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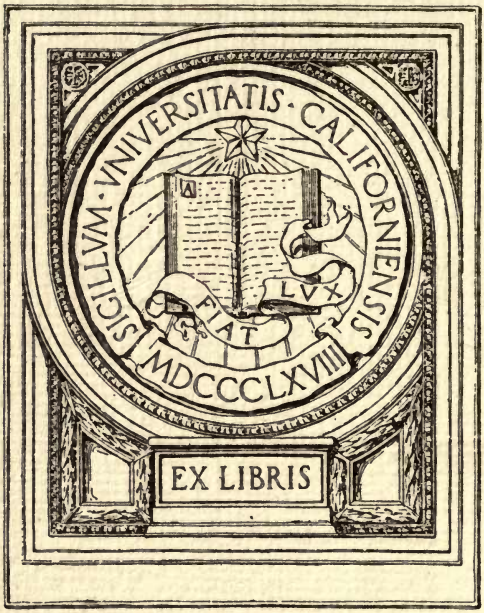
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# EXPERIENCES IN EFFICIENCY

BY

BENJ. A. FRANKLIN

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ANNEX

# INTRODUCTION

Mr. Franklin's book is offered in answer to a many-voiced inquiry for specific examples of efficiency methods. It shows the employer or manager, struggling with problems of increasing cost of operation and diminishing returns, how other men discovered and used a road to success out of similar difficulties. It is a concise record of "leading cases." The material is selected from the author's wide and successful experience and represents a diversity of situations in a variety of industries. In each case the story is reduced to its simplest elements, but it still shows clearly the character of the problem attacked and the nature of the solution found. It tells what was done, why it was done, and how it was done.

Most of the chapters appeared originally in THE ENGINEERING MAGAZINE. As here reprinted they are revised, adapted, and marshalled in sequence so as to constitute a logical and progressive survey of practice, following the order in which it demands the manager's attention. It begins with the thing which is generally uppermost in a manufacturer's mind—the handling of labor. Four chapters are given to methods of increasing both output and quality of direct production; the fifth extends the same principles to the treatment of clerical, or "non-productive," labor; the sixth enlarges the same applied ideas so as to include the entire force. In the seventh chapter

we pass from the individuals to the organization; in the eighth we attack a reduction of factory expenses; in the ninth we develop an efficiency cost system, and in the last chapter we find all the preceding measures connected to and based upon the fundamental necessity of "efficiency will" as a driving force in the establishment of efficient practice.

CHARLES BUXTON GOING

# PREFACE

The methods employed even in the most efficient plants are, in the main, after all but the methods, possibly somewhat modified, tried and found effective here and there in different places in the manufacturing and business world, and passed along consciously or unconsciously.

The successful executive, after all, is essentially or even generally not an originator of new ideas, so much as he is an assimilator and an adapter inspired by what he sees, hears and reads.

What is successful in one plant, with proper change, adaptation, and modification will be successful in another, if the basic principle of its operation is understood.

These three principles have emboldened the author to recite the few experiences herein enclosed, with the hope that here and there they may offer that inspiration by which so many efficiencies find their beginning.

BENJ. A. FRANKLIN

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# EXPERIENCES IN EFFICIENCY

## Chapter I

## A SUCCESS SECURED BY STUDY OF WORKMEN'S TENDENCIES

IN American business life, especially in the manufacturing division, there has arisen almost a hue-and-cry for methods of higher efficiency. This demand is in no sense temporary, nor is it illogical. It is the reasonable outcome of three well-known conditions.

It is, first, the natural corollary of the forward movement of the last few decades in science and invention, of which an enormous increase in efficiency by machinery has been a feature.

Secondly, the high cost of living has been persistently demanding an antidote, and greater efficiency apparently offers some hope of remedy.

Thirdly, the constant demand by labor for increase of wages, meets, on the part of

capital, an offset in a demand for higher efficiency; and there are those who hope to see, finally devised and developed into universal practice, some method or methods of efficiency and reward which will go far towards solving the problem of proper justice and balance between these two warring elements.

The methods of efficiency most often and most spectacularly attack labor. This is so because this element possesses the most elasticity in its efforts, can be quickened into more efficient action with the least expenditure in surroundings, and of course is the most oft-recurring element in production and in the cost of manufacture.

The results obtained in this attack are sometimes almost magical in effect. The magician sets out his stock in trade, rolls up his sleeves, and explains how ordinary and usual are all the conditions. A few graceful motions, and lo! the unexpected and apparently impossible has taken place, and we wonder and admire the result. But back of every wonder-production lies a simple explanation, a definite plan, the skill of practice and experience, and a knowledge of human limitations and tendencies.

So, exactly, is the case with some examples of efficiency work, although often results, which in the end are remarkable in comparison with the conditions at the start, may take some time—six months or a year or even longer—in arriving at their fullest values, and faith and patience are necessary in their moulding. And often there come by-product results well worth while, if unexpected.

Such a case, where in the work of a gang of a dozen men on one operation over $30,000 a year is saved, may be cited as an example.

The scene is laid in a large factory where leather in various finished shapes is the product. Now leather is a very valuable material in the finished state, especially in certain articles of large and fine quality, but it decreases in value very rapidly when it becomes waste. Therefore waste is to be fearfully avoided. But it must be noted that Nature, abetted by certain careless handlings *en route* to the final process, has not arranged that the bovine hide shall always be perfect, of uniform thickness, or each one like every other. The hide must therefore be cut into different parts for different uses,

and the different parts trimmed according to their particular conditions. And this makes waste.

At one stage of the preparation of certain leather for a final use, the operation consists in trimming off, from the ends of certain long heavy strips, that portion which (because of thinness or other defects) is unfit for the purpose of the strips.

The volume of business at this operation causes the employment of about a dozen men, working on the day-work basis: i.e., being paid a fixed amount per day or hour. These men are instructed to trim the strips according to their judgment, somewhat trained, and one inspector looks over all the strips when finished, turning back to the workmen any strips not properly trimmed.

Leather left on the strips is worth on the average 50 cents per pound. The leather waste, cut off at this point, is worth about 10 cents per pound—a very decided loss.

Thus the stage is set and the conditions seem very natural.

But here really exists a situation with very strong tendencies to high inefficiency, which the watchfulness of a general foreman could not prevent very materially, and

which any effort of his toward greater production per man was liable to make worse.

This inefficiency expressed itself in two ways: First, in a small production per day, based on the plea that too rapid work meant careless trimming and high waste; second, since no trimmer desired to have the inspector throw back work upon his hands for a second trimming, he made sure, so far as he could consistently with not making too much waste, that enough was cut off to take it safely past the inspector. These tendencies meant small quantity and poor quality of work; and they were very strong tendencies, because they were daily present in a somewhat monotonous task.

High efficiency for constant or increasingly better results demands right tendencies. The ordinary workman will not continuously fight against wrong tendencies without reward. It is evident, then, that the problem here was to discover methods that would reverse the tendencies, viz., make them operate towards more and better work.

To accomplish this, it is plain to every practical man that some incentive must be offered to the workman, for the tendencies

operate through him and must be counteracted through him.

In the final analysis, from a practical viewpoint, the workman works for money, and appeals through other motives must be subordinated. He has a family to support, or hopes to have, and an increased weekly pay appeals strongly to him. Not that this appeal is in any sense confined to the workman, and it is somewhat unfair to him to believe that, as a rule, he does not take pride in his work, and attempt definitely to do it in what he thinks a fair and capable manner. There is a tremendous lot of human nature in the ordinary everyday workman, and despite the occasional belief of many employers to the contrary, he is not in the class of the donkey with the corn dangling in front of him. He is exactly the man his employer is, only lacking some opportunity, training, or quality which has placed the employer in the more fortunate position. But with his pride in his ability and his work, there is needed, to keep it up to high and constant pressure, a reward which he can express in things he wants. Such a reward is, of course, money—although appreciation as an addition is always welcome.

The problem in this case, then, narrows down to the devising of a proper money incentive to turn the tendencies toward *inefficiency* into tendencies toward *efficiency*.

Now the universal form of incentive to labor is to pay it, in some manner, proportionately to increase of production in the unit of time. But it is plain that in this case an incentive for quantity would cause a haste in trimming which would only increase the tendency to waste, and thereby much more money might be lost in waste than could be saved by increased production per man.

On the other hand, an incentive to save waste alone would have the tendency to slow up production and materially increase the labor cost.

Very evidently, then, what was needed was an incentive dealing with *both quantity and quality*, in such a way as to get the maximum production with the minimum waste. But since the saving of waste was much more important than the obtaining of a large production, the incentive must be so arranged that the workman should with certainty net the highest wage from just that combination of increase of production and decrease of waste which would also net the company the

best returns of value. In such an incentive, however, there existed just as strong a tendency to leave on bad leather as formerly existed to cut off good leather. This tendency must be controlled by honest inspection. Thus far, then, went the study in human tendencies.

Now began that study of surroundings, time of operation, mechanical arrangement, tools and conditions, which every effort for efficiency demands. This involved time studies, experiments, and records, in order to fix upon that maximum number of strips which the competent workman could trim with the minimum waste, under the best obtainable conditions.

Such studies involve experience and technicalities, and are more interesting generally in the result than in the relation. Necessarily there was computed the saving to the company in labor for every hundred strips trimmed over the average number already being produced, and the saving in waste resulting from every ¼ per cent reduction under the average percentage being made.

These studies accomplished, there were now known the following facts:

Average number of strips trimmed per day, with average percentage of waste.

Standard number that should be trimmed per day with standard minimum waste.

Saving to be made to the company by every unit of advance, both in increase of production and in decrease of waste, in passing from the average to the standard.

An analysis of the tendencies of workman handling the strips, and an incentive devised to make these tendencies right.

It thus became a fairly easy matter to arrange the incentive at a base rate per hundred strips trimmed, with the waste at the average percentage and with an additional rate per hundred for every ¼ per cent of waste saved, and a decrease of rate per hundred for every ¼ per cent added to the average. Thus the rates might look like this:

| Percent of Waste | | Cents per 100 |
|---|---|---|
| 7 | | 46 |
| 6¾ | | 47 |
| 6½ | | 48 |
| 6¼ | | 49 |
| 6 | (Base Rate) | 50 |
| 5¾ | | 51 |
| 5½ | | 52½ |
| 5¼ | | 54½ |
| 5 | | 57 |

That these figures are not the actual ones does not make less their ability to illustrate the method of reward offered for betterment, and penalty assessed for doing worse than the average.

In fixing the additional rates there had to be taken into account two things—the amount saved to the company by better work, and that portion of the saving which would be sufficient to cause the workman to strive to make it; for men will make increased efforts only for what they consider a reasonable reward.

There yet had to be counteracted the tendency of this method to make the workman leave on bad leather to make his percentage of waste low; and this was accomplished by very materially increasing the salary of the inspector, with the warning that his job depended on no bad leather getting past him. He now had a much better paid job than he had ever expected. It was too good to lose, and he volunteered the remark that "any guy what got past him with any bad stuff that lost him his job was in danger of his life." He still has the job, with no casualties reported.

The new methods were now put into opera-

tion; but before success could be assured there were still conditions to be regulated. Methods alone are inanimate. They must be animated, to be successful. Many good ones fail for lack of this addition of a soul. In the first place, efficiency is the result of concerted effort, and this does not generally come except through enthusiasm. This is to say, indeed, that efficiency founds itself on a state of mind, and this is a very vital point to consider. To create in the workmen enthusiasm for the new methods, it was first necessary to assure them that the incentives were fair and that the opportunities before them were real. Certain guarantees had to be made against any loss to them. Considerable attention had to be paid them in the matter of judgment of good and bad leather, and in the way of training them. And especially was it essential to encourage and assist those who were known to be the most skilful, in order that they might, as an example, make some worth-while pay-envelopes. Once the possibilities were developed by one or two, there quickly grew the desire in others; a friendly rivalry as to records and pay sprang up, the monotony of the work vanished, and efficiency had arrived.

The company itself learned things it had not properly appreciated before. Urged by disputes between the workmen and the inspector, it made more careful tests (through a testing machine) as to what, for the particular purpose desired, really did constitute good and bad leather.

Likewise, as is always the case when men are put on their mettle—in a battle, in a game, and in work as well—when a measurable call for ability was made, it soon developed that certain men, by their performances, showed clearly their superior skill in getting out a large production, combined with the judgment of just where to cut to make the least waste—and others showed their lack of adaptability for the work. This discovery very soon brought about better training of the men, and also some readjustments in the plant which brought to this operation the men most capable for it.

The day-work method of payment permits many a man to work at a task for which he has neither taste nor ability, when he might make his mark at some other. Proper incentive methods pick out the able men and often force out the unable, not infrequently into tasks at which they achieve greater success.

Touched thus by the wand of efficiency, the net result of these changes in this operation was remarkable. The men made very much better wages, and found a real interest in the attempt to make good records and good pay weekly. They had now something definite to work for. But to the company came the magical result. In six months the percentage of waste had dropped to one-third of the former average, and the production per man had materially increased, effecting, as previously stated, a saving in operation of over $30,000 a year.

Thus a study in tendencies led to a great efficiency, through quality piece-work.

## Chapter II

## A PROBLEM OF QUALITY OF WORKMANSHIP

IN manufacturing, the problem of quality of workmanship, or, perhaps, to put it more practically, the problem of producing articles to a predetermined standard of quality, is ever present, and never completely solved to a thoroughly satisfactory degree, even in the best managed plants. Even in articles of few parts and involving few processes, there constantly occur difficulties and defects, some natural and some avoidable, causing complaints and losses.

Multiply the few parts into a greater number, many of them being small; the processes into many and delicate ones; and the production into large volume (as in the case of many complicated machines, like the typewriter, the automobile and so on), and the possibilities of loss and delay may be multiplied still more rapidly. There are those who

may desire to make the further observation that if to these multiplications, there be further added the substitution of piece work or incentive methods in place of day work, the problem of obtaining standard quality is still further complicated; and it is not to be denied that under improper conditions a tendency toward deterioration naturally lurks in any incentive method that tends to hurry the mind or body of the workman.

Nevertheless, considerable experience has shown that quality of workmanship is not a matter of day work or piece work, of slow work, or rapid work. Quality is a matter of systematic insistence. That plant which demands a standard quality from its workmen and aids them by proper appliances, training and discipline, obtains it equally well under either plan of payment. And there are very many plants operating today under incentive methods, yet producing higher quality goods than similar plants operating by the day-work plan.

The necessity of the constant struggle for standard quality of workmanship is the very natural outcome of three main weaknesses of human nature as applied to modern industrial production—(1) wide variations in

the natural skill and in the past training of operatives, due somewhat to the lapse of the apprenticeship system; (2) the constant expression of a lack of interest and concentration on the part of a certain percentage of the operatives, not sufficiently counteracted by discipline; and (3) a failure on the part of the management to make proper preparations, to give proper instructions and training, and to maintain necessary discipline.

It is not practically conceivable that these weaknesses will find any radical and universal remedy within the very near future, even if it may be said that modern methods are creating a tendency constantly to reduce them. Nevertheless the practical man finds himself impelled to seek definite remedies to suit his particular needs, and perhaps the methods employed in the case of one large plant may be of interest as illustrating a successful method of betterment, not merely of quality of workmanship but of other attendant results.

Consider, then, the elements of the situation: A large plant with some twenty departments, consisting in storerooms for rough and finished parts, machine shops, tin shop, forge, paint shop and assembling

rooms; with about six-hundred operatives, the number fluctuating somewhat according to the season of the year; producing in predetermined yearly quantities a machine of numerous parts, many of which are small, and undergoing in their preparation from five to twenty operations each, these operations frequently performed by as many different operatives—the parts being ordered in the rough from foundry or forge or cut from raw material, being worked upon in the preparatory departments in lots, till, passing through the finished stores to assembling rooms, they are first assembled into sections and the sections then assembled into the finished machine.

Such a situation is a rather usual one for many factories, and theoretically it would seem (after the questions of design are settled) rather a simple one to plan and to push. But the practical man will recognize at once the many probabilities of difficulties, delays, and losses, even granted that the large problem of getting all the parts into the plant and started to the first operation has been satisfactorily accomplished.

In practice the parts were started through the plant in lots of 10 to 200 pieces, accord-

ing to size and length of operations, the intent being that no lot should be so large in bulk or number as to halt more than a reasonable time at any one operation, so that it might be unnecessary to split it. And, of course, there were very many lots constantly on the march towards the finished stores and assembling departments.

