transaction or to allow it to work itself out. It would seem that the former would be the best method of procedure. A contrary opinion by H. C. Bentley, C. P. A., an authority on accounting practice, is as follows:—

> If ten percentum per annum of machinery and equipment is reserved for depreciation and a machine is replaced three years from the date purchased it would be theoretically correct to charge the reserve account with only thirty percentum of its cost, as this is the amount reserve has been credited on account of this particular machine. This would necessitate charging "Surplus" with the remaining seventy percentum. It is not advisable to put this theory into effect, however, as some machines will last much longer than the ten years, while others must be replaced in much less time than ten years. It thus follows that such inconsistencies adjust themselves in the long run, on a basis that is quite as equitable as if an elaborate method were operated with a view of securing more accurate results.

In the illustration cited by Bentley, $7,000 would be the loss in the year in which the transaction was closed, if the machine had cost $10,000. Assume for example that another machine, with an estimated life of ten years and costing $10,000, should last fifteen years. At the end of the ten years, the $10,000 would stand as a credit to the reserve for depreciation, with five years ahead of the machine. This would mean that the account should have been credited with $666.67 yearly or $6,667 in the ten years, leaving $3,333 to be absorbed by the years to come. We have the $10,000 in reserve, however—too much under the conditions. If, then, we open a "Values Adjustment Account" and credit it with this $3,333, the value on hand, giving this value to reserve for depreciation through a charge entry, we *reduce* the depreciation credit to $6,667, the amount it should be. We simply transfer part of the reserve credit, *corresponding to the gain to the company,* from one account to another. Crediting assets and charging "Values Adjustment Account" for the $7,000 loss, leaves an adjustment of $3,667 which we would credit to this account and charge to profit and loss.

To a concern desiring to get at the truth of things this would be the proper procedure, as in this way we recover, on items lasting longer than anticipated, a portion of the values, in depreciation reserves which can be used to assist in taking care of the losses due to units declared obsolete before the expiration of their estimated life.

Chapter IV

MAINTENANCE, NEW CONSTRUCTION, AND RECONSTRUCTION

WE now come to a discussion of what should rightly be charged to the elements—Maintenance, New Construction and Reconstruction—a topic that has caused many a bitter argument, is confusing to many business enterprises and in addition is one upon which it is difficult for accountants to unite in agreement as to a uniform or correct procedure.

Our first consideration is the fact that an expenditure of any kind either increases the value of what we may have and is therefore a charge to our assets, or it does not increase value, in which case it is a charge against our revenue.

Viewed in this light we can define Maintenance as—

All expenditure for work which simply *maintains,* without increasing in any way the value of the plant, including all *repairs* and *renewals* to *real estate, buildings* and *equip-*

ment, being the expense necessary to keep a thing in condition, operative, and useful.

The next element, New Construction, can be defined as follows:—

All expenditure for work which *increases* (instead of maintaining) the value of the plant, such as *betterments, extensions* or *additions* to *real estate, buildings* and *equipment.*

The element Reconstruction can be defined as follows:—

All expenditure for work which *neither increases nor maintains* the value of the plant, including any changing of what already exists which is not undertaken because it is absolutely necessary but voluntarily for some resultant advantage. To include also expenditures of an extraordinary nature, which may affect *maintenance.*

Maintenance would naturally be a charge against revenue; New Construction would be a charge to our assets, while Reconstruction, neither maintaining nor increasing value, would also be a charge against revenue. It might be well to state in this connection that expenditures for Reconstruction or Maintenance classed as Reconstruction, should not be entirely absorbed by the month in which they are made. Items that are chargeable to Reconstruction are generally of an extraordinary nature, and it is hardly fair to make any one month absorb the entire cost. This should be spread over a period of months to be decided upon according to the facts in the case.

It would appear as if the matter of correct charging would not be difficult, but the task becomes complicated in the absence of a well defined way of handling the various cases as they come up, so that the problem is to outline some procedure for determining a dividing line between charges to our assets and charges against revenue, in which respect misconception has done no end of harm to industrial undertakings, as a great many know —to their sorrow.

One manager whose whole aim and purpose is to *keep cost down,* will oftentimes allow this desire to get the better of his judgment, and as a result items which should be charged against revenue are classified as assets. Another manager, desirous of getting at the *true showing, regardless of the effect,* will make revenue stand such items as are a legitimate charge against it. In other cases what one manager considers a charge against revenue, another will feel perfectly justified in treating as an asset. It therefore seems as if the deciding factor as regards questions affecting assets and revenue, in many instances is either personal opinion or the desire of the executive, rather than an effort to outline a uniform policy; consequently it is but natural that we should find so many different methods in practice.

Assets in the strictest acceptance of the term, should mean one of two things:

1.—Money on hand or its equivalent.

2.—That which can be converted into money.

This establishes the fact that assets are of two kinds, *quick* and *fixed.* Cash in bank and accounts receivable would come under the first class, while real estate, buildings, and equipment would be classed as fixed assets. If this is a correct interpretation of what assets are, there is no excuse for railroading into the assets accounts, items which cannot pass this conversion test; for an item does not add a cent's worth of value to the plant, if the amount expended cannot be converted back into money. This test can be reduced to a more practical basis in a great many instances by the question: "Can I dispose of it for the money I have expended?" The answer to this, if the attempt to get at the truth is a conscientious one, will determine how the charge is to be made.

The question whether assets values should be considered from the standpoint of the "going concern" or the "forced sale" is entitled to some consideration. I well remember attending a forced sale of a plant which brought less than $10,000 under the hammer, although the assets were appraised at nearly $100,000. Investigation developed the fact that the plant was old and run down; no provision had ever been made for depreciation; the management had been of the "guess-work" kind and the appraisers had valued each item at the cost to replace it, consequently the assets were all out of proportion to their true value, although $10,000 was less than what the plant may have been worth.

It makes a remarkable difference in the amount that can be realized, whether a concern does not particularly care whether it sells or not or whether it is forced to sell. In the first case it can demand, and no doubt secure, a much larger figure than would be the case if the creditors took a hand. With the forced sale we find conditions that can be classed as unnatural. The buyers pay little attention to correct values—they are out for *bargains,* knowing full well that the consideration of prime importance to the creditors, first, last and all the time is—*the settlement.*

A doctor asks a certain fee for an operation, a fee on a par with that asked by other doctors. The fact that a prospective patient refuses to pay this fee is no evidence that the services are not worth what was asked for them, for he will find plenty of patients, if he is successful, who are willing to pay the regular amount. If the doctor is "up against it," he may consent to take the case for much less than the regular price; but this does not by any means represent the true value of surgical services, although as far as the doctor himself is concerned his condition forces his value down and that is as far as the influence can be made to go. My neighbor buys a piano for $600, has it a year but uses it very little. His wife dies and he decides to sell out everything. I want the piano, and as we have been firm friends, he consents to sell it to me for $200. That he sold it to me for this figure is no indication that it is worth only $200, for I could no doubt get nearly as much as was originally paid for it. Friendship and a desire for a quick sale, regardless of value, were the underlying motives contributing to the decline in value to $200—a false value, as everyone can appreciate. So with the forced sale—the values are false and should not be considered as a guide in arriving at an assets value.

If an item is useful and necessary; if it facilitates production or is a business getter; if it is something that can no doubt be used to advantage by a prospective buyer, it is something of value and can be added to our assets; for it is safe to assume that it would find a buyer at the price asked. If any doubt exists, however, its cost should be absorbed by revenue—a safe and sane procedure—keeping out of the assets questionable values, which if included tend only to mislead, oftentimes with results not at all gratifying.

After all, the main thing to consider is that as long as "cost of production" is to absorb everything, it is playing safe to write all doubtful cases into cost; and if, in addition to this, the attempt to have the cost absorb items that can be rightly considered as assets is an honest one, the values will not be far off.

Definitions and a general outline as to procedure are sometimes easy to understand, but when we come to deal with specific cases we may find that the proper handling is still rather difficult on account of the various ways of looking at the subject. I know of one concern making a standard type of machine which for years has been in successful competition with other makes, where the policy is to charge all patterns and drawings on all new work to the expense account in the month in which they are made. In another concern where the designs have been constantly changing, patterns and drawings have been charged to assets, subject to a ridiculously low depreciation rate, and as a result both accounts are far in excess of what they should be. Both ways cannot be right; in fact both may be wrong, for which reason it seems advisable to get down to a discussion of cases.

CASE 1.—MAKING NEW WOOD FLASKS.

A.—Stock size, for general use and not replacing old or discarded flasks—

This transaction can hardly be considered as in any way increasing value, first because of the short life of wood flasks, and second because the usual foundry wood-flask equipment is about ready to be used for firewood, and from the standpoint of a convertible security is worth next to nothing. Wood flasks are constantly wearing out, new ones being added to take their places. If they vary much as to size, is this sufficient grounds to class them as assets? Would it not be better to consider them as maintaining the value of the wood-flask equipment, which if entered as assets should be represented by a nominal figure to cover the whole equipment, subject to change only as the business expands? It would seem from the above that the case should be classed as a Maintenance item.

B.—For a special line of work—

It follows that it is the special work that makes this flask-making necessary. Value has not been increased, because the flasks will no doubt be useless when the special work has been done. Nor has value been maintained according to our definition, consequently this charge should be considered as expense and absorbed by the special work to be made in them.

C.—To replace old and worn-out flasks—

1.—If stock size for regular use, the expenditure would be a Maintenance item as it does not increase value to any extent, simply maintains it.

2.—If for special work, it would be a charge against the work the same as 1B.

CASE 2.—MAKING NEW IRON FLASKS.

A.—Standard sizes for general use and not replacing old or discarded flasks—

Iron flasks under the condition outlined no doubt increase value. They are necessary and useful; they facilitate production and are something a prospective buyer could use to advantage, and as they possess a much greater degree of permanency than wood flasks, we can safely class them as a New Construction item.

B.—For a special line of work—

Remarks at 1B would apply if the flasks would be of little value after the special work was made in them. Should they be so designed, however, as not only to take care of the special work but to be useful for general purposes, then it would be well to charge part of the cost against the special work and the balance to New Construction.

C.—To replace old and worn out flasks—

Remarks at 1C would apply here.

Note.—Care must be exercised in determining whether a new flask is a replacement, or for special work, or an addition to the existing equipment. The proposition is usually a confusing one, for there have been cases where new flasks have been made as a replacement but put in as new equipment, because the flask was *new* and also because of the fact that the ones they replaced had been lost sight of. If not rightly looked after, the proposition will soon become hopelessly confused.

CASE 3.—MAKING A LOT OF WOOD FLASKS, WITH IRON BARS, WHICH ON ACCOUNT OF THEIR CONSTRUCTION WILL LAST A REASONABLE LENGTH OF TIME.

The procedure outlined for 2 ABC seems upon consideration to take care of this case also, although the life of such flasks would be shorter than iron flasks.

CASE 4.—A NEW BELT TO REPLACE AN OLD ONE.

As this belt was added to keep the transmission equipment in good running order, it would have to be considered a Maintenance item, according to our definition given at the beginning of this chapter.

CASE 5.—A NEW BELT PLACED ON A NEWLY INSTALLED MACHINE.

The new machine adds value, and being a security that can be converted into money, is an asset. The belt being a component part of this machine along with the countershaft would naturally be included in the cost of the installation and also considered an asset, consequently a New Construction item.

CASE 6.—CHANGING THE LOCATION OF A DEPARTMENT.

A move of this kind neither adds value nor maintains it—as we would have just as much value after the change as before; consequently, the cost of the work would be chargeable to Reconstruction and absorbed by expense.

CASE 7.—CHANGING THE LOCATION OF A DEPARTMENT, AND ADDING A NEW DEPARTMENT.

As consideration will show, we have a transaction of which part neither adds nor maintains value and part adds value; hence it affects both Reconstruction and New Construction, the cost of the changing and the addition to be kept separate for correct charging.

CASE 8.—PAINTING THE BUILDINGS AND WHITE-WASHING THE INTERIOR.

In this instance the work is done to maintain value, but as the expense is of an extraordinary nature it would be hardly fair to charge the cost against the month in which the work is done, for which reason it should be classed as a Reconstruction item and the cost spread over a period of months, to be decided upon as being just and equitable, Reconstruction to be credited and Maintenance charged with the monthly portions of the amount so apportioned until the whole sum has been accounted for and distributed.

CASE 9.—TAKING DOWN A LINE SHAFT AND PLACING IT IN ANOTHER POSITION.

See Case 6.

CASE 10.—EXTENDING LINE SHAFT FOR AN EXTRA PULLEY AND BELT.

Here we have another instance of adding something which would pass our conversion test, consequently we can class this as a New Construction item under the definition set forth at the beginning of the chapter.

CASE 11.—RELOCATING MACHINERY, WITH THE VIEW TO IMPROVING THE EQUIPMENT FACILITIES, MAKING NO CHANGES IN TRANSMISSION ARRANGEMENTS EXCEPTING WHERE NECESSARY TO CONNECT THE DRIVES PROPERLY.

In this case we move what is already considered as something of value, from one place to another, and add what may be necessary to effect proper transmission; but as it is more than likely that what was added replaced worn-out parts, it is proper to treat this case as effecting Reconstruction.

Should it happen that quite a little new material had to be added *as an addition,* not a replacement, it being necessary to discard some of the equipment previously used, then the case should be handled by charging Reconstruction for the relocating and New Constructions for the additions, crediting the latter for the present value of this discarded material.

CASE 12.—RELOCATING MACHINERY, PUTTING ON ALL NEW BELTS.

Here we have a transaction affecting both Reconstruction and Maintenance, for as regards the relocation, we neither add nor maintain value, while replacing belts would be a move to maintain value. To save needless accounting however, the whole cost should be charged against Reconstruction and spread over a period of months.

CASE 13.—RELOCATING MACHINERY, INSTALLING MOTOR DRIVES TO REPLACE BELT DRIVES.

In this case we can see that Reconstruction is affected for the cost of relocating, but that we have also added something of value in the way of new motors, consequently for the latter we would charge New Construction and credit it with the present value of the belts.

CASE 14.—INSTALLING A PRODUCER-GAS PLANT TO REPLACE A STEAM EQUIPMENT.

This is, of course, a replacement, but not made to maintain value nor in the sense that we relocate a department or machine. We eliminate something of value and add something of value. The difference in values must be considered, which gives rise to the query regarding which of the following values should be used—

1.—The difference between the present value of the steam equipment and the cost of the gas plant.

2.—The difference between what we are allowed for the steam plant and the cost of the gas plant.

3.—The difference between what we pay for the gas plant and what we sell the steam plant for.

The steam plant was put in the assets, when new, at a certain figure. It now has a value, less than the original amount by what has been absorbed by cost of production; consequently the balance remains to be returned to the business. We cannot leave this amount in our assets because we do not have this value in any convertible security; consequently we should charge New Construction for the cost of the gas plant—charging "Values Adjustment Account" and crediting Assets for the present value of the steam plant. What we are allowed in exchange or receive for selling the steam plant would be a credit to "Values Adjustment Account."

CASE 15.—EXTENDING THE CRANE RUNWAY AND REPAIRING THE REGULAR RUNWAY AT THE SAME TIME.

This transaction will be seen, upon consideration, to involve New Construction for the value of the extension, and Maintenance for the repairs on the regular runway. Value is increased on the one hand and maintained on the other.

CASE 16.—REPLACING THE EQUIPMENT OF METAL PINIONS WITH RAWHIDE PINIONS AND IN CERTAIN PLACES SUBSTITUTING STEEL GEARS FOR IRON GEARS.

As the cost of the work originally placing these gears and pinions in position was absorbed by assets, the work of replacing them neither maintains nor increases value; consequently it involves Reconstruction. The cost of the new material less the present value of the discarded pinions and gears is a just charge to New Construction.

CASE 17.—REWIRING THE PLANT; REPAIRING WHAT DOES NOT NEED REPLACING; CONCEALING THE WIRES; SUBSTITUTING TUNGSTENS FOR THE INCANDESCENTS AND FLAMING ARCS FOR THE ORDINARY ARCS IN USE, AT THE SAME TIME WIRING UP A NEW DEPARTMENT JUST CONSTRUCTED.

This case is rather a confused proposition, involving New Construction, Reconstruction and Maintenance, as we add value, maintain value and do neither. Extreme accuracy would be possible but impracticable. The procedure would seem to be: charge Reconstruction with all of the cost of the work, less the work in the new department, which would be a charge to New Construction, and increase the assets by the difference in values between the tungstens and flaming arcs and the lamps discarded.

CASE 18.—PUTTING IN A NEW CUPOLA SHELL TO REPLACE ONE WORN OUT; ADDING TWO OR THREE EXTRA COURSES TO THE STACK; INCREASING THE NUMBER OF BLAST CONNECTIONS AND RELINING THE CUPOLA.

We can outline the procedure for this case as follows—

Putting in new shell. Relining cupolas. Adding extra courses.	To Maintenance on account of value being maintained.
Increasing connections.	To New Construction on account of value being added.

the cost of the work less the value of the new items to be charged to Reconstruction on account of the work being of an extraordinary nature, and spread over a period of months.

CASE 19.—THROWING OUT A MOULDING MACHINE WHICH HAS NOT MEASURED UP TO EXPECTATIONS AND INSTALLING A BETTER TYPE.

While adding something of value, we are also losing something of value. To handle this transaction properly so as to produce a true showing, the procedure should be along the same lines outlined in Case 14.

CASE 20.—MAKING NEW PATTERNS AND DRAWINGS.

A.—For an improved type of a standard machine.
B.—To suit the wish of a customer.
C.—To correct a fault existing in the design of a machine.
D.—For a new and untried type of machine.
E.—For maintenance of equipment.
F.—For new equipment.

The correct handling of the cost of patterns and drawings has always been a source of considerable discussion. A statement showing "net worth" which included all patterns and drawings would be open to question; in fact, an executive in favor of charging his own patterns and drawings to assets would be the last man to sanction the purchase of another concern without first satisfying himself that he was not going to pay for patterns and drawings that were of little value to his business, which gives rise to the query: what patterns and drawings are of value to a business?

In one sense it is doubtful if any are. New manufacturing processes, new tools, better designs, the failure of designs to be a commercial success, and numerous other reasons, all contribute to make patterns and drawing a doubtful quantity as regards their value. Uncertainty is another factor. What might be considered an asset may prove a failure, and on the other hand what was considered problematical and not regarded as an asset may prove to be a great success. It seems, therefore, as if no definite method of procedure can be outlined. If, however, the viewpoint is not so much the desire to get as much as possible into the assets as it is to make production absorb capital charges, it makes it unnecessary to "split hairs" in deciding just how to proceed. If the cost is absorbed at once, revenue takes care of what would otherwise be a capital investment—the safest way. If the cost is considered an asset and spread over a period of years, capital investment is returned slowly (in one case I know of, 3 per cent annually on decreasing balances is considered a correct pattern and drawing depreciation) sometimes much more slowly than the corresponding discarding of patterns and drawings—a procedure that assesses each year, after a certain period, with an unjust cost.

Getting back to the case outlined, a procedure might be outlined as follows:

20A.—As the type of machine is standard and the improvement made only after it has been demonstrated that it will make the design more efficient, it is safe to consider this an asset. The estimated life of the design, however, should not be placed at a figure which is equivalent to saying that it will never be declared obsolete. It must be remembered, as pointed out in the preceding chapter, that the whole aim and purpose of a depreciation allowance is to have production refund capital investment, and the more quickly it is returned, the better.

20B.—This is obviously a charge against the contract, as it is the customer's wish which makes the change necessary. He may or may not be willing to pay for this change, but this does not alter the fact that value is not increased nor is it maintained.

20C.—If a fault exists in the design, it means that the security is not as valuable as it should be; consequently to make it valuable to the trade (which is only another way of saying that it is of value to us) we must expend enough to make it so—hence the item is a charge against revenue.

20D.—Here we have an element of chance. It is possible that the type will be a success —it is just as likely, however, to be a failure. We do not know as yet whether we have anything of value or not; consequently it is not playing safe to call it convertible security, if it is not known that such is or will be the case. The safest plan is therefore to make the current year stand the expense, one-twelfth per month, if the expense exceeds a figure decided upon, or the current month if the cost is a small one.

20E. and F.—The cost of patterns and drawings for the new equipment would naturally be a New Construction item, while if for Maintenance, revenue would have to absorb it.

Chapter V

SYSTEMATIC PROCESSING, ASSEMBLY, AND ERECTION

A MAN once told me that a manufacturer who was not conducting his affairs in a manner to insure maximum results had absolutely no right to be in business; that he should step down and out and give way to some one who would fully appreciate the possibilities and take every advantage of them—who would leave no stone unturned until a full measure of success was his.

Such a statement might, on first thought, seem rather startling; in fact, it impressed me to such an extent that I asked a number of manufacturers how they felt toward those who were conducting their business in an unsystematic manner. One replied by saying that he had just been advised that his bid on a large contract had been rejected because of a much lower tender from some other concern; that he was in a position to know that the work could not be made at a profit by his competitor at the price he quoted. He said that he knew how much labor and material the work would take, and as his burden rate was accurate, he knew that his bid was actual cost plus a reasonable margin of profit; but that his competitor got the work and would lose money while he lost the work and an opportunity to make a profit.

Another stated that he had spent considerable time and money in an effort to organize and systematize his business so as to enable him to secure maximum results; that he knew where his losses ceased and his profits began, as well as just what he would have to accomplish in the way of a production; and that he was willing to give to any of his competitors the benefit of this expenditure of time and money, if it would result in a more intelligent competition. While he realized that his competitor who conducts his business in a careless manner is destined either to be forced to put his house in order or go out of business, the fact remained that his business as well as the business of many others was far from being benefited by a competition that could lay absolutely no claim to intelligence.

It is not the purpose of this chapter to go into a detailed discussion regarding the rights and privileges of a manufacturer, and while it is a fact that he may conduct his business in any old way that he may elect, there being no law against his so doing, *there should be some means to prevent him from involving others in the harm that he is bringing upon himself.* Should a bank get into financial difficulties, measures are promptly taken, not only to look after its affairs, but to prevent other banks from becoming involved; but what protection has a manufacturer from those whose "penny-wise, pound-foolish" policies cannot fail to have a detrimental effect upon the whole business structure?

The point I desire to emphasize is simply this—*do not stand in your own way.* Conduct your business in the best and most careful manner—do not let a dollar creep into the expense account that should be to your credit in the bank—make your competition what it should be; and while it has been said: "a man always believes more readily that which he prefers to believe," a manufacturer, in the majority of instances, will be more successful if he will simply ask himself the question: "How do I know that I am not getting maximum results?" In his attempt to answer this self-imposed question, he will invariably begin to feel that after all a man is in no position to determine the merits or criticize the value of something about which he knows nothing, and will put aside partiality for his own and prejudice against other methods in order to be in a position to judge intelligently.

Business is conducted for profit and must of necessity be conducted *at* a profit in order to make it impossible for the "receiver" to take over the management of affairs. The margin of profit can be so small as to be easily wiped out through lax and careless methods, while it can never be so great as to make it impossible for the best of management to increase it to a slight degree. The margin of profit, however, depends upon the manufacturer himself, although he cannot accomplish what he desires (and all desire a maximum profit) without depending upon something that will enable him to obtain the greatest degree of efficiency from his workmen and machinery. This something we will call "scientific organization," for it will be found in the efficient industrial plants, where a maximum production is obtained at a minimum cost, that the details regarding organization have received careful consideration from able and high-priced men, and that intelligent supervision occupies a most important place as a result producer.

In analyzing the seemingly complex industrial body, the purpose of which is an output, the measure of success its per cent of profit on cost, we find production dependent upon two fundamentals:

Production { Labor
Material

Looking still further, we find them subdivided as follows:

Material { Raw
Finished.

Labor { Productive
Non-Productive.

We can therefore define our production as being the outcome of a process of evolution of materials from their raw or unfinished state to finished units, through the instrumentality of labor which devotes its entire time to the producing—productive labor—assisted by labor which, while producing nothing, is necessary in order that the product may be processed and marketed most economically—non-productive labor.

We find these units, whether they be refrigeration, saw-mill, electrical, planing-mill, power, starch-making, hoisting, mining or other kind of machines, divided as follows.

Units	Standard Units	Standard and Special Parts or All Standard Parts	Various Operations
	Special Units	Standard and Special Parts or All Special Parts	Various Operations

Before we can bridge between the operation and the completed unit, the largest proportion of all work must go through two stages of development:

Machining or processing.
Assembly or erection.

In a small establishment, this machining may be done in one department, or, depending upon the size of the business, we may have a department for the lathes, one for the planers, the milling, slotting, etc., may be done by another, the drills may be in one place by themselves, while the laying out of work from drawings may be done by one department, or each department may look after its own laying out.

We have the complete unit which is the outcome of an assembling process, a number of parts being required which have to pass through certain processes of machining, or operations, before being in the proper state for assembly with one another. It is therefore evident that the more the parts that go through the various operations of machining in a given time, the greater the number of completed parts ready for final assembly. Now if we can picture a shop containing two workmen—one to do the machining and another to do the assembling—with a man in charge, and follow two parts, say a forging and a casting, from the forge and stock room to the car, we shall have an example of a supervision of the highest order; for it would be an easy matter for the man in charge to follow the parts, from their receipt as raw material, through the stock room and blacksmith shop, the layout floor, the drills, lathes, etc., thence to the assembly floor, through the processes of erection, to the car, keeping in touch with the situation until the parts reached their destination, with the result that they could be produced at a minimum cost as supervision would *force* them through in the shortest possible time. If we could transfer this same degree of efficiency to a large manufacturing establishment, making it a part of a carefully worked out organization, it would not take long before a maximum production would be the result.

If we know something we can apply this knowledge, as the architect, through his knowledge of building materials, strengths, etc., can design a sky-scraper. If therefore we know all that it is possible to know concerning the various details connected with a manufacturing enterprise, we are in a position to apply this knowledge successfully and with the expectation of obtaining maximum results, *providing* the application is a diligent one; for the success of any undertaking is in proportion to the care with which the many details are looked after. First knowledge, then diligence—organization, then supervision.

In the handling of any work from raw material to finished product, the most important things we must know are:

The various parts that go to make up a completed unit.

The operations required to make a part complete.

The time each operator should take.

The tools, jigs, etc., necessary to complete an operation.

The condition of the stock of materials necessary to complete a unit.

When the unit is wanted.

Where the parts are during process of construction.

How the work as a whole is progressing.

LIST OF MATERIAL						
DESCRIPTION One D. D. Machine. X Style WANTED April 1st.			FOR Jenkins Manufacturing Company ADDRESS Buffalo, N. Y. MADE UP BY F L Smith DATE Jany 1 1907 PRODUCTION ORDER # 420 SHEET # 1			
SPECIAL INFORMATION Regular testing instructions apply to this order						
✓	# PCS	PIECE NUMBER	NAME	DRAWING NUMBER	MAT'L	PRO.ORDER NUMBER
	2	X 420	Arm Brackets	2160	C. I	420. 1
	5	X 428	Long Arms	2140	Forge	420. 2
	5	X 429	Short Arms	"	"	420. 3
	1	B 50	Bed	3100	C. I.	420. 4
	2	A 214	Rods	2000	Steel	420. 5

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FIG. 5. LIST OF MATERIAL. (*See Page 87.*)

In addition to possessing a knowledge concerning the above points, we must have a means of notifying:

Works Manager, of orders for completed units.

Foremen, of orders for production and assembly of parts.

Workmen, of the work to be done.

Stock Clerk, of material to be delivered and to whom.

Office, where parts in course of construction are.

Works Manager, regarding condition of any order.

Foremen, regarding parts needing special or immediate attention.

Further, we must inform:

Shipping Clerk, regarding promise of shipments.

Office, when stock needs replenishment or to replace spoiled or rejected work.

Foreman, regarding the time spent on work.

As stated in the previous chapter, any introduction of methods must be made only after a careful study of the conditions. A manufacturer can no more expect to get results from a system devised to meet con-

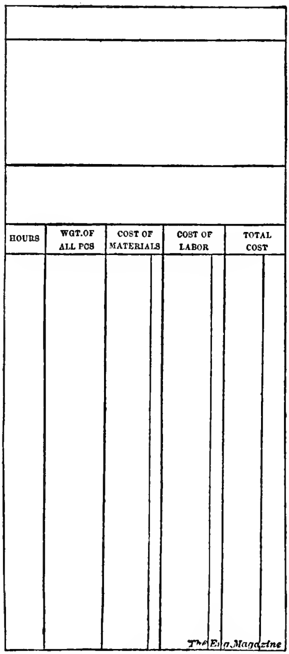

FIG. 6. COST DATA SLIP.

ditions other than his own, than a doctor can cure consumption by prescribing cough medicine or a nerve tonic. A number of plants manufacturing the same article will have conditions existing in each that are different from those in all of the others; and while principles may be the same in every instance, application must take into consideration the peculiarities and needs of each case.

Units are composed of parts—parts take operations—operations as a rule require small tools, jigs, etc., and in order to facilitate processing from raw materials to finished product, detailed information concerning them is important as well as complete knowledge concerning condition of materials.

Regarding the various parts that go to make a completed unit, it must be known how many of each are wanted, their names, the number of the pattern and the drawing number, the kind of material, and the order number of each part. For this purpose a "list of material," patterned after Figure 5 could be used to advantage; it should contain every item that enters into the construction of the completed unit, for the information of not only the office but the shops, and for future reference in case of repairs, etc. A check column has been provided for, the purpose of which will be explained later. To the right of the list and slightly separated from it is a form with five columns to be used for recording cost data pertaining to the various parts. The lists for the drawing room and the various shop departments are printed as shown in Figure 5, while the list to be used by the office and cost departments has the added slip shown in Figure 6 with the extra columns joined to the main sheet so as to make a complete list. In inserting the sheets into the typewriter—and they should be typewritten—the one for the office can be placed on the bottom with the extra part turned under. If the typewriter has a wide carriage, however, the sheet or slip for the cost department may be inserted as shown. For standard machines, it would be well to have the lists printed so as to save the work of typewriting.

PART CARD			
Name of part *Bracket*		Number of part *x 43*	
Number of Drawing *2140*		Material *C.I.*	
For what used *# 1156 Machines*		Weight *250*	
Tools and jigs *#3 and #40*			
OPERATIONS			
1	*Layout*		
2	*Drill*		
3	*Plane*		
4	*Bore*		
			The Eng. Magazine

FIG. 7. DETAILED RECORD OF PARTS AND OPERATIONS.

It is also necessary to have a detailed record of the parts and operations, Figure 7, which should show the name of the part, its pattern number, its drawing number, material, for what machine or machines used, its weight, the dies and jigs it takes, and the number and name of the operations, as well as the time each operation should take. A complete record of parts is of value to any manufacturer in addition to his pattern record, for while the pattern record cards would be filed by consecutive numbers, the part cards would be filed numerically by machines, thus giving a cross reference.

In order to facilitate the work in the shops, a means should be provided for recording the tools, jigs, etc., necessary for part operations. A place should be provided for these rigs and they should be kept in their places when not in use in the shops. Many an hour has been lost by a man looking for a certain jig with which to complete an order or operation; but by properly classifying them as shown in Figure 8, it will be known what they are for

TOOLS AND JIGS	
Number *40*	Name and description
	Clamping Rig
When made *8/12/05*	For part *X 43*
Operation *Bore*	For job *#2140*
Material *C.I.*	Weight *25#*
Where stored *Shelf #30*	In use *Yes*
Remarks	*The Eng. Magazine*

FIG. 8. CLASSIFICATION OF TOOLS AND JIGS.

and where they can be found, this knowledge going a long way toward saving considerable time in the course of a year.

After we have arranged for the proper

handling and classification of details relating to units, parts, operations and tools, the next consideration of importance is a knowledge concerning the materials on hand. It seems strange that this department of a business should be as carelessly handled as it so often is, for it is a fact that will admit of no argument that there are many manufacturers who, while they may have machine departments systematized to a high degree, have stock departments that are most slovenly managed. It will be found in such cases that stocks are arranged in anything but a logical order, a dozen pieces of the same part likely to be found in as many places—no one can tell whether a part is in stock or not without searching for it—the quantity of a certain kind of stock on hand can only be ascertained by counting each time—guess work is the only means of determining the amount used in a given time—work is often held up because it was *thought* that the necessary stock was on hand—anyone can take what is wanted without an order or even recording the withdrawal—there is no check against tying money up in excess stock, and absolutely no protection against theft, waste, or mislaying of materials.

It would be hard, in fact, an impossible task, to explain why a manufacturer will use the care he does in looking after his cash on hand and in bank, only to show an almost utter lack of concern when money is transferred into material. He would almost have heart failure if anyone would ask him for a dollar with the stipulation that no entry was to be made on the books, and he would not consider such a thing for a moment. On the other hand, so careful is he, that if only a quarter's worth of stamps are purchased, he sees to it that cash is credited and expense charged for the outlay. If he buys $100 worth of material, merchandise or whatever the account may be named is is charged, and the person from whom the material was purchased is credited; but how this material is used, when it is used, or where, receives but little of his consideration. If a dollar in the office is guarded with the care that it is, a piece of brass in the stock room, costing and worth a dollar, should receive the same degree of attention; and a workman should have no more right to take this piece of brass from stock without accounting for it than he would have the right to walk into the office and remove a dollar from the cash drawer.

RECORD OF FINISHED PARTS IN STOCK																	
ARTICLE *Guide Arm*					WHERE KEPT *Bin # 18*						MIN. TO BE CARRIED *5* / MAX. TO BE CARRIED *15*						
DRAWING # *3040*				PIECE # *X 540*						MATERIAL *Steel*					WEIGHT *25 #*		
RECEIVED				DELIVERED				BALANCE		DELIVERED				BALANCE		VALUE	
DATE	FROM WHOM	ORDER NO.	AMOUNT	DATE	TO WHOM	AMOUNT RESERV'D	AMOUNT DELIV'D	BEFORE DELIVE'Y	AFTER DELIVE'Y	DATE	TO WHOM	AMOUNT RESERV'D	AMOUNT DELIV'D	BEFORE DELIVE'Y	AFTER DELIVE'Y	@	AMOUNT
5/30	M.Dept.	2140	20	6/2	3020		2		18								
				6/3	3440		4		14								
				6/4	2160		4		10								
				6/7	1650		6		4								
				6/8	1830		1		3								
6/10	M.Dept.	2350	20						23								
				6/15	3321		4		19							1.00	19 00

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FIG. 9. RECORD OF DATA CONCERNING MATERIALS IN STOCK.

Material is a heavy item to the majority of manufacturers, and it is of the utmost importance that no more material be carried than the requirements of the business call for; it is an easy matter to lose the earning power of considerable money by placing it in stock that is not needed. It should be the duty of a competent person, familiar with the details of the business, to establish a maximum and minimum allowance covering every kind of material used, for the guidance not only of the purchasing department but of the shops as well. This will keep the materials within proper limits, which will mean a considerable saving to any manufacturer. If in conjunction with this we know when stock is disbursed and the purpose for which it is used, we can, if we know what is purchased, easily determine balances on hand, which can be checked against the allowances.

