CHAPTER IV

THE ORGANIC FUNCTIONS OF ADMINISTRATION (Continued)

In the previous chapter we discussed the two primal organic functions of administration, namely:—Design and Operation. It will now be necessary to discuss what, historically speaking, may be considered the three secondary functions, viz:—Equipment, Control, and Comparison.

In the large plants of today, however, these three functions, so far from being subsidiary, assume great importance. It may be laid down as a law that in the progress of an industry, as soon as any new function is superadded to the primal functions of Design and Operation, it assumes equal rank with these latter. In the modern plant, therefore, it is not correct to say that Design or Operation are more important than Equipment, Control or Comparison, since these latter cannot be dispensed with, and cannot be permitted to fall into a condition of inefficiency without bringing as much trouble
as would follow if one of the two first should become inefficient. It is this wonderful sensitiveness of the industrial organism in all departments that makes it so imperative to settle some definite principles in regard to administrative problems.

THE ORGANIC FUNCTION OF EQUIPMENT.

As soon as any industry enters the factory stage the question of Equipment will begin to assume importance. Equipment is that organic function that provides conditions for production, and these conditions are of varied character. Every considerable business must have, for example, suitable premises, and these premises must be lighted, heated, kept clean and bright, and the space they afford must be utilized economically. Secondly, power will be required, and this involves the provision of equipment of another kind, which also has to be maintained and kept going. Thirdly, the storage, handling and transport of material necessitates suitable equipment of still another kind, and this again requires to be maintained in a state of efficiency. Fourthly, there is the operative equipment itself which has to be repaired and kept in order.
Efficiency of Equipment naturally has two aspects, one of which may be called the installation, and the other the current or administrative aspect. In the installation division must be placed the selection and the arrangement of the Equipment, including the very important question of space-utilization, or lay-out, the suitability of each part of the site and buildings for the purpose to which it has been allotted, the question whether this or that method of generating and transmitting power should be adopted, the provision of proper storage bins, racks and fixtures, the mechanical means of handling material by cranes, travellers, conveyors, trucks, industrial railways and so forth, and the grouping of operative machines.

All these dispositions are termed installation questions because they are, properly speaking, antecedent to the administrative use and running of the Equipment. They represent engineering selection. Once the Equipment has been installed, then its current use is obviously an entirely different matter. The organic function of Equipment therefore is concerned first with the installation, and then with the maintenance of all the appliances used in the factory, and that
is really its special field. But in some cases maintenance involves operation of the equipment itself as, for example, in the case of the power service, and such matters as the lighting, heating, ventilation and cleaning of buildings. On the other hand, the working of the productive machinery is the function of Operation, and the working of the storage, and conveying or material-transporting equipment is the function of Control.

Once the equipment has been installed, then the administrative maintenance of proper physical conditions becomes the chief task of the organic function of Equipment. It must attend to the keeping of the buildings in good order, and clean and bright inside; to the question of fire protection; to the maintenance of pure air at the right temperature; to abundant light, and to providing power in the necessary quantity during the right periods. All this is obviously an administrative matter, viz.: the maintenance of conditions of physical conditions necessary to the whole course of Production. Similarly the task of keeping all machinery and appliances in a condition of efficient repair is, with equal obviousness, also a maintenance of conditions necessary to the work.
of the various departments using such machinery and appliances.*

TABLE III. SCOPE OF THE ORGANIC FUNCTION OF EQUIPMENT.

| Buildings. | Allotment of different parts of buildings to suitable uses, i.e., the lay-out of departments, installation of appliances for lighting, heating, ventilation, fire protection, etc. |
| Power Plant. | Selection of the right type of plant, and suitable means of distributing and delivering power where required. Consideration of the margin of power necessary. |
| Materials. | Provision of adequate equipment for storage and conveyance of materials. Storage racks, bins, fixtures, cranes, travellers, trucks, conveyors, etc., considered in reference to the volume of work and lines of travel. |
| Machinery. | Provision and installation of machinery and design of lay-out in relation to travel of product. |

| Buildings. | Repair and maintenance of structures, maintaining an adequate service of light heat, ventilation, and fire organization. Keeping premises clean and bright. |
| Power. | Keeping up supply of power in right quantity, during right period, on an economic basis. Attending to storage of fuel against contingencies, oiling shafts, maintaining belts, and so forth. |
| Machinery and Appliances. | Repairing and maintaining all kinds of equipment in working order. |

* The use of Analysis in regard to Equipment will be referred to in the Chapter on "Organizing the Function of Equipment".
Before leaving the subject of Equipment, it may be well to point out the independent scope of this function. It is evident, in the first place, that it has nothing to do with design of product. Neither has it anything to do with the efficiency of technical operation. Its business is to provide and maintain suitable conditions under which Operation may be free from certain hindrances, such as dark and stuffy shops, irregular supply of power, inadequate transporting appliances, and so forth. But its efficiency is quite a separate kind of efficiency from that of Operation. The conditions provided by Equipment may be perfect, and yet the Efficiency of Operation itself may be at a low ebb.