All this sounds very simple and orderly in recital. The imagination can readily picture these parts, grouped in lots, in boxes where possible, properly ticketed with information, progressing from department to department through needed operations of finishing, and all arriving finally to their intended use and function in the complete machine—for of course this is exactly what the plant, its organization and methods, existed for. But the actual practice might readily have been compared to numerous bodies of soldiers starting in good order to a battle rendezvous, going through the struggle, and assembling, though victorious, in much depleted array. For, under the conditions existing, while some lots came through quickly and intact, others came through much diminished in numbers and the missing parts could never be found. Still others came

through entirely or in part unfit for use. Some halted in their progress until insistent cries from the assembling room started tracers after them to give them a push along their way. And some lots disappeared entirely, or were discovered only after duplicates had been ordered to take their place.

Despite the fact, then, that completed manufacture went on and many successful machines were shipped out, the net result of this situation was that the floors of the departments, especially in the busier season, were clogged with parts; foremen and tracers were kept busy searching and "hustling" needed parts, and delays in the assembling room caused much loss of time and money; and the disappearance and loss of parts through poor workmanship mounted up to a considerable sum.

A peaceful canal running past some of the machine shops had the even tenor of its way frequently and rudely interrupted by the impact of spoiled parts passing swiftly and mysteriously out of the windows, and it was said to have a steel-lined bottom; a well-known quotation, representing a certain spirit in the shop, which frequently followed

them, was "what the eye don't see, the heart don't grieve for."

Now, of course, there can be no pretense that any such situation could be characterized as efficient, yet it is not different, if the imagination is not forced in this conception, from that which exists in many plants. And this plant made a fair profit.

The first necessity in any attempt at a remedy was an analysis to discover the underlying reasons why delays and losses seemed to occur constantly, as if there were some evil principle at work. It was not difficult, of course, to find the reasons in many given cases, and though they varied considerably in detail, it soon became clear that loss and spoiling of parts were definitely due, at the bottom, to the fact that very many operatives did not have (and could hardly be expected to have) any idea of the use and function of most of the parts they worked on. They were therefore performing their mechanical operations doubly mechanically and monotonously, and did not have either that supervision or that sense of constant accountability which is necessary to counteract such a condition. The loyalty and pride of work which might have been of material as-

sistance here did not sufficiently exist, because the somewhat seasonable nature of the work made many of the operatives transients, and generally of the less skilled class. Of course there were many loyal, skilful men and there were good reasons generally for losses for which they were responsible.

The delays were readily traceable to the fact that the parts were inanimate, and moved forward only at the volition of an animated system, while the management, in their order system, foremen and tracers, had supplied this so that it was a spasmodic rather than a continuous operating plan.

The problem, therefore, in the search for quality and satisfactory movement was to discover and put into effect those methods which would give each operative the desire to perform every operation he undertook in his best style, and to supply animation to the lots as desired.

Now it is a fortunate quality of efficiency, not sufficiently used as a basis of operation, that very frequently the simple method is the best, and sometimes it is the only successful one. This is recognized often unconsciously when it is said of some plan or mechanical arrangement which is successful;

"How simple! Why wasn't that thought of before?" Efficiency in its conception is not at all a complicated proposition requiring wonderfully ingenious devices. But a frequent trouble with the obvious method is that it involves expense, and requires patience and persistence to get into operation, so that faith and imagination are required in the inception and through the development.

The philosophy of Hamlet that it may be "better to bear those ills we have than fly to others that we know not of" has undoubtedly found many followers in the ranks of manufacturers in their consideration of the methods of efficiency.

In this case any method effective in making each man intent on the quality of his work, must make it very clear to him that at the completion of each job the management would know just how well or poorly he had done it, and that he should expect to be held definitely responsible for lost or spoiled parts. This is merely operating along the lines demanded by the ordinary human nature of the situation, a necessity lying at the root of all methods of labor efficiency.

The obvious necessity, then, was that each lot of parts should be inspected and reported upon after each operation. Such a plan would bring about a simple but vast difference; for, instead of a general knowledge that parts were spoiled or missing when the lot reached the finished stores or assembly rooms (creating possibly an investigation involving a dozen or so men, some of whom might have left in the meanwhile, and covering frequently a considerable lapse of time, all of which investigations usually end in befogging disputes), there was substituted a definite responsibility, readily placeable on one man at the moment. Such a method, as indeed proved to be the case, immediately tended to relieve the work of monotony, since it introduced to each operative a definite and constant accountability, and brought inquiries as to methods, uses, and needs, which much elevated the tone and interest in the shop.

Now this plan necessarily involved a corps of inspectors and a definite expense, always a point of much consideration to the executive, and properly so. On the other hand, it carried with it measurable possibilities of the saving of lost and spoiled parts, and

in addition promised a fine means of bringing parts through the shop in desirable order for the saving of delays in assembling. It proved not too difficult a proposition to balance the estimated cost of inspection against probable savings of losses and delays and the plan was accepted.

It is not to be maintained that in all such circumstances a similar decision might have been adopted. It is not true of methods of efficiency that if successful in one plant they are necessarily similarly applicable in another. The principles of efficiency are always operatable, but it frequently happens that a particular principle, effective and profitable when carried out by a given method under certain conditions, human or mechanical, under different conditions, may need to be applied by some other method to be profitable. Herein, indeed, lies the necessity and value of ingenuity in efficiency application.

In the given case, the plan being decided upon, it was proceeded upon. And the method of it was this:

An independent inspection department with a chief, a clerk and a corps of inspectors chosen from the best men in the plant, was established. This corps comprised about

ten men eventually; but since it absorbed the tasks formerly occupying the time of three or four tracers of lost and delayed parts, there was a net addition of only six or seven, at an approximate cost of $6,000 or $7,000. The department was equipped with blue-print drawers and ample inspection tools.

All parts were issued from the rough stores (where they were received at the factory) in lots, the number in which depended upon the size and intricacy of operation. These lots were sent to the operating departments through the inspection department, after passing inspection.

With each lot went a lot card stating the lot number, part number, blue-print number, operation numbers, number of pieces in the lot, and any other necessary information. This card, guarded against loss by the inspection after each operation, followed the lot through to the finished stores, and presented to the observer a history of any loss or delay.

With each lot was also issued a time note with necessary details thereon, on which was the rate, if an incentive method was used. Of course it eventually contained such necessary data as the name and number of op-

erative and time of starting and finishing, and the inspector marked on it the number of good parts finished, and the number spoiled, with cause, before it was turned in to the inspection department clerk. Each lot was thus constantly equipped with complete information.

As the lots were finished in each operation, they were inspected and the cards were properly marked, each inspector reporting daily as to what he inspected, with full information as to the result, and the lots were passed along physically to the point of the next operation.

This inspection took place as often as was possible in the inspection room when the parts could be easily brought there after the operation or where the inspection was important as to exactness. In those cases where the parts were large and expensive to move, or where the principal item of inspection was a verification of the count, as in a roughing operation, the parts were inspected in the department where they were operated upon. Common sense decided each case.

The clerk in the inspection department had in his charge large cards, one for every machine part, of different colors for different

sections of the machine. These cards, filled from the time notes daily, showed the entry of each lot of parts into the factory and its progress by dates through the various operations, with all casualties reported.

Now this is all very simple and straightforward in method and—dull in recital, even without further details added in the development of the plan. For interesting as efficiency methods are in their development and operation, it would take more than a Jack London to emotionalize these details in script to make their description fall among the best sellers. The general reading imagination, readily as it pictures and enjoys the unreal, emotional, and adventurous, refuses to deal after working hours with the affairs of everyday business life and the educational, for perhaps after all, to the majority, these are dull and dry.

Of course, simple as this plan was, it had to undergo development, for development is essentially the means by which an efficiency method passes from the theoretical, where it is believed in by a few, to the practical where it is operated by all. In every plant of any size, it will readily be understood, there are many varying opinions, habits, rights or sup-

posed rights, customs, and individual methods, not to speak of physical obstructions, all of which must swing into average accord with any plan before it becomes effective.

This development consisted first of a slow spread of the inspection to cover all parts and all departments, taking weakest spots first, and thereafter of a refining process. First the newness of the plan had to wear off. The inspectors had to be trained to work rapidly and systematically, to know what to inspect carefully and what roughly, and not to wait around to be sent here and there, so that the cost of inspection might be kept at a minimum. In short, the inspectors had to be trained to inspect accurately and rapidly and to do a day's work. It took, of course, some time to decide in each case where the parts should be inspected, *i.e.,* at point of operation or in the inspection department. Some time must pass also before the operatives got accustomed to having their work inspected without agitation and comment, and without some embarrassment on the part of the inspector if in their presence. In fact, the whole proposition had to work itself into a routine affair where the inspectors, chosen men, did a full and un-

biased day's work and reported facts. It took some time, of course, to bring order and sequence of the flow of the lots to the finished stores, instead of the former spasmodic and erratic movement.

But the plan adopted in a few months became very effective, for, once the operatives learned that the result of each job they did was a matter of record, and that they were subject to criticism and in many cases to actual loss of pay or position, the quality of their workmanship vastly improved, and the disappearance of parts and the number spoiled very shortly fell to a minimum. The poor and careless workmen very soon betrayed themselves. Questions as to uses of parts, possibilities of machinery, demands for jigs and all helpful appliances, became more frequent; the saving amply justified the expense, and the canal again flowed peacefully on undisturbed by the surreptitious *ker-plunk*. It had to conceal no more industrial crimes.

But this was not by any means the whole gain. The cards of the inspectors' clerk, giving the history and position in operations and departments of every part, soon became the basis of knowledge and operation of a

proper routing system. The finished stores, issuing in advance the assembling orders, could demand (with great certainty of obtaining them) any desired parts, thus eliminating delays in assembling; and the saving did not end even here, for the method of control of the movements of the parts soon brought about better physical order in the departments and kept in front of each operative ample work for himself and machine, thus cutting out delays on his part and essentially increasing the production per man of total parts worked on, even in addition to the increase of good parts produced by the reduction of the number of the spoiled parts. The relief to the foremen was of course also very great. Their time, formerly largely spent in hunting and pushing needed parts, could now be spent in looking after their departments in the way logically planned for them, and the knowledge of the result of each operative's work gave them some command of the situation.

In fact, as is always the case when a particular efficiency method is introduced to remedy some particular fault, especially when order is brought about, many other

faults were likewise remedied and economies unsuspected were made.

Thus by the obvious method and the courage of expenditure based on a right principle, loss of material and labor was much reduced and production increased by the removal of delays, and the ideal function of the plant to receive, finish and assemble parts into workable machines was more closely attained.

## Chapter III

## WASTE SAVING THROUGH PIECE WORK

IN these days of increasing agitation for economical methods of manufacture, perhaps the element that receives the most universal attention is that of labor. This is not to say that there are not other elements of very large importance from the standpoint of possibilities of economy in every business, and indeed, in some plants, of greater economical significance than labor. But in the first place many of these other elements have received, and are receiving, in a progressive systematic manner, such attention as to bring not only constant improvement, but (which is really very much more to be desired in the plan of things) to open up still larger fields of returns for human effort. And in the second place the quick returns on intelligent action, the human interest involved, the increasing profit that lies in volume of production, the un-

limited possibilities of increase of product per hour that every man seems capable of developing, and, perhaps not a little, the fact that in any plant more energies and brains become immediately interested and active when the element of labor is dealt with, make it of supreme interest.

And so we are developing the possibilities of this element through motion studies and scientific analysis, and coaxing it on through its human side by the incentives of piece work, premium plans, bonus methods, efficiency standards, etc., with economical results as to cost, and with a hope that in the long run, all this will lead to decreasing selling prices. But there are those who think that this latter could be radically effected much more quickly by a decrease in the tariff, the discovery of a plan of distribution more direct, or a law-compelled or heaven-sent abnegation on the part of capital of all unreasonable profits.

However, to return to labor, it must be acknowledged that very good economical results are being obtained by the various studies and methods employed, and that a new era of labor values is being developed. It cannot be denied that too often the incen-

tive back of the introduction of these modern methods in labor handling is solely the narrow one of plant profit, and not the broader one of mutual benefit to labor and capital alike. Yet it is a fact of observation that when these methods of incentive have been introduced with a sense of fairness and appreciation of the full and continuous rights of labor, the net results to capital have been even greater than when the work was done in a narrow way, since such operation has aroused the most liberal spirit of friendly co-operation, which is most absolutely and essentially the true basis of all of these methods. And it is not to be doubted that through such a spirit of co-operation lies a development of this great problem that will lead to utopian results.

But in all this effort to increase the product per man-hour, quality must not be forgotten. In the matter of moving materials, of much rough work, and even of a good deal of work with precision and automatic tools, haste does not make waste nor affect the desired quality. But there are many operations and articles where judgment and care play a material part in the items of

quality and waste, and the unquestionable tendency of haste is to deteriorate.

This latter is the statement that is met when methods of labor payment according to product are suggested to the manufacturer who is proud of the high grade of his product, and who guards, as the secret of his profits, against any tendency towards deterioration. And certainly no advance is made, either from a profit point of view when one element of cost is decreased at the later expense of the selling price, or from a broader materialistic point of view when a poorer article is made from good material which care would make into a better article.

One hears much complaint, whether with a true basis or not, that workmen are not so skilled, so careful, as they used to be; that articles are not put together so solidly and well as formerly. If this is true, as indeed it may be in cases, it is only fair to labor to say that it is probably more the fault of the design, the plan, the attempt to imitate cheaply some popular or high-priced article, or perhaps even more than these the different divisions and training of labor, brought about by modern methods, than the fault of labor itself. Nevertheless, some

years of experience in many varied industries have left the conviction that quality is a matter of insistence, rather than of methods of either day or piece work. That is to say, that in that plant where a given standard of quality is insisted upon, the workmen will work to it whether they be paid on a day-work or piece-work basis.

To obviate any danger of retrogression in quality and loss through waste by possible carelessness on the part of workmen hastening toward daily increase of production on account of the rewards offered by the piece-work or other plan, the writer, working as a business economist, devised and put successfully into operation in several plants a plan of piece work in which the rate varies with the quality and per cent of waste, so that the daily pay of the operator depends not merely upon the quantity done per day, but very largely on the quality of the work. There is nothing new under the sun, it is said, and it would not be wonderful if one or more of the minds that have for years been working on these problems should have evolved some similar methods. Nevertheless, neither at the time of introduction of these methods, five or six years ago, nor

since, has any similar method come to his attention.

There are many articles the manufacture of which, both as to quality and the waste of raw materials, can be gauged very accurately; in which no great scope of judgment is allowed; in which accurate measurement and prearranged jigs and tools play a guiding and correcting part. There is little chance for judgment or waste, except through punishable carelessness, in the work of machining to blue-print size a casting, perhaps with jigs and fixtures. Here, and in many like cases, piece work finds a safe economy.

But there are many operations in very many staple businesses where haste and carelessness may spoil much material, or where care and interest may save more in material than the total wages of the worker. In these cases the executive naturally hesitates to reward speed and volume of production, because of a fear that his loss in waste will be greater than his gain in labor cost.

In such cases the executive will find "Quality Piece Work" a valuable method.

A practical case will illustrate this method.

In a large mill an important operation involved the pasting together of sheets of material. This operation developed a large tendency toward imperfections of various kinds, not only those arising from the spoiling of the material in pasting, but others due to further enlargement of defects during the drying and finishing operations—defects which careful pasting might avoid. The value of the material was such that its waste was a very considerable matter. Quality was the most important element to be considered.

Even on the day-work plan, it was the custom to sort over the material, so that the imperfect sheets were eliminated to be pasted separately. The pasting gang, therefore, started with presumably perfect stock, offering a fair basis for waste-gauging.

Starting with perfect material, there were two losses to guard against. The first was the turning of perfect sheets, through poor workmanship, into sheets not imperfect enough for waste, but so defective as to bring a lower selling price. The second waste was that absolute one where only a scrap value remained. The scheme put into effect must take care of reward for speed, but a reward so proportioned that the most careful and

skilled gang obtained a large return for good work, while poor work carried penalties in reduced rewards which forced out poor workmanship.

The detail of the method on this case was as follows. A standard ratio of imperfect pasted sheets to perfect pasted sheets was fixed, as well as a standard percentage of total waste. These standards were, of course, the result of records and experience.

The rate was based primarily on the percentage of imperfection.

While the figures given below are not exact, the following table shows in a general way how the rates look:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $1.12 | per | 100 | pastings | at | 2½ | per | cent imperfect |
| 1.10 | " | " | " | 3 | " | " | " |
| 1.08 | " | " | " | 3½ | " | " | " |
| 1.06 | " | " | " | 4 | " | " | " |
| 1.04 | " | " | " | 4½ | " | " | " |
| 1.00 | " | " | " | 5 | " | " | " |
| .98 | " | " | " | 5½ | " | " | " |
| .96 | " | " | " | 6 | " | " | " |
| .94 | " | " | " | 6½ | " | " | " |
| .92 | " | " | " | 7 | " | " | " |
| .90 | " | " | " | 7½ | " | " | " |

In addition, the waste is set at 1 per cent, and a fixed bonus per 100 pounds arranged for every 1/10 per cent reduction, or a deduc-

tion for every 1/10 per cent increase in this amount for the week.