Materials should *not* be given out under any circumstances except by the authority of a written order; and if the proper persons are held responsible, it will be found that the stock department will count for something in the accomplishment of maximum results, for it will be known what is in stock and the quantity; purchases can be made to advantage; overstocking will be prevented; it will be known which lines are moving in a satisfactory way and which are not; responsibility will be fixed; workmen will find it a hard matter to remove material without authority to do so; mislaid and wasted materials can be traced to those responsible—and, in fact, all the important facts concerning materials will be known. Figure 9 is shown as affording a means for recording all data concerning materials in stock, the entries fully explaining the method.

Knowledge is power. The most successful surgeon is he who has made the most careful study of the human body—its bones, muscles, nerves—and the most successful manufacturer is he who has made the most careful study of the industrial body—its basic elements, its anatomy, the analysis of its forces, the proper handling of its detail. It is naturally this kind of a manufacturer who realizes his ambition—maximum production.

Chapter VI

EFFICIENCY IN THE USE OF MATERIALS AND TIME

HOW *much time are you paying for which is producing you nothing?* Time is an important element in production, and it naturally follows that any lost or wasted time means a certain decrease in the amount of output. The following illustration will serve to show what lost time may mean to a manufacturer. If we assume that 200 producers lose or waste only 5 minutes each hour, we have 166.6 lost hours at the end of a 10-hour day, which in 300 days to the year would amount to 49,980 hours. Figuring each hour on the basis of 20 cents would show that lost times, in labor alone, would amount to $9,996, not counting the fact that considerable money is lost in the diminished output, which would not be the case could these 49,980 hours have been utilized to advantage. Consider the number of machines that could be built in this lost time alone!

Doubtless every reader of this chapter can call to mind a plant where the production could be materially increased if wasted time could be used to advantage—where men have to wait around after finishing one job before receiving another—where the stock clerk is obliged to spend considerable time in looking over his stock before knowing whether a certain part is in stock or not—where machines are often idle until work can be found for them—where the assemblers are kept waiting for parts being machined before they are able to complete a unit—where it is often necessary for the shipping clerk to be on the jump a good share of the time to find a part here and a piece there before shipment of a machine can be made—where it is necessary for someone to be constantly interviewing various persons in an endeavor to find the status of an order—where more than a reasonable amount of time is consumed by men in taking work out of their machines, in order to finish a *rush* or *forgotten* order, then putting back the work they had taken out on the start—where machines are about ready to ship only to find that some part has been neglected or forgotten—where it is necessary to spend considerable time running to the office and drawing room for certain information before a part can be machined or a unit assembled—where work is made without regard to any predetermined standard. Add to these the harmful effects of friction between those in authority, the turmoil, confusion, etc., and we have a condition of affairs for which there is no excuse and which is responsible, to a large degree, for lack of maximum results. Efficiency in production can be brought about only after we have either eliminated these conditions altogether or reduced the wasted time to a minimum. I will admit that it is impossible to have everything go right all of the time, but everything can be so handled as to make things go right most of the time.

The second chapter dwelt at some length on the necessity for a carefully worked out organization that the various forces might be harmoniously united; the fifth briefly analyzed the industrial body, providing a means for taking care of the information necessary to facilitate production. In this we will go a step further and outline such methods as have for their ultimate purpose the handling of the greatest amount of work in the shortest space of time consistent with good workmanship. In order to do so, we will assume that a business has been organized to manufacture certain machines, all raw materials to be purchased outside, labor being paid by the day, the shop manufacturing departments being:—

Assembly Department.	
Lathe and Planer Department.	Machining Department.
Milling Department.	
Drilling Department.	
Forging Department.	

The connecting link between the factory or engineering branch of the business and those who consume its output is the office or commercial branch; much therefore depends upon how it is managed, and too much importance cannot be attached to the necessity of having some definite understanding, on the start, as regards the way details shall be handled; otherwise costly blunders are bound to occur. To illustrate. If orders are given by more than one person, or if they can be given by more than one department, it is only natural to expect that some orders will be entered twice, or some not at all, each person or department thinking that the matter has been looked after by the other. Delegate certain lines of work to those most competent, make the supervision such as will take care of the detail properly, and it will be found that there will be less confusion and mistakes.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

OFFICE COPY

		Buffalo, N. Y.,	June 23 1907.
Sold To	William Jenkins and Company	Date Sold	June 21 1907
Address	Utica, New York	Sold By	Johnson
Destination	" "	Our Order #	3445
Ship Via	Fast freight	Their Order #	A 25589

One cylinder head	X 442	3441
One cylinder	B 20	2811
One piston	X 440	3441

This is a rush order.

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FIG. 10. INITIAL RECORD OF ORDER. MADE IN QUADRUPLICATE.

All orders and letters pertaining to orders should therefore be sent to the order department before anything else is done with them. This is our starting point; and that the office may have a record of each order, that the works manager may know what the shop is expected to build, that the shipping and stock departments may also have this information, and that the customer may be advised that the order has been received and entered, four copies of the order should be made, Figure 10 being the office record, the one sent to the customer bearing the regulation acknowledgment advice and the possible date of shipment.

The drawing room, having been made responsible for the accuracy of all orders entered, should state what is necessary to furnish, giving the commercial as well as the shop classifications. In order to do this, they naturally need the original order to know what the customer really ordered; but the order department, in turn, must have some means of knowing where the order is before it is entered and finally filed away. The order department therefore takes the four copies above mentioned, fills in the headings only, and sends the office copy, with the original order from the customer, to the drawing room, leaving the three remaining copies of the order on the desk of the chief order clerk, which will show, at all times, the orders received but not as yet entered. The drawing room takes the order, looks up the necessary information, makes a "list of material," as described in the fifth chapter, if the order calls for a number of parts or if for a machine, but if the parts necessary be few, the information is simply recorded on the original order and returned with the office copy to the order department. The four copies of the order are then taken, the information filled in the body of the order, the possible date of shipment ascertained (the clip showing the date is indicated on Figure 10) the acknowledgment is mailed to the customer, the works manager's and shipping clerk's copies are sent to the proper persons, while the office copy is filed alphabetically in the order department, in a place which we can call the "live-order" file. In connection it might be said that the possible date of shipment should not be decided upon until after the matter has received the attention of those competent to know regarding the time the materials can be shipped. This is of the utmost importance, and the proper handling of shipments will be the subject of the next chapter.

As the orders are being made, a number of copies of the "list of material" should be typewritten—one for the works manager, one for the assembly department, one for the foreman in charge of the machining department, one for the benefit of the stock and shipping clerks, one for the order department—to be used by the cost department in entering cost data during process of construction and finally filed away by this department—the original from which the copies were made being filed in the drawing room as their record.

So far we have given notification regarding work to be made as well as the necessary information to complete the work, but no direct authority has been given to process or assemble, which cannot be done until it is known in what condition the stock of materials is in. What must be known is:

1—What is in stock finished ready for assembly

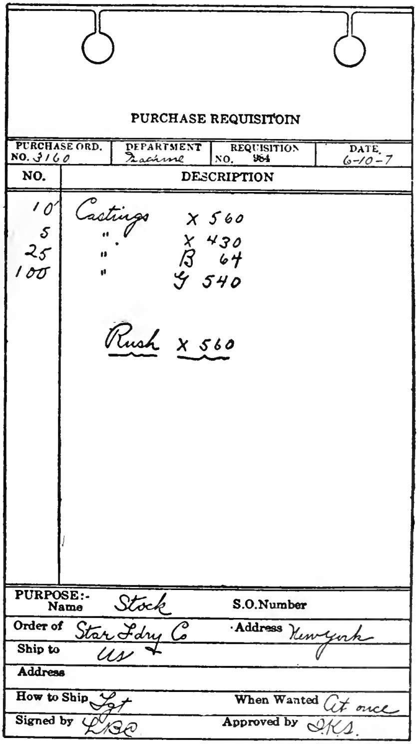
2—What is in stock in the rough.

3—What must be ordered which when received will be ready for assembly.

4—What must be ordered which when received will have to be processed.

The stock clerk therefore takes the office list which accompanies his list, checks through his stock, and in the check columns uses the following symbols to designate the condition the order is in:

vv- Covering parts under classification 1.
v - Covering parts under classification 2.
(vv)- Covering parts under classification 3.
(v)- Covering parts under classification 4.


PURCHASE REQUISITOIN

PURCHASE ORD. NO. 3160	DEPARTMENT Machine	REQUISITION NO. 984	DATE 6-10-7

NO.	DESCRIPTION
10	Castings X 560
5	" X 430
25	" B 64
100	" G 540
	Rush X 560

PURPOSE:- Name Stock S.O.Number
Order of Star Fdry Co Address New York
Ship to Us
Address
How to Ship Fgt When Wanted At once
Signed by LBC Approved by JKS.

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FIG. 11. REQUISITION FOR MATERIAL. (*See page 105.*)

PRODUCTION ORDER				FINISHED / ROUGH
PRODUCTION ORDER No. 1160.57	PIECE No. X 450	DRAWING No 3345	MATERIAL Steel	TO BE COMPLETED
DATE OF ORDER. 5-10-7	FOR ASSEMBLY ORDER No 1160 Abbott			COMPLETED 6-10-6
QUANTITY	DESCRIPTION			
50	Guide Heads			

NOTE. Execute this order, returning same to factory office upon completion of the work. Charge all labor and material to the above Production Order Number.
When this Production Order covers the assembly of a machine, charge "labor" only to the Production Order Number.

Burke FOREMAN

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FIG. 12. PRODUCTION ORDER; FACE.

Assembly				Boring				Turning				Forging				Milling				Planing				Drilling			
Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs	Amt.	Date	Man No.	Hrs	Amt.	Date	Man No.	Hrs	Amt.	Date	Man No.	Hrs.	Amt.
Threading				Grinding				Babbitting				Laying Out				Cutting Off											
Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs.	Amt.	Date	Man No.	Hrs	Amt.

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FIG. 12. PRODUCTION ORDER; BACK.

The office list is then returned to the order department along with requisitions for material needed, Figure 11, and here the information concerning the condition of the stock is transferred to the list for the assembly department, the requisitions being turned over to the purchasing department where the necessary material is ordered.

The order department then takes Figure 12 and makes an order in duplicate for the assembly department to cover the assembly work, sending the original to the foreman, duplicates being filed in the office, after which orders are made for all parts marked as in stock in the rough, or as needing to be processed upon receipt, sending the originals of the former class to the foreman of the machining department, the duplicates being filed in the office; on the reverse side are posted the cost data secured from the daily reports turned in by the workmen, these duplicates being filed either by consecutive numbers of orders or by part symbols as best suits the conditions, for we have the "list of material" showing the order number and the name of the customer or the purpose for which the work is being done, and we have the official notification, Figure 10, which is filed alphabetically, so that any reference or cross reference is facilitated. The original and duplicate orders covering the material which must be ordered and processed upon receipt are held in the order department, in a place by themselves, pending the receipt of the materials, so that the machining department receives orders to process only such

WORKMAN'S ORDER TICKET.			
PRODUCTION ORDER NO. 560.301	PIECE NO. BB680	DRAWING NO. 3340	MATERIAL C.I.
DATE OF ORDER 10-20-6	FOR ASSEMBLY ORDER NO. 560		
MATERIAL TO GO TO { WORKMAN / ~~MACHINE~~ } NO. 31 NO. 20 NO. 101 NO.			
100 Bracket Boxes			
WHEN MACHINE WORK IS FINISHED, DELIVER TO Stock Room			

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FIG. 13. WORKMAN'S ORDER TICKET. MADE IN TAG FORM FOR ATTACHMENT TO WORK.

parts as are in stock. This file we will call the "reserve-order" file. Figure 13 is made out at the same time as Figure 12, and being sent to the stock clerk for attaching to the parts when they are issued will show the workmen what is wanted; in no case should these tags be removed until the work is safely on the assembly floor, after processing.

As yet, however, no material has moved,

although we have provided for handling it as fast as it may be issued. In the first place, the assembly department knows from the list what parts are necessary to complete the order; it is also known from the checking what parts are available as finished stock for immediate assembly and what parts must be machined before they can be assembled. The assembly foreman knows, if he is familiar with the product, in order that assembly may be facilitated:

The finished parts needed first.

The rough parts that need machining first.

In order to start the work, and that his department may operate to the best of advantage, he fills out the form shown in Figure 14, for the important finished parts he needs in order to begin the assembly, making other lists as fast as he needs other finished materials, these lists being sent to the stock room. To get the parts needing machining, he uses the form shown in Figure 15, sending to the machining department the slips covering those parts he is most in need of, the balance being sent to the stock room. It is therefore evident that the stock and machining departments know what the assembly department is most in need of at all times and

FINISHED PARTS

Deliver to ________ floor .for Assembly Order # ____ the following finished parts which are needed by my department at once.

#	Piece	Drawing	Mat'l	Name	Order	Date Del.

Date Foreman Date Stock Clerk

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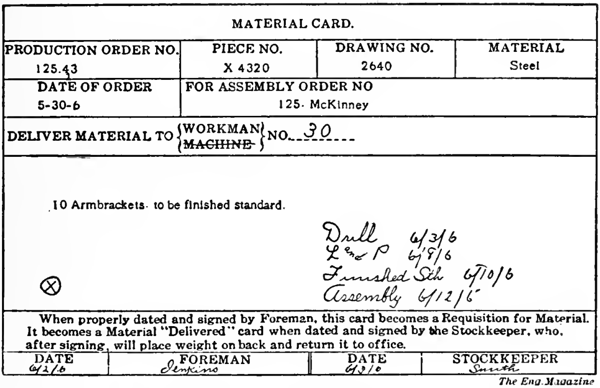
FIG. 14. ASSEMBLY DEPARTMENT'S ORDER FOR FINISHED PARTS.

can be governed accordingly, and while the stock clerk is delivering the finished parts called for, the machining department is making out requisitions for the rough parts, using Form 12 as the authority for so doing, taking into consideration the requirements of the assembly department as evidenced by their requisitions for finished parts. The stock clerk also sees to it that the requisitions from the machining department marked with the cross in the circle, which cover the parts wanted first by the assembly department, are promptly attended to.



MATERIAL CARD.

PRODUCTION ORDER NO.	PIECE NO.	DRAWING NO.	MATERIAL
125.43	X 4320	2640	Steel
DATE OF ORDER 5-30-6	FOR ASSEMBLY ORDER NO 125- McKinney		

DELIVER MATERIAL TO {WORKMAN / ~~MACHINE~~} NO. 30

10 Armbrackets- to be finished standard.

⊗

Drill 6/3/6
L & P 6/9/6
Finished Stk 6/10/6
Assembly 6/12/6

When properly dated and signed by Foreman, this card becomes a Requisition for Material. It becomes a Material "Delivered" card when dated and signed by the Stockkeeper, who, after signing, will place weight on back and return it to office.

DATE	FOREMAN	DATE	STOCKKEEPER
6/2/6	Jenkins	6/3/6	Smith

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FIG. 15. MACHINING DEPARTMENT'S ORDER FOR PARTS SPECIALLY NEEDED.

After the stock clerk has delivered the parts wanted first by the machining and assembly departments—after the machining department has begun work on the parts the assembly department is most in need of—the balance of the orders can be worked in as convenient; at any rate, we have prevented, by some such method, giving to the assembly and machining departments, on the start, materials which are not necessary until toward the end of the work while material that is urgently needed is not sent in or processed until the assembly department finds that it cannot go any further until the parts are in hand that should and could have been ready on the start. As fast as the stock clerk delivers material to the assembly department, requisitioned by Forms 14 and 15, and to the machining department by Form 15, he sends the slips to the order department. This is also done by the machining department when material covered by requisitions from the assembly department is delivered to the assembly floor.

If the assembly department could use the output of the machining department as fast as parts are finished by it, the proper course would be to send all work to the former department; but this cannot be done in the majority of cases for the reason that the assembly floor would soon be so littered up as to make it almost impossible for the workmen to turn around, and as we have a place for the storage of parts (the stock room) the most logical plan is for the machining department to send all completed work to the stock room with the exception of the few parts that are of importance in the eyes of the assembly department. If we made it a rule to send *every* part to the stock room, we would perhaps be treated to the spectacle of seeing a trucker take a piece of finished work to the proper location in the stock room, unload it, be informed that the assembly department wanted it immediately, load it, and take the part to the assembly floor—considerable unnecessary work. The better and more efficient way is as above outlined, for the order department will know from the signatures to Form 15 whether the part that went to the assembly department came from the stock clerk or the machining department; but before this latter department can deliver a finished part it must know *where* to deliver it, and no trucker must take a part unless the ticket attached shows where it is to be taken. The rule is simply this: all parts go to the stock room except those covered by the requisitions from the assembly department, so that it is an easy matter for someone delegated to look after this particular part of the work to check assembly department requisitions against the work, marking at the bottom of the workmen's ticket where the parts are finally to go.

It is the duty of the order department each day to check over the receiving clerk's list of receipts, so that if any material has been received against which there are orders in the "reserve-order" file, they can be released and the machinery started so as to get the parts through the machining department and to the stock room or assembly floor. The stock clerk has the requisitions from the assembly department covering parts which, while not needing processing, were not in stock, so that as fast as material arrives, it will be issued by him without delay.

The most important consideration now is: *where are all the parts after an order has been started and under way, and what shape is an order in at any one time?* Any manufacturer who is in a position to answer this question intelligently is on the road to getting everything out of his business that is possible. Reference to Form 15 will show that after signing by the foreman and previous to delivery, it is a "requisition" for material; but as soon as the material is delivered and the stock clerk affixes his signature, the slip indicates that the material has been "delivered" to the machine or workman specified. From this slip we know that on June 3, Smith, the stock clerk, delivered ten arm brackets to workman 30—drill department, as requested by Jenkins the foreman, and as the order department receives this slip right after the stock clerk signs it, the department has a means of knowing *when* these ten parts were issued as well as *where* they were delivered. If we file this slip against the drill department, we really charge it and credit the stock room for the parts, for these slips are used as authority for posting to the stock cards. When the order department has done this with all of the "material cards," it has in its possession a means of advising anyone who wants to know just where any part is—*providing the part is followed from place to place in some way.* This can be done by using certain information and having in the order department a file of drawers where these slips, Form 15, can be filed.

This information comes from different sources. In the order file, we have the "reserve orders" for which there is no material—we have the lists of finished parts, Form 14, which the stock clerk has delivered to the assembly department, and we have the requisition, Form 15, which comes from either the stock clerk or machining department as the case may be. A form of receipt is used to cover the materials passing *between* the departments of the machining department, Form 16, these being sent to the office when one of these departments receives material from another. The importance of this cannot be overestimated as it places each department on its own feet, each one checking the work of the other as well as fixing responsibility. The machining department and the stock room require no receipt from the assembly department for the reason that the requisitions for material are "delivered" slips after materials have been delivered, and are virtually equivalent to receipts. This is our fourth source of information, the fifth and final one being a daily list of receipts from the stock clerk covering finished parts received from the machining department. This knowledge is valuable and on tap so that manipulation is the only thing necessary to be able to furnish information concerning the work under way.

Take, for instance, Form 15. Upon receipt of this slip from the stock room, the clerk,

MATERIAL RECEIPTS

We have just received from the Drill Department, the list of parts below described

#	Piece	Drawing	Name	Order
10	X 4320	2640.	Arm Brackets	125 43
3	B 60	2120	Posts	160 82
5	X 342	1080	Cylinders	130 45
20	Y 20	4080	Caps	420.5

Date 6/8/16 By Wilson Department L & P

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FIG. 16. RECEIPT FOR MATERIAL PASSING BETWEEN DEPARTMENTS. (*See next page.*)

who knows that Jenkins is in charge of the drill department, marks in one corner—

"Drill, 6-3-6," as shown, and files in the drawers above mentioned back of the guide marked 125, the arrangement being numerical. On the 8th, a receipt, Form 16, comes from the Lathe and Planer Department, the first item being the ten arm brackets, order 125.43. The clerk then removes the slip, Form 15, from its numerical place and marks "L. and P., 6-8-6," placing it back in its position again. On the 10th, a list of receipts comes to the order department which contain this item of ten arm brackets, and the clerk then marks on the slip as is shown in the illustration. It is again filed where it remains until the assembly department requisition for these ten parts is received from the stock clerk, dated the 12th. The slip is marked to correspond, and filed with the assembly-department slip, for future reference.

It is therefore evident that any reference to 125.43, ten arm brackets, will show the condition of the order at any time after the material was delivered. Applied to all orders, it follows that the drawers, the "reserve-order" file, and the lists sent to the office by the assembly department through the stock clerk, will show at all times the condition of any order; the value of this cannot be overestimated, and while a casual reading would seem to indicate that the method is too complex to be practical, consideration will show that this is not the case. It should need no argument to convince a manufacturer that material should not be delivered anywhere without a record being made of the transaction, either in the form of a receipt or requisition, and that the stock clerk should make a list of all the materials he receives from the machining department, as the receiving clerk does for all materials received from outside. The information serves a purpose in itself, but why not go further with it? What would do more good than an arrangement whereby this information can be used to inform anyone regarding the condition of orders, especially when one considers that a few hours each day will do the work, and that in a plant of any size, where a number of machines are being built—the parts numbering into the thousands—if regular and stock orders are considered, it is out of the question to expect any one man or group of men to *know all about every part of every order at all times.* Provide some means of informing them regarding the progress of the orders and the location of the parts, and they are then in a position to take advantage of the information for they will know how to proceed to a desired end as the following will show.

If the works manager wishes to "get after" an order, he gives his "list of material" to the order department, with instructions to advise him regarding the condition of the various parts. These parts are either on the assembly floor, in the lathe and planer, drilling, or milling departments, in the stock room as finished parts received from the machining department and awaiting requisitions from the assembly department, not as yet withdrawn from stock, while some of the material necessary to finish the order may not have been received by the stock department. The order department adopts the following symbols as indicating the condition of the parts:

W—Orders waiting for material.

A—In Assembly Department.

M—In Milling Department.

D—In Drilling Department.

L—In Lathe and Planing Department.

F—Finished parts in Stock Room ready for assembly.

N—Parts not as yet withdrawn.

The clerk can turn to his file or orders waiting for materials and place a letter W in the v column of the "list of material" for parts whose numbers correspond to the numbers of the parts on the list. He then takes the list from the assembly department, Form 14, prefixes the letter A for parts in the assembly department, after which he refers to the drawers where the slips, Form 15, are filed, and checks each one covered by the order number in question against the list of material. After he has done this he will have a number of parts against which there are no check marks which must be the parts that have not been withdrawn from stock up to time the list is checked, these parts being marked with a letter N. When the works manager again gets the list—and this process can be repeated as many times as desired—he knows the exact condition the order was in up to within a short time previous to the checking, and even if the list shows a piece as being in the drilling department that has gone on to the milling department no harm has been done, for he knows *where to start* his investigation, which is far better than to have no definite point from which to begin. If, on the other hand, the works manager or any of the foremen desire to know concerning any part, the file in the office will supply the information. As before stated, the necessary facts are at hand as soon as material is delivered or transferred, and a little work will put the information in shape for use whenever needed. There is a difference between having information in every conceivable shape and having it properly classified and on tap for immediate reference.

Further information is at the disposal of the shop management in the shape of the daily time cards turned in by the workmen, all time being posted to the reverse side of the production order each day. Reference to the orders covering parts or to the orders covering assembling work will therefore show how much time has been consumed on an order up to the day previous to the reference. The clerk can furnish the works manager with information regarding the condition of an order, by turning to the file of live production orders, and when checking through the various parts that are in the machining department, mark opposite these parts:

T—Time recorded.

N—No time recorded.

This will show him not only where the parts are, but whether they have been worked on or not, and through the information furnished him he can plan for maximum production under the best conditions, for once

WORK WANTED AT ONCE							
To the Foreman of the ______ Department. The following orders are urgently needed. Give them preference over all other orders ______ W.M							
Order	#	Piece	Drawing	Order	#	Piece	Drawing

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FIG. 17. REQUISITION FOR URGENT WORK.

he knows the shape an order is in, personal effort will do the rest. He will want to make certain demands on certain departments after he knows what work is to be given preference over other work, using Form 17 for this purpose.

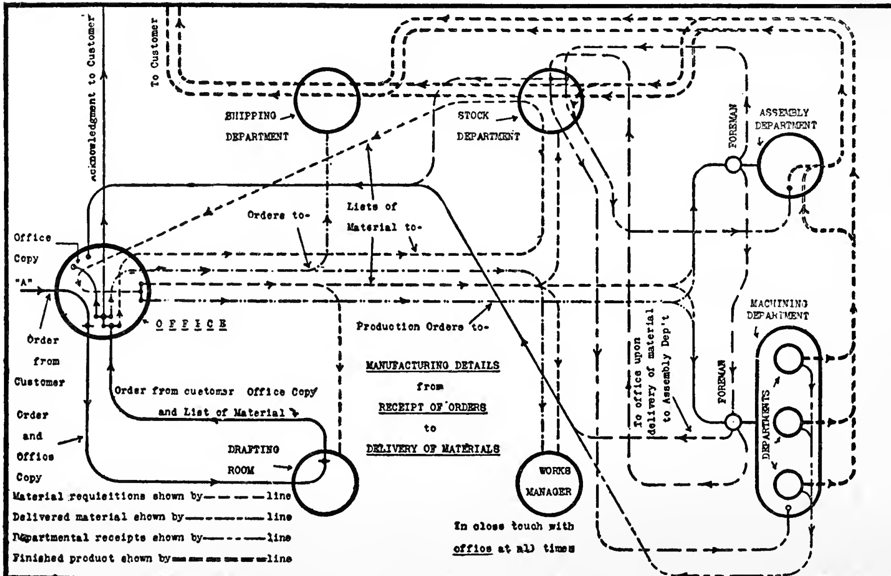


FIG. 18. DIAGRAM SHOWING THE COURSE OF ORDERS, MATERIALS, AND WORK UNDER THE SYSTEM DESCRIBED. TO READ THE DIAGRAM, START AT A.

The scheme of numbering here shown will facilitate investigation. A large number of concerns have a series of numbers to cover the various orders for machines and another series of numbers covering the parts of a machine. For instance, an order for a certain machine might be No. 3,140 while the first part might be No. 11,908, the second part No. 11,909, etc. It is evident that in looking up an order there is no such connection between the two series of numbers as in the case of the method advocated above. An order for a machine may have 250 as its number, while the first part would be 250.1, the second part 250.2, the third 250.3, etc. As soon as the order gets under way, the workmen know that the parts are for order 250 and the assemblers will soon fix 250 in their minds, so that when it is desired to follow up an order, any person looking for the parts that go to make up 250 will have no great difficulty in finding them.

The assembling of certain parts into groups, to be carried in stock for final assembly, should be given careful consideration by progressive manufacturers. In the fifth chapter it was shown that even special machines may have some standard parts, and a study of the product would show where grouping could be done to such advantage as would greatly facilitate final assembly. If we have thirty separate parts to assemble, time required to assemble being fifty hours, and by grouping certain parts it is found that only ten pieces are necessary to assemble, five pieces being groups composed of two or more parts each, as the case may be, the final assembly time will be considerably lessened; any saving in assembly time is always an object, especially when delivery is the important consideration. The work of grouping can be done in odd moments or when there is a slackening in orders, the results of which would certainly justify the efforts.

To eliminate the delays and annoyances that can usually be found, and to get maximum production in the shortest time possible, further aid should be employed as follows:

1—An intelligent advance planning of all work.

2—A standardization of operations. In processing men need jobs, material, drawings, tools, gauges and jigs, and it should be the duty of someone to see to it that these items are supplied them, not one thing at a time, nor all of them just as soon as they have completed a previous job, but *in advance.* As orders come in, as shown by the methods herein described, they should be analyzed as to consecutive operations; a date of completion determined; a planning schedule drawn up and job tickets written up and classified as "available" or "not available." As the work is planned for men and machines, they should be arranged in a planning board as follows:

1—Jobs in operation.

2—Jobs to be taken up next.

3—Jobs to follow.

It is essential that the planning schedule be kept up to date at all times, from which it is an easy matter to prepare for work coming in, and to get in readiness, in advance of requirements, what is necessary to get out the work. Intelligent planning and dispatching of all work in a machine shop—machining, assembly and erection, trucking and transportation, tool making—is a mighty factor in increasing efficiency, and in conjunction with the supervisional agency described in this chapter, will work wonders in any shop.

The matter of standardization of operations is another important consideration. There are two things to keep in mind—

1—That there is the *unnecessary* in the work.

2—That there is a reasonable and proper time to allow for completing it.

By no stretch of the imagination is it possible to conceive how a hasty, superficial examination, which is the usual procedure, can determine the unnecessary, or the best time to allow for a piece of work. It is because it has been thought possible that the usual method of setting piece rates has been responsible for so much dispute and restricted production in the past, and this will continue just as long as such unscientific methods of determining equivalency are employed.

One of the most efficient means of establishing what is wrong with the conditions, where the faults are in the planning, and the best time to allow for any work, is through a careful and scientific analysis, listing out—

1—What is done.
2—How it is done.
3—The equipment used.
4—The operation itself.
5—The working conditions.
6—The time taken.

All of which, carefully studied, will reveal facts that will prove of material assistance in any campaign of shop betterment. Once this standardization is completed, it is possible to determine the ratio between the time taken and allowed, applicable to men, machines, foremen, department, on the basis of which an "efficiency reward" could be made, which would do more to create a spirit of co-operation and a willingness to turn out a maximum amount *than all the driving tactics that could be schemed out by the keenest mind existing.*

CHAPTER VII

BETTER DELIVERIES—MORE SATISFIED CUSTOMERS

IT was a wise man who decided to incorporate as a part of his letter-head: "Agreements subject to strikes, accidents, fires and other causes beyond our control;" but little did he think how many times it was destined to be used, not only to cover such cases as fires, accidents, and excusable causes, but many inexcusable ones as well. Today the clause above quoted is either on all business stationery or is taken for granted, and it is safe to say that nearly every business house uses it many times during a year to explain their nonfulfilment of promises. While I will grant that a manufacturer is often in no way to blame because he has failed to forward his shipment according to schedule, there are a greater number of times when no real excuse exists—unless perhaps it is carelessness, which of course would not be offered as an excuse even by the frankest offender.

Every manufacturer who reads this chapter is a receiver of materials as well as a shipper, and while the argument is intended more for the shipper than for the receiver of materials, we will start the discussion from the viewpoint of the receiver.

Is it not a fact, that almost daily you are disappointed in not receiving the notice of shipment, covering materials your works manager is anxiously awaiting?

Is it not a fact, that almost daily you receive in your mails about such replies as the following, in answer to your letters asking why the materials you have ordered have not been shipped as promised?

Yours of the 10th received. We regret to advise that owing to causes over which we had no control we have found it impossible to make shipment as promised, but we expect to forward them about the 25th.

Is it not a fact that almost daily you or your assistants call up the freight offices, regarding certain materials which have been shipped, only to be advised—"nothing as yet"?

These are conditions that exist almost everywhere, and while they would not be worthy of more than passing consideration if they only ruffled a man's temper, as they sometimes do, they are entitled to careful attention as they directly concern the success of any manufacturing enterprise. You no doubt feel at times like doing business with some other concern than the one you are now dealing with, thinking perhaps that you might get better deliveries by so doing, which brings me to this question:

Do you as a *receiver* of materials, feeling as you do over your disappointment in not receiving notices of shipment—the letters of excuses and the statement, "nothing as yet," ever stop to consider that the receiver of *your* materials may be in exactly the same position as you are often in?

I will grant that you often look to those from whom you purchase, in order to make proper deliveries to your customers. Your customers, in their turn, whether they have their trade looking to them for shipments when promised or whether they are direct users of what they purchase from you, look to you for as prompt deliveries as possible, so that your success (in their eyes at least) depends to a large degree upon your ability either to make prompt shipments, or to convince them that their interests are receiving your best attention. If you cannot do this, you may be running the risk of having some of your business go to your competitors.

You may ask how can the maximum results be obtained in the way of getting shipments off according to schedule? The best results along these lines can be obtained only when proper attention has been given to conditions, present and future, before making a promise, and the work followed carefully until you *know* that you will be able to ship as promised, or that you will not be able to do so.

A promise cannot keep itself any more than a shipment can make itself, yet this seems to be the principle that so many work upon. I have known cases where promises to ship have been made and nothing more has been thought about them until letters were received asking for information as to the shipments, and as business courtesy demanded replies, the letter heretofore quoted was the result. I am therefore of the opinion that a promise composed of about one-quarter discretion in making and about three-quarters energy in fulfilling, will go a longer way towards enabling the manufacturer to ship according to schedule than anything else. By "energy" I do not mean hustle and bustle, at the last minute, in an almost superhuman attempt to rush the work through the shops and onto the cars, in an effort to "make good," but an energy that is in evidence from the time the order is received and the promise made until the material is on the cars and finally at its destination. Any arrangement that will enable you to make deliveries as close to schedule as it is possible to make them should have your careful attention, for it will mean much in the way of more satisfied customers, better deliveries from those from whom you purchase, and lower costs through an increased production, all these being points which materially assist in making an enterprise successful.

It is very likely that almost every order you receive is accompanied by a request to state about when shipment will be made; is it not well to have some well defined method of procedure in filling your orders? It should need no argument to convince a manufacturer that the shipping of materials when promised is beneficial to the whole business structure.

In any establishment of ordinary size,

those concerned in the handling of an order from its receipt until shipment are:

Chief Order Clerk.
Works Manager.
Chief Stores Clerk.
Shipping Clerk.

Indirectly, the customer depends upon the shops for his shipment; but directly, he depends upon the shipper, who in turn cannot make shipment until the shops furnish him the finished product, the shops in their turn look to the stores department for the materials necessary to complete an order, and naturally nothing can be done until the order department has given the necessary orders for the work. At least, this should be the case; but there are places where verbal orders seem to receive as much consideration as written ones—a practice that is productive of no possible good. At any rate, the order department is looked to indirectly by all concerned in the manufacture of any article; so without further argument, we may assign to this department the important duty of keeping track of all orders from the time of their receipt until delivery is finally made to the customer.

If the four men heretofore mentioned are allowed to act as one body, with full power, the result is going to be better deliveries no matter under what conditions the company may be operating. Organize a committee, composed of these four men; make them responsible for promises and deliveries—and you can depend upon it that they will exercise care before they set a time when an order will be shipped; for in their discussions, they will (or should) ascertain how much of an order is ready to ship, how much must be built, what is in stock ready to assemble, what is in stock ready to process, what must be purchased outside and about when this material can be secured, how long it will take the shops to process and assemble, etc.; and if track is kept of the progress the order is making, from time to time, there is every reason to expect that the shipment will go forward about when promised.