Nevertheless, in examining a plant for causes of inefficiency, we should begin by examining Design, and next Equipment, because Design originates everything in the way of product, and Equipment originates everything in the way of physical conditions. As has already been remarked, efficiency in one function does not increase efficiency in another, since each represents a totally different quality of efficiency, but on the other hand, any inefficiency anywhere is a hin-
drance to the total efficiency of the plant, and may hold back the possibilities of efficiency in any other function. But removing a hindrance does not increase other qualities of efficiency.

We may, for example, be able, under the most favorable conditions, to walk four miles an hour. Under given poor conditions, say a very bad road, our pace may be reduced to three. If the road is improved, we may reach three-and-a-half; if it is made perfect, we reach our maximum of four. But no improvement in the road will enable us to walk beyond our maximum pace of four. No such improvement will enable us to walk five. Yet perhaps competition might demand that we should be able to walk five, or go out of the race. In that case we must tune up our Operative function, viz., our powers of walking, for that alone is at fault.

When, therefore, it is said that the efficiency of all the functions is independent, this is what is meant. It is not implied that inefficiency in one function will not hinder another. Obviously, if one function reduced its efficiency to zero (that is, ceased to act altogether), all the other functions would stop. If there were no road, we could not
walk at three, four, or any other number of miles an hour. Similarly, if designs are stupidly made so that process work requires extraordinary skill to produce the results specified, this will hinder Operation from producing economical work, however efficient it may be in its own domain. But the converse is never true. If Operation is careless and unskilful the best designs or the best equipment in the world will not improve these bad characteristics out of existence. It may make them less harmful in their consequences but they will still exist.

Each function has a special kind of efficiency in its own domain which can be hindered but never helped by the conditions of efficiency in any other function. It is the absolute truth of this law that gives the organic functions all the importance they may possess as practical guides.

THE ORGANIC FUNCTION OF CONTROL.

This function has also a field of action equally as definite as that of Design, or Operation, or Equipment. It has its definite aim, which is quite clear-cut and precise. It supplies, as it were, the human motive power of the business. It seeks to move things.
Control, like Equipment, has its installation as well as its administrative aspect. In the former sphere it fixes the relations of persons throughout the plant. In the latter sphere it selects the right personalities to fill the posts whose duties are thus fixed, and supervises their daily performance of these duties. Control is, in fact, the nervous system (or more correctly one-half of the nervous system, the other half being Comparison) of manufacturing administration. The analogy is indeed very close. It conveys orders from the central brain (the executive), it responds to stimuli from without, and it is more than a mere telegraph system of nerves, for it has well marked ganglia, or secondary nervous centres, forming local subordinate brains concerned with special duties (stores departments, pay departments, and so forth), and responding automatically to stimuli without the central brain being concerned.

It is evident therefore that the arrangement of the system of devolution which is the most marked characteristic of the function of Control must be very carefully planned. Since the executive cannot be in all places at once, it is necessary to provide subsidiary
local brains or officers to whom definite special duties are allotted. Each of these subsidiary brains will have routine work, in the performance of which it has been coached and instructed, once for all, by the central brain, or executive. So long as the stimuli to which the local brains respond (or in other words the business they transact daily) are ordinary matters of routine, the executive remains unconscious of them. But as soon as a stimulus arrives not included in the routine (i.e., when something unexpected happens), then the subordinate officer must know to what higher brain to turn for instruction.

Historically speaking, all the organic functions represent successive devolutions of the function of administration. This is clearly shown by Table IV (facing page 73). In the beginning, one man performs all the functions of manufacturing, as in the case of the shoemaker cited in Chapter V. Then he separates out the function of Operation and entrusts that to other hands. Next he puts someone in charge of his Equipment and so denudes himself of that function. Then, possibly, he engages a designer and ceases to perform that function himself. Finally he
engages an accountant and an inspector and hands over to them the function of Comparison. But he still has left the function of Control, which he continues to exercise.