The results in saving to the company in imperfect and waste, and the weekly increase of production, have been very well worth while indeed, and the employees have benefited 25 per cent to 50 per cent in increase in wages; one operator indeed for some years having averaged nearly 100 per cent increase over the old rate. The judgment as to the quality of the sheets pasted lies in the hands of people so far away from the pasters that there can be no question of its fairness to both the company and the workmen. The pasted sheets go through other operations and are sorted out as to quality when they are put up in final counted packages.

This example has been given in some detail in order to make clear by figures the method employed. The same method has proven applicable in many cases where judgment, carefulness, and attention could get more of an article out of a given quantity of raw material, with less waste, than the ordinary methods of supervision and labor pay will obtain, and it has been especially valuable in the case of leather.

The three elements in the operation of quality piece work are:

1.—To find operations in which waste is to be saved or quality bettered by care.

2.—To find by observation and data what can be done per hour on the quantity basis.

3.—To find what the average waste or standard quality is as a base for quality rate.

There have already been some important developments of this quality piece work in several factories. It can be applied with careful study to any operation where waste is to be saved or quality bettered.

Important from the point of economy as a reduction of labor unit cost may be, the struggle for speed cannot last without a full accounting with quality, and the betterment of quality and saving of waste will take its place in the progress of the world as a good second with the betterment of morals and social practice, and indeed has an effective place in their progress. Perhaps the next step in the progress of increasing per-hour production in manufacture by means of extra wage incentive will be the betterment of quality through quality piece work.

## Chapter IV

## GANG PIECE WORK

PIECE work, founded on the ancient business principle of barter and trade, of giving a stipulated price for a stipulated article, is an old institution, in principle and practice well known of both capital and labor. And while there rests in the minds of very many (whose interests would be much better served by knowledge) a considerable ignorance of the significance of differential rates, premium plans, etc., every manufacturer knows of straight piece work, and most of them believe that their factories are operated to a very high percentage on that method of payment.

Yet actual experience with a great many manufacturing plants shows that, if the pay roll is consulted week after week, it will bear witness in the average plant to no such condition, but will usually prove that in the several departments, all labor considered, there

is from 10 per cent to 75 per cent piece work, none too often reading up to the higher mark.

It is true that manufacturers are beginning to be more susceptible to the call of increased labor-efficiency. The propagandists of scientific management are beginning to be listened to somewhat more respectfully, as the message of increased efficiency is a joyful one to the ear of the American business man, when he can be persuaded that it applies in some practical way to his particular case. And it may be believed that the agitation about the $1,000,000 a day loss by the railroads will do more than any recent occurrence to urge manufacturers farther along these lines, not only by calling the matter strongly to their attention, but also by that happy trick of our human natures that makes many of us hasten, sometimes unconsciously, to correct or improve when the fault or opportunity is shown to exist in another.

But that manufacturer who desires to operate his labor on piece work has still, on the average, a definite opportunity of obtaining a real increased efficiency in developing this method of payment to the highest degree by getting his whole factory working

on this plan. It is not impossible in many factories to get almost 100 per cent of the total labor, even including the foremen in most departments, on piece work. To accomplish this, however, it is not infrequently necessary to depart from that method of piece work whereby a fixed rate for a given operation on a given article is paid to an individual, or what might be called "individual piece work."

A most effective method of departure lies in gang piece work.

The term "gang piece work" does not here signify that form of labor payment which is not now in as great practice as it once was, and which deserves a grave in the cemetery of discarded methods, viz., the method by which work is farmed out for a given sum, to a foreman or sub-contractor working generally inside the plant, who in turn hires and pays his own labor according to his own ideas. Such a method holds in it no real economy to the final consumer, but leads generally to tyranny, insubordination, poor work, and poorly paid (and therefore inefficient) help. It is, indeed, the father of the sweat shop.

By gang piece work here is meant some-

thing entirely different. It is a plan whereby the manufacturer still pays a stipulated price for a given amount of work to a gang —the foreman generally included—but the division of the pay is made by the manufacturer himself on a basis of fairness to all concerned, each individual sharing proportionally in any increase of gang pay earned, and the manufacturer retaining to himself the usual prerogatives of hire, discipline, and discharge. This plan is not new; but it is not practised as freely as it should be, for it has distinct advantages.

Such a method is economically valuable, especially under that condition where the work in the final result is divisible into definite units performed by a gang, but in its progress passes through the hands of individuals in such a varying and changing method as to be practically indivisible into units for individual piece-work value. The gang becomes the contracting individual; the final result, the paid for operation.

Let us take a definite example to illustrate:

In an envelope factory there works a gang of eight men including the foreman. The duties of the individuals are somewhat wide-

ly divided. Two men are cellarmen. They unload paper from the cars and wagons, take up paper on order to the envelope machines, and bale the waste cuttings as they come down the chute from the envelope cutters. Four men, including the foreman who also plans and lays out the work, cut envelopes on machines. One man cuts envelopes of odd sizes by hand, and the eighth member of the gang is a boy who delivers the cut envelopes from the cutters to the envelope machines. The envelopes are of all possible sizes and quantities, and it is easy to imagine that there was ample basis in fact for the predictions that were made that it was impossible to put this work on piece work successfully, without more labor in working out the rates on the more than 1,000,000 cut daily than the saving would be, not to mention the difficulties of planning the work so that each man got an equal share. Gang piece work, however, solved the situation in the simplest way.

A rate of 2 cents per 1,000 envelopes of any size for the whole gang of eight men was arrived at by careful record and observations, covering all kinds and sizes of envelopes, and the weekly amount earned is di-

vided between the members of the gang on a fixed percentage basis, the foreman getting the largest and the boy the smallest proportion. The pay roll of this gang is arrived at in five minutes at the end of the week; for, take note, the gang is paid each week, not on what it cuts but on the number of thousand shipped out of the factory. This method has, first, the decided advantage that only good work is paid for, and the number is beyond the question of dispute.

In this case gang piece work has worked most excellently to the advantage both of the factory and the men. Production has increased largely, and so has the pay of the men, despite the decrease in cost.

Gang piece work developed here its natural tendency toward co-operation, always the great force toward results. While it would have been very difficult, if not impossible, to have made individual piece-work rates for the different operations and classes of work, it would have been much more difficult, on the individual piece-work plan, to have divided the work so as to have obtained satisfaction with each man. When all were in the same boat, however, they learned quickly to pull together.

Take another example—a plating room. Here the parts of varying sizes, weights, and shapes went now into this man's hands, now to another's. The work could not be divided into separate operations and be economically finished. The day-work plan was the only method by which it appeared possible to do this work. Individual piece work, as any plating-room foreman will acknowledge, where the operations are many and varied, seems impossible. Gang piece work, however, solved the problem. Piece rates for the finished article were worked out, and the gang (including the foreman) were paid weekly on the product turned out by the room, the piece rates varying as to the different articles and the total amount being divided between the operatives on a prearranged percentage basis, the foreman getting the largest percentage. The result was decided economy to the plant and increased wages for the operator.

Many more examples of the value of gang piece work where individual piece work is impossible might be given, but there is also to be obtained from gang piece work frequently a value where individual piece work is easily possible. Such cases arise where

the policy of "each man for himself and the devil take the hindmost" (which, we must confess, individual piece work has some tendency to foster) is a policy that leaves the company also with the rear guard.

Here the value of the co-operative force of gang piece work becomes very apparent. Let us again take an example.

A force of 25 to 30 men assemble small parts into a finished whole. There are a great many small parts, and some of these have to be assembled and passed on for adjustment with other parts likewise partly assembled. Despite careful planning, the weekly production constantly varied and an excess of small parts was constantly demanded on the individual piece-work plan. Each man was working for himself, hoarding parts whenever possible, frequently stealing them from his neighbor, passing on partly assembled parts poorly done, demanding constant inspection, adjustment of disputes, and not a little confusion.

Gang piece work was installed and the situation immediately changed. Production rose to a fixed maximum. Inspection was unnecessary except to test the finished article. There was a decrease in parts disap-

pearing. The necessity of co-operation for the general good, the broadening of the scope of the individual to look to the welfare of the whole instead of his own solely, had in this work (as it has in any other affairs of the world, political, religious, humanitarian) an extremely beneficial effect for all involved.

In fact, gang piece work seems to be especially adapted for results where numbers of small parts are involved, when these parts have to pass through many operators' hands. This same plan was put into another department of the same plant, where certain small parts went through a number of different kinds of operations necessitating that one operative should pass them to another. On the individual piece-work basis, there was considerable delay and much necessity for special rush to get certain needed parts out of this department, despite careful routing. Unforeseen delays and occurrences, lack of interest on the part of each individual except in his own work, much loss of labor paid on work spoiled before it reached the last operation, beside a great deal of calculation necessary to make up the pay roll, were discovered.

Gang piece work miraculously stopped

this. The gang, paid a single rate on good finished parts, quickly discovered ways of getting through a greater proportion of good finished parts and of reducing to a minimum the time of routing.

Co-operation—and it is a fact, comment upon it as you will, that the opportunity for gain will bring the most intelligent co-operation on the part of the average body of men when properly led—co-operation educates. It makes common to the gang the education and skill and energy of each man. It works towards greater efficiency of the whole.

To establish gang piece work it is necessary, first:—to find, as a basis for rate payment, some final result or results which a gang of men are engaged in accomplishing; second—to establish a definite method of division between them of the amount earned by the gang, this being based generally on the relative skill and position of the men involved.

While as before noted, gang piece work is not a new institution, it is one that in most plants has never been utilized to its most profitable extent. For it is useful both in attaining the highest percentage of piecework efficiency and in introducing what most

concerns stand badly in need of—co-operation. And if it be from the point of view of labor itself, since it demands equal wage for all of a class and decries piece work partly because of its discriminating effect, what could more justly meet its views and still satisfy the employer than gang piece work?

From many ethical considerations, it is well for men to be bound together for a common cause when that cause is a fair one, and any possible advantage that such a combination in a manufacturing plant may get because its demands for rates and privileges may be incited by the cleverest and strongest man in the gang, may well be considered as offset by the fact that its results, the energy and skill of its workers, are likewise incited by the same force. And it is undeniable that this form of payment brings about a concerted action on the part of the gang, which while it may not replace or be as effective as a careful and intelligent plan from a superior executive source, is, nevertheless, a good abettor of such a plan and assists materially when there is no such plan.

## Chapter V

## THE PROBLEM OF CLERICAL LABOR

IF the minds of many executives, in these days of demand for efficiency, could be read, perhaps very prominently would appear this advertisement:

> Wanted—More efficiency and the facts to base it on, without increase of clerical labor

This story is not necessarily a universal answer to that advertisement, but it gives the experience in one plant where the problem was met in a successful way.

The plant in question employed some six hundred people in the manufacture of a staple article.

It had a department of costs and statistics in which some eight men were engaged. This department had concentrated in it all the statistical work of whatever nature—cost, sales analysis, pay rolls, and records of all kinds outside of the actual bookkeeping.

This concentration in itself offered an advantage, since it meant the least duplication of facts recorded, and the most ready at hand information from the point of view of economy and effectiveness. And this is an important point.

This department furnished a great amount of information, but there came a time when more statistics still were demanded, and it seemed to those in authority in the department that more clerical labor was necessary to make the studies and produce the facts required. But the executive refused to admit this increase.

And so developed a very usual situation.

There were two things to do—to drop the idea of further statistical work, or to find a means to get the eight clerks to do it. To the active mind this is no situation for hesitation. There was to be found a way. A study of the conditions was therefore decided upon.

The problem was considered exactly as would have been the same problem in relation to eight operators or producers in the factory. Indeed, here is a mistake made by very many, working towards higher efficiency, in that too often they assume that the

direct producer needs the most painstaking study and watching, and that through him lies the only road to savings. This, of course, is most largely true because of the greater number of direct operators. But it is just as true of the indirect operator, commonly called non-producer, that his work is susceptible of study and change, and much unexpected economy can be made through this means.

In the case in question the first thing done was to put all in the statistical department on the time-note system. A nomenclature was devised for all the different final records being collated and the constituent parts thereof. Each clerk stated on his time note each day, in minute periods, what tasks he performed, and how long it took him to do them, following of course the nomenclature, so that there might be no mistake in interpretation later. The time notes were simply a recital, on one daily sheet, at what hour and minute the clerk started and finished each task of routine or given work.

This at first was met with a not entirely agreeable humor. The clerk is very little likely to take the view that, from the executive down, all are laborers for one common

cause, and alike subject to methods that promote the good of the business. But very shortly the clerks fell into the proper spirit and response.

The time notes were daily studied by the head of the department, with the result that very shortly they began to show that quickening of effort always shown when a worker is conscious that his record is under scrutiny. In the course of a fairly short time it became apparent that each clerk had a little more time on his hands than had been previously supposed.

From the time notes so obtained the chief clerk was enabled eventually to make up a schedule of how long it ought to take to make up the whole or a separate part of any given record or statistical statement. In this, of course, he was assisted by his personal judgment of the work, and the schedule so made was quite a little shorter than an average of the times taken in the different parts would have shown. It compared favorably, however, with the best times made.

This, of course, is simply following the well known methods of efficiency in making a time study and, from that, a plan. It is

merely an application a little unusual though not unnatural.

In the course of this study changes were naturally made in the office and desk arrangements so that light and quiet might be best attained.

The scheduled time for each record, or part, having been decided upon, an arrangement of the records was made in a daily, weekly, and monthly schedule for each man separately.

This schedule for each man was made up with the idea of giving him a fairly full day's work, and with that arrangement also which correlated his work so that he got the most possible to do along certain lines of work involving a like understanding and the use of the same basic records. This gave a sequence to each clerk's work so that he had some idea what he was doing and took a greater interest in it. He was naturally able, therefore, to make correlated records with more facility.

Now in this work it developed that, once the intent was understood, the intelligence of the men asserted itself. They were naturally men who desired and expected advancement.

They eventually lent every aid to the development of the study and plan.

When the work for each clerk had been scheduled, it was written out on a card, so arranged that the first column contained the names of the records or parts to be made, the second column stating what time (day, week, or month) the records were to be ready, and, following this, thirty-one columns in which each clerk must check (according to statement in second column of the day when the records were to be finished) the fact that they *were* finished. These cards then formed in effect the regular schedule of work for each man and an up-to-date record of how the work stood.

Well, this must be all very simple and plain. But it was very effective. In the first place, it absolutely relieved the head of the cost department of any specific work, since all records were scheduled to the others, but it left him to look after the whole job, to study the statistics, and to do such separate studies of costs and statistics as seemed from time to time necessary. In the second place, it permitted the taking up and carrying on of certain statistical work for which another clerk had been demanded, thus

making a saving of about two clerks' time, seven men doing what would have formerly taken nine men.

The *modus operandi* as thus seen was simple—the time study, the fixing of a fair average time for record-making, the scheduling of the work of each clerk so that his day's work was planned for him, the giving to each man correlated work, the schedule card whereon each man checked up himself the fact that the daily, weekly, or monthly record was, or was not, finished on schedule time.

This was the experience, copyable in very many plants, no doubt, with a very definite advantage. But back of all these experiences there should be a thorough understanding and belief in the philosophy, in the reasons and fundamental understanding.

The question of costs, of records, of statistics, of a systematic study of operations in any business, necessarily involves a constant investment in clerical labor. This fact is one of the great difficulties in the way of progress of efficiency; for clerical labor is the most feared and most easily-dispensed-with overhead expense, the average executive being more inclined to trust his judg-

ment than to be guided by the facts of statistics where the clerical cost of obtaining them is involved. Yet efficiency can result only from, and be maintained only by, a constant recording and studying of the running facts of operation.

The average executive, if pressed to a choice in the expenditure of $1,000 between the purchase of a piece of machinery, or a year's service of a clerk, would ordinarily take the machinery. That is tangible and possessable at the end of the year. The service of the clerk seems evanescent. The product of the machinery is definite and salable. The product of the clerk is problematical, and therein lies the difficulty. Yet it is not improbable in very many plants—in fact it is daily proving so over and over again—that the product of the clerk, through facts brought to light and correlated, may show that even some of the machinery already on hand can be discarded and increase of product obtained from what is left. This is one of the commonest things it does show. It may show losses to be corrected, wastes to be saved, profit possibilities disregarded, leaks to be stopped. But what it will show is a matter of gamble in the mind of the ordi-

nary executive, for if he suspected the things clerical labor might show in his business he would correct them without the clerical labor—or thinks he would.