Let us take, for example, a plant manufacturing engines and boilers, and let us outline the arrangement that will enable the company to make more prompt deliveries. We will assume that the company has allowed a committee to be formed composed of the chief order clerk, works manager, chief stores clerk, and shipping clerk, the order clerk being responsible for the routine and clerical detail connected with the work. As the mails are opened and sorted, all orders are naturally turned over to the order department, and these orders can be written up; but before sending them to the various de-

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 30 31

OFFICE COPY

		Buffalo, N. Y.,	June 23 1907
Sold To	William Jenkins and Company	Date Sold	June 21 1907
Address	Utica, New York	Sold By	Johnson
Destination	" "	Our Order #	3445
Ship Via	Fast freight	Their Order #	A 25589

One cylinder head	X 442	3441
One cylinder	B 20	2811
One piston	X 440	3441

This is a rush order.

The Eng. Magazine

FIG. 19. INITIAL RECORD OF ORDER. MADE IN QUADRUPLICATE.

partments, they are referred to the committee before mentioned, to be acted upon daily, along the lines just suggested. Four copies of each order should be made, one for the office (Figure 19), one for the shipper, one for the works manager, and one to be sent to the customer as an acknowledgment of the order (Figure 20). It will be noticed that

Form 20 bears the possible date of shipment while it is checked at the top under the same date as shown by the clip. The copies for the works manager and the shipper should

ACKNOWLEDGMENT

	Buffalo, N.Y., June 23 1907.
Sold To William Jenkins and Company	Date Sold June 21 1907.
Address Utica, New York	Sold By Johnson
Destination " "	Our Order # 3445
Ship Via Fast freight	Their Order # A 25589

One cylinder head	X 442	3441
One cylinder	B 20	2811
One piston	X 440	3441

This is a rush order

We herewith acknowledge receipt of your order, which has been properly entered as above, for which accept our thanks. We will endeaver to make Shipment on or before June 29 1907

THE ENTERPRISE COMPANY.

The Engineering Magazine.

FIG. 20. ACKNOWLEDGMENT OF ORDER.

be marked in the same way by using the metal markers. Upon filing these orders in an alphabetical file, we have each order filed by name of customer and cross-indexed by possible date of shipment; and as the three individuals most concerned have copies of the orders before them, it can be readily seen that it is possible for each and every one of the three to keep track of the progress of an order until the shipment is made.

In conjunction with this method of handling the orders, it would be well to use a recapitulation sheet, compiled each day by the order department, to be considered by the committee before mentioned at its daily conferences. A sample (Figure 21) is here shown with entries. This will show the com-

SHIPMENTS ARRANGED

For June 29 1907

According to our records, the following shipments have been arranged for the above date. If anything has occured in your department to change your plans, advise so a new date may be set and the customer notified of the change.

Name	Material	Fgt.	Exp.	Order #	Can we ship on above date			New Date
					Yes	No	If not, why	
Smith and Sons	Engine base			3421			Error in shop	7-10
Wm. Jenkins and Co.	Cylinder with head and piston			3445				
Jones and Co.	Complete Engine			2660				
Johnson and Frank	Boiler Fronts			3010				

THE ENTERPRISE COMPANY,
Order Department,
Per F. A. James

The Engineering Magazine

FIG. 21. RECAPITULATION SHEET FOR SHIPMENTS ARRANGED.

mittee the total shipments promised for any one day, and by having each day's slip show the shipments arranged for the following day, it is an easy matter, in case it is absolutely impossible to make certain shipments as promised, to set new dates for shipment. It should be the duty of the order department to inform the customers of the changes; this will not only forestall complaints, but will create the impression in the minds of some customers at least that their interests have not been ignored altogether, for if you receive an *unsolicited* letter from a concern from whom you are purchasing, in which they state that they found it was going to be impossible to make the shipment as promised, but that they would be able to on such and such a date, you certainly feel in a much better state of mind than if you should receive no notice of shipment and no letter explaining the reason.

After a shipment has been made, in cases where it is delayed, the manufacturer should keep after the railroad company until deliveries are shown. A "tracer" is such a common thing that it is not necessary to show one here, but the form shown in Figure 22 should be used in conjunction with tracers so that the railroad company may be reminded of the fact that they have been asked to place a tracer after certain shipments.

SHIPMENTS

July 5 1907

George Franklin . . . Agent

New York Central . . . Railroad

To the agent.- Let us know at once if you have received any advice regarding the delivery of the shipments listed below

Date of tracer. June 20th

To. The Howard Manufacturing Company

500 Franklin Street

New York N. Y.

Date shipped. June 10th

Materials claimed short

Remarks. None of this shipment has been delivered and these people are in need of the material

THE ENTERPRISE COMPANY,

Per F. A. James

The Engineering Magazine

FIG. 22. SUGGESTED FORM FOR TRACER.

In many instances, upon receipt of these notices, the agent will take up the matter with those along the line and this will assist to a certain extent in bringing about better deliveries than would be secured were the railroad company to receive no such reminders. If the agent has received no advice, he will say so, and if you take up this point with your customers, they will be quick to see that your interest did not cease when shipments were made—a decided point in your favor, and it is on such points as this that the success of your business depends.

The system is simple, and while it would require a little work each day in order to obtain maximum results, does not the end in view justify the means? Let us sum up briefly the advantages to be derived through some such system, devised to meet your own conditions. In the first place your works manager, order clerk, stores clerk, and shipping clerk all know and have collectively agreed upon the dates of shipment, the points peculiar to each order having received attention before this was done; the orders are constantly before them, the metal markers showing the dates of shipments to be made; and through co-operation, which should be insisted upon, they will be able practically to see the end at the start.

The works manager will be in a position to plan his work to better advantage, for he can notify his foremen what he wants and when he wants it, they in their turn giving their men the necessary orders and instructions that will start the desired work along and through the shops in the most systematic way, so that in reality we have the whole force doing their share in an effort to get the work through on time.

The stock clerk will know what stock is necessary to get ready for the shops, and he will also know what has to be purchased outside. He can make the necessary requisitions on the purchasing department, with notations as to *when* he wants the materials that are to be ordered.

The purchasing department can keep after the people with whom the orders were placed, which in itself will have an influence in obtaining better deliveries; for once you know *what* you want and *when* you want it, you can in the majority of cases, by keeping after the concerns from whom you ordered, get your materials in time to enable you to keep your promise to your customers.

Your order clerk each day will bring to the attention of the others the list of shipments arranged for the following day, and if new dates have to be set, it can be done and he can so notify the people to whom the materials were going. At the same time he can take up with the others the possibility of getting future shipments off as promised, and by keeping track of the details and looking after the clerical work, he is in a position to give valuable information as to the status of any order.

The shipping clerk, knowing after each day's conference what is to go forward within the two or three days following, is in a position to see to getting everything in readiness for shipment on the day set; and if anything happens to make it necessary to change any date set, he knows it the day preceding and can be governed accordingly. The shipping clerk is therefore in a position to make his work count for something, as he is able to concentrate his attention upon the accomplishment of something definite and is not forced to do a lot of work that will count for nothing.

In brief, we have a combination of brains working together along the same lines and with the same end in view, and this will accomplish more than could be accomplished by individual effort along widely different lines. The result of such effort would be more prompt deliveries and therefore more satisfied customers—the desire of every manufacturer.

CHAPTER VIII

SCIENTIFIC MANAGEMENT IN THE FOUNDRY

IF the result of the recent rate hearing before the Interstate Commerce Commission at Washington does nothing else beyond placing squarely before the American people the matter of a better and more scientific corporation management, this in itself can be considered an accomplishment of inestimable value; for the outcome is going to mean but one thing—an industrial awakening which will result in the saving of millions of dollars yearly that are now being lost through unscientific methods in the conduct of business enterprises.

The hearing brought out the point that scientific railroad operation would yield an enormous saving, estimated at $300,000,000 yearly. Senator Aldrich is quoted as saying that inefficient governmental management is responsible for an estimated loss of another $300,000,000 yearly. In other words, $600,-000,000 yearly in railroad and governmental circles alone—an amount certainly worth trying to save.

If it were possible, therefore, to outline for each one of our great industries—automobile, foundry, machine-tool, electrical machinery, etc.—the possible saving that would result from a more perfect management, the amount in conjunction with that already mentioned would result in a figure showing, beyond any possibility of questioning, the absolute necessity for taking such measures as should ultimately produce a nation of more efficient and prosperous industrial undertakings.

To the skeptic (and unfortunately there are many of them) the idea of an *ideal management* is an absurdity, this conclusion being based on the assumption that *idealism* and *commercialism* cannot be merged. To those who are of this mind, the statement made at the rate hearing by Louis D. Brandeis should be carefully considered:

> We shall show you how scientific management, when applied to the simple operation of loading a railroad car with pig iron, increased the performance of the individual worker from 12½ to 47 tons; how, when applied to shovelling coal, it doubled or trebled the performance of the shoveller. How, when applied to the operations of a machine shop, it de-

veloped, in certain operations, increases ranging from 400 to 1,800 per cent. How, when applied to brick laying, the day's accomplishment rose from 1,000 to 2,700 brick.

In this connection the following editorial which appeared in a recent issue of the *Progress Magazine* will also prove of interest:

Idealism and Commercialism are not antagonistic. Idealism is the very life and spirit of the commercial world. It is the purpose of Idealism to continually enrich the human mind so that there will be more and more to work with; it is the purpose of Commercialism to work out in practical life, whatever the mind can secure. Idealism is the *mother* of the idea, the plan, the invention. Commercialism is the *father* of the finished product. It is Idealism that discovers the thing and Commercialism that makes it serviceable or puts it to work in actual life.

What has this to do with the foundry industry? More than one may at first imagine. The closer we approach an ideal state, the more we are able to attain. The loftier our ideal, the greater the achievement in the long run, from which it is easily seen why the realization of the greatest success in the foundry or any other business is contingent upon—

1—Having an ideal.

2—Making a consistent effort to attain this ideal.

3—Placing the ideal high enough to make the effort worth while.

We get in life about what we deserve, and this applies to the corporate enterprise as well as to the individual. If we deserve much, we attain in proportion. A writer has well said, "Men fail for lack of *some* aim, but better than *some* aim is *one* aim by which good fortune is labelled 'reward by divine right.' "

In the foundry industry, investigation would develop the fact that it has suffered much from a lack of *one aim*, for it is safe to say that there are but few cases where the rule has been *one aim placed high enough and conscientiously pursued.*

This may seem a criticism not borne out by the facts in the case. If it is possible, therefore, to place before those who are interested in the industry a mental picture of conditions as they exist (to a greater or less degree) in almost every foundry, the strength or weakness of the above charge may be established. With this end in view, the following short story has been written; and while perhaps a radical departure from the usual style of engineering discussion, it is hoped that the picture the story will call up may more strongly emphasize many of the weaknesses that will be recognized as existing.

Is This Efficiency?

Jennings, the new moulder, had been in the shop two days "getting his hand in," as he termed it, and was on hand on the morning of the third day, prepared to show the "outfit" that he could hold his own with the best of them. To his helper, a hard-working chap, he made the remark:

"Are you ready for a hard day's work, Ryan?"

"I am; and if I was not, I'd have to, anyway. Those who work in this shop go some, I can tell you. It's run, jump, and chase around the whole blessed time, and you'll find it out before you have been here very long."

"Well, perhaps you're right. I did my share of this jumping business for two days, but I'm a new hand and didn't expect to have things handed to me on a platter. There goes the whistle—let's get under way."

Arriving on his floor, Jennings looks it over for a few moments, and, turning to Ryan, says with disgust:

"Can you beat that for a sand heap? The night gang must have thought I wanted to make mud pies instead of moulds. It's wet enough to take a bath in. Yesterday morning the sand was as dry as the Sahara and as hot as the place I told my side partner to go to. And will you look at the gaggers sticking out of the sand—not one of 'em removed."

At this point the shop foreman appears on the scene.

"Say, boss," says Jennings, "is this the way the night gang is supposed to leave the sand heap?"

"Well, no; but it can't be helped, so sail in and fix it up so you can start a job I have picked out for you."

"All right, boss; I'm a good sailor, but I can't make moulds and cut sand heaps at the same time."

"I don't see, Jennings, as there is any necessity for bristling up so over it. Other men in the shop are up against the same thing this morning and I'm not asking you to do two things at once."

As the foreman walks off Jennings says to Ryan:

"Go and get some dry sand and a little

new sand also, while I perform the high-class stunt of removing gaggers from a sand heap at forty cents per hour. Here goes my fine start that I was banking on."

After getting the gaggers and rods out of the heap, tempering the sand, and getting it in readiness for use, he tells his helper to mix some facing while he hunts the foreman. Meeting him down by the cupola, he says:

"I am ready for that job you mentioned just now."

"Well, Jennings, we were notified that the pattern I was going to give you has got to be changed, and I haven't had time to look up another for you since. Come with me and we will find something."

After a trip to his office to look up his orders, he takes Jennings to the pattern house and has a pattern brought out.

"Here, Jennings, make one from this pattern. I will have the cores made right away, so they will be ready when you are. See Tony, the flask boss, about a flask for it."

Going back to his floor, he tosses the pattern onto the sand, looks it over, and measures it up, after which he asks Ryan where he is likely to find Tony.

"Find Tony? Sure and you've got me this

time. Try the flask yard; if he's not there, try the pattern house; if this doesn't locate him, you will probably find him in the back end of the core room eating a lunch. If this don't work, start all over again. Tony is a hard man to find when you want him."

"Here is where the rebellion starts, Ryan. I am not going to do a 'hot foot' after Tony. I didn't enter a Marathon race when I hired out. I'm here to make castings, if I can ever get started. Look him up and tell him I want a flask, and be quick about it."

Ryan starts out to find Tony while Jennings goes over to the moulder next to him.

"Well, Bill, how is she going this morning?"

"Oh, after a fashion. Things could go a lot better. I've been on this job two days now and I feel like shaking the whole thing out. First they give me a pattern that nearly pulled the mould to pieces when I drew it, and then to improve on the thing I get a flask that's ready to fall apart. The cores don't fit, either, and I've wasted I don't know how long, filing and fitting to get them into place. They must make their cores out of cement here; they are so hard."

"What's the matter with the place, Bill?

Are they running a foundry for fun or to make money?"

"Search me. I don't see any fun in the thing and I can't figure out where any one would get rich here, judging from some of the boneheaded stunts I've seen pulled off."

Ryan comes along with the statement that Tony is busy getting flasks for other work and will be up as soon as he can.

"Have I got to loaf around on this job waiting until Tony gets good and ready to get me some of their old fire-wood to work with? Where is the boss?"

"Say, boss," as the foreman approaches, "why can't Tony stretch a point and get a flask for this job? At the rate I'm going I'll never get started."

"All in good time, Jennings; all in good time. You must remember that you are not the only man in the shop to get started in the morning. There are a few others."

"All right, if it suits you, I suppose it will have to go; but I'll be blessed if I see where you get any good out of me at this rate."

"Oh, you can speed up when you get your flask."

About fifteen minutes later, Tony appears and, measuring the pattern, says:

"I'll have to bring you a four-foot-six by seven-foot by three-foot-six flask for this job."

"Hold on a minute—I'm not figuring on making two of those to the flask."

"I know that, but we don't have any smaller flasks handy now—all in use."

"How do you know? Did you look?"

"I don't have to. I know what we have in the yard."

"Well, you must be a star if you do; for from what I saw of your fine flask yard, it would take a Philadelphia lawyer a month of Sundays to figure it out."

"What is it to you? You are paid to make moulds—not butt in about the flasks. I'll attend to that part."

"All right, Tony. Go as far as you like, but get the flask on the floor so it will look as if I was doing something. It's a good thing for me, Ryan, that this is not a piece-work job, for if this is a sample of what a man has to put up with I would earn but little."

Jennings, at a call from the moulder next to him, goes over to help him close a mould.

"Lift her off, Bill. I saw some sand drop from the cope."

"Just what I expected. It's a wonder the whole thing did not fall out. The cope is a dandy."

The foreman happens along, and, noticing the fall-out, exclaims:

"What is the matter, Bill? Didn't you ram and secure that cope properly?"

"I did the best I could with it. The cope is too wobbly to hold the sand as it should."

"That's right—blame it on the cope. Why didn't you let me know it was in need of fixing, or tell Tony to have the flask carpenter tighten it up for you?"

"If you remember, boss, I called your attention to a flask the other day, telling you it needed fixing, and you told me to use it; that it was plenty good enough for the job. I thought this time I would make no kick."

"Well, in the future let me know when you think things are not right, and I'll decide what is best to do."

"What do you know about that, Jennings? You get called if you kick and you get it if you don't. It's hard to please."

Tony and his helper bring in the flask, and, laying his bottom board, Jennings starts in.

"Well, Ryan, we are under way at last. I want to mix that facing you fixed for me a little better, and while I'm doing it you oil the pattern. It's covered with dirt and dust. Here comes the time clerk for a list of the daily doings."

"What are you doing this morning, Jennings?"

"Trying to make a mould. Think I was flying an airship?"

"You seem to be up in the air, all right. Yes, it looks as if you were *trying*, for you haven't got very far with the job."

"I won't get much further with it, either, if you make any more such cracks as that. I'd gladly take a round out of you and quit the place. What do you know about what is going on here? My sand was not right in the first place; I had to wait for a job; then waited for a flask, so I can't tell you just when I started. I don't know what the job is, and I don't care, either."

"Were you on hand at seven this morning?"

"I sure was."

"Then I'll have to start you on this job from that time. I'll get the details as to the job from the foreman."

"Go ahead, but don't come around in a few days to find out what made Jennings take so long on this job. I've lost two good hours now for which I am not to blame."

"All right, Jennings; keep your shirt on. Kicking won't help things much."

"You never said a truer word in your life. Kicking seems to get one in wrong here every time."

As the timekeeper goes on about his duties, Jennings rams his drag without any further delays. When nearly finished he says to his helper:

"Ryan, I'll soon be ready to roll this drag. Go hunt some chains—half-inch chains will do—and hurry so I can get the crane before Wilson wants it. If I can't get them in time there will be another private communion at the expense of the company."

Ryan comes back in a few minutes, reporting that two sets are in use and that the night gang broke the third set taking out some castings.

"Get some heavier ones, then, and hurry. I'll go with you."

As Jennings and Ryan return to the floor with three-quarter-inch chains, they see Wilson signal the crane man.

"It's all off, Ryan. No lift for a while. Oh, well, go and get some gaggers for me.

I'll need a bunch of eight-inch gaggers for this job."

One of the moulders happens along with the remark:

"Hung up, are you?"

"Yes, waiting for that crane."

"You'll get used to that if you stay here long enough. I've had to wait as long as two hours for it when a number of gangs wanted to close up at the same time."

"Oh, I don't mind a wait now and then, but it seems that I've been having more than my share of them since I came here. If I got paid for the work I do and not the waits, I'd get mighty little. I may be fussy, but I like to keep going."

"What's the difference? You get your pay, don't you? If they don't see where they are losing out, it's not up to us to tell them, is it? They'd make us turn out all the more and we'd get nothing extra for it. Let well enough alone."

Wilson lifts off, and calls to Jennings to get the crane. Jennings, with the help of Ryan, rolls the drag over and after sizing up the job, says:

"Ryan, go and have the flask carpenter come to the floor. The cope needs a lot of chucks to take that deep lift, and a couple of bars will have to be knocked out to make room for those large bosses.''

The flask carpenter soon appears on the scene, and, after looking the job over, says:

''It's a shame to change this flask over. It was made for a special job. It's too large for this job, anyway.''

''I can't help that. I kicked to Tony when he brought it in, but he told me to mind my own business.''

''Why didn't you ask the boss for another piece to put in with this one?''

''He is giving out the work—I'm not.''

The carpenter chucks the cope, knocks out the necessary bars, after which Jennings sings out:

''Two up for a lift! (See them tumbling all over themselves to get here, Ryan?) Come on, just two needed for an easy lift! (Fine crowd, this—they seem so anxious to assist each other.) Two up—any time to-day will do!''

Just then the foreman comes along, and, noticing the work, says:

''I don't want that made that way, Jennings. That lift is too deep for those chucks.

We had an arbor made for this job and I want it used.''

''Well, boss, I knew nothing about an arbor. You didn't tell me anything about it, nor did Tony or the flask carpenter. It seemed to me the chucks would be all right, so I had them put in.''

''They may suit you, but they don't suit me.''

''How was I to know what you wanted? You gave me the job and told me to have Tony get a flask. You didn't mention an arbor.''

''No more chewing about it. Have the chucks knocked off and send Ryan after the arbor. It's out in the yard somewhere. Next time you're not sure of a thing, don't go ahead until you have asked me about it.''

''All right.''

Jennings knocks off the chucks himself and a little later Ryan comes along with the interesting information that the arbor was broken the last time the piece was made, to which Jennings exclaims:

''Well, if this isn't the limit! Does any one around here know what is going on? I suppose the boss will tell me to put the chucks back on again.''

Jennings hunts up the foreman again, and says:

"I can't use the arbor, boss. It was broken the last time the piece was made."

"That's a fine piece of business. If I knew the man who broke it without reporting it to me, I'd fire him on the spot. A man has got to be in a dozen places at once to keep track of what is going on here. Have the carpenter put the chucks back on again. Hurry, too; it's nearly noon, and you haven't started to ram the cope yet."

"No, and if the afternoon is going to be like the morning has been, I won't get the job ready for a week."

"Go easy—accidents will happen."

Jennings goes back to his floor and sends Ryan after the flask carpenter. The noon whistle blows, so Jennings proceeds to eat his lunch, after which he joins a group of workmen.

"Well, stranger," one asks, "how do you like it as far as you've gone?"

"From what I have seen as far as I have gone, I can tell you that I won't go very far. I'm not in love with this hop, skip and a jump business."

"No? You must be one of them 'kill the

job guys.' Perhaps if you'd fix it up they would make you boss."

"Soft pedal on the sarcasm. I'm not anxious to be boss, nor do I go out of my way to show off how much I can do in a day, although I can go some if it is necessary."

"What is the particular brand of kick, then? Liver complaint, grouch, or what?"

"Neither. I simply don't like this way of working. It's start, then wait; start, then wait some more; commence again, then stop; begin all over again—and you have the general scheme of things here, as far as I have been able to size things up. Now, this may be all right to those who have not worked in better shops, but I have; and the difference is something you don't have to put on glasses to see."

"Why didn't you stay in them shops, then?"

"That's none of your business, but what I said goes, just the same."

"Jennings is right," says an old moulder standing close to him. "There are shops where a man can do more and yet work no harder than we do here. The men can work to better advantage because they are given things to work with; there is some head and tail to things; the conditions are better—not this rush and hustle and then accomplish little. There is no use in kicking though, Jennings. We couldn't change things if we wanted to. If we tried, we'd probably lose our jobs for trying to tell them where they are losing out."

"Perhaps you are right. I suppose I'll get used to it in time."

At this the whistle blows and Jennings goes back to his floor. Ryan and the flask carpenter soon appear, the chucks are placed back in the cope, and, with the help of two others, it is placed in position.

"Now, Ryan, bring me some facing while I sift, and step lively. . . . That's enough; now bring me some gaggers . . . I asked you to bring me some 8-inch gaggers, and not 10-inch and 12-inch."

"I got all I could find of the 8-inch kind."

"Do you mean to tell me that the 8-inch gaggers that you brought up are all you could find? Where do they keep them here?"

"In some racks in the middle of the shop and on the back end of the floors."

"Well, I'm going after some. What you brought is not enough, anyway."

A little later Jennings comes back to his floor with his hands full of gaggers.

"Oh, but this is a swell place. The rack looks as if a cyclone struck it—gaggers mixed up in every possible fashion. I wouldn't paw over that bunch if I lost my job. What I got I coaxed from the men and they didn't seem any too willing to let me have them, at that."

Jennings now tells Ryan to get him some 18-inch gaggers for the deep lift. Ryan comes back in a few minutes with the statement that he couldn't find any.

"Say, boss," as the foreman comes along, "I need some 18-inch gaggers, and the helper says that he can't find any."

"There should be some around somewhere. We often use them."

"Where are they, then? I was down to the rack a short time ago and don't remember seeing any 18 inches long."

"I don't know just where they are. Do you suppose for a minute that I have nothing else to do but keep track of gaggers?"

"Do you think it's up to me to look for them? I'm willing to set gaggers and make moulds, but I don't see where the company gets any good out of me when I chase after gaggers."

"If you think I'm going to look for them for you, you have another guess coming. Send your helper for them."

"He says that there is none at the racks. No use sending him among the men, for after the swell reception I got from some of them when I went after some 8-inch gaggers he'd stand a fine show of getting what I need for this lift."

"Go get them yourself, then, and quit your kicking. You have done nothing but howl and fume ever since you've been on the job. If you don't like the way I run this proposition, you had better quit."

Jennings is about to tell the foreman what he thinks of things, but decides not to do so. Going to the floor next to him, he says:

"Got any 18-inch gaggers, Bill?"

"No, but I guess Flanders will let you have some. He had a few yesterday."

"Looking for 18-inch hooks, Flanders. Can you spare any?"

"Had some yesterday, but some kind friend relieved me of them. Come again."

"Where do you suppose I could find some?"

"Ask Dr. Cook. He might discover 'em. Or, try the racks."

Going to the rack where the gaggers are kept, Jennings asks where the 18-inch gaggers are. On being informed that Peters on the cylinder floor has some, Jennings goes on his way until he arrives on the floor mentioned.

"Can I have some of those 18-inch gaggers I see on the back of your floor?"

"You can—*not.*"

"Why not? You are not using them."

"That's got nothing to do with it. I've got a job that will take that size and I'll need them. I got called right by the boss yesterday for not keeping what I had, and if any one in this shop gets those gaggers from me they will have to go some, let me tell you that."

"Well, where in Sam Hill will I find some? I'm getting corns on my feet chasing around for a few gaggers."

"You had better see the blacksmith. He can get some out for you quicker than you can find them around here."

"That's a good suggestion. I'll try it. Where does he hold out?"

"At the lower end of the shop, next to the air furnace."

Jennings locates the blacksmith and says:

"Could you cut and bend me some 18-inch gaggers?"

"I couldn't just now. I'm making some new sand hooks for the night gang."

"Ah, be reasonable. I've been called down by the boss because I mentioned gaggers, and I've been to three floors in an attempt to find some and got left each time. Stretch a point and get me out a few, if you can."

"How many do you want?"

"Oh, about 25 will be enough, I guess."

"All right, I'll give you a lift."

A little later Jennings goes to his floor with a supply of 18-inch gaggers and in a few moments has them set.

"Now, Ryan, get busy and shovel in as fast as you can. I want to get this cope rammed up as quickly as possible. Perhaps I can make up a little of the lost time."

Ryan shovels sand, Jennings rams and finally the cope is in readiness to lift off. He gets the crane without much delay and is soon at work finishing the mould.

"What's going to happen, Ryan? No delays for some little time. I don't mind an occasional loaf, but I do hate them as a steady diet."

"The day is not over yet, Jennings."

Jennings finishes as much as he can of the cope, and is about to draw the pattern, when he notices two dowel-pin holes in one end of the pattern.

"It don't look good to me, Ryan. I didn't notice them before, but those holes mean something. Go find the boss."

When the foreman arrives, Jennings shows him the pin holes.

"Well, Jennings, I see you are in wrong again. Don't you know that dowel-pin holes are put in a pattern in order to attach another piece to it? There is a lip that goes on that pattern and I don't see it in the cope."

"You gave me the pattern yourself, boss, and there was no extra pieces with it. I didn't notice the holes before."

"That's right—try and blame it on to me. You should have noticed the holes. You are paid to think and notice things, as well as mould, you know."

"Am I supposed to check up the pattern shop? They should have assembled the pattern properly before allowing it to go into the foundry. Where I worked last the patterns were right before the work was started, and the moulder didn't have to bother to see if the parts were together."

"Yes, the pattern shop is partly to blame, but I still don't see where that lets you out. At any rate, get the piece, cut into the cope, set the piece and ram over it."

Jennings goes to the pattern house, gets the missing piece and after a half-hour's work gets the cope in shape once more. He then draws the pattern from the drag, and while finishing tells Ryan to go after the cores. Ryan comes back with the statement:

"They are not ready yet. The boss says they have been so busy they could not get them made this morning. He says he will make them now."

"What good will that do me? I'll be ready to core up in about ten minutes. I guess it's nix on finishing this to-day."

The boss comes along at this, with the remark: "You will have to hurry, Jennings, if you want to get that in the heat to-day. The blast is on now."

"You won't get it to-day, boss. No cores for the job. Core room too busy."

"I told Jenkins to be sure and get those cores in so that you would have them in time. A nice state of affairs. I'll find out why."

The foreman goes to the core room, and, stepping up to the core boss, says:

"Say, Jenkins, why didn't you get those cores for Jennings, as I told you this morning? He is ready to core up, and he tells me they are not made. I gave you plenty of time."

"Yes, you told me about them, and ten minutes later you come and tell me to get out the cores for the Wilkins engine contract as fast as I could."

"I know I did, but the few cores for Jennings would not have taken long."

"Perhaps not; but you said that the engine cores were to take preference over all others, and I acted accordingly. I'm making the cores now for Jennings, but they must be dried before he can have them."

Going back to Jennings' floor, he remarks: "Finish your drag, and then go and help Potter close his mould. The cores won't be ready for you to-day."

Jennings finishes the drag as instructed, after which he reports on Potter's floor.

"Well, what do you want here?"

"The boss sent me over to help you close. I can't finish my job. No cores."

"I don't need any help. I can close this alone. The boss knows this, for I have made enough of these castings."

"Well, will I go and tell him you don't want me?"

"No; stay on the floor, as long as he sent you. It means that unnecessary time will be charged against this job, though."

"Yes, Potter, I can see that it was not necessary to send me over here, but I suppose that he was too busy to look up another job for me. What do you want me to do?"

"There isn't much you can do. It's ready to close now. You can make the runner while I get wedges and clamps and clamp up. Then we will put on a few weights and we're ready for the iron. I could do the work myself in time for the metal, but I guess we can make it last the day out."

Between them they close the mould, make the runner, clamp and weight, after which they proceed to the back end of the floor, light their pipes and discuss things in general. About a half hour later their iron comes, the piece is poured and the men go home, Potter satisfied that he has done a good day's work, Jennings feeling rather disgusted over the happenings of the day.

The next morning Jennings is on hand ready to finish his mould. He goes to the core boss with the remark:

"Are my cores ready?"

"Yes; but we have not drawn the carriage from the oven yet. As soon as we do this I'll get your cores, have them pasted and blackened and send them up to you."

"All right, but hurry, as I want to get the job finished."

Jennings goes back to his floor, and in about twenty minutes the cores are brought up to him. He sails in, sets the cores, then secures his work, after which he sends Ryan after four 42-inch clamps. Jennings makes his runner, then waits for Ryan to bring him the clamps. While leaning against his flask, the foreman appears. He watches Jennings a moment, and then says:

"Well, what are you waiting for, Jennings?"

"I've sent Ryan after some 42-inch clamps and he has not returned with them."

"Perhaps he is loafing on the job. You had better see where he is."

"He is probably chasing all over the place, the same as I did yesterday when I was looking for 18-inch gaggers. Clamps and gaggers ought to be where they could be got at easily."

"That's right, start kicking bright and

early, the same as you did yesterday. The next thing I know you will want me to have things manufactured to order for you; lay everything at your feet and say, 'Mr. Jennings, there you are; now go ahead.' Would that suit?"

"The fact is, boss, if things had been in better shape yesterday, this job would now be on the cleaning floor. I can't make moulds and do other things at the same time. If you want me to be a combination moulder and laborer, that's up to you. Don't come around, though, and tell me that I'm taking too long on a job."

"I'll tell you what I please about your work. You are no better than any one else around here. They all have to dig in and help themselves, and you can do the same. If you are going to do chronic kicking, the sooner we part company the better it will be for both of us."

At this Jennings explodes.

"You've said it right. You can have your job. Perhaps you can find some one who don't know how a shop should be run—some easy mark who is content to chase around half his time, doing what should be done in advance and 'getting his' regular because he does not turn out more. Nothing like that for mine."

"All right; I'm satisfied, Jennings. You're too high and mighty for me. If you stay here you would probably be running the shop in a short time."

"No, I'm not crazy to run the place; but in parting I might tell you that it can be run a heap better than it is being operated now. Take that from one who knows."

TIME ANALYSIS (IN HOURS AND MINUTES) OF WORK MADE BY JENNINGS

Italics indicate standardized moulding operations.

Column 1—Standard time allowed standard moulding operations.
Column 2—Actual time by Jennings against these standards.
Column 3—Time in trips made by Jennings.
Column 4—Time in discussions.
Column 5—Time in waits and delays.
Column 6—Time in unnecessary work.