Even the executive who has had some experience of the gains to be made still hesitates to invest further in clerical labor, doubting, despite some happy experience, whether a still further gain sufficient to offset the expense is possible.

Theoretically, of course, every business entity deserves thorough study throughout. Practically, it deserves that clerical labor be engaged for the study of all operations and their phases where it appears possible that savings commensurate with the expenditure may be hidden, with the reasonable expectation that when such study is carried on in a practical and economical way, the advantages actually gained in some operations will more than offset the expenditure without results in others.

As a matter of fact, the average executive goes at efficiency attainment a good deal like a boat in a fog, feeling his way slowly and making a good deal of noise about it—which is perfectly natural, and just as it should be, provided he has the compass of confidence

and is steering knowingly toward the port of high efficiency.

From the point of view of the average executive it must be admitted that there is something irritating in the persistency of the burden of clerical labor; something agitating in the constant question as to whether it is a dead weight or really valuable. It seems non-productive very often, and even when the results it has brought about have been worth while in the past, there must still be the question as to whether the records it keeps piling up are ever again to be valuable. When the ordinarily necessary tasks, having to do with keeping the business machine smoothly moving, are performed, such as bookkeeping, putting through of orders, etc., it is bound to be a question as to how much more clerical labor is profitable, and no effort is made here to solve this question.

Of course, the methods of efficiency, of scientific management, offer some definite advice on this point, but it has never been shown to the average executive's satisfaction that there is any sure relation between success and the volume of clerical labor.

The one fair gauge of this problem, to be taken only over a reasonable period of time,

is based on a consideration of the purpose of clerical labor. Clerical labor is employed specifically to facilitate the work of the producer by preparation for him, and to economize or "efficiencyize" it by study and records showing the relation of actual cost to standard. It must be very apparent, then, that clerical labor is spent in the definite expectation of saving more than its cost in the work of direct producers. Under these circumstances, a total economy by clerical labor is made when the total index figure of labor *plus* expense is reduced. Increasing clerical labor with logic is merely to increase expense with the expectation of reducing productive-labor unit-cost more.

This is of course merely to bring again to the attention that, after all, labor and expense as cost figures cannot be considered separately. Expense is the tool through which labor is efficiently handled, and that tool is rightly bettered and made more efficient and effective, even through considerable expenditure, so long as it reduces cost per unit of labor more than it increases cost per unit of expense. Only a cost system will show the net value of clerical labor.

It is fair to say, however, that the preponderance of experience is that it *does* pay to expend clerical labor in making a thorough record study of manufacturing operations. The average case (and it is to the average case that most methods of efficiency should appeal) is that of the executive who is making some study of his operations, whose clerical labor is quite a material and growing expense, and who has obtained results which encourage him to further effort but yet is deterred by the fear of the burden of clerical labor. To this one this study should be interesting and encouraging.

The reasons for the results obtained in this experience were simple, for a regular order or schedule or planning of any work productive or non-productive, simple or complex, co-ordinated or not, brings better results with human nature. Moreover, an added orderliness and interest was given. The mere fact that each clerk must check himself up on his own card, and be ready to present it on demand, in itself offered a large reason for efficiency in ambitious young men.

The method thus outlined will readily ap-

ply itself to any intelligent indirect labor, no matter how complex, and the principles involved are applicable in all indirect labor and will be found efficiency-worthy.

## Chapter VI

## INCLUDING THE WHOLE FORCE IN LABOR REWARD

MOST of the exploited efficiency methods deal with the human element in production—labor. This is not because labor cost is usually the largest element in unit cost (for as a matter of fact it is most frequently the smallest), but because it is the most elastic, the most susceptible to improvement, by its very nature yields most readily to intelligent effort; and particularly because, from the cost point of view, the element of expense is so closely knit with it, that any increase in production per time-unit carries with it often a greater decrease in unit cost through expense reduction than through labor-cost reduction.

Of course little argument is needed to clarify this partiality of efficiency schemes for working with labor. The tendency of the other two elements of cost—material and

expense—is to resist reduction when operated with apart from labor.

Material, given the quality and design, it is true, offers some definite opportunity of cost reduction in most plants through saving of waste and recovery of by-product values, but not continuously so in any large per cent; and the tendency toward increase in cost of raw material seems to be such as to overcome such savings as are possible in most plants.

Expense, as a bulk, both by the studied increase of the administrative function in the attempt to increase efficiency, and by that counterpart of the increasing cost of living which attaches itself to business, has a tremendous tendency to enlarge, its main opportunity of reduction being in lowering the unit cost through increase of production.

Labor, on the other hand, while it demands an increasing reward in a bigger weekly pay envelope, nevertheless, through its intelligence and will power, its susceptibility to training, and its skill in the use of machinery, possesses an unlimited ability to increase its productivity or daily output. It is elemental, then, that it should be the mark of efficiency methods.

To accomplish the increase of efficiency of labor there are three main bases or methods of operation.

The first and oldest, and indeed the most effective, is the substitution of machinery for hand work, and its constant improvement is of course having an always increasing effect. This method, as far as management is concerned, has to do mainly with capital.

The second method is the building of an executive organization to assume, to the maximum, all the functions of preparation up to the final direct labor operation, so that this operation shall be most efficient. This has to do with expense.

The third method is the rewarding of labor itself in some fixed proportion to its attainment of results under given conditions of operation.

Probably the first of these methods will always be the most effective. For the second there have been devised several distinct plans or schemes, that of scientific management being the most complete in theory, and the old military plan by far the most practised.

For the third method, that of offering incentives to labor, there have been advanced

some fifteen or twenty plans. In almost every manufacturing plant some of these plans are in use (straight piece work being the most popular), for this third method is the only one which meets labor's demand for increased pay without increasing unit labor cost, or indeed with a decrease in that cost.

These plans, under which labor may be induced by a reward to increase its output, have nearly all been explained in detail with charts showing the tendencies of labor and expense cost under their operation, and it is not the intent of this article to discuss their merits. Time study and motion study, the means of fixing the basis of reward, have also been sufficiently made clear. But all these methods may be said to fall short in one respect not entirely unimportant—namely, that they usually reach only those performing the direct and more simple operations. It may, therefore, be interesting to cite the experience in a plant where all the employees, even the office force, were paid on the incentive basis.

This plant manufactures a very simple article, but in several thousand shapes and grades and in large quantities, so that it is fair to say of it at the start that its product

is somewhat exceptionally susceptible of being placed on the incentive basis. It employed some two hundred operatives, but its business was growing rapidly, so that there was an ample field for efficiency work. On the other hand the executive had already for a long time had the principal and simple operations on piece work, and this involved more than three-quarters of the force. These operatives were earning what was considered fair pay, but were not increasing their output, having arrived at that point, probably, where they thought it to their advantage to keep the amount of work done at about the level it had reached, for fear that the rates might be altered. Certain important operations, which were "squeeze points" so to speak (since all production had to go through them), were on day work, thus making it difficult to get through them more than a given amount of work except at the expense of new equipment. Now this condition had not been unsatisfactory, and indeed was reasonably profitable, until the increasing business began to crowd the situation, demanding either increased efficiency or increased equipment. The foremen apparently had been "energized" as far as was possible,

and seemed to have "crowded" the operatives and equipment as much as they could. But more production was necessary and some action had to be taken.

Now this is not an uncommon situation, even in very well operated and very successful plants. It is not improbable that it will persist in many for a long time to come, simply because it is the easiest plan on which to operate, *viz.*, to put the main and straightforward operations on piece work and to depend on organization for further effort in expansion of production. And it is not to be denied that this is found a very satisfactory method. But it is to be said of every manufacturing situation, no matter what and where, that efficiency holds for it, now or in the future, a plan or method by which it can be improved, no matter how good it is—which is one of the cheerful, enticing, and eternal virtues of efficiency, and the basis for efficiency engineering as a profession.

Many experts in such a case as this, where (despite a fair efficiency existing) increasing demand called for increasing supply, and the main equipment was not to be increased, would have advised the introduction of some different form of incentive as being more

encouraging to the highest attainment of efficiency of the operatives than straight piece work, and this might have had some good effect. But there were elements in this proposition (or possibly in the mind of the executive) whereby it was determined to adhere to the plan of piece work in practice. This made it necessary, then, to turn to that part of the operative force and organization not working on the piece-work basis, and to devise schemes which would make the organization in part and whole all work toward greater production, and would so actuate the installed piece-work plan to get the maximum results.

An analysis of the situation showed, then, that its weaknesses, to be corrected by any efficiency scheme, must be strengthened along the following lines: the organization must have a reward for any increased results; the operations where work was most liable to be held up, or the "squeeze points," must have an incentive to improve; and some guarantee must be offered to piece workers to increase their output. This meant simply that working from the already obtained standard of production, all concerned must

obtain an increased pay for an increased output with the same equipment.

Working then on this basis, the first part "tackled" was the work where the principal "squeeze point" existed—the point where all production began, since it had to do with the cutting of the blanks. There had always been some delay caused by this operation, and it had never been put on piece work because of the great variety of the size and shapes, and the quickness with which even a large order could be produced. Moreover some of the cutting had to be done by hand, and much of it was done by the foreman, and there were only five men employed at the work. The management had concluded that on account of the small number of operatives and the great variety of sizes, it would cost more to calculate and keep track of this situation, on the piece-work basis, than the gain over the day-work basis would warrant; moreover it did not understand how to operate the rates so that the foreman, who worked at the cutting most of his time, should make more than his men, or how to regulate the rates of the hand cutting.

A little investigation, however, soon

showed that there were two other elements to this operation to be taken into account—namely, the prompt supply of material to be cut, and the removal of the cut pieces and the waste. The workers doing this work were therefore included in the gang credited to this operation. But to put this operation on piece work there first had to be found a fair unit of production for payment.

An examination of the records of shipment over a considerable period of time showed that despite the great variety of parts, there actually existed a somewhat regular proportion of the main sizes, and only a reasonable variation per week in the total number shipped. Naturally, then, from these facts it was no great difficulty to bring forth the following scheme. A rate was fixed per 1,000 pieces shipped per week, regardless of size. This rate had several very patent advantages to the company. It paid only for pieces shipped, and not for those spoiled in operation; and the pay for the gang was easily obtained by one calculation at the end of the week—total number shipped multiplied by rate. The regularity of shipment and proportion of sizes made it a fair rate as to these two points, and of course

it was lower than the day-work cost. The gang among whom it was divided on a weekly percentage basis formed by hours worked, on a percentage arrangement which gave the foreman the larger share and the unskilled handlers the smaller, consisted of the workers who brought up the raw material and took away the waste, the cutting gang, and those who removed the cut pieces and carried them to the forming machines. They worked as a harmonious unit thereafter with marked results.

This same general scheme was put into operation on the only other set of operatives not already on piece work, namely the storekeepers, labelers, and shippers. These were all formed into one gang and the gang slightly decreased, the day-rate cost being decreased in a slightly less ratio as a piecework rate. The operatives were now all on piece work.

The second proposition taken up was to make increased production monetarily worth-while to the foremen and superintendent, for it is not to be presumed that because those in responsible positions are usually paid fixed salaries, they are not susceptible, and as reasonably so, to the lure

of the incentive as the general line of operatives.

To accomplish this it was of course necessary to fix standards of production per operative for each department. But it was likewise necessary to fix standards of expense for each department, since it was plain that otherwise increases might be obtained at the expense of the company. There was eventually arrived at, then, for each department, a standard based on a given production per week per operative, and a given percentage of expense to productive labor, the foremen to get an increasing bonus as the production went up and the expense ratio went down. It must again be confessed that the simple nature of the work made this an easier task than it would be in many plants, but it is not on that account less possible in other plants.

The superintendent received his bonus as a percentage on the foremen's bonus.

The office force was paid on the increase of shipments, the payment for any extra help to come out of the bonus. This was a paying proposition for the company, because the bonus paid was at a lower cost per 1,000

than the original cost, as indeed were the bonuses to foremen and superintendent.

It was now arranged that all the operatives and all the organization had an interest in the increase in production through incentive.

But the third and most important feature of the plan, since it had to do with the greatest number of operatives, had still to be put into operation with the piece-work plan, *viz.*, to assure all that no fear of a cut need be felt no matter what the earnings. This was simply accomplished by a guarantee on the part of the company that for a term of years no change would be made in the rates.

It took some six months to get all these plans into operation, simple as they were, and it must be acknowledged that the product of this plant in its uniformity and the possibility of expansion through the pressure of business made this proposition rather easier of comprehension of scheme and carrying out of plan than might always be the case. But the unification of the interests of all, the centralization of the good of each in the good of all, and the fact that every one, no matter what his position, shared in the forward movement, brought

about very definite results. In a year, with practically the same force, production and shipments had advanced over 20 per cent, and there seemed then to be greater leeway for a still larger output than had existed a year previously.

And though this was a simple case, and worked on the old plan of piece work, it wound up by being at least somewhat unique, in that it included successfully the whole force, organization and all, in the labor reward.

## Chapter VII

## PRODUCTION LARGELY INCREASED BY SIMPLE REORGANIZATION

A GREAT struggle takes place constantly in nearly every American manufacturing plant for increase of production. This is not the result of natural growth alone, but also of an effort based on the economic argument that the greater the production from a given plant, the lower the unit cost, and of course the greater the profit. And so, in a healthy factory, a friendly rivalry takes place between the sales force and the factory force—the one to keep the plant full of orders, the other to increase the production.

Such a rivalry shortly brings the plant to that condition where, at least in some departments, its capabilities and facilities of production seem to be taxed to the limit. It becomes then a necessity either to build increased facilities, or to discover some

method of increasing its capabilities within the facilities it possesses. This latter accomplishment is frequently attained very satisfactorily by an increase of efficiency.

Now, since production involves nearly all the plant forces, material and human, its increase without added facility is not always simple, nor brought about by improvement in one direction alone. There may be many weaknesses of operation, but it has been made very plain in a great many cases that inefficiency (or, let us say, lack of highest efficiency in the matter of production) is nearly always a fault chargeable to the plant organization, and not to the producers. And indeed it may be set down as a general rule that lack of efficiency in any plant is, in the main, chargeable to the executive organization rather than to the workmen, exception being made only when labor organization interferes, as it unfortunately does at times, in the matter of restriction of output, opposition to the introduction of incentives, and restriction of the number of apprentices.

An apt example of increase of production through the introduction of methods of efficiency may be cited in the case of the water-hose department of a large rubber-goods

manufacturing plant. Some idea of the conditions of this department before the said methods were introduced, is necessary to make plain how and why they were effective, and it may be said that these conditions are in no wise exceptional today in very many manufacturing plants.

This, then, was the situation. Orders were received daily from all sources, and those items belonging to the water-hose department were neatly typewritten on a printed form, with necessary specifications, and sent to the department office, where the foreman, assisted by a clerk, studied them, sorted them, and, according to his best judgment, ordered, at the proper time from another department, the various materials of which they were to be constructed. When these were received the foreman saw to it that his men made the hose in a workmanlike manner. This appeared to be a simple, straightforward, and indeed a usual condition; but it was an extremely inefficient one, not a little because of the following conditions which existed in relation to this department:

First: The department upon which the hose department depended for its materials

of construction, was receiving just as important orders from the foremen of eight or ten other departments as well. These calls were all independent and urgent; but no man can serve two masters, not to mention eight to ten, in a busy manufacturing plant, any more than he can outside of it. The result was, plainly, that the water-hose department got its material just when and as it wanted it, *only* when the other departments were not busy, or when it was the most violently insistent.

Second: The demand for water-hose, especially garden hose, is seasonal, and dependent upon the action of nature. The shipments are much the largest in spring and early summer, and of course production is most demanded then.

Third: The buyer demands generally some mark of his own put on the hose, which can be done only in the course of manufacture, and he will not always anticipate his wants.

Fourth: Rubber goods deteriorate somewhat, and so cannot be manufactured and piled up very long in advance.

This, then, was the state of affairs; and the net result was that during the busy sea-

son there was piled up in the foreman's office a sheaf of orders, the daily production was less than the demand, and the complaints, cancellations, loss of present and future business (to which were added the constant investigations and comments of the management), made the lives of the foreman and his clerk, during the busy season, uncomfortable, to say the least. This affected the efficiency of the department still more unfavorably, for highest efficiency is neither attained nor maintained under conditions of stress of mind and physical effort, but with tranquil minds and an effort reasonably within the elastic limits of the mental and physical nature.

The problem here was to get the maximum production from the facilities of the department, and to take care properly of a demand that was greater at one season of the year than another, all of which, when properly done, would, of course, forestall complaints and bring increased shipments, sales, and profits, not to speak of the peace of mind of all concerned—a rather usual factory problem.

Now, most efficiencies are attained by direct operation along the lines of definite

principles. The seeker after efficiency must know something of these principles, and they have been much written about, if not well known and practiced (for executives generally are not great readers of technical writings). They are based on experience, experiment, and a knowledge of human capabilities.

The principle, or principles, that deal most directly with production volume, decree, in plain language, that there shall be a constant planning of work, an effective preparation according to the plans before the work starts, and a persistent following up of the plans from start to finish; and that the tasks involved under such a scheme shall be divided along certain lines of easiest and most effective operation, termed, under scientific management, functional organization. And, indeed, it will not be difficult for any practical man to believe that in work of any complexity or changing mass of detail, it is only common sense when maximum results are desired, to put one set of brains and energy sorting out the work as it comes in, into classes, grades, lots, and planning its course through the factory in accordance with the previously studied facilities and capabili-

ties; another set of brains and energy following the details of these plans; and the operations themselves under still another set which can concentrate thus on the all-important element of actual performance where, everything prepared, the very efficiency of action must take place. For the common intention and the common sense is that the organization shall be planners and preparers, and the workmen the producers only; but, scientific management points out, organization has never been properly educated to do its full share of the work.

After all, efficiency is largely the result of educated common sense.

Now, working on this principle in the hose department, a little analysis soon made it evident that any man of the standard which the pay would cause to be retained (for it is a fact in our economic arrangement that certain positions can seldom pay more than given rates) would be working generally just within his elastic limit, if his task were only to handle his gang in such a way as to get out daily the standard production. And so all other duties were taken from the shoulders of the foreman except those of seeing

to it that his men did this daily allotted work.

To discover what this allotted work should be, or rather the standard probable daily production of the department, a definite study of operations was made, a careful arrangement of benches and machinery to best permit of consecutive progress of work was determined, and proper incentive methods to the workmen for production volume were established. The department was then ready to do its part, and the foreman relieved of all clerical work to see that it was done as fast as the orders and material were delivered.

But following the principle of efficiency laid down in the matter of production volume, the main solution in this case lay with the executive organization. There was, first, the question of planning to be dealt with; and a planning or production department, using the services of the hose-department clerk, was started in the factory office. It became necessary now, since the foreman was relieved of this duty, for this production clerk to lay out a daily stint for his department. To do this in any different way from what it had formerly been done, it be-

came immediately evident that, for intelligent action, several regular bases of knowledge in definite statistics must be laid, for statistics of all kinds play a large and important part in good management. Action should be based on facts.

The important fact for the production clerk to know in planning was, not what individual customers ordered, but what the orders totaled by grades. So there was made up a production schedule showing just how many lengths of hose of each size and grade were needed to fill all orders, and this schedule was corrected day by day by the addition of new orders and the subtraction of production. Where the production was more than the quantity needed to fill shipping orders, as when stock orders were filled, the balance in stock was shown on the schedule in a circle, so that in case new orders came in for this article the production clerk would know they could be filled from the shipping room—an apparently small matter, but really important, since it made the knowledge complete.

With this schedule in hand, the mind of the production clerk, instead of being agitated by the details of a great number of individ-

ual orders, now found itself suddenly rising above the situation. On one sheet could be seen the total demands on the department, and with the new knowledge of the standard probable daily production in mind, it was very readily calculated how many days' work there was ahead, and the day's work was laid out with the whole situation in view, the details of special markings being separately ordered.

Now the great step had been taken toward actual efficiency, when, through this schedule, a mental ascent was made so that the situation could be viewed as a whole, not so much in the handling of the daily situation as in looking to the future, since in factory life, as elsewhere, the preparation for the future makes the present more effective. For the dusty tomes secreting the orders and shipments of the previous year were hauled out, and their conditions likewise scheduled as a guide for the changing conditions and the coming busy season.

In a simple way, then, there had been substituted a certain knowledge instead of a despairing wave toward a mass of orders, in answer to the all-important practical question of planning production,—"What has

this department got ahead of it?'' With this knowledge the magic touch of efficiency was made.

So far, then, two important points had been covered—the foreman was relieved and his department studied and arranged to get out the standard daily production, and the production department was established and a proper basis for planning the daily work and the future established, and the planning begun.

But since the hose department could get out its standard production quota only when it was supplied promptly with its material of construction, the trick was not yet turned. It became necessary that the production department, when it laid out a daily stint for the hose department, should analyze this stint into its elements of construction, and plan its progress through the other departments several days ahead, so that it would arrive on time.

Of course, it must be plain, then, that such a plan, when persistently put through, would simply operate to the advantage of the hose department as against all other departments, and the corollary in good management was that all other departments soon came under

the same scheme, and gained their schedules and their place in the production department work.

This was accomplished in much the same way in the other departments, consistently with their peculiarities of manufacture, as it was in the hose department. The foremen were relieved of all responsibility of laying out a plan of work or order fulfillment, but were simply expected to see that their men accomplished the work planned daily for them by the production department. The clerks formerly used by the foremen, when they had any, were put into the production department. Each department was studied as to its physical arrangement and production possibilities, and desirable changes made.

Thus there was established a central production or planning department with no more total clerical labor than was formerly employed, (since in some cases several smaller departments could be handled by one clerk), and to this department came daily all orders. From it issued daily to each department the orders for the work of the following day, and to the preparation departments went also orders for material looking

forward several days to the work of the finishing departments.

Thus instead of "each department for itself," their interests were tied together and made to fit in with each other, which of course made for harmony and increased production for all.

A good method once firmly introduced into a manufacturing plant travels through it faster than a poor one.

Once the planning was under way, the next essential (and a very difficult one to get under way at first) was to make sure that the plans were carried out. In this particular case this work was given an assistant superintendent, and it may be taken for granted that no easy task was his. He was asked to institute a set plan in place of the long-used, independent judgment of foremen who did not even desire at first to be convinced that a production clerk could do as well as they in planning what should be done in their departments. He was asked to institute new ways with workmen who had formed habits of their own in their operations. He was asked to meet all the thousand-and-one difficulties, natural and unnatural, that sprang up to thwart the program. Efficiency de-

mands a state of mind in predisposition toward it, not in opposition to it.

But gradually the situation righted itself. The production clerks planned the plant capabilities; *i.e.,* they learned what combinations of materials and articles could best be put through. The foremen learned that the new ways produced more goods with less labor to them, and praise instead of blame became their share of the new order of things. The workmen learned that to obey orders strictly meant to make higher wages through greater production.

Efficiency had arrived. The department standard production fixed, the foreman relieved of all duties except to operate through his gang, the orders scheduled, and a view given of the total necessities of the present and future with the schedule of the previous year as a guide, the daily work planned back to the origin of raw material, and intelligent effort made to see that the plans were carried out—the hose department's capabilities with its old facilities were found to be very materially larger than were suspected. Its production rapidly increased. The wages of the workmen increased with the production. Customers were satisfied. Orders flowed in

more freely. Work became a pleasure. Ordinary intelligent vigilance,—always an absolute essential in the life of efficiency,—alone became the necessary element to the continuation of a vastly improved situation in production increase, lower cost, and greater profit. So production volume was really merely a matter of organization.

## Chapter VIII

## REDUCING THE FACTORY EXPENSE

IN considering modern theories and practices of management one fact which has always given pause to the average executive, and has been a decided deterrent to the more rapid introduction of methods of efficiency, is that they appear to increase that element so difficult to control in cost—expense. Indeed, the more prominent theories teach the necessity, generally, of deliberately increasing certain items of expense, of materially enlarging, for example, the ratio of non-producers to producers.

The logic of the efficiency experts is plain, of course. They argue that it is only the part of wisdom to add sufficient expense to gather statistical facts as a basis of action, since these facts will bring greater economies through wise guidance; that it is only economic common-sense to create expense in organization to plan for, to prepare the work

for, and to train and assist, operatives, since thereby greater efficiency may be attained, bringing about total cost reduction; and that increased expense, in physical arrangement and preparation, finds its ample offset in increased production. And there can be no doubt as to the truth of these theories if their introduction is made along practical lines.

But on the other hand, the executive has very naturally certain definite points of view gained through his experience, and urged by the burden of his responsibilities. He sees the increase of expense constantly encroaching on his profits. He is handling his labor and material within his best knowledge and ability, and ordinary human nature does not readily permit him to believe it can be much better handled in his particular case. And a somewhat natural inertia of the busy executive in the matter of radical changes is not easily overcome, when the force used involves an increase of that bugaboo to progress—expense.

For it is true that despite all struggles to the contrary, expense, both in its total and in its ratio in the cost of the production unit, has a tendency to increase. The experts admit this, and advise therefore that the ex-

ecutive swim with the tide, and increase his expense intelligently and scientifically, in order to save greater amounts through the other elements of cost—labor and material; and the wise executive may certainly lend an attentive ear to be shown whether this is probable.

But after all, by the very nature of his responsibility, the mind of every executive will hark back to the problem of reducing expense, and perhaps therefore some may find an interest in a successful experiment, wherein both the total amount of expense and its percentage relation to production unit cost were reduced without detriment to general efficiency.

This experiment was conducted in a large factory employing about 1,200 hands, and manufacturing large quantities and varieties of a small mechanism. This mechanism consisted of some one-hundred parts—iron, steel, brass, and wood. The plant was divided into about thirty departments, productive (preparatory and assembling), and non-productive, and the volume of expense, as separate from labor and material, ran uncomfortably well up into six figures per year.

This plant had grown from a small one to

a large one with many years of success; but a few years of falling off in sales when it had reached its zenith, while in no sense endangering its existence, yet made its bulk seem a little unwieldy. And at the psychological moment, there entered the combination of a new element into the management, a determination to revamp the methods of the plant, and an expert.

Of course this forecast eventually the doing of many things, but only one of these—the attempt at expense reduction—is of present interest. And it is by no means unusual or strange that it takes some such event as occurred at this plant, to make many concerns conscientiously study their expenses. Yet efficiency teaches study and comparison of expense as a constant practice.

Now in the consideration of any application of efficiency to a given situation, it is always wise to study and analyze the existing conditions, to consider the method and reason of its existence, and the nature and value of its application.

This is especially so of expense. For expense is not directly a producer. It is very plain that a given amount of material, varying as the waste per cent, is essential in the

manufacture of a given article. Labor of course must be used to shape it. These may not vary much in given countries and under given conditions. They have a direct application, generally the straightforward operation of one mind working from a plan, or according to a general practice, and especially in staple articles, are readily susceptible to standardization.

But expense has only an indirect, even if important, bearing on the manufactured article. In theory it is the tool of the executive, with which he operates his labor and material to produce the salable article, and it varies materially with the ability and plan of operation of each executive. It is the channel through which one man, or group of men, put into operation their plans and orders, controlling large production. Its sole reason of existence is to forward, improve, and quicken the work of the producer. It furnishes machinery, power to operate it, and keeps it in repair. It purchases material, cares for it, transports it. It obtains orders, transmits them, makes records of their cost and progress, and makes shipment. It supplies light, heat, and comfort. It furnishes a guiding organization to command,

instruct, and reward the acts of labor. It creates and maintains channels of exchange. It starts, guides, assists, and disposes of production. And from this enumeration it is not difficult to imagine what wide variations varying abilities and conditions bring about in expense.

In primitive industry almost negligible, it has grown with industrial civilization and concentration of production to be a tremendous factor, being frequently one-half of the total cost.

Its theory is essentially beneficent. Every original expense and every addition, in theory is presumed to be, and should be, designed to make labor efficiency increase in larger return. And of course expense is natural and necessary under our industrial *régime.*

But in practice it has become a bugabco. It is called a "burden", and many executives sweat under it; or it is spoken of as "overhead", as if it might occasionally fall and bring down the structure, as indeed it sometimes does. The method of its upbuilding is varied and occasional, and plans of actual organization and operation vary

very considerably. Standardization has not found in its practice any large use.

Too frequently an addition to it is made, especially in larger plants, on the foreman's "I need" or "if I had", without sufficient consideration of the truth of the position taken. Too often, indeed, the foremen, or even workmen, are permitted to undertake additions to the expense account without consultation with higher authority. The fact, in practice, therefore is that frequently the structure of expense is the result of the plans of many architects incapable by experience or unripe of judgment. The old proverb "Too many cooks spoil the broth" is very pat to the expense accounts of many plants. Or it frequently happens that certain expenses, built up properly to meet given conditions, as of rush or increased business, are not altered when these conditions change.

Of course it is also true that much expense is contracted with the idea of preparing for an expansion of business or an economy which does not eventuate. This is frequently a necessary "gamble", in which even very experienced and successful business men lose, and about the only comment that can be

made as to it, is that a recession from it should be made as soon as failure of expansion or economy seems certain.

With this understanding in mind, it is plain that there are two important elements in expense consideration—(1), the theory of its plan of operation; and (2), study and watchfulness in the economic practice and carrying out of that plan.

In the case in question, then, this realization of the theoretical and practical nature of expense was glimpsed, and it was determined that possibilities of improvement lay in the second direction, because it became evident that the expense of this plant had not been a miscellaneous growth, and had not received the close study it deserved. The plan in use (namely, that of a sequence of executives down to the foreman, or the military plan usually adopted in manufacturing plants) was not seriously altered, except in the addition of a cost department, an inspection force, and a production department responsible for laying out, balancing, and following through production. This is not at all to say that the plan used is the best one, for this is only a story of how a given expense was reduced. And of course

it is not to be understood that this case, offered as it is as a typical case of what can be done in many plants, is intended to controvert the theories of the experts that it pays to increase certain expenses. For even while expense as a whole was being reduced here, certain organization expenses were increased.

But one does not pull down a structure without studying its detail of construction, especially if in its place is to be reared another, and all the while "business is still going on at the old stand during alterations". It was necessary first, then, to make a study of the expense, and its relation to the running production.

This brought into existence the expense analysis. This expense analysis was the necessary concomitant of the cost system, which was first introduced. Its method and plan (see Chapter 6, Cost Reports for Executives *) were devised to give a comparative monthly detailed picture of the various items of expense in each department of the plant, productive and non-productive, so that each item should tell its story without fur-

* Cost Reports for Executives. By Benj. A. Franklin. The Engineering Magazine Co., New York, 1913.

ther analysis, so that all items pertaining to the department, direct and indirect, should be portrayed, and so that finally the relation of the total expense to the productive hours of the department, *i. e.*, the expense cost per productive hour, should be shown.

In form (see Forms 13 to 19, Cost Reports for Executives *) it was for each department a recital month after month, in parallel columns, of the details of the expenses of the department, set down one below the other, but in related groups, the figures for the same item appearing always in the same horizontal line. In addition to these parallel detailed columns of monthly expense, there were likewise interplaced each month columns showing the totals of each item to date from a given date, and a monthly and period indicative figure, showing at a glance the running cost per hour of expense for the month and period.

Now it may take a little imagination to see this expense analysis, but once seen its mission and value are plain. For the indicative hour-cost figure shows, monthly, whether the expense cost is increasing or de-

* Cost Reports for Executives. By Benj. A. Franklin. The Engineering Magazine Co., New York, 1913.

creasing, whether an effort toward economy in expense is being effective or not; and any and all items, such as the use of supplies, non-productive labor under different headings, repairs, and other details, may be followed and compared month after month, their value in the progress of production studied, their relation to production understood, and the result of any attempt at their reduction observed immediately.

And it was not difficult to see in the concrete; for with thirty departments, beside some divisions of them, and odd items, such as shipping, etc., this analysis filled a loose-leaf book of some forty pages or so, and took about one-fourth of the time of a clerk each month to make it up from the books.

Of course it will be understood that when expense is dealt with here, it covers every expenditure made by the plant, with the exception of the material which went into the salable article and the labor which actually shaped it into its salable form. Expense then included supplies of all kinds, tools, repairs, power-cost, non-productive labor of every nature, inspection, office force, selling force, and all miscellaneous and general items

not properly specifiable under the heads of material and labor as described.

The new executive, eager then to economize, and the expense analysis in operation long enough (two or three months) to be telling a fair and average story of expense in its relation to the progress of production, the study of reduction was undertaken vigorously.