Items.	Elapsed Time	Time Distribution. 1	2	3	4	5	6
1—Observing sand heap and calling attention of foreman to same	3	—	—	—	2	1	—
2—Removing gaggers from sand, cutting over, tempering, etc	25	—	—	—	—	—	25
3—Hunting up foreman for work and trip with him to the office	7	—	—	7	—	—	—
4—Trip to pattern house with the foreman	4	—	—	4	—	—	—
5—Getting out the pattern	6	—	—	—	—	6	—
6—Trip back to the floor	4	—	—	4	—	—	—
7—Sizing up pattern for flask and discussion with Ryan with reference to finding Tony	3	—	—	—	—	—	3
8—Conversing with "Bill" while Ryan is looking up Tony	5	—	—	—	—	5	—
9—Waiting for Tony to come in and measure up the work	10	—	—	—	—	10	—
10—Waiting for the flask to be brought in	11	—	—	—	—	11	—
Carried forward	1:18	—	—	15	2	33	28

Items.	Elapsed Time.	Time Distribution. 1	2	3	4	5	6
Brought forward........	1:18	—	—	15	2	33	28
11—*Laying bottom board, pattern and drag*...........	2	2	2	—	—	—	—
12—Remixing the facing sand	4	—	—	—	—	—	4
13—Discussion between Jennings and the time clerk..	3	—	—	—	3	—	—
14—*Ramming the drag*.......	2:31	2:10	2:31	—	—	—	—
15—Going for chains........	4	—	—	4	—	—	—
16—Waiting on crane to roll drag..................	8	—	—	—	—	8	—
17—*Rolling the drag*.........	3	3	3	—	—	—	—
18—Waiting for the flask carpenter................	5	—	—	—	—	5	—
19—Waiting for cope to be chucked and bars cut out	14	—	—	—	—	14	—
20—Waiting for two men to assist in placing the cope.	4	—	—	—	—	4	—
21—Discussion between Jennings and foreman as regards chucking cope instead of using arbor.....	3	—	—	—	3	—	—
22—Knocking out chucks....	2	—	—	—	—	—	2
23—Waiting for Ryan to bring in the arbor.......	9	—	—	—	—	9	—
24—Advising foreman as to broken arbor...........	3	—	—	3	—	—	—
25—Trip back to floor, sending Ryan for the flask carpenter and waiting until noon..............	7	—	—	3	—	4	—
26—Waiting for flask carpenter after whistle blows...	3	—	—	—	—	3	—
27—Rechucking the cope....	8	—	—	—	—	8	—
28—Placing the cope........	3	—	—	—	—	—	3
29—*Sifting facing sand over the pattern*.............	2	2	2	—	—	—	—
30—Going to racks for gaggers and getting small gaggers from the men....	9	—	—	9	—	—	—
31—*Setting these gaggers*.....	15	12	15	—	—	—	—
32—Discussion with foreman with reference to the 18-inch gaggers...........	2	—	—	—	2	—	—
33—Trip to "Bill" Flanders and cylinder floor for the large gaggers...........	6	—	—	6	—	—	—
34—Trip to blacksmith and waiting until some are made.................	12	—	—	2	—	10	—
35—Trip back to floor.......	3	—	—	3	—	—	—
36—*Setting the 18-inch gaggers*	5	5	5	—	—	—	—
37—*Shovelling sand into cope* .	6	5	6	—	—	—	—
38—*Ramming cope*.........	24	20	24	—	—	—	—
39—*Lifting off cope and placing for finishing*........	3	3	3	—	—	—	—
40—*Finishing cope previous to noting dowel-pin holes*.....	10	8	10	—	—	—	—
Carried forward	5:51	3:10	3:41	45	10	1:38	37

Items.	Elapsed Time.	Time Distribution. 1	2	3	4	5	6
Brought forward........	5:51	3:10	3:41	45	10	1:38	37
41—Waiting for foreman after noting holes...........	3	—	—	—	—	3	—
42—Discussion with foreman as to these holes........	3	—	—	—	3	—	—
43—Trip to pattern house for the missing part........	4	—	—	4	—	—	—
44—Search for the piece.....	4	—	—	—	—	4	—
45—Trip back to the floor....	3	—	—	3	—	—	—
46—Placing piece, cutting space, setting cope and ramming over piece.....	8	—	—	—	—	—	8
47—Lifting off cope.........	2	—	—	—	—	—	2
48—*Finishing the cope*.......	10	7	10	—	—	—	—
49—*Drawing pattern from drag*	4	4	4	—	—	—	—
50—*Finishing drag*.........	1:10	1:00	1:10	—	—	—	—
51—Discussion with foreman as to cores not being ready.................	4	—	—	—	4	—	—
52—Trip to core room next morning..............	5	—	—	5	—	—	—
53—Trip back to floor.......	6	—	—	6	—	—	—
54—Waiting for cores.......	10	—	—	—	—	10	—
55—*Setting cores and securing them*..................	1:54	1:40	1:54	—	—	—	—
56—*Closing mould*..........	10	8	10	—	—	—	—
57—Waiting for clamps, and discussion with foreman which results in Jennings deciding to quit........	16	—	—	—	5	11	—
58—*Making runner and clamping*..................	12	10	12	—	—	—	—
Totals............	11:39	6:19	7:21	1:03	22	2:06	47
Percentages...............	100	——	63	8.6	3.4	18.1	6.9

Stories are written, plays staged, sermons preached, in order to drive home a lesson of some kind. So with the foregoing—not written for the purpose of indulging in a lot of destructive criticism, but with a desire to show as forcibly as possible the weaknesses of ordinary practice, in order that suggested betterments may be better appreciated and consideration be given to what "scientific management" means to the foundry industry.

What, then, are the lessons that a study of the story discloses? I know of no better way of pointing them out than by putting down, in a systematic manner, a careful time analysis of the work done by Jennings, as shown by the accompanying time-analysis. From these figures, which are valuable in proportion to the study that is applied to them, we find that the job was standardized as one which should have been completed in 6:19 hours, and that 11:39 hours were actually spent in making the casting. Consequently, the ratio of actual performance to possible attainment is:

$$\frac{\text{Standard Moulding Time, } 6{:}19}{\text{Actual Moulding Time, } 11{:}39}$$

An efficiency of 54.3 per cent, which means that 45.7 per cent of the time is inefficiency or waste (100 per cent—54.3 per cent).

This leads us to two conclusions: 1, that a man should be able to spend more time in productive endeavor than the figures indicate, or something is decidedly wrong; and 2, that the inefficiencies should be rigidly investigated and eliminated as rapidly as possible. The problem is therefore to arrange the factors so that proper consideration can be given to (2) in an endeavor to better (1).

In order to deal fairly with the man, we must consider the inefficiency of the man as distinct from that of the management. The time spent by Jennings against the standard of 6:19 was really 7:21; consequently, his efficiency is 86.3 per cent (6:19÷7:21) and his *inefficiency* 1.02 hours, or 13.7 per cent of the actual time against the standard moulding operations—distinctly a man inefficiency. If, however, a moulder spends 0.25 hours getting his sand in condition before he can begin work, this is an inefficiency due to poor shop conditions. If he waits 0.50 for a job, pattern, and flask, this is an inefficiency due to faulty planning, for *both of which the management of the foundry is responsible.* Arranging the time factors from the analysis, with these points in mind, we have:

	Hours.	Per cent.
1—*Standard moulding operations*—Items 11, 14, 17, 29, 31, 36, 37, 38, 39, 40, 48, 49, 50, 55, 56 and 58	6:19	54.3
2—*Inefficiencies due to poor shop conditions*—Items 1, 2, 12, 13, 15, 16, 20, 30, 32, 33, 34, 35, 41, 42, 43, 44, 45, 46, 47 and 57	2:06	18.1
3—*Inefficiencies due to faulty planning*—Items 3, 4, 5, 6, 7, 8, 9, 10, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 51, 52, 53, 54	2:12	19.0
4—*Inefficiency of the moulder*	1:02	8.6
Totals	11:39	100.0

If we call the above inefficiency 100 per cent we will have the following:

	Hours.	Per cent.	Per cent.
Inefficiencies due to poor shop conditions	2:06	39.6	81.1
Inefficiencies due to faulty planning	2:12	41.5	
Inefficiency due to the man	1:02	18.9	
Total	5:20	100.0	

It follows from the above that through the elimination of the inefficiencies listed we would see the standard attained, so it is but natural to ask what this would mean in the way of results. The following summary of production and costs will show this aspect of the case clearly:

As to Production:	
1—If casting weighed 850 lb., the production per man per day for the 11.6 hours actual time would be	732 lb.
2—If same casting had been produced in 6.3 hours (standard time), production per man per day would have been	1,349 lb.
3—Increase in productivity would have been.	617 lb. or 84.3 per cent.
As to Cost:	
1—Casting made in 11.6 hours would cost at 40 cents per hour for Jennings and 20 cents per hour for the helper, with a burden of 100 per cent................	$13.92
2—If casting had been made in 6.3 hours, cost at the same rates would have been......	7.56
3—Reduction in cost......................	$6.36 or 45.7 per cent.

If, therefore, Jennings had been able to produce the 850-pound casting in the 6.3 hours, not only would his productivity have been *increased* and the cost *decreased* as indicated, but the inefficiency in time (5.3 hours) could have been utilized in turning out more production—*a clear gain*—for using the same ratio per hour (134.9 pounds) this saved time would have meant 715 pounds in additional tonnage or $21.45 in sales at $3.00 per 100 pounds.

While not acknowledging that this is in any way an isolated case, if it is possible to accomplish one-half of the results outlined, through "scientific management," then the thing to do is to get down to "brass tacks" and *cut out the unscientific features.* How?

1—Through a study and application of the efficiency principles that have been so convincingly defined by Harrington Emerson, in his recent series in *The Engineering Magazine.**

2—Through a systematic planning and dispatching of all work along the lines indicated in Chapter II.

3—Through a close study of the shop conditions in order that the delays due to this feature, contributing to inefficiency, may be eliminated or at least reduced to a minimum.

4—Through a careful and scientific study of all operations, in order that standards as to time may be determined which will not only serve to reveal the weaknesses in the conduct of the business but as the basis for reward for personal effort.

5—Through bonus reward to those who endeavor to take advantage of bettered con-

* "The Twelve Principles of Efficiency"; *The Engineering Magazine*, May, 1910-September, 1911. Now republished in book form.

ditions and efficient planning, in proportion to their assistance in eliminating inefficiency.

Scientific management? By all means, for it contributes to the betterment of *efficiency;* it aids in the attainment of an ideal; the profitable conduct of any undertaking, whatever it may be.

Chapter IX

FOUNDRY ORGANIZATION AND MANAGEMENT

A FOUNDRY enterprise, considered as an organization, is in many respects like a chain, the strength of which is measured by its weakest link; and until the profit-eating elements—the inefficiencies—are discovered and eliminated, it cannot be expected to perform the *impossible* task of producing the results anticipated by its founders, any more than a chain can lift ten tons if one of the links, because of its weakness, is only strong enough to lift seven tons. To strengthen the links of a business—to make them work under a greater load—is the task which confronts every ambitious executive, and it cannot be done by concentrating attention on one link or a few links; *all links* must receive their proper consideration.

The demand of the times is *increased earnings;* this involves a search for latent earning capacity—a search in every nook and corner for opportunities to better results, whether good or bad; and this searching process must not be a haphazard, occasional, half-hearted affair, but a critical, systematized analysis all along the line. "Chemistry of results" is of vital importance, just as important to the success of the foundry as a business as "chemistry of iron" is to the melting operation as a single department of the business, for it considers the important fact that *productivity* is the essential factor in the success of any foundry enterprise applicable to the methods in use, the clerks, the machines, the cupola, the cleaning room, as well as to the moulders and coremakers. Even a trifle of increase at each point will certainly result in greater earnings, for the little things, which are oftentimes overlooked because they are little, amount to something substantial in the aggregate.

Analysis, important as it is, is a *post-mortem,* a tearing-to-pieces-looking-for-trouble process, and while it is an important element in pointing out the way to correct existing evils, it is just as necessary, as was pointed out in a previous chapter, to have at work an *ante-mortem* process—a process anticipative in nature—a creative and constructive force —a force which considers that all work, while distinct, must be subservient to a general scheme of things, which admits of something being done with regard to its relation to other things—"organization" in other words, applicable to the business in its entirety, to the various departments, to the clerical work, etc., and definable as follows:

"The result of a resolving of the forces at work into their component parts; their classification so as to enable them to follow well-defined channels, that the work may be guided along the most logical lines and responsibility placed where it properly belongs; and finally their combination into one harmonious effort, supervised and directed by a master mind."

A customer ordering castings will specify a certain analysis of the iron. He will want a certain percentage of silicon, sulphur, manganese, etc., and it is up to the foundry superintendent so to plan his work as to produce castings which, when chemically analyzed, will show how they fulfil the specification. In conducting your business, you specify a certain analysis—profits; perhaps you specify the margin of profit that you require your final analysis to reveal to you, and you must organize your business so that this final analysis will either come up to your desires or show you what was wrong in order for you to introduce the elements necessary to bring about the results you specified. There is no more excuse for a lack of organized effort in the foundry business than there would be for a foundryman to dump his different brands of pig iron, scrap irons, etc., onto one common pile.

An accounting arrangement, no matter how carefully planned and installed, can only *register* results, not *produce* them, but this does not mean that the accounting should be considered as of little or secondary importance; in fact, the forces which register or record the results, as well as those which produce them, must be well organized if maximum efficiency is to be the outcome. Let us therefore take up the matter of organization, first as applied to the accounting and then to the engineering branches, by briefly considering the following questions:

1—Should the cost accounting be considered a part of the general accounting or be kept separate from it?

2—Should the accounting be on the basis of monthly, quarterly, or yearly results?

3—Should the inventory be a perpetual or continuous one or taken at regular periods for closing the books?

4—Can mechanical aids be employed to advantage?

5—What may be expected from an efficient accounting arrangement?

One of the basic principles about which a system of foundry accounting should be built, is that it should consider the important fact that business as it is now conducted is nothing more or less than a conversion of assets from one form into another. A foundryman starts with cash in the bank, which he converts into labor and material. From this expenditure he secures castings, which, when sold, appear as accounts receivable, then as cash, as payments are made, and back into labor and material again, from one state into another, in the form of a complete circle.

From this point of view, a foundry accounting arrangement, to be efficient, should consider the costing as a part of the general accounting scheme, in order that *all* items affecting the business can be properly recorded and not lost sight of. Cost information carried through the general books so that everything must be in balance, at the end of a period is going to mean that the accounting will be more comprehensive than if the costing was a sort of spasmodic, hit-and-miss, incomplete and inaccurate sort of an affair.

It would not seem as if question two was entitled to any consideration whatever. It is difficult to explain why an executive will rest content, as so many do, with anything short of a monthly accounting, making possible a thirty-day statement as to his conditions. Cases are numerous, however, where a monthly trial balance and an annual or perhaps a semi-annual closing of the general books seems to be the custom. Twelve opportunities in a year for locating and correcting faulty conditions, as against one or perhaps two chances, is something worth considering, as it places an executive in much closer touch with the various details of his business than a yearly accounting possibly could—in fact, in the majority of cases, if results are not as they should have been, it is almost impossible to analyze a yearly statement so as to lay a finger on the leaks and the inefficient conditions which were responsible. As no manager in these days can afford to "fool" himself or to work in the dark regarding what is going on all about him, we are safe in concluding that a thirty-day accounting arrangement is absolutely essential.

Regarding question three, as to the matter of a continuous inventory, a brief consideration should show that such an institution is not only advisable, but necessary if the accounting scheme is arranged to make possible a thirty-day statement. Material is converted money and should be regarded just as carefully as the cash is; but how is this converted asset regarded by the majority of our foundries? Every reader can call to mind case after case where the proper care of the materials purchased is a matter of little concern; where careful attention is given to the matter of buying, but once the material arrives, this same careful attention seems to be conspicuous by its absence in so far as concerns the way this material is used. An item like torches and wicking does not seem to be of any great consequence, but how about the thousand and one items with which the foundry is concerned in the course of a year? Some workmen are careless by nature; others become so, even the most careful, sometimes, when they realize that not only are there no safeguards thrown about the materials, but that it seems to be the duty of no one in particular to see to it that the materials are used judiciously. Even if a lax handling of the purchased materials does not result in making them careless, it tends to make them so; and at the same time it robs the executive of the means that might enable him to "cut corners." A concern which had been rather liberal in allowing their workmen to use waste as they saw fit, decided to place the issuing on a more systematic basis, with the result that in the first month the consumption was reduced by about 25 pounds —a small item, perhaps, but an item which in a year meant 300 pounds less to pay for. No more material should be purchased and used than is necessary to produce good results, and the less an executive has to pay for, the more he can use in other directions. As the aim of a continuous inventory is to furnish the executive an efficient control of his materials, so that he can know that this expenditure is not out of proportion to the results obtained, it should need little argument to convince a foundryman that purely from the standpoint of good business, of possible financial gain, a positive knowledge of his material is something to be desired. Even if it did not save him a cent, he would at least know that because of this control of things he has not wasted any money.

As to mechanical aids in accounting, I am of the firm belief that they can be used to decided advantage in any foundry office. What an executive wants is a knowledge of his results as quickly as they can be gotten to him, and if he is forced to depend upon his clerks to add columns of figures, multiply and divide, without the aid of mechanical devices, he must either employ a large force of clerks or wait for his information until it is too late to be of value. A progressive manager should do neither when an installation of machines makes it possible not only to operate with a minimum number of clerks, but to secure his information on time. One of the most prominent manufacturers of adding and listing machines has a machine peculiarly adapted to the needs of the foundry business, in that pounds-hours-dollars can be added at one time, materially reducing the work of summarizing production costs according to the various classifications. There are several makes of multiplying and dividing machines, any one of which will pay for itself within a short time, as they not only make the work easier for the clerks, but enable them to do their work with much more rapidity—the most important result being the absolute accuracy with which the machine can be made to operate.

As to what may be expected from a comprehensive accounting arrangement, it can be said that the principal result would be clear and concise statements reflecting the conditions of the business. Not very high sounding, perhaps, but full of meat just the same. A hospital doctor arranges for information concerning his patients during his absence, and at regular intervals the nurses and attendants register in a systematic way the important details concerning pulse, temperature, etc., which, upon the arrival of the physician, will show him the condition of the patients during the time he was away from the hospital. He knows whether they are better or worse, and from this information, plus his knowledge of the cases, he is in a position to plan out his future action. A manufacturer is the doctor of his own business, his statements and charts being the information as to pulse, temperature, etc., a study of which will enable him to plan for the future. Figures in themselves are dry and uninteresting, but with reason and judgment (analysis) applied to them they assume a far different aspect. To illustrate. A correct accounting scheme would show what the total production was in a certain period and it would also show the number of hours in which this production was made. Placed by itself, this information would mean very little to the executive beyond the fact that his plant worked a certain number of hours and that his production was a certain amount. If, however, these figures should show, in addition, that this production in the time specified meant 500 pounds per man per day, the executive would have something in the way of valuable information, for, by comparing this figure with the relative production per man for previous months, he could satisfy himself from his knowledge of the work, as to whether the result was satisfactory or not. Analyzing still further, he could get the relative production of the work for Jones, Smith, and Brown, and would perhaps find that on the work for Brown the production fell below what it should have been. It is fair to assume that by concentrating his attention on the production of Brown he would be able to increase it to some extent, any increase being accompanied by decrease in the cost to produce the work, consequently more profit—this added profit being the result of an arrangement which reflected the condition of only one feature of the business. There are many other possibilities in this reflection process, but the one given is sufficient for purposes of illustration. At any rate, from the above arguments we can decide in favor of an accounting arrangement which will not only be accurate and efficient, but designed to show the pertinent details of the business in a simple yet comprehensive manner.

Efficiency is the elimination of inefficiency—once it is found. It therefore becomes the duty of the executive so to arrange his details as to allow this "finding" process to work to advantage, which can best be done through means of a correct and well balanced organization. Human nature is liable to pass over the possibilities for profit when some one else is likely to receive credit for the good that is done, but once put a responsibility squarely up to an employee, letting him understand that while he will be held strictly responsible for failure, he will receive credit for accom-

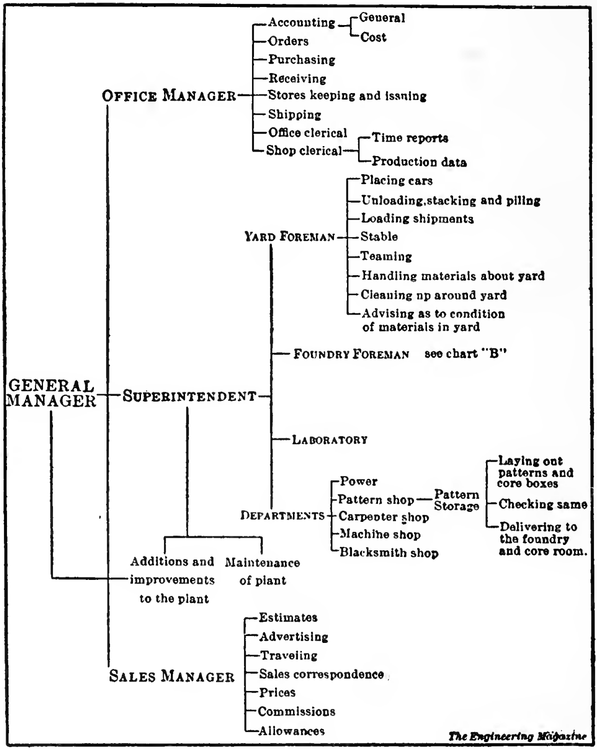


FIG. 23. GENERAL ORGANIZATION OF THE FOUNDRY.

plishment, and from that moment better results may be hoped for. In other words, the incentive to do must be furnished, for there is nothing that will do more to create harmony and promote action than mutual trust. Nonconformists must, of course, be weeded out or swung into line, for there can be no successful business without authority. This can be accomplished through the force of organization and personality much more easily than it can be by the force of fists. Men

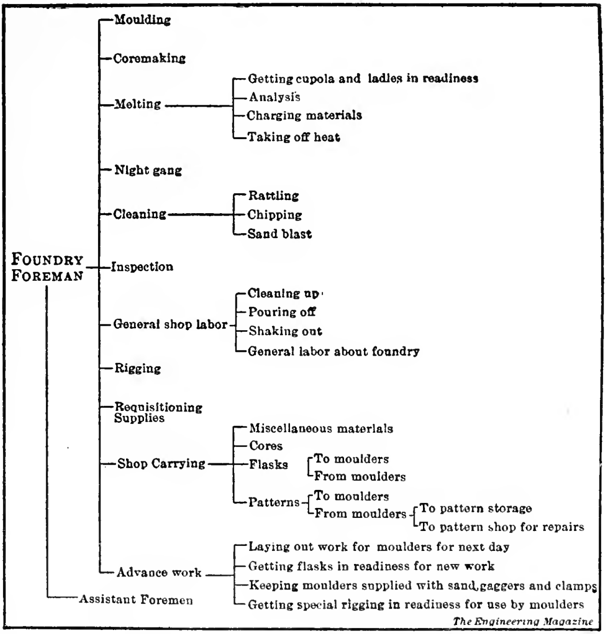


FIG. 24. ORGANIZATION OF WORK UNDER THE FOUNDRY FOREMAN.

cannot be made to do a thing, but they can be led. The employee owes a duty to his employer, to be sure, but this does not mean that this duty is all one-sided. Make the organization what it should be—place responsibility where it properly belongs—furnish a man with an incentive to look for the troubles which exist to a greater or less degree in every business, and the inefficiency will be brought to light, for efforts will be made to bring about increased productivity, and increased productivity is synonymous with increased efficiency.

Authority should be carefully defined and then centralized along the lines suggested in this chapter; a list of duties patterned after the outline in Chapter II should be drawn up; criticism and recommendations for betterments should be solicited and acted upon; the details of the business should be studied, analyzed and standardized; attainable performance should be set, against which accomplishment can be measured, and once those connected with the organization can feel that their opinion is desired in matters affecting their own work, it will not be long before they will be on the lookout, all along the line, for the loose ends, the leaks, the inefficiencies; and as a man looking for trouble is sure to find it, so will the man looking for places which can be bettered be better able to locate them than he who goes about with his eyes closed, especially if discovery carries with it a *monetary reward,* which would talk louder than mere praise could ever hope to.

Chapter X

FOUNDRY PRODUCTION AND ITS DETAILS

A PROMINENT foundryman recently told me that in the plant in which he is employed, elaborate accounting methods were devised and installed (at no small cost) and an elaborate force organized to compile accurate and detailed cost data (also at no small cost). He stated that results were made known so long after the performances covered by the records that it was simply an impossibility for him or any one else to point out reasons for certain fluctuations in costs; and that as a matter of fact, he knew more about what was going on before the introduction of the methods than he did after their installation. If this is not paving the way for a long string of excuses, enabling those responsible for inefficiencies to hide behind the much used "I don't know," then it would be a difficult task to ascertain what would be.

As has been stated before in these pages, an accounting arrangement is a *recording* agency, not a *producing* agency, and if this recording is not a reflex of the existing conditions, then how can it be expected that one or a few men will know what caused this and what caused that? At any rate, a close study has convinced me that accounting schemes fall down *because of the many things the cost statistics do NOT show.* Without questioning the theory of accounting, without doubting the accuracy of the recorded data, we must all agree that any system of records should show where the faults are, enabling the executive to go to his management with facts explaining the figures, *instead of asking them to explain the figures by substituting the facts;* which, by the way, are most elusive.

The principal element in the foundry business is its production, and it has been a source of wonder to me why the details of this production have not been analyzed to see if they could be made to submit to some sort of uniform procedure, instead of something which could be viewed about as one pleased. It therefore seems advisable to take up the discussion of production details in an endeavor to make this recording a *constructive* as well as an *analytical* force.

Commercial Production.—This element should comprise all castings made for sale to outside foundries, or to the company of which the foundry is a part, or to both, and should represent the *net good castings* produced in a period, with no *deductions made for whatever may be returned on account of error, defect, or other reasons.* In other words, the total castings produced in a period, less the bad castings of the same period, is the production. This may sound strange to a great many, but as I have found that the practice of several foundrymen has been to deduct from the current production whatever has been returned as defective, it seems advisable to outline what seems to be the correct procedure.

In the first place, what is produced is produced regardless of any outside consideration; and the rule should be that after castings are cleaned, carefully inspected, passed and shipped, they form a part of the production and are subject to no deductions whatever for returns from the outside. In proof of this, let us assume that in a given period, 500,000 pounds or 250 tons of castings have been produced by the foundry, costing $12,500, and that the customers in the same period have returned 50,000 pounds of defective castings, which have been billed back at a price of $50.00 per ton, or $1,250. Assuming that the market value of scrap is $15 per ton, these returned castings are worth $375 to the foundry, leaving a balance of $875, which the foundry must absorb. If we *increase* the cost and *decrease* the tonnage, the cost per ton is greater (on account of the decreased divisor) than it would be if we simply increased the cost and allowed the tonnage to remain as it stood.

The following figures will clearly show just what is meant:

A—Production reduced by returns:			
Cost of 250 tons		$12,500	
Cost of returns:			
Price	$1,250		
Scrap	375		
To expense		875	
Total cost		$13,375	
Cost per ton of the 225 tons (250 — 25)			$59.44
B—Production not affected by returns:			
Cost of the 250 tons		$12,500	
Cost of returns (see above)		875	
Total cost		$13,375	
Cost per ton of the 250 tons			53.50
Difference in cost per ton			$5.94

It is evident that if method "A" is incorrect but in use, the results are certainly going to be misleading, for no foundryman wants to use a cost of $59.44 in estimating if $53.50 is the correct figure. Assume that in the period during which 250 tons are produced no sales are made. The castings are piled in the storeroom ready for delivery, when along comes the 25 tons of defective castings, and, as a result, we proceed to adjust our figures so as to read 225 tons produced at a cost of $13,375, or $59.44 per ton. Should we decide to take an inventory on the first of the succeeding period, we should find that we had 250 tons of castings on hand. Our book, however, would show 225 tons of castings, and as their value, according to the accounting, is $59.44 per ton, we would naturally have to inventory 225 tons of castings at $59.44 per ton, making $13,375, and haul in 25 tons of castings from nowhere, at no value whatever—decidedly what the foundryman would not do. If, however, he inventoried 250 tons of castings at the rate $59.44, *the valuation would be $14,860, or $1,485 more than the production cost*—which would still be incorrect. If he had charged *25 tons of scrap* to the scrap account at $375, and $875 to his current producing cost and *left his production alone,* his result would be 250 tons at $53.50 per ton, making a valuation of $13,375. In case the practice in any particular foundry is to reduce current production figures by defectives returned, it should be discontinued as the above discussion should show its incorrectness.

Working Conditions.—The next consideration is the conditions under which the work in a foundry is usually made, which, as every foundryman will be able to appreciate, directly influence cost of production. A job may be made in an iron flask or in a wood flask that may have seen better days; it may be made in a flask of suitable size, or a flask may be used considerably larger than the work calls for. The pattern may be a mere skeleton which must be built up by the moulder before he can commence his moulding, or it may be a regular pattern, doing away with this extra work, or the pattern may be in the form of a sweep. One piece may be made in the flask, although it is just as likely that several pieces will be made in the same flask. The flask may consist of a cope and drag, or the drag may be dispensed with and the work made in a pit with a cope, or perhaps the cope and drag are both dispensed with and the work is made in a pit with loam plates for a covering, while for certain work we may see flasks consisting of drag, check, and cope. It may be that on certain occasions work is made on moulding machines, but because of congestion at the machines, is made on other occasions by hand. The work may be bedded in a pit or in a drag, or it may be rolled as when copes and drags are used. One time the work may be made in green sand, another time the decision will be to skin-dry the mould, or perhaps the order will be to make a dry-sand mould. Loam and sweep work also enters into the consideration as regards cost.

From the above it can easily be seen how difficult it is to comprehend what a cost really means, unless some information as regards the working conditions is at hand; for in a shop of any size, having quite a variety of work, it is safe to gamble dollars to pennies that, after a period of a few weeks, no one can tell with any degree of positiveness exactly how the work was made or what really caused certain fluctuations in cost. To get this feature down to a basis that will admit of the working conditions being an open book at all times, the following classification can be used to advantage in correctly defining how a piece of work was made—the prefixed letters being the designating symbols of the various conditions:

METHOD OF MOULDING—

G—Green Sand.
S—Skin Dry.
D—Dry Sand.
L—Loam.

KIND OF MOULDING—

B—Bedded.
S—Swept.
R—Rolled.

HOW MADE—

M—Machine.
H—Hand.

RIGGING—

C—Cope only.
DC—Drag and Cope.
DCC—Drag, Check and Cope.
LP—Loam Plates.

PATTERN—

R—Regular.
SK—Skeleton.
S—Sweep.
..—Patterns to Gate. (Use correct numeral.)

FLASK—

M—Metal.

W—Wood.

..—Size. (List dimensions.)

If, for instance, a mould was made in dry sand; was rolled; made by hand; a cope and drag used; the work made from a regular pattern, two patterns to the gate; in an iron flask 5 feet by 3 feet by 2 feet 6 inches in size, the symbol would read:

DRH—DC—R2—M, 5×3×2-6,

which would give any one investigating the record a year from the time it was made, the exact facts in the case.

DELAYS.—Another feature which has never received a fraction of the attention it is entitled to is the matter of delays in the foundry, which are usually buried so deep in the cost figures as to be beyond all possibility of uncovering. Because of this, I am of the firm opinion that the usual foundry accounting data cannot be anything else than inefficient, because of the lack of clear and intelligible comparative evidence.

A moulder gets a job, we will say, and it takes him 24 hours to make it. According to current practice, the moulding cost is $9.60, if the man receives 40 cents per hour.

Is this the correct cost? A moulder is hired *to make moulds*—not hired to do a great many things that he is oftentimes forced to do, which in nearly every instance net the company absolutely nothing. If then in the 24 hours just mentioned, the moulder in question had lost any time for causes over which he had no control—causes which careful management could no doubt eliminate, *then the facts with their reasons should be properly recorded and classified,* for it is fair to neither the work nor the job to tax it with what Mr. Emerson so aptly styles "preventable waste."

A point which seems curiously difficult to bring to the understanding of managers accustomed only to "old-line methods" is that a large part of the gain obtained by efficiency methods comes from the elimination of these wastes. The skeptic as to "scientific management" has before his mind only the conception of driving men to higher physical exertion. Efficiency methods, by reducing needless wear and friction, make the workman's task lighter instead of heavier. Actual acceleration of the workman's motion is the smallest part of the whole plan. Stimulative wage systems are the final step, and the least important as to exact method in detail. Let us assume that the following is a time analysis of the job in question:

Number of Operation.	Operation.	Elapsed Time. Hrs.	Min.	
1	Getting sand in condition to start work	..	40	(*)
2	Waiting on bottom board and drag	..	15	(*)
3	Waiting on pattern	..	25	(*)
4	Placing bottom board and pattern	..	15	
5	Placing drag	..	10	
6	Ramming the drag	3	30	
7	Waiting on crane to roll drag...	..	25	(*)
8	Rolling drag over	..	10	
9	Making joint	..	30	
10	Placing cope section of pattern..	..	10	
11	Waiting for cope	..	20	(*)
12	Carpenters barring and chucking cope to suit the pattern......	1	25	(*)
13	Placing cope	..	15	
14	Setting gaggers	1	00	
15	Ramming cope	4	00	
16	Waiting on crane to lift off cope.	1	00	(*)
17	Lifting off cope	..	20	
18	Drawing pattern drag side	..	30	
19	Drawing pattern cope side	..	40	
20	Finishing drag	2	00	
21	Finishing cope	2	30	
22	Waiting on cores	..	30	(*)
23	Coring up mould	2	10	
24	Closing mould	..	20	
25	Clamping and weighting	..	30	
	Total elapsed time on mould..	24	00	

A study of this analysis reveals the fact that on starting the job in the morning the moulder had to spend 40 minutes in cutting over his sand and getting it in condition for using. It then develops that he loses 15 minutes waiting for the laboring gang to bring his bottom board and drag, after which, because of some delay in the pattern shop, he is made to wait 25 minutes for his pattern. He then starts work and all goes well until he is ready to roll over his drag, when he is forced to wait 25 minutes on account of the crane being in use elsewhere. After he rolls the drag and makes the joint, the next delay is 20 minutes, waiting for the cope to be brought to his floor. It is then found necessary to reset and chuck the bars of the cope, so that it will suit the pattern that is being made, this taking 1 hour 25 minutes. He then works for 5 hours 15 minutes, placing his cope, setting the gaggers and ramming, and when ready to lift off, so as to begin the finishing of the mould, finds that the crane is in use by some of the other moulders and that before he gets it one hour has elapsed. Things go along nicely until he is ready to core up, but because of the cores being not quite ready, he is forced to wait 40 minutes. Listing these delays and their length in minutes, we have:

	Hrs.	Min.
Operation No. 1—Getting sand in condition to start work	..	40
Operation No. 2—Waiting on bottom board and drag	..	15
Operation No. 3—Waiting on pattern...	..	25
Operation No. 7—Waiting on crane to roll drag	..	25
Operation No. 11—Waiting for cope	..	20
Operation No. 12—Barring and chucking cope	1	25
Operation No. 16—Waiting on crane to lift off cope	1	00
Operation No. 22—Waiting on cores	..	30
	—	—
Total time in delays	5	00

As a result we find that in the 24 hours the moulder spent only 19 hours on work that can rightly be classed as "moulding," and 5 hours in delays—a clear waste, or at least the greater part of it. Assuming that in the 19 hours the man worked he did all that could be asked of him, then the ratio between the total elapsed time and the actual moulding time of 19 hours, is 78.5 per cent, consequently the loss or inefficiency of 5 hours is 21.5 per cent. If, however, the job had been standardized as a 15-hour job, then the efficiency would be but 62.5 per cent and the inefficiency of 37.5 per cent divided as follows:

Fault of the moulder	16.0 per cent.
Fault of the management	21.5 per cent.

If, however, the cost of the work is compiled on the basis of the 24 hours (as it no doubt would be) and is noticed on account of the length of time that was taken, we are virtually charging the inefficiency to the moulder, for after the costs are compiled, *who in the place knows anything at all about the delays on this particular job?* The result is that the management attaches absolutely no blame to itself; the inefficiencies are lost sight of and the cost record filed away after the customary—"don't let it happen again." A statement of this kind, in the absence of pointing out any specific happening whose recurrence it is expected to avoid, is like asking a child to pick up something it did not drop.

Men should be encouraged to report delays that are preventable or for which they are not to blame, in order that they may be properly classified so as to *force action* in the direction of bettering conditions to eliminate the majority of delays that are usually met with in the foundry, which can be eliminated if the proposition is approached in the right spirit.

PRODUCTIVITY.—It is essential in any undertaking to know as much as possible about what is being accomplished, but it is equally important to have this knowledge condensed in as brief a form as will correctly convey the desired information. In the foundry business we deal to quite an extent with *weight,* and because of this fact the tendency has been, and is now, to indulge in too much consideration of "tonnage." Tons, tons, and more tons is the eternal cry; consequently, who can blame the usual shop management because it suffers from "failing memory" as regards *light stuff* which cuts such a small figure in increasing tonnage; because it crowds work oftentimes regardless of cost; because it puts five or six men ramming a cope, in order to get the job out with a rush, when two men or three at the outside could work to decidedly better advantage? Not the management, but the wrong ideal set before the management, is to blame for these things.

Many an executive is perfectly satisfied when his statement shows a high tonnage, for the reason that it is usually accompanied by a low relative cost, and, as a result, it is considered that the attainment is up to the mark. It may sound very, very strange, but *it is this one feeling of satisfaction over high tonnage that has proven such a stumbling block in the way of attaining the highest efficiency in the foundry.* A large tonnage *because it is large* is in itself a direct factor in bringing about a reduction in cost, oftentimes regardless of any other consideration, and because of this fact it is a very easy matter for inefficiencies to be lost sight of. Men may be working to disadvantage; the planning of the work may not be all that it should be; materials may be used recklessly; rigging may be used without much regard to its adaptability to the work; and yet "when the returns are all in," a high tonnage at a low cost overshadows the defects in the existing scheme of things. Reflection should show that it is possible for an inefficient shop to do a business at a profit so long as its tonnage can be kept above a certain figure, but once let it drop below the balancing point and an investigation of the inefficiencies is immediately in order. The trouble is that there is too much consideration given to figures in the aggregate—the final results; and, as was pointed out in a preceding chapter, the usual study of things begins at the wrong end—the top instead of the bottom.

To reverse the usual order of things, to be in possession of knowledge in condensed form, that will show how things are progressing, it is necessary to decide upon some unit that will convey more meaning than is usually conveyed by the final tonnage and cost statements. The law of cause and effect may help us. Production is the result of the work of the men who make it. Why not hitch the two elements together—the production *in pounds* and the work of the men *in time,* calling the ratio that it is thus possible to ascertain, *productivity*—which would mean the relative amount produced in a given time? This would seem a logical unit for two reasons:

1—Because the amount that a man produces in a given time is the basic factor determining the cost of what he produces.

2—Because it furnishes a unit of comparison as regards accomplishment.

The importance of the first reason will be appreciated upon consideration of the example given on the following page:

EXAMPLE SHOWING INFLUENCE OF PRODUCTIVITY ON COST

Case	A.	B.
Weight of casting	250 lb.	250 lb.
Produced in given time (ten hours)	1,000 "	1,500 "
Labor rate per hour........	$0.30	$0.30
Cost of the total amount produced in the ten hours....	3.00	3.00
Cost of the total amount produced per 100 lb.........	.30	.20
Cost of the 250-lb. casting then becomes	.75	.50

NOTE.—For a further discussion of productivity see chapter 13, on "The Importance of Correct Burden Apportionment."

As regards the second reason. Assuming the casting in cases A and B to be from the same pattern, it is evident that in the same length of time, the production at B was increased 50 per cent over that shown at A, consequently the man who made the six castings is a better workman than the one who made the four castings; or, if the same man made the work, his productivity was better in one instance than in the other. Our unit of productivity takes into account the importance of both 1 and 2, whether the test is applied to a single casting, a group of castings, a division of the production, or the total amount produced.

The unit can best be expressed in terms of *pounds produced daily* and the rule would be:

M = Hours of moulding.
W = Weight of casting in pounds.
H = Hours to the working day.
P = Productivity.

$$\frac{W}{M} \times H = P.$$

Some attempt has been made in a number of foundries to use this unit in getting at facts concerning production, but it has been found that a decided difference of opinion exists concerning the elements making up the unit. The time element has been found in certain cases to be:

1—The hours of moulders *only*, disregarding special laborers working as moulders, apprentices, and laborers directly assisting the moulders.

2—The hours of moulders, special laborers working as moulders, apprentices, and laborers directly assisting moulders.

3—The hours of moulders, special laborers and apprentices (laborers not included).

4—The hours of moulders and coremakers because their time is considered a part of Direct Labor.

It naturally follows that each one of the four elements, if used, will give different results. One foundryman using No. 1 will tell another who may be using No. 4 that he is producing 1,000 pounds per man per day, and the second will say that he is getting 800 pounds per man per day. Both may be producing about the same amount, but the difference in the element used seems to make the practice of one foundryman much better than that of the other. If consideration is given to No. 1, it will be found that the relative expression of productivity is not absolutely correct; for, while the moulders may be producing a certain amount, others have assisted the moulders to a greater or less degree in turning out the production, and the time of this assistance is as much a part of the producing time as that of the moulders themselves. As for No. 4, it will be apparent upon consideration that coremakers do not influence production as far as the core labor is concerned. The core setting by the moulders is, of course, a part of the producing time, the result of which is castings. Core labor, however, produces nothing of a tangible nature, and, as the aim of our unit is to get at the relation between what is produced and the time in which it is produced, it seems reasonable to exclude the time of coremakers from our consideration of productivity. This leaves No. 2 and No. 3, either of which can be used, depending upon the policy in any certain shop, the procedure being as follows:

1—If the policy is to assign a laborer as a regular assistant to the moulder, then the time element should include the time of the laborer.

2—If, however, the gang of laborers is a floating body, their time can be left out of the consideration.

It may be well to state in connection, that while the terms *productivity* and *efficiency* are in a sense synonymous, the above remarks on productivity must not be construed as meaning that considerations of efficiency are to be relegated to the rear. Efficiency, as was pointed out in a preceding chapter, is the ratio existing between the estimated or possible performance and the actual attainment. A standard producing time against the actual producing time; the possible production against the actual weight produced, will give the relative degree of efficiency as to time or weight. The productivity ratio, however, considers *actual attainments only,* and merges two *different* elements—production and time—instead of the same elements, so while there may seem a sameness in the terms, there is, after all, a difference in the two units of comparison.

AVERAGE WEIGHT OF CASTINGS.—Another unit which can be used to advantage takes consideration of the average weight of what is produced in a given period, and this can be employed with special reference to productivity. We sometimes hear that the reason for a high cost of production is the light work made, or if the cost is a low one, heavy work is given as the reason. The following rule will therefore give some information which may prove of value:

W = Weight of the castings produced (in total or by classes).
N = The number of pieces made.
A = The average weight per piece.

$$\frac{W}{N} = A$$

It is a good thing to know that in a certain period of time the productivity was 800 pounds per man per day, while in another it was 1,000 pounds per man per day, but if it was found that in the first period the average weight of the castings was 800 pounds and in the second period 500 pounds, our information, which would naturally include a knowledge of the class of the work made, would be much more complete.

Classification of Production.—A general policy of classifying production should be adopted, as outlined in the concluding chapter—"Cost Apportionment in Various Classes of Foundries." To each one of the classes, a symbol should be given for use in charging and identifying them. I doubt very much if it is advisable, except in extreme cases, to classify according to the individual pattern, as this makes the costing altogether too elaborate and cumbersome, but I do believe in classifying by main classes having a limited number of subdivisions, with a proper provision for getting the production cost of any particular patterns if desired.

Chapter XI

EFFICIENT DISPATCHING IN THE FOUNDRY

PARADOXICAL as it may seem, many apparently unimportant things are found in the end to be vastly important. Under the heading, "delays," in the preceding chapter, it was found that the waste of five hours of the twenty-four spent on the job in question was due to causes most of which could have been eliminated. No one would accuse the management of this shop of deliberately forcing the five hours of waste time on the moulder who made the work. If not the result of deliberation, the waste must have resulted from carelessness, faulty conditions, or other reasons. It seems certain it could not have been considered of the utmost importance, or steps would have been taken which would have resulted in the wasted hours *not appearing in the list.*

What, then, was the trouble? It can no doubt be said for this particular shop management that it was probably doing the best it could to run things economically, according to the generally accepted conception of what constitutes the best one can do; it was probably holding its own with other foundries in turning out castings of good quality in point of material and workmanship; it was no doubt ambitious to get castings made as quickly as possible; it probably felt a "fall down" as keenly as you or I would feel it; it no doubt possessed as good a technical knowledge of the foundry business as would be found in other shops. Yet, in spite of all this, the illustration cited shows very forcibly that something must have been decidedly wrong—something that would justify a careful analysis as to underlying causes, with an outline of a more efficient procedure—the purpose of this paper.

Did you ever see a bird, in its search for twigs, straw and the like? Hunting these things for fun? Hardly. It is simply planning ahead against the time when a warm, comfortable nest will be wanted for the little ones to come. It does not wait until they have arrived—the bird sees to it that the nest is ready before it will be needed, and, as a result, we call it a wise bird.

Watch a sprinter. He does not depend altogether upon his speed to carry him over the course. His whole aim is centered on the *start*—the dash at the crack of pistol. Even to the long-distance runner the start is of moment—he thinks ahead. Would he run his head off at the beginning? Not if he knew the racing game as an expert knows it. His start would consider conserving his energies for the contest before him. He would even let others pass him, secure in the belief that the finish would take care of itself if the start was one that did not make too many inroads upon his vitality before he got his "second wind."

These illustrations point out a lesson worthy of attention, for they show conclusively the importance of the prepared state—*the value of the start.* Results, whether in life or in business, depend largely upon this start, and because this is so, *industrial endeavor has suffered much from failing to give proper attention to a definite plan of procedure.*

This, then, is a cause of the trouble that we started to find. If the work had been made to submit to a definite plan of procedure, the start would have received its share of attention—as much attention as the work itself, if not more. Not only is this general neglect of the start largely to blame for inefficiency, but the spirit of things is usually impulsive rather than methodical. "Get the thing done," is the order, and the procedure becomes one of a rush, hustle, tear-things-to-pieces kind, in a mad effort to obey orders, regardless of whether or not these orders could have been obeyed to better advantage some other way.

As a test, it would be well to try the following: In the first place, size up the situation generally as regards work under way, orders ahead, etc., and after the noon hour, call in the shop foreman, the core-room foreman, the flask boss, the flask carpenter, the man in charge of the pattern storage, the labor boss, and the pattern-shop foreman. In a general way tell them that the purpose of the meeting is to line up the procedure for the next day and perhaps the day following, and that each one will be expected to outline his share of the work. Be prepared to list the procedure as it is outlined. Have before you a list of the moulders, and begin by asking the shop foreman what he proposes giving each of his men on the list, for next day. Also inquire what they will start on after the work just mentioned has been made. Ask the foreman for his ideas as to the time the jobs mentioned will probably take. If two jobs are not sufficient for the day, get him to assign enough work to cover the man's time fully.

Now get your core-room foreman to advise you what cores he has made or is going to make for the next day's work. Ascertain if the pattern-storage man can tell you what patterns he has laid out or is going to lay out for the work on the following day, and then quietly ask the labor boss what rigging in the way of flasks, plates, etc., he is planning to bring in for the work to be made in the next few days. See if the flask boss can tell you what he is doing towards getting flasks ready for the next day's work, and then ask the flask carpenter what flasks he is working on, or what he expects to work on to accommodate the new work coming in. Find out what patterns the pattern-shop foreman is getting ready for the shop. Other questions will suggest themselves as you go along, which you can put to those interested.

After each one has had an opportunity to outline his share of the procedure, dismiss the meeting and study carefully what you have before you. Also arrange on the following day to check up the shop operations to see how closely the outline of the preceding day is being lived up to by each one interested. Note the waits, delays, changes in plans, etc. If the results prove surprising, both in the meeting and the procedure on the day following; if you find that the "all pull together" spirit is conspicuous by its absence; that the actual carrying out of the work comes as close to schedule as a train in a winter blizzard; if you find that the meeting which started with broad grins ends in bewilderment and confusion and that there was considerable guess-work about the whole thing, *it is safe to conclude that the value of the result depends upon the efficiency of the start.*

A train leaves New York at eight o'clock in the morning and is due in Buffalo at five o'clock in the afternoon, stopping at Albany, Utica, Syracuse and Rochester. From the time preceding its leaving New York until it arrives in Buffalo, the train is carefully watched, its leaving time at each point being wired ahead, orders being issued at each stop for the next lap of the journey. Does the engineer or conductor worry about the arrival in Buffalo? Hardly. Their chief concern is the trip from New York to Albany; Albany to Utica; Utica to Syracuse, to Rochester, to Buffalo. If engines are to be changed at Albany, the engine is ready when the train pulls in. If a slower train is ahead of the fast one, at a certain place, *known in advance,* it is side-tracked to allow the fast one to pass. In case a dining-car is to be attached at Utica, it is a safe bet that the diner will be added to the train as soon as the stop is made. If the crew is supposed to change at Rochester, it will be found that the new crew is on hand and waiting for the train—something would happen if they were not. The train arrives in Buffalo on schedule time, according to plan mapped out in New York before the train left, and lived up to all along the line—a smooth, harmonious working arrangement, known in railroad circles as "dispatching"—the theory of which is, *no train is ready until everything is or will be ready for the train.* Why not, therefore, apply the same theory to the foundry business and dispatch jobs in the same manner as a railroad dispatches its trains?

In order to get all that is possible out of the foundry, we must get away from the theory that making a piece of work depends altogether upon the moulder, for the moulder in the broadest sense *is only a medium*—the factor between (A), what he is given to work with, (B), the conditions under which he works, and the finished casting, from which we can readily understand why A and B should receive careful consideration in their relation to proper dispatching of work—more attention than is usually given them.

As to A—the articles a moulder is given to work with—they can be classified as shown on the opposite page.

Concerning B—the conditions under which a moulder works—it is obvious that he can work efficiently only when he can use, to the best advantage, the items listed at A, so *it is distinctly up to the shop management* to see to it that the men are not held up because of faulty conditions. They must be made right. As an example of what I mean: A moulder (now a shop foreman) had been hired, and, coming from another city, he started in the next morning. He was given a piece of work to make, and from 11 to 12 o'clock he was hunting up gaggers for his mould; not finding any, he looked up his fore-

Classification of Articles with Which the Moulder Works

- 1—Those subject to changes (equipment and rigging).
  - Patterns
  - Sweeps
  - Flasks
  - Loam plates
  - Lifting plates or rings
  - Spindles
  - Arbors
  - Cores
- 2—Those subject to little or no change.
  - A—Facilities
    - Sand
      - Facing
      - Heap
      - Parting
    - Risers
    - Nails
    - Gaggers
    - Rods
    - Chaplets
    - Blacking or wash
    - Clamps
    - Wedges
    - Chains and rolling devices
  - B—Tools
    - Rammers
    - Hammers
    - Shovels
    - Finishing tools
    - Torches and wicking
    - Hooks
    - Wood screws
    - Brushes and swabs

man and advised him as to his fruitless search. The foreman asked the moulder if he thought he had any tucked away in one of his vest pockets, to which the moulder replied—"no, and I didn't bring any in my grip, either." After the noon hour, the moulder quit, and the foreman was at a loss to understand why. The moulder was quick to see that he would be working at a disadvantage if the foreman evinced no greater concern than his remark indicated, and the foreman violated two of Mr. Emerson's twelve principles of efficiency—common sense and the fair deal—first, in making the speech he did, and second, in not seeing to it that the gaggers were quickly found and promptly supplied the moulder.

The conditions under which a moulder works we may classify in a general way as follows:

1—Foundry orders—knowledge of and their following up.

2—Storage and handling of materials, supplies, etc.

3—Selection of patterns, sweeps and core boxes.

4—Repairing and altering the above.

5—Selection of flasks.

6—Repairing and altering the above.

7—Flask storage, piling, etc.

8—Removal of castings, gaggers, rods, etc., from the sand.

9—Tempering of moulding sand for use by moulders.

10—Mixing of facing sand.

11—Shop carrying arrangements with reference to the equipment and rigging listed at A1.

12—Supplying the moulders with facilities listed at A2A.

13—Furnishing the moulder with proper tools by list A2B.

14—Crane facilities.

15—Arrangements affecting the general shop labor.

Foundry dispatching is made up of three principal elements:

1—The parties concerned.

2—The planning.

3—Execution according to the plans.

And if proper attention is given to them, faulty conditions will cease to exist, for their assumption is—*no job is ready until everything is OR WILL BE ready for the job.*

The persons concerned are:

1—The foundry foreman.
2—His assistant.
3—The core-room foreman.
4—The pattern-shop foreman.
5—The man in charge of the pattern storage.
6—The man in charge of the flasks.
7—The flask carpenter.
8—The labor boss.

The element planning is made up of six principal considerations:

1—*What* is to be made } Selection
2—*Who* it is to be made by } Selection
3—*Where* it is to be made—Location
4—*When* it is to be made—Time
5—*How* it is to be made } Procedure
6—*With what* it is to be made } Procedure

while *execution* is made up of:

1—Knowledge of the plans made.
2—Preparations for carrying them out.
3—Carrying out the plans as per schedule.

Now that the articles used have been classified, the general shop conditions outlined, and dispatching defined as regards elements and considerations, the task of next importance is to harness the three together so as to make an efficient working arrangement. To this end we must give some consideration to that which is really our starting point —*the order,* both as regards its *availability* and *the promise to ship.* Right here is where nearly every foundry experiences trouble—some occasionally, others nearly all the time —because not enough attention is given to the availability of the work and promises are made before all the facts are known.

What must be considered in order to pass upon the availability of a piece of work? An order must pass the following test:

1—Are the patterns and core boxes as per order?

2—Are they ready for delivery into the foundry?

3—Are there flasks to accommodate the work?

4—If not, will they have to be made, or can other flasks be altered to suit, and if so, what work will be necessary?

5—What will the job take in the way of rigging?

6—Is the rigging on hand ready for use, or will it have to be made? If it will have to be made, what will be necessary?

7—Will anything be necessary in the way

of specials, as for instance rods, gaggers, clamps, etc.?

8—How long will it take to get the job prepared as above?

Until an order can pass this test, it should be classified as *not available,* and every one so advised, and under *no consideration, except that of the most extreme urgency, should such a job be started.* A rule of this kind will work wonders in any foundry.

After the matter of availability has been passed upon, the next thing to consider is—the promise—a point about which a book could be written. Orders are either accompanied by a request to make shipment at a certain time or are marked "rush," "as soon as possible," "at once," or perhaps the making of the work is left altogether to the shop management. Promises are usually required in all instances, and if not they should be made and recorded just the same as if they were required, so that there will be some information on hand should the shop be asked a little later to furnish some idea as regards shipment. After promises have been made, it is not a difficult task to keep such track of them as will result in an excellent knowledge of anticipated delivery dates. One thing should be remembered, however—*promises should never be made before the availability of the work has been passed upon.* Such promises are never dependable, and the time and energy in making them is usually wasted—as a great many know.

An efficient order arrangement that will give proper consideration to the two features (availability and the promise) must therefore be so arranged as—

1—To admit of a quick and ready reference to the various items called for.

2—To show availability or non-availability, *at a glance.*

3—To show anticipated delivery dates.

4—To notify the pattern storage what is wanted in the way of patterns, sweeps and core boxes.

5—To enable pattern storage to promptly notify foundry as to the condition of the items called for.

6—To have the patterns, sweeps and core boxes laid out by the pattern storage in a space necessary to allow those who are responsible for the planning to get at them easily.

7—To show the reasons why the work is not available.

8—To have a provision for checking the work as the following items become ready:

A—patterns and core boxes; B—flasks; C—rigging.

It is evident from the above that we are now in possession of three valuable items of information:

1—We know what is *not* available, and *why*.

2—We know when work becomes available.

3—We know when work is wanted, or the promised date.

This knowledge serves as a valuable aid in keeping after the jobs not available and selecting what should be made—a condition of affairs much to be desired, as every one conducting foundries can well appreciate. If every foundryman was in possession of the above information, what a saving there would be in time that is now wasted because the patterns are not ready, or cores are not made, or flasks are not in shape, or rigging is not in, and many other causes which result in loss of time that nets the company absolutely no return for the amount invested.

With our knowledge of what is available and what is to take preference, we can commence the task of getting the work under way according to the following general outline:

1—The work should be in charge of a committee, comprising the foundry foreman, his assistant, the core-room foreman, the flask and labor bosses.

2—The work should be undertaken as early in the day as possible, so as to allow ample time to get in readiness whatever may be needed to start the jobs off properly.

3—The work being made in the shop and the men engaged on it should be carefully sized up.

4—A means should be provided for listing the work as planned.

5—In selecting the work, the six considerations under the element *planning* should be brought into play.

6—If more than one job is selected for a man, attention should be given to the order in which they are to be made, as in this way it will be known what work to get ready first.

7—The core-room foreman should note carefully the selections, so he may have the important core boxes sent in first.

8—The flask boss should note what flasks will be necessary for the various jobs that are planned.

9—The labor boss should note what rigging will be necessary, so that he can get at work as soon as the planning is over with.

10—A means should be provided for marking the patterns with the names of the men who are to make them.

11—The pattern-storage man should set apart from the patterns available such as have been scheduled for making.

With the above consideration given to the planning, we can next consider the third element of dispatching—*execution.* As was previously pointed out, this is made up of three steps—knowledge of the plans made, the preparation for carrying them out, and carrying out the plans as per schedule.

Knowledge of the Plans Made.—Any plan for betterment, in order to be productive of results, must take into consideration the importance of a general understanding of things. Several persons may be involved, and unless the relation to each of the whole scheme of things is clearly outlined, there is certainly going to be confusion, the same as there would be confusion on a railroad (or even worse, a serious wreck), if there existed any doubt as to a correct understanding of the orders that may have been issued. With this in mind, the idea of presenting the plans made to those interested, in some convenient form for reference purposes, is therefore self-suggestive. This should be done as soon after the work of planning as possible, in order to give those concerned the schedule of work so that they will have plenty of time in which to give proper consideration to the next step.

Preparations for Carrying Out the Plans.—An analysis of this will show that it divides into the following:

1—The patterns.

2—The cores to be made.

3—The flasks to be located, repaired or changed.

4—The rigging to be brought in and the necessary changes made.

5—Special features looked into; for instance, special gaggers, rods, clamps.

6—Changes in conditions to facilitate the particular work coming in.

7—The work at night.

Patterns. — Small patterns should be brought into the foundry on the afternoon previous to making and placed in racks for the men. Large patterns should be brought in toward night and be arranged in some convenient place from which point they can be easily handled.

Cores.—As soon as possible after the planning, the core-room foreman should see to it that the most important core boxes are sent in so that his force can begin on them without delay. As soon as he gets his schedule showing the planning in detail, he can have the rest of the boxes brought in and the cores made in the order in which they are scheduled to be used.

Flasks.—The man in charge of the flasks should ascertain what is necessary to take care of the work coming in. Flask parts that may have been previously made should be assembled; those needing chucking or changes in the barring should be promptly attended to, the necessary patterns to be taken from the pattern storage for this purpose. If repairs are needed they should be made at once.

Rigging.—Rigging in the way of plates, rings, arbors, etc., should be brought in and the necessary changes made so that they will be available when wanted. Only in very rare instances should a moulder have to wait until an arbor or a ring is looked up and brought into the shop.

Special Features.—If special gaggers, rods, or clamps will be needed, they should be made on the day previous so as to be in readiness when wanted.

Conditions.—Changes in conditions should not be slighted. A job may take a special mix of sand; a pit may have to be dug; a large amount of heap sand may be needed; brick may be used, or something else possibly varying from the ordinary method of procedure may have to be done, and the time to do it is certainly not when the moulder is at work.

Night Work.—The man in charge of the night force should be informed as to his share of the work necessary to carry out the procedure as scheduled. Castings should be shaken out and taken to the cleaning floor; gaggers removed from the sand heap and placed on the back end of the floors; sand tempered and put in condition for use by the moulders in the morning, and the flasks not needed by the men taken from their floors. Pits should then be dug, according to the sizes needed for the work to be made in them.

At any rate, a proper knowledge of the plans, plus careful preparations, will assist materially in getting everything in readiness. There is no excuse, except, perhaps, in the case of breakdown jobs, for work to be held up because something has been overlooked. Wise planning will see further than the day following—it will look two or even three days ahead so that if a flask has to be made or rigging planned, the work can be begun a day or two previous to scheduling the jobs.

Carrying Out the Plans as per Schedule.—This is a subject of vast importance. Planning in itself may be careful and thorough; preparations to carry plans out may be up to standard, but unless the actual procedure is one which does things according to the schedule, the results will not be forthcoming.

In the first place, the first hour or so in the morning is really the most important time in the day. There are a lot of men to be attended to; flasks, patterns and rigging must be distributed, and it cannot all be done at once or to advantage unless there is some organized arrangement. The following plan, therefore, seems to fit:

1—The night force, after the regular night work as outlined is done, should (according to the schedule furnished the night foreman) place on the moulders' floors the large flasks that are to be used, in which should be placed the large patterns. If pits are to be used, the patterns should be placed near them. This will lighten the work of the cranes to quite a degree.

2—About a half-hour before the regular starting time in the morning, the laboring force should report and distribute the smaller patterns and flasks.

3—As soon as work is begun in the morning, whatever may be necessary in the way of rigging should be taken to the floors.

4—A man should be placed in charge of the laboring men, whether they directly assist moulders or not, to whom the moulders can make known their wants and he should be held responsible for seeing to it that they get what they want as quickly as possible.

5—There should be a regular place for the supplies, etc., listed previously, and the knowledge of their location should be in possession of all concerned.

6—Facing sand (which should be mixed in advance) should be kept at each moulder's floor and replenished as necessary before (not after) the men may need some.

7—The labor foreman should keep careful watch over the needs of the men as to copes. There is no excuse for a moulder asking for his cope only to find that it is at the bottom of a pile.

8—The moulders should be kept supplied with tools and equipment and should report when they need such things. I recently saw a moulder trying to mend a mould in the dark. Some one had stolen his torch and he was afraid to mention the matter for fear of being called down for his carelessness. There is certainly no money in such a state of affairs.

9—Cores should be furnished the men in advance of their requirements. They should never be made to go for them.

10—The crane service should be watched very, very carefully. "A whole mouthful," a foundry foreman recently said when this was mentioned to him. True, but a study and ingenuity will find ways to keep the delays due to crane waits at a surprisingly low point.

11—The general shop labor should be made to *jump quickly* when moulders want things, such as gaggers, clamps, etc. The idea is to save time, and if two steps can be taken instead of one, things will be further ahead.

12—It should be a *rule* that no work is to be done by moulders or coremakers that can be done at less expense by those less skilful.

A pretty large contract this? Certainly—an ideal state of affairs—an ideal that many a foundry can come within reaching distance of, if the work is properly organized, in the hands of a hustler, and every one made to do his part. It means work, of course, but no one ever accomplished anything worth while by weak, half-hearted trying.

Why necessary? *To save time that can be utilized in turning out castings.* Do not count by the usually accepted standards—

the hours time or the wages expended per hour—but by *the pounds you can produce in every hour saved at the value per pound.* Your men are your investment on which you win or lose. Arrange it so that they can work to the best advantage, and you are assured excellent dividends in extra tonnage. They will not only like it, but will show their appreciation by exerting themselves in order to stay with such a progressive concern. You will like it, too, for after all you measure your likes and dislikes in the foundry business by the size of your bank account after you balance up. The suggested procedure will help you to increase it.

Chapter XII

HANDLING SHOP DETAILS

"BE sure you are right, then go ahead"—a bit of advice as applicable to the foundry industry as to the individual, for if the business of the foundry is to get its share of work at right prices, and make it at a figure which will net a reasonable profit, then it is essential that attention be given to—

1—A definite method of procedure.

2—Action according to the procedure outlined.

A foundryman once came at me with—"If you white-collared gentry would once get out here in the thick of things, you would soon cease your ranting about how a foundry should be run. I'm doing all the jumping around I can, but the result seems to be a slam at this and a kick at that performance." I replied that his criticism was a fair one; that knowing how he was hampered because of the conditions under which he was working, there was certainly little use of kicking without offering at the same time some good workable suggestions aimed to boost things along.

A few years ago I saw the written instructions given to the superintendent of a large concern at the time he assumed charge, and the whole proposition was nothing but generalities indicated by about 150 words. No specific instructions; no details of what he was to do or how far he was to go.

I have known good shop managers to make every effort to obey the order "maximum production in the shortest time and at the lowest cost"—who were not able to carry on their work properly because of the conditions under which they were working. In other words, *quality* of work was sacrificed for *quantity*.

If a shop manager is supposed to be a mind reader, to sense out what is required of him; to be a chaser, going after this, looking up that, devoting his time to details that, while important in themselves, keep him from attending to more urgent matters—don't hold him responsible if he fails to make good—if the management knows what constitutes "making good." If, however, the idea is not merely "he is supposed to know his business," but "it is our place to tell him what his business is to be," *plus* an arrangement whereby he can devote a good share of his time to planning and scheming, studying his men, his work and his conditions, then it is a safe bet that unless he is incompetent (which would show in a very short time) he will not have to be "carpeted" many times in a year.

The effort to get away from this unfairness, this shifting of the responsibility, this hand-washing process, has led me to surround the shop manager with such assistance as will enable him to *be a manager*—not an apology for one. This means not only "the fair deal," not only better relations between man and management, but greatest of all—maximum results.

An analysis of foundry work will show that the making of castings is separable into the following elements:

A.—Receipts of orders
B.—Orders to the foundry
C.—Making—
Rigging
Cores
Moulds

D.—Casting—
  Melting
  Pouring
E.—Night work
F.—Cleaning and inspection
G.—Shipping.

Each one of these seven elements is a factor in efficient management, and must receive its share of attention. A prominent foundryman once told me that every customer was a "preferred" customer, and that it was necessary for him to be in possession of such information as would enable him to supply any of them with the details regarding their work "right off the bat." Unless he could do this, he could not convince them that he was looking after their interests. The arrangement must therefore be designed to take proper care of these elements and at the same time supply those interested with the necessary facts—not after digging into records for an hour, *but at once.*

In a general way any efficient shop method must be designed with these considerations in view: It must furnish a maximum amount of information at a minimum expenditure of time and money; it must provide the executive with a proper follow-up arrangement;

it must reflect the conditions in the shop at all times as regards both production and cost; it must be elastic in order to fit the requirements of any foundry or the wishes of the executive; it must furnish information which is on tap and in serviceable form; it must supply clear and concise records as to results daily, weekly, and monthly. In short, it must be designed to provide the executive with the means of conducting his business "to the machine-shop door" with the same care that is usually exercised "*from* the machine-shop door."

While a hard and fast rule can never be laid down for any specific case without a good knowledge of conditions, the following is an outline of a procedure which can be varied to suit requirements. If the foundryman finds it difficult to decide what he really wants, outside advice should be secured so that he will get the best arrangement for his particular business.

To start at the beginning: Upon receipt of orders from customers, the first step is their proper numbering. Each order should have a separate and distinct number for identification purposes, and in addition a number to designate the particular class of work, which can be termed "symbol numbers." Order numbers should be assigned with reference to the elements outlined in the fourth chapter, as follows:

Special work for customers	1,000-1,999
Maintenance	2,000-2,999
New Construction	3,000-3,999
Reconstruction	4,000-4,999
Expense	5,000-5,999
Commercial Production	6,000-9,999

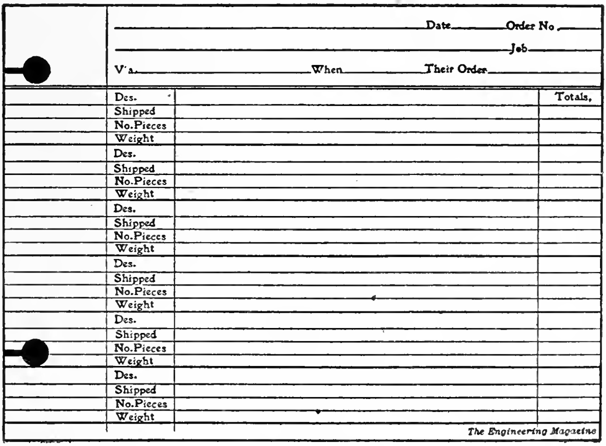
The first figure of any number shows at a glance the kind of work covered. Symbol numbers may be alphabetical and numerical for the number of times letters have been used. As an example, Smith, Jones & Company may order castings four times during the month, and we may assume the numbering to be—

Symbol—K2;
Orders—6,125, 6,210, 6,225, 6,304.

While the numbering looks complex, it has proven efficient in foundry production and cost accounting. Classification according to the symbol K2 at the end of the month will give production, time and cost of castings for Smith, Jones & Company without reference to order number or specific casting.

Sorting will give weight, time and cost by order numbers. If No. 6,125 includes twenty fly-wheels, sorting and totaling would give the information for them. In this way we have all the essentials necessary to cost of any casting or order made without having to compile it in each instance.

After the order has been properly numbered, it is obvious that the customer's order must be converted into an order which those interested can use for getting out the work. A simple and efficient form is shown in Figure 25, which should be made in triplicate


Date____ Order No.____
Job____
V'a____ When____ Their Order____

		Totals,
Des.		
Shipped		
No. Pieces		
Weight		
Des.		
Shipped		
No. Pieces		
Weight		
Des.		
Shipped		
No. Pieces		
Weight		
Des.		
Shipped		
No. Pieces		
Weight		
Des.		
Shipped		
No. Pieces		
Weight		
Des.		
Shipped		
No. Pieces		
Weight		

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FIG. 25. FORM FOR WORK ORDER.

for final delivery as follows: One copy to shop superintendent; one copy to shipping department; one copy as office record—all to be filed according to customer.

The orders are now properly numbered and issued. What is the next step? To start in and make the castings from the information as we find it, or to go a step farther and furnish the shop management with additional assistance? It is true that the foreman knows what is to be made. He could go out to the pattern house, get the pattern, and give it to a moulder. The moulder could get a flask, make the mould, and pour it. The casting could be cleaned and shipped, and the transaction would be ended. But if we multiply these performances by the number of jobs that run through the foundry during the course of a day, we should find a most unscientific state of affairs, due to the confusion that would exist. A more efficient management is therefore absolutely necessary.

The first thing to do is to provide a place from which point the details, as outlined in the chapter on "Dispatching," can be properly handled. This should be located so that it can be reached easily by the men in the shop, and it can be called the "Dispatching Office."

To get the work started properly, the copy of the order (Figure 25) intended for the shop superintendent should be sent to the dispatching office and the one for the shipper to the pattern house.