There has been so much exploitation of efficiency in a somewhat sensational way from the days of the fight before the Interstate Commerce Commission against higher freight rates, and possibly even before, that the everyday reader is likely to get the idea that it is some sort of secret subtle ability or power possessed by those who practice as experts, by which, while a gaping executive force looks on, shop conditions are transformed to produce unheard-of results, as if the experts were the medicine men of the industrial tribes. Of course scientific management, efficiency, call the movement what you will, is purely a set of principles and rules, and of methods based on them, which, when applied to particular cases by experienced men, with common sense and persevering co-operation of those concerned,

are capable of rendering marked results. And these results, when strongly contrasted with previous conditions, with the machinery of alteration lightly touched upon, and the operator well brought out as the *deus ex machina,* certainly present attractive features. The efficiency expert is doing a great work. He is doing it because he is operating on the known principles and methods, guided by his wide experiences in them. But everywhere in manufacturing plants, without the conscious knowledge of these principles, and before they were enunciated or bruited abroad, common-sensed executives were and are still making changes which bring marked beneficial results. It was through this work that the principles and methods of efficiency were developed and brought to the front; and more and more, the executive is learning and using the principles of efficiency himself, for they were enunciated for his use and guidance.

It ought to be enough for efficiency, then, as a modern movement, if it be said of it that it has its place with the many other advanced movements, scientific and philosophical yet practical, of the last several decades.

Certainly in this case of expense, reduc-

tion there was nothing sensational. It was brought about through hard work, by constant consultations of three or four men who were frequently gathered together (perhaps not always prayerfully) with the expense analysis in hand, and who dissected it, discussed item after item of expense in each department, studied the needs and necessities, and decided upon definite changes or experiments, after further discussing them frankly with the foremen of the departments. And this method must essentially underlie any economic consideration of expense from the point of reduction. While many definite schemes, and logical ones, are offered for increasing expense, no one has yet come forward with any systematic plan (other than that offered here) for reducing it, despite the eagerness with which the business world awaits it. Such plans are still in the class with the non-refillable bottle, the non-pneumatic tube, and (shall we say?) perpetual motion.

One of the first items demanding economy application in the given case was the use of general supplies. Supplies in every plant seem to offer a great opportunity for waste. There appears to be no definite relation be-

tween their cost and production cost in the minds of operatives generally; and it is not uncommon, when electric bulbs, for example, are broken (and the new kinds are expensive), or oil is wasted (and its price is rising constantly), to hear the operative say jokingly, "What's the diff! the company's rich." Yet the same operative worries when he spoils a small part of his work because he feels a direct responsibility to check this condition.

A supply store-room was established, some study was given to fix the necessity and amount of supplies to be used. They were issued only on order of the foremen, charged to his department in the expense analysis, and the total detailed cost, with comments thereon from the management, given the foremen monthly. This had a decided economical effect. The foremen realized their responsibility immediately, and they realized that the management had a measure of it. They began to see to it that their men realized that supplies cost money, for the figures shown them monthly gave them a definite measure thereof. It became impressed upon their men through them, that economy of supplies is due to watchfulness

and care, and that this was as important as any other economy. Morale was introduced —a tremendous aid to efficiency.

A second important element of expense, taken into consideration promptly, was repairs. The cost of repairs is probably the most difficult of all expense elements to control. It possesses no regularity to be standardized. Its necessity is not offset by any feeling of gain made by satisfying it. It is done merely to prevent loss, for the necessity is generally considered as due to carelessness. There is too seldom in operation in most plants any systematic inspection and oiling of machinery. The operatives of machinery too seldom understand the mechanism, or speed, of the machines they operate. The machines therefore are liable to get out of order quickly. Each repair is usually a different proposition from previous ones. The question of how long a repair ought to take in the making, has never been given any study as compared with direct-labor operations. Many repairs are rush jobs to permit of restarting production, and are often made without regard to best permanency. A little study will frequently show that more repair expense is spent on some machinery

in a year than replacement would cost, but of course in many different amounts. Then there are days when the repair gang has more work than it can accomplish, and other days when there does not seem to be any necessity to hurry. There is likewise overtime and Sunday work to be put in, unfitting the men for the next day's work. Altogether, then, repair expense is difficult to control because of its irregularity, and the impossibility of obtaining standards.

Now certainly this is a terrible score against repair expense, but it exhibits the necessity of a good, hustling, common-sense foreman and the value of care of plant and machinery as a means of avoiding this expense.

To assist in controlling and reducing this cost, a repair schedule was first made, which consisted merely of a large sheet, or sheets, with all orders and description listed. This list permitted a quick and complete view of repairs and changes. All repairs or alterations were done only on order signed by the superintendent. Rush repairs were of course put through at once, but in case of all other repairs the schedule was considered at an every-other-day meeting by the foreman of

the repair department and the superintendent, and the work was laid out with instruction cards for the repair men for at least two days ahead. Each instruction card, being also a time note, had a standard of time set (very frequently by guesswork) as to how long the repair should take, and a bonus for the repair man who bettered the standard. Always two full days' work was planned for each man, and instruction cards for this period issued to him. By this means, then, the repair man got the idea that he was "full of work", and had some standards to go by, even if they were not scientific, and in the work thus laid out, preparation was made so that delay was avoided in repair.

Perhaps a digression will be pardoned here for a slight consideration of this form of "guess" incentive method. There are frequently forms of work, like repairs, where each job is different from the next. It might seem that such are impossible of impetus through incentive, because of lack of standard units. But these jobs do contain certain standards, not readily set down on paper, but rather sensed by the practical man who is familiar with them. So it is not a scientific fact, but it is a practical fact,

that in the hands of the practical man a "guessed at" rate, really obtained through the mental action of a mind with good judgment and practical experience, hits very close to the mark on the average, and has the effect of accomplishing economy by keeping the operative thinking and hustling.

This constant going over the schedule for repair orders by the superintendent and foreman of repairs, with occasional conferences with the room foremen, gave a familiarity with the situation not before had, and led to criticisms of the care of machinery, the necessity and method of repair, the value of certain repair men, which brought about changes and economies unexpected. In fact, the question of repairs had constant and detailed study, instead of as formerly and usually, the attempt of the foreman of repairs to carry out, on his own best judgment, any and all orders sent him. And in this solution is really involved a large fact, which should be a definitely understood principle of efficiency—namely, that in all manufacturing there are constantly arising situations and necessities for action which cannot usually be most satisfactorily met by the judgment of one man, but require for best

solution discussion by several, involving co-operation. This principle indeed underlies the whole question of expense reduction.

The expense analysis showed each month the cost of repairs in each department, and each month these figures were given to the room foreman. It is not hard to believe, then, that this method eventually led to a reduction in repair cost. But this economy was obtained only by hard work and study.

A third element of expense study was non-productive or indirect labor. Now direct labor is given intense study, but what executive pays the same attention to his indirect labor, to the elevator man, the sweeper, the inspector, the shipper, the trucker, etc.? Yet this class of labor is expensive, and taken throughout a plant of any size amounts in volume of wages to a considerable sum. When it is considered that in most plants from 10 to 30 per cent of the employees are non-producers, it is plain that there is a large field here for efficiency work. And it is not too much to say that at given periods of the year the capable executive can go through his plant and make decided economies in cutting out non-producers, who, by changing conditions, or occasional and ill considered

judgment in addition, are "making the work last the day".

It ought to be no part of any economic system to blame the operative, especially the unskilled one, for "soldiering", loafing, or "making the work last the day", for after all the hold and influence of the ordinary and unskilled worker on his place in any particular industry or business is so slight, and his strong selfish interest in life and the support of his family so great, that if he willingly co-operates to do just what he is told to do, he is hardly to be blamed if he realizes it is to his interest to appear to be busy during the time he is paid, rather than to work himself or his companion out of a job. This of course may not be the moral view of the situation. It is purely the actual and practical one, and any system should simply be based on it as a fact. While it is true that the exceptional, ambitious, and capable man shows his superiority to this view, and consequently generally rises out of his position by rising above it and the methods it entails, nevertheless it should be the part of the executive, and of any economic system he employs, to meet the case as it stands.

In this case the work of each of these em-

ployees was studied—their busy days, their busy times of each day, and the amount of work they did per day. This really involved the larger questions of the movements of materials, and the relations between the departments. The net result was satisfactory from an economical point of view. For it soon became plain that while no one of these employees could fairly be called a loafer, yet because of a lack of capable arrangement or co-ordination of their tasks, and particularly because they lacked an incentive and the same attention and constant "hustle" given their producing shopmates, there existed large possibilities of greater efficiency among them. These possibilities were brought out in various ways. In some cases certain tasks were rearranged to fit in with others, and a time schedule arranged. In many cases two men were given the former tasks of three, with a bonus if they accomplished them. In some cases it was found possible to introduce straight piecework, as in sweeping and shipping, with a reduction in the number in the gang, and increased pay to those left. But altogether a tidy sum was saved in the non-productive labor.

In the matter of tools, a systematization along the lines (now fairly well known) of their care and issue, also brought a decided saving. The power cost did not prove susceptible of reduction, and the office and administration expense was actually increased by some three or four clerks because of the introduction of the cost system and statistics. But items of general expense, which included all the odds and ends other than those mentioned which could not be charged to department expense, were likewise studied, and certain extravagances in stationery, postage, etc., were discovered and remedied.

In a properly divided expense, general expense is a sort of catch-all, which shows, in addition to the administration expense, all those little and sometimes large items, which are the result of the executive's ventures into policies which have not succeeded, his co-operation with other concerns in the carrying forward of plans for the general good, advice which he seeks, legal or otherwise, and those miscellaneous expenses due to the office use of supplies. It will always stand study and consideration, for it frequently tells a very interesting story, and despite the superior intelligence of those who are re-

sponsible for it, shows, no less than the department expense, a strong tendency (and indeed a natural one on account of the salary increases) to increase in bulk. While in theory increase in volume of production of the ordinarily successful plant is supposed to keep down its ratio to the production unit, only constant care makes the practice conform to the theory.

Thus the main elements of expense, supplies, repairs, non-productive labor, power, tools, general expense, were each taken up, studied, discussed, and altered where possible. Right through the whole expense analysis each expense item ran the gamut of criticism, suggestion, experiment, and cut and try. In many cases the economies, and the methods employed, might almost make a story in themselves, for they were not always brought about readily.

In many cases, once the expenses had been reduced, the fixed standard or budget plan was used to keep them down. This plan consists merely in fixing a monthly sum beyond which the department is not allowed to go in its expenses, and in certain cases it is very valuable in its effect. In some cases where judgment was particularly to be exer-

cised, the foremen were paid bonuses for reducing expense or keeping it to a standard.

It took some six months of time to accomplish a fairly satisfactory result; but it was well worth while, for the relation of expense to the productive hour was actually reduced by some 20 per cent, which meant a saving of many thousands of dollars. And it was well worth while for several other reasons. For in the first place, it gave the management a real knowledge of the factory operation, which it had thought it possessed, but did not. It had builded the expense structure bit by bit (an entirely common and somewhat necessary method in growing plants), and it saw the whole now for the first time in many years. Each department had been taken off its peg, looked over and cleaned, just as a jeweler, with his magnifying lens in his eye, might take down from his board watch after watch, clean and repair it, and hang it up to go on ticking accurately and merrily. And the clean-up gave the management a new grasp of the situation, and new courage and energy. It was made very plain to them, as a single instance, for example, that it was just as important to them to weigh in advance the ad-

dition of one non-producer at a cost of $500 a year as it would be to investigate the wisdom of purchasing an $8,000 machine, the interest on which investment would approximate $500. It became clear to them that expense in practice (no matter what the theory) is a good deal like a fruit tree—a necessary thing if the fruit of good profits is to grow, but needing constant and careful pruning, sometimes grafting; and the older it gets, and the larger the plant, the more careful attention and pruning is needed.

This study brought likewise and necessarily economies and changes in the matter of material and labor; for so closely is expense allied to these elements, that the study of one leads essentially into consideration of the effect on the others; and always it was necessary to make sure that changes in expense formation brought no reduction in the efficiency of the others. And of course such studies suggested improvements.

Furthermore, in the second place, this work led the management into closer touch and accord with the factory organization. The latter gained new ideas as to their responsibilities. They realized that there was something to their tasks besides mere vol-

ume and quality of production, important as they were. They gained (those who remained as capable ones) a larger idea of the watchfulness and intelligence of the management under which they were serving. Morale arrived.

So in this case large savings in expense, made by study, by discussion based on the expense analysis as showing true expense relations, and by co-operation of the whole organization, were accomplished. And after all, how else can expense as an element be controlled?

## Chapter IX

## BUILDING A COST SYSTEM

THAT executive would be a bold one (and perhaps some might use another adjective) who would today deny to his plant an advantage in the possession of a cost system. Not that this statement is to be construed to mean that every manufacturing plant has a right and effective cost system, nor that there is any agreement as to how far it is necessary and valuable to carry a cost system. It is indeed the common complaint of those executives who have had modern cost systems installed that most of their competitors appear to be without any, and in a measure they are very close to the truth. Most plants, however, have some method of figuring their costs, although the occasional boast one hears that a certain plant's system is "all its own" has a Gilbertian flavor.

And it may further be taken for true that

most plants have cost systems that may be termed "occasional" or "approximate", not continuous and complete; for that plant which has developed the cost system to its farthest value is even today still somewhat rare. Indeed, it takes some courage of expenditure and constant patience to develop a thorough system, and the remark of one manager, in explaining his lack, that you "can't make a bookkeeper out of a dago", is both a criterion of the labor market in some localities, and of one of the difficulties of the case, though by no means insuperable.

Now no long arguments are to be advanced here as to the value of the cost system in every business. No intelligent manager is going to deny the value to him of a knowledge of the facts of his business, if he is satisfied that they are facts, even if he does not possess them. The burning question is how far to carry the cost system in its completeness.

It is, however, true that the complete facts of the business can be shown in any way desirable; that complete and practically accurate records of the use of material, labor, and expense can be gathered; that it can be done with no great expenditure of clerical

labor; and that it is very profitable to do so. But those who have no theoretical doubt of this, still find many difficulties in a practical attainment, and perhaps the story of the introduction, development, and use of a cost system in a plant already successful, may be of interest as illustrating this.

It is a somewhat long story perhaps, with no particularly exciting incidents, but then that is just the truth of obtaining a cost system—it is a long, slow job. And while the introduction of modern methods may be as difficult and slow of progress, and need as much preparation, patience, and persistence as the discovery of the poles demanded (and be much more useful to humanity), nevertheless, the details are so common and intimate to most of us, in some phase or participation, that no writer of shop adventure has been able to make their recital as widely read.

This particular cost problem was worked out in a machine-building plant employing about one hundred and twenty-five men, involved in three main departments—a foundry, a wood-working plant, and a machine shop, with a product varied in six or eight main classes, and repairs on all of these.

While a certain amount of the work was standard, yet much of it varied in size and detail, necessitating bids, and much repair work was done.

The executive, often away from his plant, wanted several definite results, regularly and accurately, as a means of giving him some control of the situation. He wanted, first, certain figures of labor costs and expense percentages as a proper basis for estimating. He wanted, secondly, to know the true cost of every order finished, so that he might know where profits and losses were. He wanted, finally, his expenses correlated and compared in detail monthly, as a means of controlling them.

The first need was of course automatically met when the second was filled, and the third was essential in obtaining the second. Not unnaturally there eventually came out of the fulfillment of these needs a fourth value, *viz.,* a complete showing of profit and loss for the whole plant each month, the showing being made as to all the work, divided into eight different classes. And the yearly inventory developed, not as usual into a means of discovering whether any and how

much profit was made, but merely as a means of checking the figures shown monthly.

Now the needs of this executive are essentially the needs of every executive. But it cannot be said that they are fulfilled often or completely enough, and indeed rather seldom is the final development of a complete monthly showing brought about.

There are, of course, many reasons for this. In the first place, all businesses, on account of variations of processes, length of time in progress of production and difficulty of tracing elements to final product, are not equally susceptible to the obtaining of these results. In the second place the expense of going the full distance indicated in certain classes of work may not seem warranted by possible returns. But unfortunately, and most frequently, the valid reason that exists for not obtaining the results is that the executive is not willing nor able to give his time in the development of the system, to help work out the details and overcome the difficulties, and to interpret the results when obtained. And it appears extremely difficult to obtain cost clerks or bookkeepers capable of carrying out and interpreting the system in a practical way.

The human equipment in this case consisted of a bookkeeper and an assistant, since augmented after three or four years of operation (and because of increase of business) by another assistant. But these two were very capable and hard-working. The only other office force that existed in the plant were two stenographers, although there were an engineer and his assistant, who had their part in the system, as will be seen later.

Now this equipment is a very important element in the cost situation. As a matter of fact, it is by far the most important element in the development and use of a cost system. For costs are not a matter of figures. Even bookkeeping is not an exact science. For behold! how often is it that one man will put into the expense account a given expenditure, say the rebuilding of a machine, thus reducing his profits by this amount, while another will put such an item to asset account. And each can advance weighty arguments and reasons as to the logic of his methods. But the net results of operation will differ widely with the same actual occurrences, so that even bookkeeping may be said merely to present results dependent upon the aspects of the situation, as

rendered by those who have the authority or opportunity to interpret. Now the same and indeed greater opportunity to render varying interpretations exists in cost work, but much aggravated by the further fact that, while bookkeeping, through the double-entry system, offers a proof, and gathers in all the facts (even though some, by misinterpretation, may be wrongly placed), cost keeping offers the further very strong temptation to present incomplete figures as complete. For the gathering, or, rather let us say, the arranging of channels for continuous and correct gathering of facts (involving, as it must, all the operatives, their necessary co-operation, their changing work, the issuing of and keeping track of raw material, and the proper correlation of expenses), is a laborious, painstaking, and frequently discouraging task. Successful accomplishment demands therefore a good equipment—common sense, patience, diplomacy, a sense of accuracy, and an ability to interpret facts and figures—for all of which most executives are willing to pay the cost clerk possessing them $15.00 to $20.00 a week!

This, then, was the situation:—machine-

building plant; three departments, foundry, wood-working, machinery; one hundred and twenty-five men; product varied in, say, eight main classes; all work put through the plant on order numbers.

Wanted: a cost system showing in detail the cost of each order—proved, and leading eventually through the bookkeeper to a complete profit and loss shown monthly—same to be checked yearly by inventory.

Equipment: bookkeeper and assistant. Incidentally there were three foremen, and they were pretty good foremen as foremen go.

Well—the installation of the cost system was undertaken in the usual divisions of material, labor and expense.

The development was made along all three divisions simultaneously, but necessarily progressed in the division of expense most rapidly. This was because of two reasons—(1) the total expense figures, with the exception of certain items of materials and labor (the definite use of which had to be regularly reported from the factory), rested monthly in a total in the books, which total was readily analyzable from the entries; and, (2), the

work of the expense analysis involved only one man—the bookkeeper.

Of course it was necessary in analyzing this expense first to decide into what main divisions the expense should be divided—and the three departmental divisions of foundry, wood-working shop, and machine shop, with the further division of selling, were chosen. It was then necessary to settle upon a relation of expense to the running production, so that when, in any given order, the material and labor cost had been collected, the proper proportion of expense might be added; and it was decided to show the departmental expense cost per productive hour of labor and the selling expense cost per dollar of sales. No argument can be entertained here as to the validity of these decisions. They have been treated elsewhere.*

These things decided, it was merely a matter of time to produce from the books an expense analysis for each department, showing month after month—in comparative detail—the expense and its relation to production, with also period figures showing the average

* See Cost Reports for Executives. By Benj. A. Franklin. The Engineering Magazine Co.

relation over a given time. This was merely a bookkeeper's job.

But when finally produced the result was astonishing and disappointing to the executive. He had always had some idea what value of materials and labor went into certain machines, because their application was direct, and individually measurable as to any given order. But expense had always been a guess because of its general application. And so, when proper depreciation and all the other marshalled expenses of each factory department were taken into consideration and shown in relation to the running game, *i. e.* as so much per every working hour, the executive was a little startled. For he discovered that he was not making profits in the way he had thought, and also he found out that it costs more to keep a workingman working for an hour, than the man was paid for that hour. And indeed this is usually the case, varying very greatly of course with the kind of work and the size of the plant. And though there is a tendency constantly for wages to rise, it is true, despite all theories of expense-ratio reduction because of volume increase, etc., that the tendency in practice for expense to rise both in total and

per cent is fully as strong as that of wages, and can be kept down only by intelligent and vigorous economy. But this analysis, showing the same expenses comparatively month after month, offered the executive a means of criticism and control of expense. The discovery of the true relation of expense to production, and the variation on this point in the different departments, immediately brought the executive closer to the facts of the situation and caused actions looking toward the profit and loss column to be discussed later.

But the expense analysis also emphasized one other important feature in cost-system building, *viz.*, a total sum, provably complete, was always started with, and the analysis showed what became of it. Eventually this same method was adhered to in the matter of material and labor, so that always a proof was maintained. Thus eventually the total expenditures of the business were divided into the three main heads of material, labor, and expense, and these were analyzed on to order costs instead of operating from the detail to the total.

Now of course this expense analysis, simple as it was, did not arrive at once. It was

necessary to get certain facts for it from the factory. One of the most important was the amount of non-productive or indirect labor, and the obtaining of this item was involved in the whole problem of getting an analysis of the application of the second main division of cost—labor. And here is where the first troubles began.

For when the doings of labor began to be collected in any reasonably exact way, of course every man in the shop became involved, and human nature came into full play. The foremen had the loudest complaint to make, for it was attempted to issue through their instrumentality all time notes made out from the orders in their charge. The work was too onerous and too distracting to them. They were men well along in life, and their ways were "set". Of course a clerk might have been put at this work. It usually takes in fact a certain amount of expense in clerical labor to gather shop data for costs. In most plants this must be reckoned upon to some extent. This was not, however, a large shop and it was believed that the facts could be gathered cheaply.

Eventually the way out proved to be not so far removed from the most modern meth-

ods. For it was finally decided that the engineering department, in making out its orders, was to make them in the detail of the operations on each part, and these were made in the form of time notes with necessary instructions on them. This did not of course include every little odd job that was done. For these, there were blank notes which the foreman willingly handled.

It thus became the duty of the foreman merely to see that in giving out and taking in the time notes of the workers, the times were properly stamped thereon. The foremen satisfied, and their co-operation gained, the workers were not so difficult to handle. A willing foreman is half the battle won. There was the worker who could not speak English, termed the "dago" by those who could not speak his language, but, with his time note made out, he could easily punch the time of starting and finishing on a time clock, or indeed write it. And once he was shown, he did it more willingly than his more fortunately linguistic shop-mate.

There was the suspicious man who was afraid the company had some ulterior motive in finding out exactly the time in which he did his work—the careless man, the thick-

skulled one, etc., but all these with time and patience came into line, for the time note and instruction card combined really improved the situation over the old way of verbal instruction. But they all came into line more particularly, because, in all recalcitrant cases, the situation was frankly, clearly, and sometimes repeatedly explained to them, and their co-operation invited to make the whole shop an intelligent unit. When they were treated as human beings they responded. But patience and persistence were needed to get the time notes finally practically accurate—a matter of five minutes inaccuracy not being considered.

Of course this problem comes up in every plant. Around it are frequently thrown safeguards and helps, as time clocks, clerical help, etc. These are always valuable aids, but necessary only when the conditions are complicated and the force is large. In most shops of reasonable size, if the co-operation of the workers is obtained, the facts can be gathered very cheaply and sufficiently accurately.

Once there began to flow to the office the time notes of the men (and for all jobs not finished Saturday night a special time note

was turned in), it became an easy job to make out a payroll showing not merely the hours worked and the pay earned by each man, but an analysis of this showing a division of the labor as to indirect and direct, and the hours worked on each order. The indirect labor went of course to the expense of the proper department in the extreme analysis, and the direct labor to the record of order cost.

And thus the total weekly payroll was analyzed each week, and proved. Thus, again working from the total paid to all labor, the complete proved analysis was presented.

It actually took two or three days a week to make this analysis. To the assistant who undertook it, it at first seemed a terrific task to take the time notes of one hundred and twenty-five men, averaging possibly some eight or ten per week, to set down on a payroll all the facts of pay for each man and all amounts of hours and charges for each order number, and then make them all add up correctly. But by proving the figures for each man separately this scheme eventually worked out very well indeed, and since, when the expense percentages were obtained, the

expense chargeable to each order could be added on the payroll sheet to the labor chargeable to each order (see "Cost Reports for Executives") the fact that on this one sheet they had a complete weekly proved division of all labor and expense ready for distribution to cost sheets and bookkeeping records,—this fact made the bookkeeper and his assistant enthusiastic. They felt they had cleaned up the situation, and, instead of having a mass of disconnected figures on their cost sheets, they had a proved situation to be sworn by, instead of *at*. They had a weekly grip on the labor and expense cost.

The next step now was to corral the material. Most of the difficulties in the way of this were physical. Everyone was perfectly willing to report material used if the means were readily offered. Barring those occasions when parts might be spoiled through careless work (not so recurrent in this shop except on small parts controllable through the storeroom) there was no reason material used should be concealed.

The first step in this work was to put into shape a storeroom, already in existence, and arrange that any materials issued therefrom should be reported daily by requisitions and

with order numbers. All large supplies, such as pig iron, coke, etc., for the foundry, lumber for the wood-working shop, and iron and steel for the machine shop, could not be put into the storeroom of course, but had to be under the general charge of the foreman of the department. But in order to offer a proper basis of use and report, the engineering department again came to the rescue, and undertook to issue to each foreman for each order a bill of material covering all parts kept outside of the storeroom, and of course of many kept in the storeroom.

It was not difficult for the foundry foreman to keep track of pig iron, etc., used daily, as any foundryman will recognize, since it was necessary to weigh it for the furnace charge. The greatest difficulty came in the matter of lumber. Here for many reasons a lumber-moving gang was made to bring in all lumber as planned by the foreman. This situation was helped by the fact that the lumber yard was some distance from the shop.

So, through the storeroom, the engineering bills of material, and the foremen's daily report, records of the material used, and on what order number, were started. The

question arose, however, as to the accuracy of these reports.

Accuracy could be checked only by occasional inventories, and these were made, with the result that curious and natural shrinkages and overages were discovered, corrected, and allowed for. Coke was found to have a natural shrinkage of about 7 per cent between carload weight paid for, and truck load weighed into furnace. This per cent then had to be added to reported weights. In the matter of lumber, so difficult was it to make the feet bought and the feet used tally, that eventually a definite per cent was added to all reported as used, and the lumber inventory was always expected to come out higher than the book showing of it, which it has done for the last five years. Cars of pig iron were checked, bought weight against used weight, and shortage or overage taken care of in the costs.

In order to get the material reports into such shape as the payroll for cost and bookkeeping purpose, a material journal (see "Cost Reports for Executives") was devised. Here all material reported was credited to its class of raw material on one side and debited to its class of work in process on

the other, the sides balancing weekly. And since the order number was inserted opposite each item, the journal offered a basis of operation both for cost and bookkeeping purposes.

And so eventually the material was corralled, so that in the last five years actual inventory has shown it practically right.

Expense, labor, and material figures of proved exactness collected, and flowing daily and weekly into the bookkeeper's office, the real work of making the cost system and of using it with value now began. And this was both pleasant and troublesome.

It was not so difficult of course to gather the facts of labor, expense, and material onto a sheet showing the total costs of each order. The real difficulties were (1) to put these figures together in such a form that they would tell the executive the true story of the order costs quickly, and permit a rapid back "trek" to details as desired; (2) to tie all these facts up to the bookkeeping so that each month's trial balance told the story of the business as a whole; and (3) to make the proof of the whole as easy as possible.

There was, of course, still the largest and longest of all the tasks—to discover oppor-

tunities of economy and profit-making, and operate from the cost system so as to bring them about—in fact, to gain those values which the cost system was designed to give. But this was not a matter of building the system, though dependent on the proper working out of the first difficulty.

It would be impossible, of course, to recount all the steps that were gone through in overcoming these difficulties, but very interesting if all the scenes could be re-enacted; for the executive took a very active part in them, knowing what he wanted but without accounting knowledge, and the bookkeeper possessed accounting knowledge, lacking the practical, but like many accountants thought that affairs must be handled according to certain routines. And always there had to be kept in mind the real truth of the bookkeeping method, *viz.*, that it is not a set of fixed rules, but, consistent with the double-entry plan for proof against clerical mistakes, it is merely a method of putting figures together to show results, and if practical intelligence demands that the results be cast in any given form, bookkeeping can be made to fit this form.

Bearing in mind, then, that direct labor

was shown analyzed by order numbers each week, completely, with expense added weekly by rates per hour, and that material was likewise shown in the material journal divided weekly (labor and material being proved weekly, and expense monthly) it is readily seen that a bookkeeper could weekly record, on a properly arranged cost sheet, the labor, expense, and material in such detail as would easily refer back to the record in case of necessity for clarification, and in such columns as would permit adding them at the finish of the order to show total labor and expense by departments and material by classes. Thus was the detailed order cost for every order put in assembled and complete writing a week at most after its shipment.

For the sake of the executive, however, there was made a condensed sheet—one sheet for each kind of work—on which were entered only the totals in the detail of labor and expense by departments and material by classes, showing the selling price and the profit and loss. Each duplication of an order was placed under the result of the previous order. This, as can readily be believed, gave the executive a quick cost knowledge of

each job put through his plant, and, as orders were duplicated, a comparison which soon gave him a grasp of the situation. And he could refer back, as he desired, to the detail, when the results proved unsatisfactory to him. Thus was problem No. 1 solved.

Problem No. 2 was also purely a bookkeeper's task, namely, to unite all these facts into a monthly showing of the whole. The work was divided into about eight classes into which all work finished must fall. It was merely a question of focusing all the information to a point, where, in one of these eight classes, when the work was finished, the sale price on one side should be offset by the cost on the other side to get the balance of profit and loss. To accomplish this, it was necessary to establish eight accounts of work in process, and desired classes of raw-materials account. Bearing the fact of the weekly payroll sheets, the material journal, etc., in mind, the process briefly was this. Weekly when the payroll was finished, with the expense added, it became a journal, the totals of which were credited to labor and expense accounts, and debited to work-in-process accounts. The material totals in the material journal were credited to raw-ma-

terial accounts, and debited to stock-in-process accounts. When the order cost was finished, and goods billed, the sale price was credited to one of the eight profit-and-loss accounts and the cost of the order credited to work-in-process accounts and debited to its profit-and-loss account.

Now this looks formidable and technical, except to the accountant; but note the net result, which any executive would be glad to obtain, even at the expense of a little worry to some one else. Every month there were produced (1) figures showing the value of raw material on hand, (2) the amount of money tied up in various classes of work in process, (3) the profit or loss on eight classes of goods shipped during the month. And all this information was only about ten days old at the latest. The executive, and not merely the bookkeeper, mastered every detail of the development of the scheme.

There was then the third problem of accuracy to settle. In the matter of labor this was easily settled, because, as shown, the payroll, a certified amount, analyzed and proven, was used. The expense used was the analysis of the total monthly amount from the books. The material was operated

as explained, to leave figures showing in different classes what remained on hand, and only actual inventory could show the accuracy of these figures. But five years' experience has worked these down to the point where actual inventory always comes within a fraction of one per cent of the book inventory.

Then, of course, came the main test, *viz.*— the answer to the question as to the value of all this work. And in this case the activity of the executive made the results very real. From the order costs came the first results, for they showed many things astonishing, as they always do. It was immediately apparent that many orders were being filled at little or no profit. This was particularly apparent as to repairs made, and on all work done away from the plant, and an immediate increased charge per hour for men so employed took place.

These order costs likewise showed that, while many orders undertaken were especially profitable, many were not. Where prices were strictly competitive this could not always be remedied, but assuming the new proven elements of cost in the estimates many future orders were obtained at better

prices, and the introduction of incentives to labor in the cases of certain regularly made staple articles, on which loss was being made, so reduced the cost as to bring them on the right side. In the cases of special or patented machinery no hesitation was had in raising these prices on the basis of fair cost. Thus the order cost alone brought, in six months, more value than the system cost.

But the comparative detail of expense soon brought about changes that made future saving. The saving in the tool bill alone was very large, because as soon as the executive saw, several months running, the amount of money spent on tools, and the time notes began to show time wasted in waiting for tools and in sharpening them, a reform in the tool system made a very respectable economy. And there were many like economies through this expense analysis.

The regular system of time notes also made an entirely noticeable saving in time occupied in most operations, for most of the operatives worked on the day-work basis, and the moral effect of the knowledge of the operative cost was great.

In fact, as is both theoretically and prac-

tically always the case, the men, honest before, if you please, soon realized (as the foreman was called to the front to explain, and passed the word along upon his crestfallen return) that "the boss was wise". And they acted upon the boss's wisdom. They began to "make the cost". In fact, savings took place all along the line in logical ways brought about by constant knowledge.

The saving of material, based on the fact that all material used had to be accounted for, was well worth while.

There was finally the satisfaction of the executive in his monthly showing of the profit and loss. This had the very definite value of casting up the whole situation as an assurance as to the general result, which, of course, flowed from the average of the details, and gave a secure feeling which tended much to give energy and direction to the mind of the executive. It did more indeed, since the showing of the eight classes made it clear in what general direction an increase of the business should veer, and efforts made in pushing it in those directions were effective.