The person in charge of the pattern house should note the orders received and make out a small card for each pattern, on which is to be entered the information necessary to identify it properly, the reverse side of this card being gummed for attaching to the patterns. He should then look over his patterns, laying out such as are ready for sending into the foundry; to these should be pasted these small cards, and over them should be applied a coating of shellac, to make reading an easy matter when the patterns are in use.

If it happens, as it often does, that he has cards covering patterns that will have to be made, altered, or repaired, he should make out an "exception" report covering such work, sending this report to the dispatching office, filing the cards he holds in his office. As patterns of the kind just mentioned become ready for delivery (gummed cards for which he has on file), a report is made out which accompanies the "exception" report. So much for the pattern-shop procedure.

As the foundry is concerned with time consumed on work, production, rejections, and efficiencies, we must provide some means to link these together. To do this to advantage we must provide a card which can be used in dispatching, for costing, by the men in the shop, as an order, etc. Such a card, which can be called a "tally" card, may be arranged as shown in Figure 26. It should be written in triplicate for moulders and in duplicate for all other employees, and be handled as will be outlined later.

FOUNDRY TALLY CARD

Symbol No	Order No.	Acct. No.	Issued

No. Req'd.	DESCRIPTION
Patt No.	
Wanted	

	Standard Time			Actual Time			Cost		
Machine No.	Schedule			Quit			Men	Rate	Amount
Floor No.	No.			Started					
Pieces to Flask	St'd Time			Elapsed					
Dept.	Per -------		Men	Allow					
Cast	Total St'd Time			Total Act. Time					
Not Cast									

PRODUCTION		INSPECTION		SHIPMENT
No. To Do	Balance	Good	Bad	Shipped
				Via
Finished -------	To be Replaced	Weight	Weight	Billed

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FIG. 26. FOUNDRY TALLY CARD.

In connection there are three things which should be carefully considered:

1—What is being made;
2—What should be made next;
3—What constitutes the work to follow and the order in which it should be made.

This suggests the idea of providing a means for properly filing these cards as they are made out. They can be filed in card files, although the best arrangement would be the use of a large board, so that everything would be in plain view.

In addition to this, the dispatching office should be provided with three card files, marked:

1—Current day;
2—Unavailable;
3—Available.

Upon receipt of orders received, as shown by the superintendent's copy sent to the dispatching office, this office should at once make out a card in triplicate for each pattern called for, filing these in the tray labeled "Current Day"; after this the copy of the order should be forwarded to the proper person. When the "exception" report comes in from the pattern house, designating the patterns that are *not* laid out, the dispatching office takes the cards from the file mentioned, sorts out the ones listed in the "exception" report and places them in the "unavailable" file, while the balance (which are ready for the foundry) are placed in the "available" file. From the auxiliary report from the pattern house, accompanying the "exception" report and covering patterns that since the date of the original order have been made, repaired or altered, the dispatching office learns which cards may be removed from the "unavailable" file and filed with the ones covering "available" work. These cards should be classified by class of work and by symbol and order number.

As work is planned and scheduled, the corresponding "tally" cards which are on file in the "available" are to be removed and properly distributed on the board mentioned, according to the schedule adopted by those responsible for the planning. We are now ready for shop operation, *up to which point everything should have been properly planned and laid out.*

When men begin work in the morning, they should report to the dispatching office for "tally" cards, which should be on the boards classified as "available work to be started next." The starting time should be entered, the triplicate copy given to the men, and the other two copies filed together as "work being made." As this is being done, the top "tally" card in triplicate of those classified as "work to follow" should be moved up to file for "available work to be started next."

As men complete their work, they are to return to the dispatching office with their triplicate copies. The corresponding copies are to be removed from the boards, the finishing time entered, the number completed, and the date; the tickets for the next job are then issued to the man and a new "tally" card is made out to cover the balance to be made shown on the card just turned in—this to be properly filed according to the planning. All cards should show account numbers as outlined in Chapter XIV. The original and duplicate of all cards turned in are to be sent to the office, while the triplicate is to be sent to the shipping department.

This department should have two files, arranged as follows:

A—For "work coming through."

B—For "castings on hand."

These are indexed by symbol numbers and sub-indexed in some cases by name of pattern, as, for instance, beds, cylinders, pulleys, etc., for customers whose work amounts to quite a little. The clerk, upon receipt of the triplicate cards covering work made, files them according to symbol number, by pattern number, by date in the file for "work coming through"—an inventory of what is going on. As received, these cards do not show entries covering number and weight of the pieces good, the pieces bad, or the cost postings.

On the day following the making of the work and after the castings have been cleaned, the inspector takes the file for "work coming through," weighs up the good castings and enters on the proper card the number and weight under "good"; these cards are placed in the front of the file.* After

* It might be well to state that the slips placed in the front of the file by the inspector include the cards covering the work rejected, for the reason that such work ceases to be "work coming through," and while not "castings on hand," should be first posted to the corresponding cards in the office and then placed in the file for "castings on hand" in order that the shipping clerk may know that the work was made, but proved defective. When the cards covering the work replacing the bad come through, those covering the bad are taken up and destroyed.

this is done, he proceeds to make out a rejection report covering the castings which do not pass inspection, marking the number rejected under "bad." These also are filed in the front of the file. The file is then returned to the shipping department.

This "rejection" report should show what is rejected; who made the work; complete information as to cause for rejection; whether the work is to be replaced or not, and whether or not the moulder who made the work is to receive credit for the rejected work.

The procedure after the inspection is as follows:

1. The "tally" cards, covering the work inspected and classed as good or bad, are sent to the office, where the entries as to inspection results are transferred to the corresponding tally cards (still kept in duplicate) as sent in from the dispatching office, after which the triplicate copies are sent back to the shipping department for proper distribution in the file for "castings on hand."

2. The "rejection" cards are sent to the one in charge of the foundry, so that he can see what was lost and why, and investigate if he desires; after which he is expected to

O. K. any credits to men for spoiled work if they were not responsible. The cards are then sent to the dispatching office.

The dispatching office, upon receipt of the rejection cards, must note the number rejected on each of the various orders, and if the orders covered have not been completed, the proper entries are to be made on "tally" cards on the boards, under the heading "to be replaced." If the order has been completed, a new card is to be made out; the pattern house is notified and the work planned in the regular way. This arrangement will enable any foundry to keep a true and accurate account of castings made and to be replaced—a point of importance, as keeping track of the number of good castings made is often a confused proposition.

When castings are ready for shipment, the corresponding slips are removed from the "castings on hand" file, marked with the date of shipments and the routing, and as soon as the shipment is made, are sent to the office, where they are then used as the authority for rendering invoices to the customers. It often happens that the shipping clerk wants to make a shipment as soon as a casting is cleaned, or a casting will be rushed from the foundry, cooled, cleaned as quickly as possible and shipped. In such cases, the shipping clerk takes the triplicate "tally" card from the "work coming through" file, enters the proper information, and sends it through the office, for noting, to the billing clerk for invoicing.

Let us consider for a moment some of the special conditions this arrangement takes care of. Assume that a casting has been started, but that it has not been completed at casting time. The card as turned in would show that no pieces were made and that nothing was cast and would be filed in the "work coming through" file, reference to which would show that the work was started but not completed. We will assume that on the day following a workman spends four hours finishing up the job, which is cast the same night. The card would be turned in properly marked, forwarded to the shipping department, and filed in front of the slip for the previous day. On the day following, when the casting is inspected and reported as good, this information would be posted to the card covering completion and sent to the office for entry, while the one covering the starting of the job, which is no longer of any use, is destroyed by the shipping clerk. Here we have a complete history of the transaction, for we have, first, knowledge that the work was started but not completed; then completed and cast but not inspected, and finally inspected, reported as good, and ready for shipment. From this it can be seen that, regardless of the time taken to make work, the shipping department will have this information on file.

Let us consider a case where a large casting is made and cast the day it was started, although it remains in the sand during the following day. The card would be filed as "work coming through," and would be taken with the others, in order to post the results of the inspection. In going through the list, the inspector finds that no such casting is on the cleaning floor. He therefore marks it with an N, denoting "not on cleaning floor," places it back in its proper place in the file, and if any reference is made to it, the card will show that it was made and cast and that the casting was not delivered from the foundry. This also applies to cases where work is made and checked as cast but not poured because of a shortage of iron.

In cases where castings which have been

reported as good (slips for which are in the "castings on hand" file) are subsequently found defective before shipment, the cards are removed, marked "scrapped," and sent to the office for charging to the scrap account for the scrap value, while the castings would either be taken to the scrap pile or the cupola.

Now as to the office procedure: After the transfer to the original and duplicate "tally" cards of the information contained on the triplicate received from the shipping department, the cards are checked against the "in" and "out" clock time cards, in order to balance the times as shown, after which they are rated and extended. The cards are then separated and the originals filed according to symbol or order numbers and classed as moulding labor, while the duplicates are sent to the efficiency department—if there happens to be such a progressive department in the scheme of things.

As the cards covering core and general labor would be sent to the office direct from the dispatching office, rated and extended and properly filed, it follows that we have the cost of all labor properly classified. At any time during the month, required infor-

PRODUCTION OF CASTINGS. Order No.________ Symbol No.________

FOR MONTH OF									
WEIGHT PRODUCED									
Metal Cost	Per 100 Lbs.			Per 100 Lbs.			Per 100 Lbs.		
Molding—Pro. Labor	Hours			Hours			Hours		
Coremaking " "									
Expense on Pro. Labor	%			%			%		
Expense on Tonnage	Per 100 Lbs.			Per 100 Lbs.			Per 100 Lbs.		
Expense for Rigging									
SHOP COST	Per 100 Lbs.			Per 100 Lbs.			Per 100 Lbs.		
Commercial Expense on Pro. Labor	%			%			%		
TOTAL COST	Per 100 Lbs.			Per 100 Lbs.			Per 100 Lbs.		
Produced per Molder per Day									
Average Pro. Labor Rate									
Weight Casting Replaced									
% " "									
Cost to Replace Castings									
	Per 100 Lbs.			Per 100 Lbs.			Per 100 Lbs.		

REMARKS:

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FIG. 27. REPORT OF CASTINGS MADE.

mation could easily be ascertained, while at the end of the month, the productive moulding time and cost and all burden costs could be determined, the necessary rates calculated and reports covering orders, castings or symbols made out as shown in Figure 27.

Let us see what the method really accomplishes:

1. It shows what is available and not available.

2. It shows what is being worked on.

3. It shows what is to be made next.

4. It acts as the means of tallying up the work of each employee each day.

5. It shows the time spent on all work done each day.

6. It transfers, automatically, the work of each employee, without regard to the number of symbols or account numbers affected.

7. It shows the work which has been started but not completed—work in process.

8. It shows the work made and cast but not inspected—work coming through.

9. It shows the work made, cast, inspected and ready for shipment—an inventory of manufactured castings on hand in balance at all times.

10. It furnishes the means for planning the work to be done.

11. It furnishes the means for planning and making shipments.

12. It furnishes the authority for invoicing shipments made.

13. It furnishes the file of castings shipped, by date of shipment.

14. It acts as the means of making up the payroll, if this is desired.

15. It shows from day to day the production and cost of all work, by castings, symbol or account.

16. It shows from day to day the amount of work to be replaced.

17. It furnishes facts as to rejections, with reasons therefor.

18. It makes every casting pass an inspection.

19. It provides the means of furnishing the executive with weekly distributions of results accomplished.

20. It forms the basis of making up monthly costs according to any classification desired—whether by pattern; customers' work; departments; light, heavy and medium work; by workmen; floors; machines; classified weights, etc.

21. It furnishes the basis for calculating efficiencies and the payment of bonus for individual effort.

In conclusion, the methods outlined enable the executive to obey the injunction—"Know where you are going, then GO."

Chapter XIII

THE IMPORTANCE OF CORRECT BURDEN APPORTIONMENT

HAVE you ever stopped to consider what is really involved in finding your costs of production, or appreciated the true significance of the word "costing"? If you are keeping costs as a means—cost reduction and increased production being the end in view—then you are (or should be) getting results. If, however, you look upon your methods as a "fad" or necessary evil, using the information at your disposal to no real purpose, you are losing the earning power of money which might be expended to advantage in other directions, and the only consistent advice is either to throw them out altogether, or begin all over again with the determination to make your methods count for something as a result producer.

We are told that "art" is *doing,* while "science" is *knowing;* and if this is correct, we can only conclude that costing as an art cannot and does not accomplish what is possible if treated as a science, which (to put it another way) is "organized knowledge" and as such must and does get down to the principles involved. The term "costing," considered in the abstract, falls far short of conveying the full meaning, and here is, perhaps, the reason why so many fail to appreciate its dormant possibilities. Let us define it as:

A science, which has for its purpose the giving to the executive of an organized knowledge of all pertinent details, that he may be in a position to plan for maximum efficiency. It demands, first of all, a search for the underlying or basic principles which affect the success or failure of the enterprise, in order to get at the *why* or reason of things. Once established, they facilitate the consideration as to *how* things should be done—the *product* or result being proportionate to the excellence of the art or *doing,* upon which depends the *application* and practical use of this product to specific ends. Every foundryman will agree with the statement that a business is conducted for profit, and that while it is one thing to dispose of something, it is quite another to dispose of it at a margin over and above total cost, knowing that you have made it and how much. The basis of the sale is what is produced, which, as far as this chapter is concerned, will be *castings.* Therefore, to find the true condition of affairs, we must determine what the profits or losses are, which cannot be done until *costs* are ascertained. It has long been taken for granted that costs could not be determined until the completion of the work, but the foundryman should have some means of knowing about what the costs are going to be *before the work is even started. And they can be known in advance through time studies, as well as standardization of operations and conditions.*

The next consideration is the elements entering into the cost of producing good castings, which can be divided into three general classes:

1—Materials { Direct or productive—A.
Indirect or non-productive—B.

2—Labor { Direct or productive—A.
Indirect or non-productive—B.

3—General Expenses.

No argument is necessary to show that if the three elements with their subdivisions could be charged to the production direct, the determination of costs would be a simple matter; but a glance at the table just shown will convince the reader that direct charging is possible in two cases only:

Direct material—1A.
Direct labor—2A.

and this fact makes it necessary for the production to absorb the other three items in some just and equitable manner to be decided upon, the sum of these three items being, in the majority of cases, a large one; so that upon the correctness with which these items are spread over or apportioned to the production, depends more than is usually conceded. In our search for principles, the matter of handling these three items properly is of the utmost importance and can be really classed as our basis or foundation.

Direct or productive materials comprise the various pig irons, scraps, fluxes, coke or coal, the total cost for any period being a *direct* charge against whatever is produced.

Indirect or non-productive materials comprise incidental stores, supplies, etc., which are used in order to facilitate the manufacture of the product; the total cost of which, although a charge against what is produced, cannot be charged direct, but must be apportioned to it.

Direct or productive labor is the money paid to those who actually produce or directly assist in producing something having a *commercial value,* which can at all times be charged direct to specific production.

Indirect or non-productive labor is the money paid to those who, while they do not actually produce or assist in producing anything of value, are necessary in order that production may be facilitated and carried on to the best of advantage; this expenditure constitutes a charge to production by apportionment, owing to the difficulty in attempting to charge to product direct.

Expense is the expenditure entering into the general administration of the business, the securing of a finished product, as well as the marketing of this product to the best of advantage, which, on account of its very nature, cannot be charged to production direct, but must be absorbed by it through apportionment.

In this discussion, the three items—

Indirect materials
Indirect labor
Expenses

will be classed as "burden"—aptly styled by one as "unseen dollars"; and as was before stated, the amount of this burden is usually a large one, so that apportionment must be as correct as possible, otherwise total costs are bound to be misleading. We can get at this matter of apportionment more easily by supposing that a month's production consisted of *one* casting, in which case the entire burden would be charged direct to it. If the production consisted of ten castings, however, each weighing the same, with the material and labor costs the same for each of the ten castings, then each would absorb one-tenth of the burden; and when the cost of the last casting was ascertained, it would be found that the entire burden had been absorbed in a just and equitable manner. If, on the other hand, we substitute, as the production, one thousand castings of different shapes and weights, with absolutely no relation existing between the cost of the direct labor or direct material, how are we going to make these castings absorb the expense item so that each casting or class of castings will be charged with an equitable amount?

If one thousand tons of good castings are produced in a certain period and the total burden for the same period is $10,000, we can make the production absorb this burden by charging $10 to each ton of castings produced—this being one method which we will term *tonnage apportionment.*

If, on the other hand, one thousand tons of castings are produced in a certain period and the direct-labor cost of producing these castings is $5,000, with a burden against this production of $10,000, we can make this production absorb this burden by adding 200 per cent to the direct-labor cost of any casting or class of castings, or $2 in expense for every $1 in direct labor—another method which we will term *direct-labor apportionment.*

It stands to reason that both methods cannot be right, although each seems to have its defenders. If one method is correct, then there is some reason *why* it is right and the other wrong, and this "why" must appeal to you, from a *dollars and cents* point of view. To present it properly, it has been deemed advisable to submit several cases, showing the difference between the two methods; and while at best figures are dry and uninteresting, a quiet hour, plus a careful study of the figures which are to follow, will make the deductions surprisingly interesting.

We will suppose that in a certain period of time your foundry produced 2,500,000 pounds of salable castings, your direct or productive pay roll (moulders and coremakers) being $15,000; the burden amounting to $22,500, and your rates for apportionment, in order to make the 2,500,000 pounds absorb the $22,500, being:

Tonnage basis—90 cents per 100 pounds.
Direct-labor basis—150 per cent.

Case No. 1—Light and Heavy Work.
Different Weight—Same Labor.

You make two castings, in this period, one being a small, complicated affair, weighing 250 pounds, which we will call a gas-engine cylinder; the other being a small flywheel, weighing 2,000 pounds, each on account of its nature requiring the entire time of a moulder for a day. Figuring material at $1 a hundred pounds for melted iron and labor at $3 per day (30 cents per hour), we have costs as shown in the table on page 276.

A study of these figures will show that in the case of the 250-pound casting, the cost B is $2.25 *higher* than cost A, while in the case of the 2,000-pound casting, cost D is $13.50 *lower* than cost C. Looking further, it will be found that cost A is $3.10 per 100 pounds, while cost B is $4 per 100 pounds, the cost B being greater than cost A by 90 cents per 100 pounds, *only* a difference of $18 per ton.

	250 lb.			2000 lb.	
Tonnage Basis.	$2.50		..Material..............	$20.00	
	3.00		..Labor (10 hours).......	3.00	
	$5.50		..Prime cost............	$23.00	
	2.25		..Burden (90c. per 100 lb.).	18.00	
		$7.75 (A)	..Total cost.............		$41.00 (C)
Labor Basis.	$5.50		..Prime cost............	$23.00	
	4.50		..Burden @ 150 per cent..	4.50	
		$10.00 (B)	..Total cost.............		27.50 (D)
		$2.25	..Difference.............		$13.50

Cost A is $3.10 per 100 lb.			Cost C is $2.05 per 100 lb.	
" B " 4.00 " " "			" D " 1.37½ " " "	
Difference .90 " " "			Difference .67½ " " "	

Cost C figures out at $2.05 per 100 pounds, with cost D at $1.37½ per 100 pounds, the latter being less than the former by 67½ cents per 100 pounds, or $13.50 per ton. As the intention of this chapter is to show that the tonnage basis of burden apportionment is incorrect, this can best be proven by showing that direct-labor apportionment is correct. In the first place, we have a small casting weighing only 250 pounds and taking the entire time of a moulder for the day, while a casting eight times as heavy was produced in the same length of time, so that the *productivity* (relative amount produced per man per day) of the latter is eight times greater for the particular case than that of the former. If, for the sake of argument, we assume that the tonnage basis is correct, giving the preceding statement the consideration it is entitled to, we find that the tonnage basis, as compared with the labor basis, forces the costs per 100 pounds to *decrease* as productivity *decreases* and to *increase* as productivity *increases*. Does this strike you as being logical? On the other hand, we find, comparing labor apportionment against tonnage apportionment, that the former forces costs to *increase* as productivity *decreases*, and to *decrease* as productivity *increases*, which is as it should be. Looking again at case No. 1, it will be found that in cost B, the burden of $4.50 is really $1.80 per 100 pounds, instead of a flat rate of 90 cents per 100 pounds, and in cost D, the burden is 22½ cents per 100 pounds, instead of the 90-cent rate. In this way you are making the light, complicated cylinder cost the most per 100 pounds to produce ($4 instead of $3.10), and the heavier but easier-to-make wheel cost considerably less per 100 pounds ($1.37½ instead of $2.05)—which are things that the tonnage basis of apportionment ignores altogether. Putting it still another way, would you rather accept cost C as the correct cost, add 10 per cent as profit, and run the risk of losing the order through what is in reality an overestimation of $13.50 per ton; or take cost D as your basis, add your profit, which, with other things being equal, would land the order? On the other hand, would you rather take $4 per 100 pounds as your cost for the 250-pound casting, which in making cost you $1.20 per 100 pounds, add your profit and *make it,* or use $3.10 per 100 pounds as the cost—90 cents per 100 pounds less—add your profit, and get the work—but lose money on it?

Case No. 2.—Heavy Work.

Same weight—Different labor.

In this case I assume that in your foundry you have made two castings, each weighing 10,000 pounds, one taking 60 hours to make, while the other was made in 20 hours. As the productivity of the man who made the one piece in two days is greater than that of the man who made the other piece in six days, it is logical to expect that the piece which took the least time to make—where the productivity was greatest—would cost much less than the piece taking the larger amount of time with a smaller productivity.

Let us see, however, how it works out, placing the six-day and ten-day jobs in parallel columns:

	10,000 lb.		10,000 lb.	
Tonnage Basis	$100.00	..Material	$100.00	
	18.00 (60 hrs.)	..Labor	6.00 (20 hrs.)	
	$118.00	..Prime cost	$106.00	
	90.00	..Burden (90c. per 100 lb.)	90.00	
	$208.00 (A)	Total cost		$196.00 (C)
Labor Basis.	$118.00	..Prime cost	$106.00	
	27.00	..Burden @ 150 per cent.	9.00	
	145.00(B)	..Total cost		115.00 (D)
	$63.00	..Difference		$81.00

Cost A is $2.08 per 100 lb.	Cost C is $1.96 per 100 lb.
" B " 1.45 " " "	" D " 1.15 " " "
Difference .63 " " "	Difference .81 " " "

A study of these figures will show, in the first place, that cost B is less than cost A by $63, while in the case of the casting where the elements are greater productivity and lower labor cost per 100 pounds, cost D is $81 less than cost C, a net decrease of $18. Also that cost C is less than cost A by $12, while cost D is less than cost B by $30. Looking at it still another way, we find that cost A is $2.08 per 100 pounds, while cost B is $1.45 per 100 pounds, a difference of 63 cents per 100 pounds, or $12.60 per ton. Cost C is

$1.96 per 100 pounds, with cost D $1.15 per 100 pounds, a difference of 81 cents per 100 pounds, or $16.20 per ton, showing that the decrease is greater in the latter case, *as it should be.* By this method we are making the casting in which the elements are high moulding cost and low productivity, cost the most; and, instead of charging a flat rate of 90 cents per 100 pounds, we make cost D bear 9 cents per 100 pounds, and cost B 27 cents per 100 pounds—the increase being a logical one, as reflection will show, yet both rates are much less than the 90-cent rate. It should be plain that if costs A and C are used as a basis, they are overestimated to the tune of 63 cents and 81 cents per 100 pounds respectively—large enough to make any foundryman "sit up and take notice," inasmuch as there cannot be an *overestimation* in one place without *underestimation* in another, neither of which elements should be allowed to creep into any business. The advantages of using costs B and D in bidding for heavy work, instead of the prohibitive figures shown in costs A and C, are no doubt apparent without any explanation.

Case No. 3—Light Work.

Same weight—Different labor.

In this case we have two small castings, each weighing 150 pounds, one taking 7 hours to make, the other 3½ hours—low productivity in both cases, one being even lower than the other. As direct-labor apportionment makes costs increase over tonnage apportionment as productivity decreases, we naturally expect to find that costs under the former will be higher than under the latter, which the following figures will show to be the case:

	150 lb.		150 lb.	
Tonnage Basis.	$1.50	..Material	$1.50	
	2.10 (7 hrs.)	..Labor	1.05 (3½ hrs.)	
	$3.60	..Prime cost	$2.55	
	1.35	..Burden (90c. per 100 lb.)	1.35	
	$4.95 (A)	Total cost		$3.90 (C)
Labor Basis.	$3.60	..Prime cost	$2.55	
	3.15	..Burden @ 150 per cent.	1.58	
	6.75 (B)	..Total cost		4.13 (D)
	$1.80	..Difference		.23

Cost A is $3.30 per 100 lb.	Cost C is $2.60 per 100 lb.
" B " 4.50 " " "	" D " 2.80 " " "
Difference $1.20 " " "	Difference .20 " " "

From this case it will be seen that through the labor basis of apportionment cost B is $1.80 greater than cost A, while cost D is 23 cents higher than cost C. Comparing A with

C, we find the former greater by $1.05, while B is $2.62 greater than D. Consideration will show that once more we get our greatest increases where they should be, costs B and D being greater than A and C by $24 and $4 per ton respectively. In this case, instead of using a flat rate of 90 cents per 100 pounds, we have the burden $3.15, amounting to $2.10 per 100 pounds and the item of $1.58 amounting to $1.06 per 100 pounds.

Comparing all of the three cases, we find that in every case the burden cost on the tonnage basis was 90 cents per 100 pounds, while on the six castings of the three cases cited, we get rates, in cost per 100 pounds, on the direct-labor basis, as follows:

$1.80	per 100 lb.
.22½	per 100 lb.
.27	per 100 lb.
.09	per 100 lb.
2.10	per 100 lb.
1.06	per 100 lb.

We find that the lowest rate is 9 cents per 100 pounds (cost D, case No. 2). Here we have an hourly product of 500 pounds—*high* productivity, and a labor rate of but 6 cents per 100 pounds, consequently the cost should be low and reference will show that through direct-labor apportionment, the cost was $115 instead of $196. Is not the low rate of 9 cents instead of 90 cents justified, when the facts in the case are considered? We also find that the highest rate is $2.10 per 100 pounds (cost B, case No. 3). Here we have an hourly product of about 21½ pounds instead of 500 pounds—*low* productivity, and a labor rate of $1.40 per 100 pounds, instead of 6 cents per 100 pounds; consequently, to take care of yourself properly, you must have a higher cost than tonnage apportionment would give you, for by means of it you get a cost of $3.30 per 100 pounds, while through direct-labor apportionment your cost is $4.50 per 100 pounds.

The only logical conclusion from the figures heretofore shown is, first, that through the tonnage method of apportionment, the cost of heavy work is made too high; and second, that the cost of light work is made too low. We also get a rule from direct-labor apportionment, that *burden costs are inversely proportional to productivity,* which the tonnage basis does not recognize. Now then, as the tendency in commerce is to lose in bulk of sales as price increases, it should be evident to every foundryman, that making the cost of heavy work too high is sure to result in lost sales in the case of the jobbing foundry, or an excessive cost of the foundry production to the machine shop in the case of the specialty foundry. On the other hand, by making the cost of light work too low, the tendency is to get plenty of light work at prices which are in reality less than cost. The result is that both jobbing and specialty foundries are hurt alike.

Getting back to productivity, we may state the fact that the more a man produces in a given time, the less should be the cost of what he produces, and *vice versa*. If, then, the tonnage basis of apportionment as against the labor basis does not take this fact into consideration (and the figures heretofore shown clearly indicate that it does not) then the method has absolutely no merit and is consequently worthless from a commercial standpoint. To demonstrate its inaccuracy clearly, it was decided to show the difference between the two methods graphically.

Figure 28 shows amounts produced per man per day, from 200 pounds to 2,000 pounds, at different costs per 100 pounds, line 1 showing burden apportioned to direct labor and line 2 showing burden apportioned to tonnage. In plotting this chart, the rates heretofore mentioned were used, namely 90

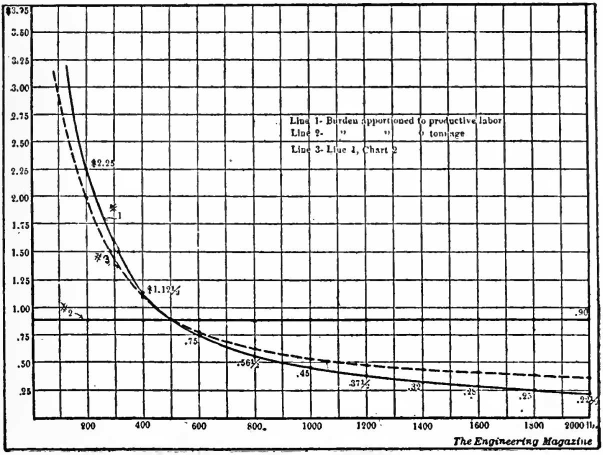

FIG. 28. BURDEN COSTS PER 100 POUNDS FOR DIFFERENT WEIGHTS PRODUCED PER MAN PER DAY.

cents per 100 pounds on tonnage, 150 per cent on the direct labor, and a daily labor rate of $3, so in order to arrive at our values for line 1, we take $4.50 as the burden, which is divisible by whatever weight is produced per man per day. A glance at the chart will show that there is a vast difference between costs of $18 and $22.50 per ton, on a production of 400 pounds for a man in a day, on the one hand, and $18 and $4.50 per ton, if the same man can produce 2,000 pounds in a day, on the other.

A foundryman is likely to bring up the

point, at this time, that certain items of expense are proportionate to the increase or decrease of the amount produced, which a uniform basis of labor apportionment would fail to consider. That such a point would be well taken can be seen when it is considered that in a large number of cases, the more a foundry is able to produce, the greater would be such items as foundry, core-room and cupola supplies, cupola labor, repairs to flasks, yard labor, handling materials, and perhaps a few other items. A compromise, then, which will enable tonnage to absorb a certain proportion of the burden, and productive labor the balance, is perfectly logical—the result of such a combination method being shown by Figure 29, the same expense items being used as in the case of Figure 28, with the exception that we assume that $4,500 of the $22,500 is proportionate to tonnage, the balance to direct labor, the rates being:

Line 1—Compromise basis—18 cents per 100 pounds on tonnage; 120 per cent on direct labor.

Line 2—Flat tonnage basis—90 cents per 100 pounds.

To show the comparisons properly, line 1, Figure 29, has been carried to Figure 28 as

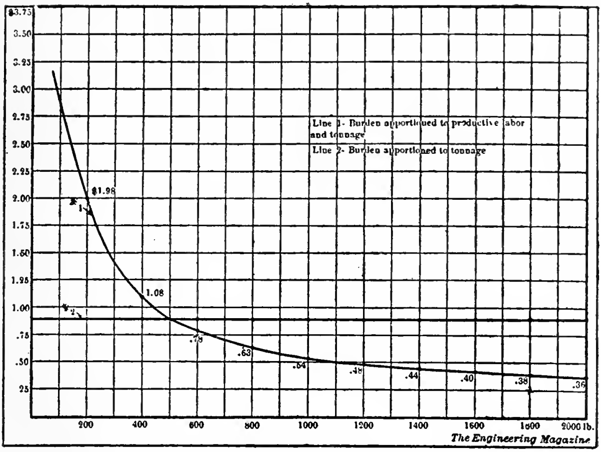

FIG. 29. BURDEN PER 100 POUNDS FOR DIFFERENT WEIGHTS PRODUCED PER MAN PER DAY.

line 3, the following illustration serving to show the difference between burden apportionments—one case being a large production per man per day and the other a small production. Taking the case of large production per man per day first, we have:

CASE NO. 4.

	Tonnage Basis		Labor Basis. 2000 lb. Casting.	Tonnage and Labor	
Material	$20.00		$20.00	$20.00	
Labor (10 hrs.)	3.00		3.00	3.00	
Prime cost	$23.00		$23.00	$23.00	
Burden	18.00	90c. per 100 lb.	4.50 (150%)	3.60	18c. per 100 lb.
				3.60 (120%)	
Total	$41.00		$27.50	$30.20	
Per 100 lb	2.05		1.37½	1.51	

Examining now the figures with small production per man per day, we find:

		400 lb. Casting.	
Material........	$4.00	$4.00	$4.00
Labor (10 hrs.)..	3.00	3.00	3.00
Prime cost......	$7.00	$7.00	$7.00
Burden........	3.60 {90c. per 100 lb.}	4.50 (150%)	.72 {18c. per 100 lb.}
		....	3.60 (120%)
Total..........	$10.60	$11.50	$11.32
Per 100 lb.......	2.65	2.87½	2.83

After considering all that has gone before, Figure 30 will no doubt prove of particular interest to foundrymen, in that it shows *total costs* for different weights produced per man per day by the various methods of apportionment. Moulding cost has been taken at $3 per day of 10 hours, with material at $1 per 100 pounds of melted iron, burden on the tonnage basis being 90 cents per 100 pounds, on the direct-labor basis 150 per cent, and on the tonnage and labor basis, 18 cents per 100 pounds on tonnage and 120 per cent on labor—these rates being the same as used in previous illustrations. The labor of making cores is not included in the figures, as for the purpose of illustration it was deemed advisable to consider simply the work of moulding, which would include the work of setting the cores, making it an easy matter, in using charts of this nature, to add the core labor to any of the total costs.

The conclusions that can be arrived at from a study of these charts are, first, that *the various methods are correct at the point*

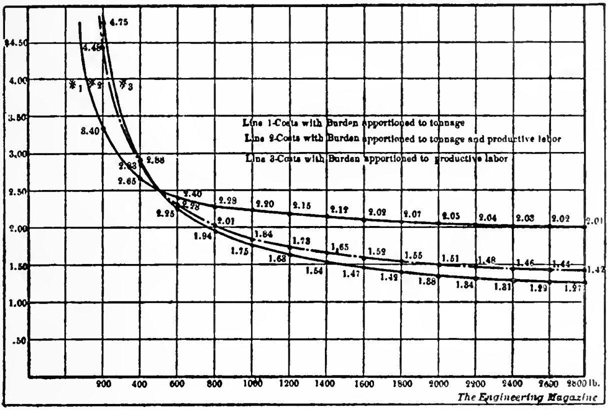

FIG. 30. TOTAL COSTS (MATERIAL, PRODUCTIVE LABOR, AND BURDEN) FOR DIFFERENT WEIGHTS PRODUCED PER MAN PER DAY.

where the lines cross; but that to the right of the intersection, the burden and total costs, per 100 pounds, on the direct-labor or direct-labor and tonnage methods of apportionment, decrease as the amount per man per day increases; while to the left of the intersection, the costs increase as the product per man per day decreases, while it will be seen that from Figures 28 and 29 the burden costs on the tonnage basis are the same, *regardless* of whether 200 pounds or 2,000 pounds are produced per man per day; this explains the slight increase and decrease of the cost as shown by line 1, Figure 30. The direct-labor or the compromise method considers that the direct labor is in a sense the *real investment* on which success or failure depends, for the reason that, as a rule, the more producers there are at work, the greater will be the production and the lower the costs, while costs increase and production decreases as the number of producers decrease. Consideration is given to the great variety of work in a foundry, making the costs of both light and heavy work about what they should be, instead of too low in one case and too high in the other.

The value of Figure 30, to those who desire to know instead of guess, will be apparent after due consideration, and as it is possible to plot such a chart from the records of any foundry, the rules given on pages 292, 293, may be found interesting as well as helpful in determining the values for charting. With figures from your own records, substituted for the values shown in Figure 30, you will be surprised at the margin of difference between the three methods. The costs of good castings at 2,200 pounds per man per day, from Figure 30, are shown as $2.04, $1.48, and $1.34 per 100 pounds, while at 200 pounds the costs are $3.40, $4.48, and $4.75 per 100 pounds, while further all three lines cross at $2.50 per 100 pounds for 500 pounds per day per man. *What does the chart covering your own work show you?* From Figure 30, or from your own chart, it is evident that all three methods cannot be right; and as the inaccuracy of the tonnage method of apportionment has been demonstrated, it leaves only two others to choose from.

Eliminating from our burden those items which are more proportionate to the increase or decrease in the production, we have left those items which are proportionate to direct labor; so that we have, by this process, also demonstrated that direct-labor apportionment is incorrect, although it would be far better to use this method than tonnage apportionment—leaving only one method, *apportionment to tonnage and direct labor.*

Tonnage Basis.

$$\frac{\text{Expenses}}{\text{Weight of Castings Produced}} = \text{Rate per 100 lb.}$$

Direct-Labor Basis.

$$\frac{\text{Expenses}}{\text{Productive Payroll}} = \text{Rate in Per Cent.}$$

Tonnage and Direct-Labor Basis.

$$\frac{\text{Expenses Proportionate to Tonnage}}{\text{Weight of Castings Produced}} = \text{Rate per 100 lb.}$$

$$\frac{\text{Expenses Proportionate to Direct Labor}}{\text{Productive Payroll}} = \text{Rate in Per Cent.}$$

Rules for Apportioning Burden at the Rates Above.

W = Weight produced per man per day.
M = Metal cost.
L = Amount paid to moulder per day.
B_1 = Burden on tonnage.
B_2 = Burden on direct labor.
B_3 = Burden on tonnage (A) and direct labor (B).
C_1 = Cost per 100 lb. on tonnage apportionment.
C_2 = Cost per 100 lb. on direct-labor apportionment.
C_3 = Cost per 100 lb. on tonnage and direct-labor apportionment.

RULES FOR APPORTIONING BURDEN RATES

TONNAGE BASIS.

$$\frac{(W \times M) + L + (W \times B_1)}{W} = C_1.$$

DIRECT-LABOR BASIS.

$$\frac{(W \times M) + L + (L \times B_2)}{W} = C_2.$$

TONNAGE AND DIRECT-LABOR BASIS.

$$\frac{(W \times M) + L + (W \times B_3A) + (L \times B_3B)}{W} = C_3.$$

As the purpose of this chapter was to start our foundation before commencing the structure, we can with safety decide on this latter method as being the basic element about which a system of foundry costing can be created; and with the matter of burden *apportionment* disposed of, knowing that we are right in principle, we can take up the elements entering into burden *construction,* which will be the purpose of the chapter to follow.

Chapter XIV

ELEMENTS OF FOUNDRY PRODUCTION COSTS

MAINTENANCE of price never implies a maintenance of profit. Careful buying may result in a lower cost for direct materials, and proper supervision may reduce the cost per 100 pounds for direct labor, but the best of management cannot expect to reduce the overhead expenses or "burden" in proportion to the reduction in the volume of production. As a result we find burden costs increasing as the output decreases, this increase affecting profit, as the following will show:

	A	B	C	D
Monthly Tonnage	250	200	150	100
Monthly burden	$5,000	$5,000	$4,000	$4,000
Direct material per 100 lb	$1.00	$1.00	$1.00	$1.00
Direct labor per 100 lb	.75	.75	.75	.75
Prime cost	$1.75	$1.75	$1.75	$1.75
Burden per 100 lb	1.00	1.25	1.40	2.00
Total cost per 100 lb	$2.75	$3.00	$3.15	$3.75
Selling price per 100 lb	3.00	3.00	3.00	3.00
Profit per 100 lb	.25	....	....	....
Loss per 100 lb	....	....	.15	.75
Per cent. of burden to direct labor	133⅓	166⅔	186⅔	266⅔

It can be seen from this table that the item of "burden" has considerable to do with the amount of profit, that there is a certain point in the amount produced *where income balances cost,* and that profits as well as losses begin from this point. *Do you know where it is in your business?*

A shrewd manager recently stated that his designer once handed him the design covering a proposed addition to one of the main factory buildings, with the petition that he approve it at once so that the work could be started, stating that the plan as set forth by the design had been looked over by several and approved by them. The manager looked at it for a moment and laid it on his desk with the remark that he would decide later in the day as to its merits. This rather incensed the designer, who stated that he felt the manager qualified to reach a decision from the facts as set forth by the design, and that the desire to postpone the decision was really a reflection on his ability as a designer. The manager replied by saying that as far as he could see, the design covered the ground in a satisfactory manner; but that he was less concerned with what *was shown* on the design than he was with what had *not* been shown at all, which would have to be considered before an intelligent decision could be reached. The manager told me that in going over the design later in the day, he found that it failed to consider several important points—that it did not take into consideration the future growth and expansion of the business; consequently the design had to be revised, the revision eventually saving the company in question considerable money, due to nothing but a search for points that had not been covered.

What you are doing is apparent and evident; but it is what you are *not* doing that should receive your careful attention. *Appoint yourself a court of investigation, issue to yourself an order to show cause why your methods should not be discarded on account of their inability to secure you, through their use, maximum results at a minimum outlay.* In the preparation of your defense, you will undoubtedly be surprised at the large amount of information you will gather as you investigate the merits of your methods. You may start out with the feeling that they meet all requirements, but in actually defending them you will begin to see that here, there, and elsewhere there are weak places—strings which lead to nowhere in particular, points not covered at all, inaccuracies, and many other faults which render efficient operation out of the question. Even though you find but few serious faults, you will discover enough to warrant the investigation.

Success in any branch of endeavor does not just "happen," but is rather the result of intelligent oversight and supervision. If the owner of a foundry business could be the moulder, coremaker, melter, business getter, bookkeeper, and executive combined, all would be well; but as this is impossible, the foundry executive must depend upon as intelligent an assistance as is possible to secure—succeeding or failing, according to the efficiency of this assistance. Methods, men, clerks, etc., are simply "tools," which can be used to decided advantage or to no real purpose, at the will of the executive, and it should be his duty to see to it, first, that these tools are what they should be, and second, that they are used to advantage. This duty the executive owes to himself, to his business in particular, to his industry in general.

Looking at the matter from a standpoint purely financial, expenditures are of every conceivable kind, and need the most careful watching in order that the returns shall include a fair margin of profit. If you purchase a knife at a hardware store for 75 cents and induce some one to purchase it from you for $1.00, you have made 25 cents on your investment, or 33 1-3 per cent. If you purchase pig and scrap irons, coke, the services of moulders, core makers, cleaners, laborers, supervision, clerical help, materials, and supplies, and sell the resulting product of this investment to several people, you must see to it that you charge each one enough to cover your investment and at the same time allow yourself a margin for your efforts. If, after taking care of this investment, you are able to deposit a reasonable amount to your credit, you have a right to feel that you have successfully conducted operations. This success is an effect; something contributed to it, and what this something was and why it assisted you, is entitled to more than passing attention, for if you can ascertain the reasons and properly classify, tag and file them away for future reference, you have at your disposal a means of forestalling disaster. If, on the other hand, you had found, after meeting your obligations, that you were on the wrong side of the books, you would, without any question, want to know what the causes were; but unless you had at your command some means for assisting you in your search, you would be forced to spend considerable time in an endeavor to pick past performances to pieces before locating your trouble, and the chances are that at best you would get only a general idea of what you desired to ascertain.

A man in the act of putting his hand in his pocket for his knife was asked why he did so. He replied by saying that he did not know, but believed that his head told his hand to do so. When asked why his head suggested such a procedure, his reply was, "my head knew that the knife would not come to my hand, so it sent my hand after the knife." Putting this same bit of logic in another way, we have—"details will not come to the executive, so the executive must send something after the details."

Expenses (details in the aggregate) are either conservative or beyond all reason—legitimate or illegitimate, and the executive must provide himself with some method which from time to time will acquaint him with these details properly classified, so as to enable him to keep his fingers on the pulse of the business and ascertain its condition. Chemistry of bodies undertakes their resolving into component parts, while "Chemistry of Costs" undertakes the resolving of facts and information into the elements necessary for arriving at result-producing conclusions. It is evident to all, however, that we cannot separate that which has not been grouped, hence the necessity for logically joining together the pertinent details of a business. This joining or grouping we will term "synthesis," which may be defined as:

> The process of automatically grouping together the various details of like nature, which, when properly arranged and classified, will show, at stated periods, what has been expended or accomplished.

The resolving of results, which we will term "analysis" may be defined as:

> The process of separating and placing by themselves the various details of like nature, which when contrasted or compared with the details of the same nature for previous periods, will enable the

executive, through the instrumentality of thought and deduction, to determine whether results are as they should be or not, or to reach a definite conclusion regarding a policy.

It has been well said, "complexity breeds perplexity." This is especially so in the case of a foundryman who has been the recipient of repeated reminders, in one form or another, that things are not as they should be. How low can I consistently bid? Where is my money going? What can I do at different productions? What is my real efficiency? These are some of the questions that the foundryman will ask himself, realizing that to turn a loss into a profit, or to increase his profits, he must either increase his prices or decrease his cost of producing castings; but as competition is such as admits of no increase in prices, his operation is the something upon which he must concentrate his attention. He finds, however, that in the absence of a well-organized means for furnishing pertinent details this information can be given to him only in a general way, and that it will be rather a difficult task to answer the self-imposed questions to his entire satisfaction. He therefore determines to find out what he wants to know, but is confronted with what seems to him to be a problem more or less complex. As a starting point, however, he decides to arrange for a careful monthly accounting of his expenditures, giving the various details proper consideration and bearing in mind that there are three principal elements in production cost —A—Materials, B—Labor, C—Expenses— he sets out, in a receptive mood, for impressions to assist him in his work, making proper notations as he decides on methods of procedure.

In the first place, he notices, in going through the foundry at casting time, that he has certain materials going through a melting process before castings are produced, these materials being the pig irons, purchased iron and steel scraps, his own or home scrap (comprising bad castings made in the shop, gates, sprues, shot and over-iron), and the coke necessary to melt the iron. He knows that in the core room they are using a coke inferior to that charged into the cupola, and that to operate his plant he is forced to buy coal for power. Earlier in the day, when the moulders and core makers were putting up their work, the fact that sand was used by them suggested the two kinds used—moulding and core sands; also that a miscellaneous lot of materials were being used by the men throughout the plant, such as chaplets, hammers, brooms, brushes, facing, oils, iron and wire, bolts and nuts, etc., all of which he decides to call "stores," before they are delivered to the men and "supplies" when delivered to them. To control his item of materials properly, he decides that it can best be handled by giving each kind of material a separate number, opening an account with it on his books, charging it with what is received and crediting it with whatever is consumed, arranging at the same time to take care of adjustments that may be necessary, the following being an exhibit of his material accounts:

Account Number.	Name of Account.
100 to 114	Various pig irons purchased.
115	Scrap iron—purchased.
116	Scrap steel—purchased.
117	Home scrap—Bad castings and remelt.
118	Core sand.
119	Moulding sand.
120	Foundry coke.
121	Stock coke.
122	Coal.
123	Stores.
130	Material adjustments.

In studying the conditions more closely, he observes that there are many things being done by his men, which, if classified and tagged, would provide a means for acquainting him with the channels through which his money passes. He notices laborers digging pits, ramming up, and in other ways assisting the moulders; that some of them have regular helpers; that there are apprentices at work; that certain men are operating moulding machines, and that a part of this work which he calls "moulding" is given up to cutting sand, pouring off, and shaking out. The moulding process naturally suggests core making as a separate operation, while the cleaning of the castings suggests another, and as he notices that considerable chipping is necessary before castings are in a condition for inspection and shipment, he decides that it would be well for information purposes, to keep this item separate from the cleaning of castings.

He carefully watches the laboring men working around the cupola in the yard, around the shops, at night getting out the work, etc., making notes as he does so; he sees that considerable is expended to replace castings that have not been accepted by the inspector, which, according to his way of looking at it, is information he should have in deciding as to the efficiency of his men; and, while he knows that he expends quite a little for supervision and clerical work, he decides in favor of keeping this item separate so as to tell, periodically, just what this amounts to, without having it looked up for him. As before stated, he has noticed that quite an amount of miscellaneous materials is being used by the men around the plant, and as it is his desire to place each department upon its own footing, he concludes to charge them with the supplies they use in a given period of time, which information he can use for purposes of comparison and analysis, in this way perhaps reducing the consumption of the indirect or expense materials.

He finds it necessary to repair one of the factory buildings; this suggests a logical division of the expenditures for maintaining his plant, instead of depending upon one total at the end of the year, which really tells him nothing regarding where the money went and what required the most or repeated repairing or replacing. As he has several departments, such as his stable, power plant, pattern, machine, carpenter and blacksmith shops, pattern storage and shipping rooms, he decides in favor of keeping separate the expenses of operating them, so as to enable him to keep in closer touch with the details of his business.

In watching his shop operations, he observes that some lifting plates are being made in order to facilitate the making of a particular order; this suggests to him an account that would tell him what it costs to rig up for special or new work. He decides to charge this expense for rigging against the work necessitating the expenditures—as a direct charge—at the same time providing a place in his expense account for this item, apportioning to his product the difference between the total expenses and the rigging expense, the advantages of which are that while each order is charged with its proper rigging cost, the rigging expense is *in total* in a place by itself—in this way facilitating study and analysis; and as it appears in the burden statement as a memorandum charge only, he is in a position to take this expenditure into consideration when estimating on new or special work.

The item of salaries he divides into officers' and office salaries; travelling expense into sales travelling and general travelling; donations and dues perhaps amount to enough to warrant him in keeping this item separate, and in this way he goes through each class of expenditure like taxes, insurance, depreciation, legal expense, office expense, commissions, allowances, etc., but before finishing his preliminary work, he happens to see some credits to customers for defective castings returned, and, while heretofore he has credited his customers and charged his sales—thereby reducing his sales or revenue account—he decides to open an account which he calls "defective castings," crediting his customers the same as before, but charging his scrap account with the scrap value of the castings returned and his defective castings account with the difference between the scrap value and the invoice amount. He decides this way because first of all he wants some means that will bring to his attention, automatically, the amount of defectives returned, so that he may concentrate his endeavors along the lines necessary to keep the item down to as low a figure as possible, and because it is hardly fair to reduce the sales of one month by work that was credited to the sales account several months before. If the sales this month are $50,000, the business is entitled to this credit, despite the fact that castings to the invoice value of $2,000, invoiced three months ago when the sales were $40,000, are returned this month. We cannot reduce the sales of three months ago; the defectives returned have nothing whatever to do with this month's business, and as the $2,000 in credits to the customers is a *loss,* less the scrap value, the logical plan is to place this item where it will *plainly show as a loss.* In effect both methods are the same as regards "net income"; for by charging sales with returns, we reduce income but allow costs to remain as they are, while by charging cost with the returns, we increase cost but allow income to remain as it stands, so that the net income would be alike in either case. It seems, however, that there is more justice in the latter method with the decided advantage of providing the executive with the best kind of danger signal.

After deciding on the various items that he wants to keep track of, the foundryman opens an account with each one, giving each an account number to which can be posted the various expenditures. His first consideration, after taking care of his materials, as was explained heretofore, is to separate his labor into "direct labor" and "expense labor"—under the first classification placing:

MOULDING.—*Account No.* 150—which is to include all time of:

- Moulders.
- Moulders' helpers.
- Apprentices.
- Moulding-machine operators.
- Laborers digging pits.
- Laborers ramming up.
- Cutting sand.
- Pouring off and shaking out.

CORE MAKING.—*Account No.* 151—which is to include all time of:

- Core makers.
- Core makers' helpers.
- Oven tenders.
- Mixers and pasters.

Under the second classification—expense account—he will include:

CUPOLA LABOR.—*Account No.* 152—to include all labor:

- Getting materials from yard to charging platform.
- Weighing and placing charges.
- Taking bad castings and remelt to charging platform.

Cupola Labor.—*Account No.* 152 (*Continued*)
Charging and tending cupolas.
Breaking stock.
Cleaning and daubing ladles.
Cleaning and preparing cupolas for each heat.

Cleaning.—*Account No.* 153—to include all labor:
Cleaning and grinding castings.
Tending rattlers.
Pickling castings.
Using sand blast.

Chipping.—*Account No.* 154—to include all labor chipping and getting castings in condition for inspection and shipment.

Handling Materials.—*Account No.* 155—to include labor unloading, stacking and piling of:
Pig and scrap irons.
Coal and coke.
Sea coal.
Fire clay and brick.
Limestone.
Core flour.
Lumber and slab wood.
Moulding and core sands.
Other materials not specified above.

Yard.—*Account No.* 156—to include labor loading dirt cars, cleaning up yard, etc.

Shop Supervision and Clerical.—*Account No.* 157—to include salaries and wages of:
Superintendent.
Foremen.
Shop clerks.

Replace Labor.—*Account No.* 158—to include labor in foundry or core room replacing work lost or extra work done on account of causes other than faulty design or construction of patterns.

FOUNDRY GENERAL.—*Account No.* 159—to include time of all laborers (when not acting as moulders' helpers) working around foundry or core room:

- Cleaning up floors.
- Carrying iron.
- Shifting weights.
- Going after supplies.
- Carrying flasks, patterns and cores.
- Time of—
  - Watchman.
  - Crane men.
- Any incidental work not specified above.

NIGHT GANG.—*Account No.* 160—to include all time of laborers:

- Taking out castings.
- Placing flasks.
- Removing gaggers and clamps from sand.
- Fixing sand and getting floors in condition for use by moulders when they arrive in the morning.

The third element—expense—is divided into Supplies, Maintenance, Departmental, Miscellaneous Shop and the Commercial expenses, as follows:

SUPPLIES.

FOUNDRY SUPPLIES.—*Account No.* 165—to include all supplies used by the foundry which cannot be charged directly to any one order such as:

- Moulding sands, charcoal, stock coke, brushes and brooms, pails, bellows, files, nails and spikes, hammers and hammer handles, torch oils, chaplets, riddles, shovels, iron and wire, Foundry Supplies.—*Account No.* 165 (*Continued*) facings, parting, bolts, nuts, screws, buckets, torches, wicking, cement, mallets, sledges, wheel barrows, waste and any other incidental materials used as supplies in the foundry.

Core Room Supplies.—*Account No.* 166—to include all supplies used by the core room which cannot be charged directly to any one order, such as:

Stock coke, moulding sand, core sand, core oils, molasses, paper, bolts and nuts, files, slab wood, wire and rods, core wash and core compounds, flour, gravel, brushes and brooms, nails, bellows, wheel barrows, wax tapers and other miscellaneous supplies used by the core room.

Cupola Supplies.—*Account No.* 167—to include all supplies not otherwise chargeable, such as:

Sand, slab wood, alloys, gravel, clay, limestone, wheel barrows, shovels, coke forks, coke baskets, brooms, tapping bars and any other materials used as supplies around the cupola.

Cleaning Room Supplies.—*Account No.* 168—to include supplies, such as:

Brushes, shovels, wheel barrows, brooms, chisels, hammers and hammer handles, carbo blocks, etc.

Maintenance.

Buildings and Real Estate.—*Account No.* 170—to include all labor spent and materials used in repairing:

Buildings, roofs, fences, sidewalks, tracks, etc.

Plant Equipment.—*Account No.* 171—to include all labor spent and materials used in repairing:

Cupolas, blowers, moulding machines, cranes, grinding, rattling and sand-blast machinery, elevators, air equipment, pattern, machine, carpenter and blacksmith-shop equipments, the stable equipment, etc.

POWER AND TRANSMISSION.—*Account No.* 172—to include all labor spent and materials used in repairing:

Boilers, engines, compressors, dynamos, lights, line and counter shafting, boxes, hangers, belts, pulleys, brackets, etc.

CAST EQUIPMENT.—*Account No.* 173—to include all labor spent and materials used in making:

Stars, clamps, gaggers, braces, bench and flask weights, etc.

PATTERNS.—*Account No.* 174—to include all labor spent and materials used in repairing patterns, also replacing patterns broken. This account is to cover work that is not chargeable to customers.

FLASKS.—*Account No.* 175—to include all labor and material used in repairing burned, broken or worn out wood flasks, wood flask bars, also broken iron flask parts.

DEPARTMENTAL.

STABLE.—*Account No.* 180—to include time of teamsters and those employed about stable, also feed, bedding, horseshoeing and supplies used.

PATTERN SHOP.—*Account No.* 181—to include labor and materials that cannot be charged direct to some other account, also pattern-shop supplies.

MACHINE SHOP.—*Account No.* 182—to include labor and materials that cannot be charged direct to some other account, also machine-shop supplies.

CARPENTER SHOP.—*Account No.* 183—to include labor and materials that cannot be charged direct

Carpenter Shop.—*Account No.* 183 (*Continued*) to some other account, also carpenter-shop supplies.

Blacksmith Shop.—*Account No.* 184—to include labor and materials that cannot be charged direct to some other account, also supplies used by the blacksmith shop

Power Plant.—*Account No.* 185—to include time of engineer and fireman and any other labor used in the boiler and engine rooms, also coal, oils, compound, waste, tools, etc.

Pattern Storage.—*Account No.* 186—to include time of those in charge of the pattern storage as well as any supplies used in same.

Shipping Room.—*Account No.* 187—to include labor in shipping room, boxes or barrels (made or purchased) with which to ship castings as well as any supplies used in same.

Miscellaneous Shop.

Rigging.—*Account No.* 190—to comprise the rigging or special equipment made for some particular customer or work and to include time of moulders, core makers, pattern maker or carpenter or any other labor applied to this particular class of work and to also include cost of metal used, and supplies like bolts, nuts, screws, rods, rings, etc.

Taxes.—*Account No.* 191—(*).

Insurance.—*Account No.* 192—(*).

Depreciation.—*Account No.* 193—(*).

Analysis Expense.—*Account No.* 194—to include expense of operating chemical laboratory, such as

* Self-explanatory.

salary of chemist, supplies used, etc., or the amounts paid to outside chemists for metal analysis.

COMMERCIAL—ADMINISTRATIVE.

OFFICERS' SALARIES.—*Account No.* 200—salaries of the executive officers of the company.

OFFICE SALARIES.—*Account No.* 201—salaries and wages paid to heads of departments, clerks and stenographers.

LEGAL EXPENSE.—*Account No.* 202—(*).

INTEREST AND DISCOUNT.—*Account No.* 203—(*).

GENERAL TRAVELING EXPENSE.—*Account No.* 204—all expense of traveling, having nothing to do with the selling of product.

TELEPHONE, TELEGRAMS AND POSTAGE.—*Account No.* 205—(*).

OFFICE EXPENSE.—*Account No.* 206—to include such items as:

Pencils, pens, stationery, forms, rubber bands, pins, ice, inks, brooms and dusters, folders and other miscellaneous office supplies.

DONATIONS AND DUES.—*Account No.* 207—to include such items as:

Subscriptions to magazines, association dues, gifts for charitable and other purposes.

COMMERCIAL—SELLING.

SALARIES OF SALESMEN.—*Account No.* 215—(*).

SALES TRAVELING EXPENSE.—*Account* No. 216—to include expenses for traveling when expended for the purpose of selling the product of the plant.

COMMISSION.—*Account No.* 217—(*).

* Self-explanatory.

SALES FREIGHT.—*Account No.* 218—to include prepaid freight or express charges on shipments to customers.

ALLOWANCES.—*Account No.* 219—to include credits given to customers when they do not come under the head of credits for defective material or invoice corrections.

DEFECTIVE CASTINGS.—*Account No.* 220:

A—to be charged with castings returned from customers at invoice prices, less scrap value.

B—to be charged with difference between scrap and invoice values when castings are kept by customers.

C—to be charged with castings scrapped after being weighed and reported as good, at cost value less scrap value.

These various items are in reality a number of "magnets" which are ready to draw the various details to them *automatically* in such a manner as to show periodically the totals of the various accounts. It would hardly do, however, to list the various totals on an adding machine in order to arrive at the total cost, for two reasons:

1—Because analysis is facilitated only when the item of *total cost* is divided into the groups necessary to enable the executive fully to grasp the real significance of the grand total.

2—Because the various items vary widely in their nature. It is therefore necessary to separate the items, as shown above, into their logical controlling elements; but as the length of this chapter renders further elaboration out of the question, the discussion of the elements entering into production costs will be concluded in the chapter to follow, which will show how the various items are grouped, how and why they are apportioned to product, etc.

Chapter XV

THE APPORTIONMENT OF FOUNDRY COSTS TO PRODUCTION

NOTHING is large or small except by comparison. When a man speaks of the judgment of another as being "sound," he has compared this man's judgment or his success either with his own or with that of other men of his acquaintance. When a man is called upon to decide regarding a policy, he compares the advisability of carrying it out along certain lines with that of carrying it out along opposite lines. When a man is called upon to decide between the choice of two vocations, he studies the possibilities in one as against those of the other. A lawyer, in summing up, compares his arguments with those of his legal opponent, while the jury, in turn, compare the arguments advanced by the opposing lawyers. Before a man becomes a member of a church, he first compares creeds and beliefs; before a man designs a machine, he compares the different ways he could construct it; before a man builds a house, he compares different styles of architecture—in fact, comparison seems to be a basic element of vastly greater importance than is at first apparent.

It is no doubt evident to all that nothing is done, no move ever made, except through the instrumentality of an *action* of some sort, and that no one acts one way or another without first deciding as to the course to pursue—*conclusion*. Looking at comparison, then, as a basic element, it can be seen that after a comparison has been made but *before* a conclusion can be reached and action taken, it is necessary for something to bring out the good features and eliminate the bad ones—to affirm or to deny—this something being a mental process—reasoning. Accomplishment, then, is an effect—the result of an efficient action, based on a logical reasoning applied to a thorough and complete knowledge of comparative elements. If this is true, it follows that if our elements are incomplete or faulty, the reasoning and conclusions are bound to be illogical and the action a failure or at least inefficient.

All this means a great deal to the business world, being of special significance to the foundry industry; for in the conduct of a foundry business, success is dependent upon the course pursued by its management—action—which to result in accomplishment depends upon the reasoning applied to comparative elements—analysis in other words. The lesson is plain. *Study your business in a scientific manner; set up attainable standards as to cost, expenses, production; then analyze the relation of actual performance to your standards.* Intelligent action—accomplishment—success, will follow as a natural result.

The preceding chapter gave a suggestive outline of the comparative elements peculiar to the usual foundry enterprise; this chapter will take these elements, which serve a two-fold purpose—first, the finding of costs; second, the facilitating of analysis—and reclassify them so that the exposition will not only be more comprehensive and efficient, but show correct apportionment to production as well.

The conducting of a foundry business involves two things—the making or production of castings, and the sale or disposition of the castings produced—the shop being responsible for the making or production, and the second element being a purely commercial transaction with which the shop has very little if anything to do, exercising no direct influence over the executive control and administration of the business; consequently, in justice to both interests, we must consider the following as being the principal divisions of the grand total of the elements entering into cost of production:

1—Shop Cost—the cost of making the product.

2—Commercial Cost—the cost of administering the business and disposing of production.

Shop Cost is found to be made up of two kinds of costs, which we will term "Direct Cost," including those items which can be charged direct to specific production, such as iron, moulding, etc., and "Indirect Cost," including those items which cannot be applied direct, such as sand, supplies, supervision, laborers—the elements entering into Direct Cost being classed under the headings or subdivisions of "Direct Materials," such as pig and scrap irons, etc., and "Direct Labor," such as moulding and core making.

The elements which go to make up Indirect Cost are also of two kinds—those which have a tendency to increase or decrease as the volume of product increases or decreases, and those which do not seem to have this tendency; consequently, it is necessary to observe this distinction in our calculations, and we will therefore divide "Indirect Cost" into (1), Tonnage Charge, and (2), Foundry Charge, the first being applied to product as an additional charge to the amount which it receives through Direct Material, the second being applied to product on the basis of Direct (or Productive) Labor.

Commercial Cost, defined above as the cost to administer the business and dispose of product, should be divided into "Administrative," including all items of expense which enter into the successful management of the business, such as executive and office salaries, office expense, supplies, etc., and "Selling," including all expenses made necessary because of the marketing of the product of the shops, such as salesmen's salaries and expenses, advertising, etc.

From this it will be seen that we have six subdivisions of costs common to the majority of foundries:

DIRECT MATERIALS,

DIRECT LABOR,

Tonnage Charge,
Foundry Charge,
Administrative,
Selling.

These control the numberless details peculiar to them, the subdivisions being in turn controlled by others:

Direct Labor } making Direct Cost.
Direct Material }
Foundry Charge } making Indirect Cost.
Tonnage Charge }
Administrative } making Commercial Cost.
Selling }

Commercial Cost, combined with Shop Cost (Direct and Indirect Cost), make "Total Cost"; so that no matter what the executive wants to scrutinize, whether the amount of sand or chaplets used, or the cost to sell the product—the cost to make the castings or the details regarding the shop expenses—he has a means of getting at what he wants to know *automatically*, all being arranged and classified for immediate reference. It is, therefore, necessary to reclassify the various cost accounts previously shown, according to the six subdivisions; Figures 31, 32 and 33 show what each subdivision comprises, Figure 34 being an exposition of how they are merged into Total Cost and apportioned to product.

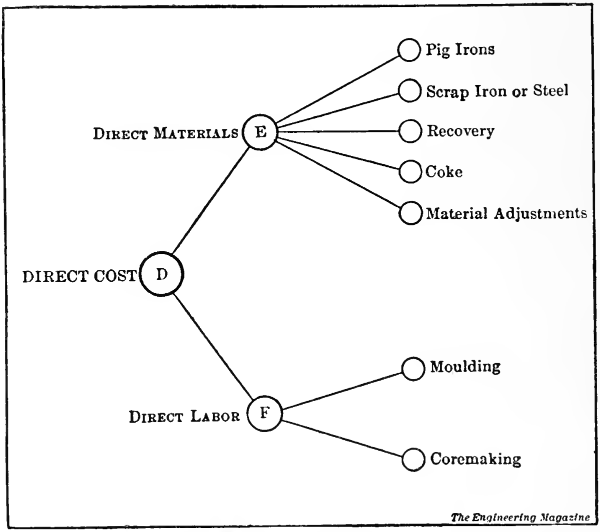

FIG. 31. THE ELEMENTS ENTERING INTO DIRECT COST.

Regarding the suggested apportionment, it will be seen that Direct Material and Direct Labor, on account of their nature, are *direct* charges to production and are therefore easily disposed of in costing. In Indirect Cost we have an element not capable of being handled so easily, for while there is absolutely no question regarding the advisability

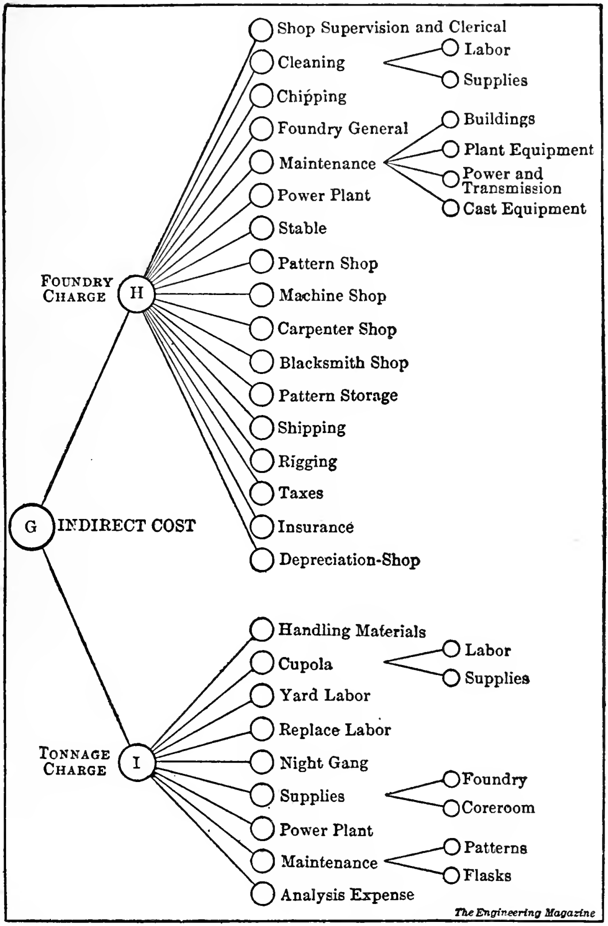

FIG. 32. THE ELEMENTS ENTERING INTO INDIRECT COST.

of apportioning this element, part to product on the basis of tonnage and part on the basis of direct labor, there may be considerable question regarding the advisability of apportioning the various elements which made up this subdivision according to the manner outlined in Figure 32. In determining to which class any item of Indirect Cost belongs, the relation of each one to the tonnage produced must be given consideration. If the tendency is for the cost of an item to increase or decrease as the volume of the product increases or decreases, the item is a charge to production on the basis of *tonnage*. If this is not the case, however, the apportionment must be made on the basis of direct labor.

Take, for instance, the item "Handling Material." Here we have an element that will increase or decrease with the tonnage produced, not proportionately, perhaps, but to some extent at any rate, while the increased tonnage which necessitated this extra handling cost might have been accompanied by the expenditure of about the same amount of labor, owing, perhaps, to a different line of work. This reasoning also applies to Yard and Cupola Labor. Regarding Replace Labor, it is evident, though it does not always follow, that the greater the total of production the greater will be the labor expended to replace castings condemned in the foundry; for it is natural to expect that more castings will be lost and replaced when the production is 500,000 pounds monthly than when it is only 200,000. From this it seems proper to include Handling, Yard, Cupola and Replace Labor in the TONNAGE CHARGE section.