And so after eight months of work, the most finished of cost systems was installed and began its work of economy. Met by the ordinary opposition of the individual and collective human natures, it was fought through to such a quick and successful finish by almost the only means that can accomplish such a result—the constant insistence, interest, and co-operation of the executive. When the system was finished he understood it, because he had helped to build it.

And it saved money because he used it. It actually increased the average per cent of profit.

And a year later he offered to pay one-half the cost of an expert if three of his competitors would install a similar system because, he said, their "fool competition almost compelled him to take some orders at a loss, which he hadn't minded doing when he didn't know it, but hated to do now that he did know it". And, after all, does not that characterize the value of a cost system?

## Chapter X

## THE NECESSITY OF EFFICIENCY-WILL

THE profession of efficiency engineering, while not yet entered largely through a definite course of education and training looking towards its practice, but rather manned by practical men (and perhaps drawing a little too largely from one branch, accountancy), is nevertheless becoming more and more fundamentally established in the United States as of real service to progressive business interests.

The efficiency engineer, under whatever title he may offer his services (and there are as many different styles used as there are phases of this large subject) is being consulted and respected for his attainments, and his profession is becoming recognized as a distinct and worthy branch of engineering science. If occasionally someone has entered upon its practice without the necessary experience and standards, or (what is frequently

fully as important) without the right temperament or personality, he will perhaps not be able to accomplish any great or permanent harm, or place his profession in any worse position than the other professions find themselves in through their least able members. And it must be remembered that the profession is still young and in a state of development.

It is true also, and not unnatural, that the attitude of the executive towards this profession is likewise in a formative state, and is full of a doubt, hesitation, and suspicion which has to be met.

An early argument of the efficiency engineer was that he stood in the same relation to a business as a doctor to his patient, or a lawyer to his client. This the executive has as yet been unwilling to admit. He recognizes his ignorance of his body despite his intimate association with it, and has long ago realized that the intricacies and technicalities of the law are to be handled only by an expert. But his business! Why, that's the thing he's expert in himself! He spends his time, thought, and energy in its details. He has been a part of it or made its development. And if he has made it successful, it is

entirely natural that he should doubt the ability of an outsider, not intimate even with its nature, much less its details, to improve it. And this is not an unnatural view. Moreover, he generally is most ready to give ear to the efficiency engineer when he is feeling best, financially, and not when he is sick or in trouble.

There is, however, a basic and proper viewpoint of business which offers the executive and the efficiency engineer common ground. Business could never have become so successful, so widespread, so far-reaching, if its practice were not based on certain principles of action; or, if it depended solely on certain peculiar individual abilities, and not on definite methods and formations general and applicable in all. Individual abilities, it is true, have made for greater successes, but only as they have guided and animated or energized the general plan of operation.

Every business, then, has at least two general divisions. One division deals with the particular article or articles of manufacture, the machinery of its processes, its grade and quality, and those elements which pertain to its peculiarities. But another division deals

with methods and practices which in principle are necessary and common to all businesses, *i. e.*, organization, planning, routing, storekeeping, costs, waste saving, incentives to labor, etc.

Out of this common necessity there has logically grown the fact that there have been different developments along the line of this second division, and similar developments of varying degrees. Here and there analysis and experiment are still developing fundamental theories and improvements in practice of economic value in some businesses, which are of value to all. The busy executive, tied down with the daily detail of his own business, and struggling with the difficulties of his own peculiar production and problems, cannot know of these developments; or knowing generally, cannot put them into detailed practice.

The efficiency engineer, on the other hand, studying and developing theory in relation to this second division, but particularly experimenting and experiencing in plant after plant, becomes acquainted with these methods and their necessary detail, developed with successful practice. He is, therefore, easily able to offer valuable advice in almost

any business along the lines of his experience. If he possesses tact, patience, personality, and particularly common sense, in addition to experience, he is almost invariably able to be of large service in at least some of the elements of this second division. Efficiency introduction thus becomes a natural branch of engineering. The broad-minded executive has seen this to his advantage.

But both before, and for some period after, an executive has made up his mind to submit his methods to the scrutiny, advice, and eventual reorganization at the hands of the efficiency engineer, he retains in his mind a large question mark as to the outcome of his determination to invest in such services. It may, therefore, be not uninteresting to some to hear of experiences through which others have gone, and the net general result, and there are in mind three establishments, all metal-working, which illustrate fairly well the possibilities, difficulties, and necessities of a successful relation between an efficiency engineer and his clients.

The situation in the first concern was one nearly always unfortunate as to organization. The president was the chief stock-

holder by inheritance, and so maintained his position on this account, and not through any special ability to fill it. The authority under him was divided between three or four who had some ability, but not enough to dominate the situation, or to push to successful conclusion any plan, which, by apparent radicalism or expense of operation, might meet with the criticism or opposition of the president. Too often the weak executive gathers weak men about him.

The profits of the company, while real, were not of such a volume as to encourage this management to risk any appreciable sum in making any changes or additions to organization or methods that seemed desirable. There was a general feeling that efficiency was some plan whereby with little expenditure or outlay of money, other than the fee of the engineer, marked improvement in profits must follow. This idea had been gained because of some work in a neighboring plant, where conditions were entirely different, being simple, and under the control of an able, industrious executive.

Now this situation contained one great weakness from the point of view of permanent results. Efficiency *is* first of all, or

*needs* first of all for successful operation, a certain state of mind. This state of mind involves first the belief that efficiency, beyond that already attained, is certainly possible, attainable, and vitally valuable; second, the understanding that efficiency, like any other result of value, is to be attained and maintained by study, records, organization and inspection demanding maintenance expense; and thirdly an active determination of the executive organization to co-operate enthusiastically and continually. This state of mind may be called efficiency-will. It is, of course, a part of the efficiency engineer's task to produce this state of mind. It is, however, difficult to accomplish when the chief executive is really inactive in control and his authority is delegated to several others.

In this particular plant the attitude of the president was one of watchful waiting, of criticism of any expense through additions to the organization, such as the cost clerks; and because of a lack of understanding of the principles operated upon, it developed into a desire to judge all proceedings by the next inventory trial balance. Such an attitude, under the conditions, naturally induced a similar one all down the line.

This showed itself in several concrete ways, which detracted from the attainable values. For instance, the basic plan of the cost method was developed, and that which pertained to the book-keeping end—expense analysis, payroll division, etc.—was well handled. But the necessities for material-cost gathering—proper store room and issue of material by requisitions—were refused, because of the cost of equipment. It was expected that reports could be gathered while material was stored all around the plant and the workman took it as needed. The material was valuable and the waste great. Needless to say the reports were not credible; and what was really most important—waste was not stoppable under such conditions, to say nothing of the resultant costs. Such a condition was one of adherence to form, rather than to certain value of costs.

Another example was that of the use of the production schedule. This schedule showed clearly the amounts on hand of a great number of small parts, orders out unfilled, and—in connection with an analysis of the use in periods of time of these parts—offered a right and reasonable basis for

planned production. But such a plan needed study and insistence. The man in charge of this found his work blocked constantly by the orders of a superintendent, who had been accustomed rather to keep his machines going in the way best suited to their set-up, the condition of raw materials, and his own judgment, and the lack of efficiency-will in the executive organization had not developed that confidence which insists that the old ways, where they conflict, be set aside for the unobstructed operation of the new.

These examples illustrate, of course, what is actually happening in a great many plants where efficiency is delayed. In plants where the suggestions come from those of lesser authority, it is, of course, somewhat excusable on the score of unripe judgment, if such suggestions do not receive a thorough consideration. Where expert advice is engaged such action seems folly, but is really due to the lack of efficiency-will. The net result in this plant was that while the body of efficient methods was gradually built up—cost methods, production schedules and planning, incentives, waste reports, etc.,—the soul was lacking. And efficiency schemes without a soul are liable to develop into red tape, or to

arrive at a certain low plane of value, and bar further improvement.

In one department alone, where there was a change to a new and energetic head, did the methods really reach any intelligent energetic development or use, and in this department a loss was quickly turned into a profit of equal amount.

Here, then, is a typical case illustrating one large reason why efficiency does not travel forward as rapidly as its enthusiasts think it should. Efficiency needs belief and enthusiasm behind it. At its best it can at first only start on a career. Its methods must be developed. Except in its simpler propositions it cannot jump at once into its best pace. Doubt and executive inactive watchfulness do not foster it. The first necessary principle of efficiency must be co-operation. "What the executives do not stand behind, the operators stand in front of" is a rule that follows infallibly from the human nature of the factory situation, as it follows in an army with a poor general, or a baseball team with a poor manager.

The methods applied, conforming of course to conditions, were precisely such as had proved much more successful in other plants,

but they failed in this plant, except in certain spots, to possess more than a form. Their development was stunted by lack of efficiency-will. The executive organization were not opposed to the suggestions made, they were simply not enthusiastically for them.

The second case was a very happy one both in operation and results. The executive and selling authority was divided between two men who owned majority stock control, and who had built the plant up from a small but practical foundation. They could never have been persuaded to invest a sum of money in any plan of efficiency, because they had worked in all parts of the plant themselves and their training and familiarity with the details, together with the condition of their finances, were not conducive to any expenditures along broad lines of action. They were persuaded into the adventure, however, by one to whom they owed some money.

Once they had committed themselves, nevertheless, being practical men and wanting to get the value of their money, they entered into the proposition enthusiastically. It was a little difficult for them to grasp with complete understanding and foresight all the

theories enunciated; but as the work began to develop, and they saw some practical results, they arrived completely at the proper state of mind. They developed efficiency-will and talked all of their organization into it.

The first work put into complete operation was the cost system. Long arguments as to the proper theory of costs ensued.

Certain theories of cost—very simple and easy of operation, involving an addition of material and labor costs, and multiplying them by a fixed figure—were held by one partner. Any scheme which demanded the following of an article through its operations, wherethrough it took its accretions of labor and expense as it went along, looked needless. The other partner took the attitude that if the manufacture of an article in their line was demanded of them, the method of such manufacture was left to them as experts, and the efficiency engineer should have the same chance. He was given a free hand and results were awaited.

But the plant was one where everything went through in definite lots of shippable articles, so that by the introduction of lot costs it became possible to balance up every

month and show profit or loss for the whole production, in addition to obtaining the detail costs with profit or loss on each lot of articles finished. And when these figures, hitched up to an estimating system for bidding in new work, began to operate well, and produce tangible results and increased profits, no suggestion was deemed impossible of accomplishment. This plant, indeed, bore out very well the belief that a right cost system is the proper basis for all improvement, since it offers visible and indisputable evidence (through its pictures of profit and losses) of efficiency and lack, of opportunities of improvement. Care of materials, incentive methods, waste reports, expense consideration, planning of work, all followed quickly with the minimum difficulty.

A typical case of efficiency-will was shown in the progress of the work. One department handled an operation requiring very skillful and highly-paid hand-work. This work was paid on the hour plan, but it was thought that a bonus plan would produce definite economies. The operatives were difficult to obtain, and consequently very independent. They had no enthusiasm for any change, and frankly stated so. In very many

cases the matter would have dropped here; not in this case, however. The partners got the men together and told them plainly that the scheme was going to be put into operation; that it would undoubtedly work to the benefit of both the company and the men who tried it earnestly; and that others were invited to quit, a guarantee of certain results for a given period being made, however, for those who stayed. The scheme proposed proved advantageous after a short trial to all concerned, but illustrated very well one of those occasions where lack of the proper spirit and efficiency-will would have prevented a material gain.

And after three years the whole scheme, under their insistence, has remained so closely in operation that an examination by another firm of efficiency engineers brought out the comment that this concern had one of the simplest and most effective and up-to-the-minute systems they had seen. The result is amply observed in the profits.

Thus hearty and quick co-operation in this plant and a determination to hold to and develop all suggested improvements, made efficiency a simple and valuable proposition, despite the fact that the executives had pre-

viously developed no great reputation as business men.

The third example developed still a different eventual result. This plant, manufacturing a specialty, was quite successful financially. The president had originated, and made successful by shrewdness, his venture. But he had reached quite an old age, and his infirmities prevented him from taking a very active part in its management. The authority of management was divided between the superintendent in the factory and an officer who had charge of the office and the selling. It was this latter who desired more efficient methods in the factory.

There of course is something very human about such a situation, where the head of one section desires to see some other section improved. This is a situation arising very often. It is usually unfortunate only when conditions are such that there is not some bond of broad spirit of loyalty to the plant, or an over-executive who is able to control. This was one of the unfortunate situations.

The superintendent had developed some methods of system gathered from his experience and reading, and was frankly much opposed to the service of any outsider. This

situation had in it what not unusually exists in the majority of cases where efficiency is introduced, namely, one man in an important position who was unfavorable to any method other than his own. It lacked what saves many such situations, viz., an executive above him who eventually would make it clear to him that his co-operation was expected. There were really two somewhat antagonistic and independent authorities.

The superintendent, firm in the conviction that his own methods were adequate, (and perhaps, as is not unnatural, and indeed is unfortunately a large cause of the stoppage of the progress of efficiency, fearful that methods introduced by others would be to his detriment), could not, and did not oppose any plan offered openly. But he took the practical position that since the work was proceeding without his consent, it did not entail any necessity of assistance from him, and he took many opportunities to create a spirit against it, the effect of which was that those engaged in the work as employees of the plant felt that their jobs were not permanent, and themselves possibly a little ostracized. Such a spirit, of course,

held nothing encouraging to quick and valuable results.

The work was proceeded with under the quiet opposition of the superintendent, however, and certain methods which led to the office, and could be watched from there, were introduced and gotten into good working order. First class store rooms with card-records of the income, outgo, and amount on hand of parts in progress, and of finished parts, were built and put into operation. Lot-routing systems were introduced. Records of waste and spoiled parts, and by whom spoiled, were introduced. And finally a lot-cost system on all parts and finished assembled articles was established, as was a production system. These were of course valuable and fundamental and they were tied together by reports and records to the office. Under the conditions this was all that could be accomplished. But much can be done with such basic methods.

As a matter of fact, what happened in this case was that after two years a change came about. A new element in the form of a general manager was introduced, and the fundamental methods having been maintained, efficiency began anew with this as a base, and

the work introduced without co-operation began to bring forth its true value.

These experiences, unexciting and ordinary but humanly natural, serve to illustrate nevertheless some important necessary conditions for success in efficiency attainment, not always fully comprehended nor operated upon either by the engineer or by the executive who desires efficiency in his plant.

They indicate clearly the fact that efficiency needs, as a fundamental to build upon, *a proper state of mind in the executive organization not improperly termable "efficiency-will."* This state of mind, or efficiency-will, involves (if perhaps not at first, yet finally) a strong belief in the existence of a higher efficiency and its attainability under makable conditions. Following an understanding of the principles of operation and perhaps some slight attainment, there must ensue energetic enthusiasm. For it must be realized that after all most efficiency results are to be gained through human effort all the way down the line of employees, and enthusiasm is a tremendous energizer.

And it is no more true of a metal bar that a constant heat at one end will gradually be felt at the other end, or that an icy bath at

one end will transmit coldness throughout the bar, than that enthusiasm or indifference will likewise be transmitted from the executive organization down. Too many executives think of efficiency introduction as parallel to the case of a wire connection to an electric current when the current flashes immediately through the whole. Too often the bar simile (and the simile of a long bar at that) holds more nearly true.

But it must not be forgotten, also, in considering the efficiency-will, that knowledge and enthusiasm must be transmitted downward through a lure as well as a drive. Efficiency attainment is essentially a mutual affair. The advantage gained must be shared between employer and employee on a fair basis.

Efficiency attainment involves, then, cooperation of the executive organization. All must work together with one purpose. This natural law of any operation involving the working together toward one end of many people is indeed all the more essential in efficiency attainment, because of the fact that it means extraordinary results striven for, and involves the uprooting and eradication on the part of many, who are past that time

of life when it is easy and natural to change, of old habits, customs, methods, and manners.

The executive who desires results should understand and endeavor to bring about this efficiency-will and co-operation, and not depend entirely on the engineer to accomplish it. The cases cited illustrate results obtainable by its lack and its presence suggesting an underlying feature of the psychology of the situation.

The operation of this psychology is so plain in the ordinary every day affairs of business, that its necessity in practical action when the attainment of extraordinary results is attempted it seems might be taken for granted, and striven for or forced by any interested executive. It is unfortunate, however, that too often efficiency attainment is looked upon wholly as experimental.

Efficiency progress will however undoubtedly make stronger and more rapid advances in the right direction when the executive has learned to develop in advance, or at least coincidentally with the attempt at efficiency increase, a strong efficiency-will.

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