A foundry starting with a tonnage of 10 tons daily will find that it will have to add more men to the force who take out the work at night when the tonnage increases to 20 tons per day, so that it is proper to class the item Night Gang as a tonnage expense along with Foundry, Core Room and Cupola Supplies, which tend to increase as production increases, while to this same class can be added Maintenance of Flasks and Patterns, as these expenditures will be greater with a larger production than when the production is such as does not call into play so many flasks and patterns. As the power used is proportionate to the run of the cupola, the proper amount of the Power Plant charge should be included in the tonnage item along with Analysis Expense, which is included in this section, not so much because the expense of apportioning this element, part to product on the basis of tonnage and part on the basis of direct labor, there may be considerable question regarding the advisability of apportioning the various elements which made up this subdivision according to the manner outlined in Figure 32. In determining to which class any item of Indirect Cost belongs, the relation of each one to the tonnage produced must be given consideration. If the tendency is for the cost of an item to increase or decrease as the volume of the product increases or decreases, the item is a charge to production on the basis of *tonnage.* If this is not the case, however, the apportionment must be made on the basis of direct labor.

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Let us consider for a moment the suggested apportionment to "DIRECT LABOR." If the items have a tendency to increase in cost as the amount of direct labor increases; or if, on the other hand, there is no relation between the two, and no relation between the cost of the items and the tonnage produced, then they are correctly shown in the exposition. Take, for instance, Shop Supervision and Clerical. It stands to reason that the more producers there are at work the greater will be the need for supervision and clerical work, while with fewer producers less will be required, although the cost per dollar of direct labor will be greatest when a minimum number of producers are at work, because of the fact that supervision and clerical work cannot decrease in proportion to the decrease in the amount of direct labor expended; they decrease as the amount of direct labor increases, until a point is reached when more supervision is required; and, as consideration will show that the same expenditure of direct labor might result in a large production one week and a small one in the week following, it is evident that the item mentioned is more nearly proportionate to labor expended than to tonnage produced.

The item of Labor and Supplies for the Cleaning Room, as well as Chipping, has been included in the expense apportionable to direct labor, although the labor of cleaning and chipping can be charged direct to production, if the foundryman so chooses. It was included as shown for the following reasons. Consider, for instance, a small, complicated casting, which might weigh only 500 pounds, taking the entire time of a moulder for a day, as against a large, plain casting, made in the same time; it is more than likely that the cleaning cost will be about the same in both cases, while on the other hand a small, plain, easy-to-make casting could be cleaned quickly, while a large, complicated, difficult-to-make casting would take considerable time for this operation. It seems, after watching the cleaning operation, that it bears a close relation to direct labor, comparing the making and cleaning of complicated with complicated work and plain with plain work, although it does not follow from this statement that the relation is always proportionate. On account of this relation, however, and because of the fact that the entire cost of cleaning and chipping could not be applied to product direct without considerable detail work, necessitating the charging of a part of the cost to Direct Labor and the balance to Foundry Charge, it has been included as a labor apportionment item, not only for the sake of simplicity, but because in this way the executive is provided with a logical control of this expense. I know of an instance where by keeping separate the entire cost of the cleaning, the executive was enabled to reduce this expense, through comparing it with his other elements, as well as with the same item for previous periods, which would not have been possible had part of the cleaning cost been in expense and part divided as Direct Labor, in small amounts, among the various jobs.

As to Foundry General, it may be said that this expenditure is largely dependent upon the number of producers at work, regardless of the tonnage produced, although there might be times when it would be more nearly proportionate to tonnage than to labor—as, for instance, in cases where, because of change in work, about the same amount of labor might produce a considerably larger tonnage, necessitating additional shop labor. In most cases, however, the tendency is for this cost to increase or decrease with the increase or decrease in direct labor, for which reason it has been classed as a Foundry Charge expense. Regarding the maintenance items, it should be evident that keeping the real estate and buildings, the equipment of the plant, etc., in proper condition really has nothing to do with the amount of the tonnage produced by the shops. Repairs might be the lowest when production was the highest, or *vice versa;* in fact, deterioration might be greatest when there was no production at all. As a matter of fact, they might not bear much relation to the amount of direct labor, but as they are not items which increase or decrease with the tonnage produced, we must include them in the FOUNDRY CHARGE section, applying them to production on the basis of labor. As we arranged to charge a certain proportion of the power-plant cost to tonnage, we must include the balance in the FOUNDRY CHARGE section along with the cost of various departments, stable, pattern shop, machine shop, carpenter shop, blacksmith shop, pattern storage, which must be conducted regardless of whether the amount of tonnage produced is 5 tons or 20 tons daily, although these costs would very likely increase with the increase in the force of producers.

Upon first consideration, it might seem as if Shipping belonged to the TONNAGE CHARGE section, because of the fact that the shipping expense is sometimes greater with a large amount of tonnage than with a small amount. A moment's reflection will show, however, that it is possible for a large amount of labor to turn out, instead of large tonnage, a large production in the count of pieces, necessitating considerable shipping expense for gathering, tagging and shipping, so that in the strictest sense this term is proportionate to neither tonnage nor labor, and not being a tonnage charge, it must be placed in the labor section. As regards Rigging, it follows that the nature of the work being done, etc., really governs this expenditure, and that it might be greatest with a small tonnage or when the number of producers was not large, or *vice versa,* so that, like Shipping, this item really belongs in neither section, for which reason it has been placed in the labor section as a memorandum charge only, in order that Total Cost may show the total expenditure for rigging for comparative and estimating purposes, while the items Taxes, Insurance and Depreciation, bearing, as they do, no relation to the increase in the tonnage produced, are apportionable, because of this fact, to DIRECT LABOR.

In considering the handling of Commercial Cost, all will agree that some means must be provided for taking care of it—that it is not a cost capable of direct charging, and must therefore be classed with the apportionable items; and that in our search for a basis on which apportionment can be made,

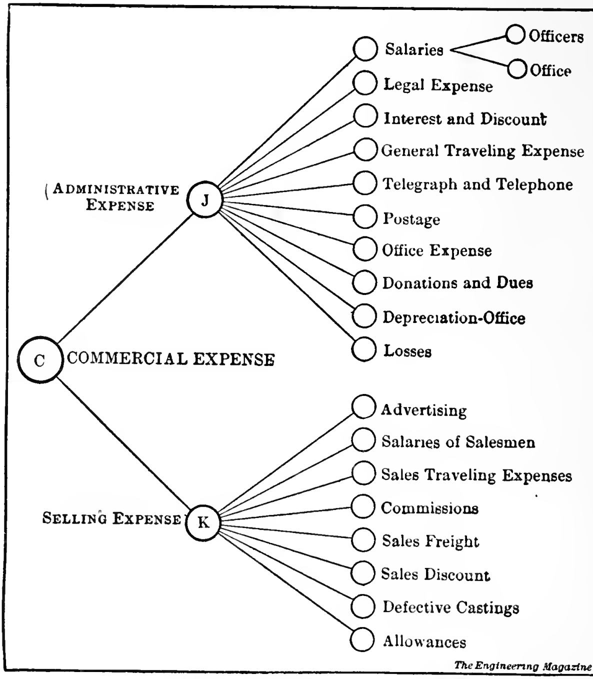

FIG. 33. THE ELEMENTS ENTERING INTO COMMERCIAL COST.

we can find only two elements—Production and Sales. On the latter basis, the ratio between the amount of Commercial Cost and the amount of the sales is ascertained and the selling price of the different orders multiplied by the resultant percentage, the product being added to Shop Cost. Another method is to deduct monthly, from the revenue from sales, the Shop Cost of the sales, the difference being gross profit—the amount of net profit being ascertained by deducting the commercial expenses from the gross profits. There is no question that (as before stated) the difference between production and commercial costs is of sufficient importance to warrant us in strictly observing this distinction.

An analysis of the items which go to make up the administrative and selling expenses will show that the expenditures have to do with the past, present, and future—that some are concerned with sales, others with production or production and sales combined, and still others with neither production nor sales. The item "Donations and Dues," for instance, has nothing to do with production or sales, the past or the future. Some of the items in the selling expense division, like "Advertising and Salesmen's Salaries," are concerned with getting future production—others with what was done in the past, like "Commissions" and "Allowances." Items like "Telephone and Telegrams," "Postage" and "Office Expenses," are likely to be as much concerned with what is being produced as with the work of making sales or taking care of the sales that have been made. The past cannot absorb that which belongs to the past; we cannot hold the items belonging to the future until they shall be applied; it would be difficult to apportion to sales those items which belong to sales, and to production those which belong to production. It therefore seems, after briefly analyzing the make-up of the commercial expenses, that it would be best to make each month's production stand on its own feet by making it absorb the entire expense for the period, in this way converting all of the expenditures of a period into an asset; for, on the assumption that we ship none of the castings we might have made, at the end of the period they would appear in our resources as "Manufactured Castings" at an amount equal to the cost of the material, labor, and expenses. On a basis of commercial expense apportionment to sales, a month's production would be charged to inventory at shop cost, and assuming that there were no sales from which to deduct the commercial expenses, these expenses would have to be considered as a loss. A profit or a loss should show *after* sales are made, not *before,* as the difference between the selling prices of what is sold and the cost of product, which is the result when inventory is charged with commercial as well as shop cost.

A good casting is the result of a moulding process which involves the making and setting of cores—two distinct operations. A completed engine is the result of an assembling process which involves the machining of the parts—two distinct operations. Viewed in the light of the illustrations just cited, production is the result of a manufacturing process which involves a commercial process—the administration of the business and the disposition of what is produced, without which production would be impossible—two distinct operations. Manufacturing expenses bear a direct relation to production —the commercial expenses, an indirect; but *production,* nevertheless, is the underlying element with which any enterprise is concerned.

We can apportion "Commercial Cost" to production in three ways—on tonnage, direct labor or shop cost. The method to choose should be one which will be fair to the company, the shop management, and the workmen, and which will also point out to the executive what he should know to supervise and direct intelligently. This can best be accomplished by using direct labor as our basis for pro-rating; but as opinions count for nothing unless backed by some substantial evidence, let us see if there is any logic in this assertion. In the first place, all will agree that direct labor is the true investment in any enterprise, for the reason that the more we expend for labor that actually produces something, the greater should be the amount produced, regardless of how much material was used or the amount of the indirect expenses. It is also evident that the greater the number of producers at work the lower will be the relative overhead expenses or "burden," while these will increase as the number of producers decreases, so that the relation of burden costs to the amount expended for direct labor is too important to be lost sight of—the ratio between the two being an inverse one. If a workman produces a large amount for a low labor cost, his production should absorb a *lower proportion of the burden cost* than that of one who produces the same amount at a higher labor cost, or a lower production at a high labor cost. If this is logical, then it is right

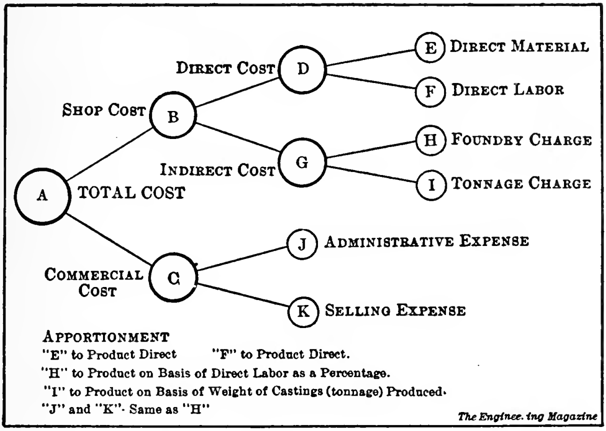

FIG. 34. THE MAIN ELEMENTS OF PRODUCTION COSTS AND THEIR APPORTIONMENT TO PRODUCT.

for us to make the product of each workman absorb the burden *in proportion to the amount paid him for direct labor.* In this way, each man will stand on his own feet, for the one having the greatest production will absorb the lowest burden cost, and *vice versa*.

The result to the management is this—work costing the most in direct labor will cost the most in burden, which is as it should be for furnishing the best means for accurate price determining, as well as a basis for determining the efficiency of the shop management and the workmen. A customer should pay the most money for castings costing in direct labor the most to produce. If a mistake has been made in quoting, it will show in the form of a much smaller profit than anticipated, or perhaps in a loss, or in the form of an excessive profit—an over-estimation. If no mistake is made in quoting, however, and the amount of direct labor greatly exceeds what it should have been, it will not only show in the form of an increased direct-labor cost, but in the increased amount of burden absorbed, with the result that the total cost will be in excess of the price received, showing a *loss* for the executive to take up with the shop.

Profits or losses will be what was made or lost; prices will be based on true costs; the product of a workman will bear no more or no less of the burden than its direct labor makes it stand; fluctuations will be noticed, as burden costs will rise or fall with the rise or fall in direct labor, so that after due consideration, I am of the firm opinion that the points brought out logically point to "Commercial Cost" apportionment to production on the basis of "Direct Labor," as being right and proper.

Chapter XVI

COST-APPORTIONMENT IN VARIOUS CLASSES OF FOUNDRIES

A MANUFACTURER, whether making castings or candy, is generally inclined to the belief that he can derive no direct benefit from a discussion of proposed betterments, because of his "peculiar" or "complex" conditions, which, according to his way of thinking, call for specific treatment—if any betterment is necessary.

There is, of course, no denying the fact that there are many cases where Jones puts into operation methods that are successful in the plant of Smith, and after a heartbreaking attempt to get things to run smoothly under the new arrangement, finally discards them for his old methods, with the result that any other innovations thereafter are frowned upon. As a matter of fact, no betterments can be introduced into any business, no matter how correct they may be in principle, if little attention is given to the matter of their application to the existing conditions; and to this one defect of inapplicability—a serious one, indeed—can be laid the failure of many a system that was no doubt correct as far as the principle was concerned. An improvement involves a change, although a change does not always imply an improvement; therefore, before a manufacturer plans any changes, he wants to feel sure that they are going to better his results and still cover his conditions—he wants them right, both in principle and application.

The three preceding chapters have dwelt upon correct burden apportionment; the elements entering into the burden; their apportionment to production and the necessity for analysis. The suggested burden apportionment took into consideration the fact that some of the items were proportionate to direct labor, others to the tonnage produced; that it was advisable to divide the burden into the elements necessary to give the executive an intelligent grasp of all of the pertinent details of his business when compared with standards; and, although the suggested division might impress a manufacturer as being "too much detail," the fact remains that we must know *where* to concentrate our attention before we can better results, and that compilations cannot anticipate whether information is going to be valuable or absolutely worthless. Therefore, it would be better to divide into three parts an item which could be carried under one heading, if by so doing there is any possibility that one of these subdivisions may point out the way, through analysis, to greater efficiency—the conditions to be covered largely governing the kind and number of accounts. Finally, we saw that analysis of "comparative elements" was an absolute necessity, because it took into consideration the fact that first impressions are usually lasting, whether correct or incorrect, and that it is an unwise policy to jump at conclusions unless we can see the conclusions.

Granting the importance of analysis—the correctness of a burden apportionment part to labor and part to tonnage—and the necessity for a detailed division of what is expended, the next feature a foundryman is concerned with is the consideration as to *how* his costs are to be absorbed by his production. In order to treat this phase of the subject as intelligently as possible, it is necessary to divide the foundry industry into different classes, as follows:

1—Jobbing Foundries—Foundries selling all their production to outside concerns.

2—Specialty Foundries—Foundries selling all their production to the business of which they are a part.

3—Specialty Foundries Doing a Jobbing Business—Foundries selling part of their production to outside manufacturing enterprises and the balance to the business of which they are a part.

There seems to be little uniformity in foundries in the above classes when the matter of the division of the production is considered. Some foundrymen want it divided one way, while others have some other method of ascertaining the cost of different kinds of production; in fact, a half-dozen foundries in the same locality may have as many different ways of figuring. The following are the principal divisions of the several ways possible for a foundryman to treat his production, applicable to the three classes of foundries specified above:

(*a*) Cases where a foundryman is satisfied with simply the *weight* and cost of his production *in total*.

(*b*) Cases where the production is *classified* according to *weight* and is divided into—

Total weight and cost of "light" work.

Total weight and cost of "heavy" work.

(*c*) Cases were the production is classified according to the principal *methods of moulding,* being divided into—

Total weight and cost of loam work.

Total weight and cost of dry-sand work.

Total weight and cost of green-sand work.

(*d*) Cases where the production is classified according to the *use* of the castings produced, being divided as follows (if we assume, for example, a concern manufacturing engines and boilers)—

Total weight and cost of engine castings.

Total weight and cost of boiler castings.

Or, if the output consists of a varying line, such as the manufacture of steam and gas engines, boilers, and a special line of work such as laundry machinery, we can divide—

Total weight and cost of steam-engine castings.

Total weight and cost of gas-engine castings.

Total weight and cost of boiler castings.

Total weight and cost of laundry-machinery castings.

Or we can still further classify by taking the production of the steam-engine castings according to—

Total weight and cost of beds.

Total weight and cost of frames.

Total weight and cost of wheels.

Total weight and cost of cylinders.

Total weight and cost of all other steam-engine castings.

(*e*) Cases where the production is classified according to the *way the castings are made,* being divided into—

Total weight and cost of machine-made castings.

Total weight and cost of hand-made castings.

(*f*) Cases where the production is classified according to the weight and cost of *each separate casting.*

(*g*) Cases where the production is classified according to the total weight and cost of *each customer's work.*

(*h*) Cases were the production is classified according to *departments* in which they are made, as for example—

Total weight and cost of bench-work castings.

Total weight and cost of side-floor work.

Total weight and cost of main-floor work.

(*i*) Cases where the production is classified according to the various *classes of weights,* as for instance all castings weighing from 200-400 pounds being treated as in a class by themselves.

(*j*) Cases where the production is classified according to the *disposition,* being divided into—

Total weight and cost of castings made for our own consumption.

Total weight and cost of castings made for sale to the trade.

If space permitted, various combinations of the cases shown could be cited, as for instance, *j* and *b* could be combined, the castings made for sale and consumption being in turn divided into the weight and cost of the light and heavy work. Care should be exercised before deciding on what case or combination of cases to use, as conditions (and conditions only) must govern the plan to follow.

The following rules have been worked out in order that the calculations entering into the apportionment of costs to production may be more clearly understood, our known elements being—

1—Weight of castings produced.
2—Total cost of Direct Material.
3—Total cost of Direct Labor.
4—Total cost of Foundry Charge.
5—Total cost of Tonnage Charge.
6—Total cost of Commercial Cost.

Rules for Rate Determination

1.—To find the rate per 1,000 pounds of Direct Material, divide the cost in total of Direct Material by the tonnage produced.

2.—To find the rate in per cent of Foundry Charge, divide the cost in total of Foundry Charge by the cost in total of Direct Labor.

3.—To find the rate per 1,000 pounds of Tonnage Charge, divide the cost in total of Tonnage Charge by the tonnage produced.

4.—To find rate in per cent of Commercial Cost, divide the cost in total of Commercial Cost by the cost in total of Direct Labor.

5.—To find the rate per 1,000 pounds of Total Cost, divide the total cost by the tonnage produced.

Apportionments.

6.—To ascertain the cost of Direct Material, multiply the tonnage produced by the rate from Rule 1.

7.—To ascertain the cost of Direct Labor, charge the proper amount direct.

8.—To ascertain the Foundry Charge, multiply the Direct Labor by the rate from Rule 2.

9.—To ascertain the Tonnage Charge, multiply the tonnage produced by the rate from Rule 3.

10.—To ascertain the Commercial Cost, multiply the Direct Labor by the rate from Rule 4.

After the rates have been determined, the following rules can be used for enabling the foundryman to cost correctly any classified production:

RULES FOR THE TREATMENT OF THE VARIOUS CASES.

11.—Select from list prevously shown—cases *a-j*,—the division desired.

12.—Classify the production according to the division selected.

13.—Ascertain the Direct Material cost by using Rule 6 for each classification.

14.—Post to each classification the correct amount of Direct Labor.

15.—Apportion Foundry Charge by using Rule 8.

16.—Apportion Tonnage Charge by using Rule 9.

17.—Apportion Commercial Cost by using Rule 10.

18.—Add 13-17 inclusive.

19.—For rate per 1,000 pounds of Total Cost, use Rule 5.

Rules 15-19 inclusive apply to each classification separately.

ILLUSTRATION.

Values.	Apportionment.	
Tonnage—3,050 lb.	Tonnage—3,050 lb.	
Direct Material—$10.00 per 1,000 lb.	Direct Material...	$30.50
Direct Labor—$20.00.	Direct Labor	20.00
Foundry Charge — 125 per cent.	Foundry Charge..	25.00
Tonnage Charge—$2.50 per 1,000 lb.	Tonnage Charge..	7.63
Commercial Cost — 35 per cent.	SHOP COST	$83.13
	Commercial Cost.	7.00
	TOTAL COST	$90.13
	Per 1,000 lb.	29.55

Through the use of the above rules, a foundryman is in a position to determine the costs of his production, in total as in Case *a,* as one extreme (hardly to be recommended, however), or by each individual casting, as in Case *f,* as the other extreme. He would have, in any case other than Case *a,* a classified cost of his production, the amount of detail work necessary to secure the costs depending upon the selection from the list of cases; and, as outlined, the costing would take into consideration the fact that the production, though classified, was the output of a single department.

If, however, the foundryman found it necessary, because of his conditions, to obtain *all* the information possible to secure, it would then be necessary to divide the foundry into certain departments. Take, for instance, a foundry where a number of machines are in use; where a considerable amount of bench work is done, but where the bulk of the work is light and heavy floor work. It would then be well to divide the foundry into Machine, Bench and Floor departments, and each in turn could have its production classified according to one or more of the cases previously shown. To treat the foundry as made up of these three departments, it would be necessary to make a number of separations in the figures. The cost of Direct Material and Labor would be separated into the costs for the three departments, by divisions decided upon, while the other three items—Foundry Charge, Tonnage Charge, and the Commercial Cost, would have to be separated as far as possible into—First, the costs, which could be charged direct to the three departments, and second, the costs of a general nature which would have to be apportioned to the production of each department.

A brief analysis of the costs accounts, which appeared in Chapter XIV, will show that there are several elements which could be charged direct to the departments; others could be charged part to the departments and part to the "general" section, while still others would have to be included in the "general" section. Each individual case would, of course, determine the divisions, but in a general way the apportionment shown on pages 352, 353 would be representative of the items which would appear as direct, direct-general, and general charges.

After the costing has been done along the lines suggested, it will be found that the departments are charged with the proper amount of Direct Material, Direct Labor, and a portion of the Foundry Charge, Tonnage Charge, and Commercial Cost, and in order that the production of the departments may absorb all the expenses, it will be necessary to distribute the remaining portion of the three latter elements in the "general" section, in such a manner as shall give to each department an equitable amount. To do this Direct Labor can be used as the basis for distributing the Foundry Charge and Commercial Cost items, while the Tonnage Charge items are distributed on the basis of tonnage produced. This seems to be fair, as the department having the largest amount of Direct Labor and tonnage would have to stand the largest amount of these expenses apportionable to labor and tonnage, which could not be charged direct.

Representative distribution of Costs

Foundry Charge.

Direct to departments—
Power Plant, Shipping, Rigging, Taxes and Insurance.

Part direct to departments and the balance to "general"—

Cleaning Labor, Chipping, Shop Supervision and Clerical, Foundry, General and Cleaning Room Supplies.

General—

Maintenance of Buildings, Plant Equipment, Power and Transmission Machinery and Cast Equipment; Stable, Pattern Shop, Machine Shop, Carpenter Shop, Blacksmith Shop, Pattern Storage and Depreciation.

TONNAGE CHARGE.

Direct to departments—

Replace Labor, Night Gang, Foundry Supplies, Core Room Supplies on the basis of the Core Labor in each department, and Maintenance of Patterns.

Part direct to departments, balance to "general"—

Maintenance of Flasks.

General—

Cupola Labor, Handling Materials, Yard Labor, Cupola Supplies, Power Plant, Analysis Expense.

COMMERCIAL COST.

All of the Administrative to "general."

All of the Selling direct to the departments where possible and the balance to "general."

The following rules can be used for distributing to the departments the Foundry Charge, Tonnage Charge, and the Commercial Cost items in the "general" section:

Rules for Departmental Distribution

1.—For Foundry Charge and Commercial Cost—
A—Direct Labor in the Machine Department.
B— " " " " Bench Department.
C— " " " " Floor Department.
D—Total Direct Labor $(A + B + C)$.

$\frac{A}{D}$ $\frac{B}{D}$ $\frac{C}{D}$ = Departmental rates in per cent.

Distribute to each department, using the rates ascertained, the proper proportion of the Foundry Charge and Commercial Cost, treating each expense element separately.

2.—For Tonnage Charge—
E—Tonnage in Machine Department.
F— " " Bench Department.
G— " " Floor Department.
H—Total tonnage produced $(E + F + G)$.

$\frac{E}{H}$ $\frac{F}{H}$ $\frac{G}{H}$ = Departmental rates in per cent.

Distribute to each department, using the rates ascertained, the proper proportion of the Tonnage Charge, treating each expense element separately.

3.—For each department, add the amounts charged direct and distributed, according to the following classes—Direct Material, Direct Labor, Foundry Charge, Tonnage Charge and Commercial Cost.

We are now in possession of three sets of figures covering the three departments, and to get at the detailed costs of the product of each of them, use the rules 11-19 inclusive, by simply adding the words "for each department" as, for example: (Rule 11)—"Select from the list previously shown—cases *a-j* —the division desired, for each department," and after the rates per 1,000 pounds have been ascertained for each classification of the production in each of the three departments, the foundryman will be in possession of what he wants to know regarding his costs to produce.

Each foundryman must determine for himself, from his conditions, whether he wants to treat his foundry as a single department or to divide it into several. If the principal requirement is almost absolute accuracy, regardless of the detail necessary, and the proposition is a large one, then there is no question but that the accounting should consider the foundry as made up of several departments. If, however, the foundry executive does not want to go into the detail that is necessary to departmentalize his foundry, and if costs are wanted that are fair and within reason, the foundryman can then consider his foundry as one department with a classified output, which will give the results he wants at a minimum expenditure.

While not within the province of this discussion to lay down hard and fast rules as to specific treatment, the following is offered for foundries considered as a single department, as a means of covering the ordinary conditions that are met with in the three classes of foundries previously mentioned:

1.—Foundries under Class 1, classify production according to Case *g* (customers' work) with provision to treat certain work according to Case *f* (individual castings).
2.—Foundries under Class 2, classify according to Case *d* (use).
3.—Foundries under Class 3, classify production as shown at 1.—for jobbing work, and at 2.—for work for consumption by the business of which the foundry is a part.

Through the methods above suggested, we get at the end of a period, for Class 1 foundries, the cost of production by customers, which cost is offset by the price at which the work is sold to the trade, the difference establishing the desirability of the work in question as well as the places where attention must be concentrated; and as provision can easily be made for ascertaining the cost of certain castings for certain customers, the foundryman has in his possession, through the classification suggested, the information necessary to improve where necessary, the conditions determining *how* he shall improve. We also get at the end of a period, for Class B foundries, the cost of the castings for the machine or boiler shop, according to the use, which cost is offset by the price allowed the foundry and charged to the departments using the castings.

Few appreciate the fact that consumption of castings should be at rates which recognize the difference in the cost to produce them, so that it seems important that our costing take this difference into consideration. A clothier, because he purchases 100 suits at $15 each, 100 suits at $20, 100 suits at $25, and 100 suits at $30, will not sell them at $27 each simply because $27 means the average cost of $22.50 plus 20 per cent profit. Assuming, however, that he did this, on his $15 suits he would make $1,200; on the $20 suits he would make $700; on the $25 suits he would make $200, while on the $30 suits he would *lose* $300, and as a result he would have $1,800 profit in all. The chances are that he would have a hard time disposing of $15 and $20 suits at $27; while because of the quality, his customers would jump at the chance of buying $25 and $30 suits at $27. At any rate, on his two most expensive lines he would make $200 and lose $300, and he would perhaps have to trust to good fortune and "sales" to dispose of the others; so that by the time he had sold them all, he would very likely find that he was a long way from making his 20 per cent. Instead of this, our clothier would take each cost and add his profit, and if a man wanted a cheap suit, he would pay a price that would net a profit of 20 per cent, which would also be the case should a man want a more expensive garment, and when the suits were all disposed of, the clothier would find that he had made a profit of $1,800 on his investment.

This illustration applies to machinery manufacturers making their own castings. An average cost, because of the word "average," means that some cost more and others less, and there seems to be no consistent reason why the difference should not be observed. Assume that in a machine shop two lines are being manufactured—one a steam engine of simple construction, and the other a gas engine of intricate and complicated design; it will be found that the castings for the first line will cost considerably less than the castings for the gas engines. If the steam-engine castings cost $2.25 per 100 pounds and the gas-engine castings $2.75, why use an average of $2.50 for all? A difference of $5.00 per ton either way is something to think about when the total weight of the castings in the engines is taken into consideration, for on the steam-engine castings it would mean a reduced cost of the finished engine, which would result either in a greater profit, if the regular price is obtainable, or the *same* profit on a larger number of sales, due to a decreased price; and while the cost of the finished gas engines would be greater, necessitating a higher price, it is reasonable to ask the consumer to pay the most for that which cost the most to produce, especially when it is a complicated proposition of superior design and workmanship, enabling the manufacturer to talk quality.

I wish to emphasize, at this point, the importance of treating *all* foundries as *jobbing* foundries. If a machine shop is purchasing its castings from an outside foundry for $2.70 per 100 pounds, this figure is naturally used by the machine shop in figuring the cost of the cast iron in the machine. Should a foundry be built and operated, the person who is placed in charge of the foundry may, through efficient management, turn out a production costing $2.45 per 100 pounds. These same castings, purchased outside, cost $2.70; therefore the castings that are made are worth this same amount to the company, the foundry being entitled to a credit of $0.25 per 100 pounds as the difference between what these castings are worth and what they actually cost to make. Suppose, for instance, a certain machine selling for $2,000 contains 20,000 pounds of cast iron, which at $2.70 per 100 pounds would mean $540 as the cost of this material. Would it be good business, if the machine had a ready sale, to reduce the price by $50 simply because the castings are being made for $5.00 a ton less? Or would it be better to treat this saving as a profit—which, in reality it is—and as such having nothing whatever to do with the matter of price? The latter method seems the most logical, and if any cut in price is necessary it should be at the expense of the department getting the credit for the sale.

In estimating, market conditions largely prevail; and there seems to be no good reason why a price of $2.45 should be used instead of $2.70, if this latter quotation is near the market figure. A sales manager recently stated that whenever he bid on a job which contained considerable cast iron, he was generally able to get the work—in fact the orders seemed to fall into his lap. This led him to investigate, and he found that his competitors were using a *greater* rate for cast iron than he was. Looking still further, he learned that he was using the actual foundry cost figures—which was not a complete cost by any means—instead of the rate that he would have been forced to use had his company been purchasing the castings, with the result that he had, unknowingly, been "doing" his company out of profits which would have been made had the rate been higher. At any rate, the cost figures were increased without any apparent reduction in sales.

On the other hand, suppose on account of a low tonnage or other reasons the castings should cost \$2.90 instead of \$2.70. Would it do to charge the machine shop with castings at \$2.90—an increase in the cost of \$4.00 per ton—or make the foundry stand this loss by charging the machine shop with castings at \$2.70, in this way costing up the work at a price for which the castings could be purchased outside? It would certainly not do to take the $2.90 price into consideration for estimating purposes, because of the fact that the competition might be using a price around the $2.70 mark—the difference amounting to quite a little on an order of any size. At any rate there is no getting away from the fact that a loss has been made, for if castings which cost $2.90 to make can be purchased for $2.70—and only good ones at that—then $4.00 per ton is being thrown away; and as the machine shop is in no way to blame for this loss, we should make the department producing these castings stand whatever the loss might amount to. If the foundry is to take care of its own losses, *then the foundry is entitled to any profits it might make.*

The foundry should therefore be considered as a producing department, in the same sense that the machine shop is a producing department, instead of treating it as an adjunct of the machine shop. It should be carried as a separate department through the general books of the company, in this way placing the foundry squarely on its own feet —side by side with the machine shop, a position it is most certainly entitled to—besides furnishing the proper incentive to each and every man, from the foundry superintendent down to the apprentices, for the reason that they feel that if all do their share in making a success they can participate in that success through increases in pay. In addition, such a procedure gives to the management a means for determining the efficiency of its foundry department, as well as deciding them as to whether it would be policy to close their foundry and purchase their castings elsewhere. It also places the foundry on about the same basis as outside foundries, which not only tends to make estimation more uniform, but competition more intelligent.

To carry the foundry properly through the books of a manufacturing company, I would suggest that two accounts be opened as General Ledger accounts — Foundry Manufacturing Account, and Foundry Income Account, and as a large number of concerns are beginning to treat all materials as "stores" until used, the plan should be to sell monthly to "stores," as "castings," the total output of the foundry at a price that will correspond as closely as possible with the price that would have to be paid for purchased castings. To illustrate: assume that the foundry produced 300 tons in a month at a cost of $48.00 per ton, or $14,400, the divisions being—materials, $6,000; labor, $3,900, and expenses, $4,500—the price allowed the foundry being $2.65 per 100 pounds, or $53.00 per ton. Our Journal entries would read:*

	Charges.	Credits.
(1) Foundry Mfg. Acct. 300 tons produced @ $48.00 ton..	$14,400	
Stores Acct..........		$6,000
Labor Acct..........		3,900
Burden..........		4,500
(2) Stores.............300 tons purchased @ $53.00 ton...	15,900	
(3) Foundry Mfg. Acct..300 tons sold to Stores..........		15,900
(4) Foundry Mfg. Acct..Profit, month's production.......	1,500	
(5) Foundry Income Acct—Monthly profit 300 tons..........		1,500

LEDGER ACCOUNTS.

Stores.

(2) 300 tons castings purchased from fdry. @ $53.00 per ton.....	$15,900		

Foundry Mfg. Acct.

(1) 300 tons produced @ $48.00 per ton.....	$14,400	(3) 300 tons sold to stores, $53.00 per ton......	$15,900
(4) Monthly profit......	1,500		
	$15,900		$15,900

Foundry Income Acct.

		(5) Monthly profit 300 tons,	$1,500

Before concluding, it might be well to state that in determining the cost of production in foundries in Class 2 and 3, consideration should be given to the fact that there are no selling expenses to be added to the produc-

* Figures show Journal entries and corresponding postings.

tion made for use for the business of which the foundry is a part, because of the fact that this expense is necessary in marketing the finished product of the machine or boiler shop, for which reason it would be a charge against the production of these departments and not against that of the foundry—the business really buying, as before stated, the entire monthly production of the foundry, this transaction being one in effect only, involving the expenditure of no money whatever as a selling expense. Defective castings returned from the machine or boiler shop because of defective workmanship in the foundry—the only selling expense element the specialty foundry has to deal with—would be treated as "foundry errors" and included in the Foundry Charge section, at the price less scrap value. Foundries in these same classes, in the absence of an organization of their own, should be made to stand a portion of the general administrative expenditure—a combination of judgment and an analysis of the items making up this element, to determine the proper proportion to charge to the Foundry Department.

THE END.