As the business grows, however, devolution *within* all the functions becomes necessary. The designer must have his assistants. The accountant and the inspector must have subordinates for specific duties.* The superintendent must have foremen and assistant foremen. The engineer must have men for the power plant and other men for the repair staff. And the executive himself, exercising the function of Control, will soon find himself in need of devolution also. He cannot be in several places at once. He cannot receive customers' orders, and circulate them to those concerned; he cannot purchase material, nor receive and take care of it; and at the same time exercise the higher function of Control, namely:—seeing that everyone is doing his duty to the best of his ability.

Consequently he devolutes the subdivisions of Control, as before he devoluted the big organic functions. In this process of throwing off or devoluting work, there comes a time when what is devoluted is no longer
worthy of being regarded as a separate organic function, and so while some case might be made out for considering the purchase, care, and handling of material as so entirely independent a kind of aim or activity that it becomes organic, still it is so intimately connected with the prime factor of Control, namely ordering, that it is best included in that function.

This imaginary case of the development of a plant from small beginnings will serve to make plain what Control really is. It is not Design, it is not Operation, it is not Equipment, it is not Comparison, for we have seen all these organic functions thrown off one by one by our suppositious manufacturer as his business is increased. *It is that function which co-ordinates all the other functions* and, in addition, supervises their work.

In popular language it is the function of the "boss". As Design is the originator of the nature of product, and Equipment is the originator of conditions of production, so Control originates *orders*. It controls first by arranging devolution of duties (these being the installation of control and its arrangements are, of course, static and fixed)
and secondly by issuing orders. It sets things in motion and keeps them in motion.

Control is the organ by means of which the picture of management that exists in the mind of the executive is realized as an actual fact. No system is ever more than this. No system can be greater than the executive that wields it to effect his purposes. In our admiration for clever arrangements of system, of forms, books, schedules, planning boards, and records, this simple and elementary fact has become obscured, but it remains today as true as ever. Incompetent generalship has, time after time in history, brought the most disciplined armies to grief. Competent leaders have also, time after time, built up victory out of unpromising materials. The object of studying management principles is not to supersede leadership, but to discover the most efficient system of devolution of functions for the competent leader to use.

The advantage of sound theory to the competent leader is nevertheless great. It saves his energy. He can dispose his forces with less thought and with greater assurance than if he had to work out every detail for himself. If he is a soldier he can arrange
the duties of his staff, his regimental commanders, his subaltern officers, his auxiliary corps of supply, transport and sanitation, with confidence, and is thus set free to devote his attention more easily to the prime business of conducting war. He is sure of his subordinate ganglia or local brains and of the way in which they will respond to the stimuli of their daily routine, and that is the first condition of success for all leaders.

In manufacturing, as in all great aggregations of human effort, the most difficult part of administration lies in first mapping out the sphere of duties of individual men, and then in selecting men of the right temperament and qualifications to fill these posts. In small businesses, we must sometimes fit the duties to the men who happen to be at hand, but this is one of the reasons why the very small business finds it difficult to compete with larger concerns, where devolution is on an extensive scale, and corresponds with the natural division of the organic functions. Control, as an organ of administration, comprises the specification of duties, the determination as to who shall issue orders, and what fields these orders shall cover; who shall transmit orders; who
shall receive and interpret orders; who shall carry orders out. It comprises also the organization of experience and advice; who shall be the final authority on purchases, and who on tests. It comprises the careful planning of subordination, and mechanism for adjusting disputes between persons of equal authority in their respective spheres. *It is the organ concerned with duties, responsibilities, and the exercise and limitation of initiative.* It is the great Organ of Synthesis.

**TABLE V. SCOPE OF THE ORGANIC FUNCTION OF CONTROL**

**Installation of Control**

**The Delimitation of Duties**

*Within the Other Organic Functions.* Commencing with the heads of departments, i.e., the men who are in charge of the organic functions of Design, Operation, Equipment and Comparison, it plans their duties, decides what subordinates they should have, and what specific duties these subordinates should fulfill. It therefore plans the interior structure of the systems by which these functions are exercised.

*In Its Own Special Department.* It plans the relations *between* the above departments, and says which persons shall confer, and when. It arranges all the specially administrative duties, such as ordering, receiving or storing material; receiving customers’ orders and passing them to the various departments concerned; su-
pervising the current work of all departments, in the light of costs, wastes, delays, poor work, and other irregularities. It arranges all this by planning specific duties for specific persons, including the organization of specialists' advice or "staff" assistance.

**Administrative Function of Control**

**Supervising, Ordering, Instructing and Training**

*Within the Other Organic Functions.* Once organized under a head, each function is to a great extent autonomous. In other words, control of the Departments of Design, Operation, Equipment and Comparison is exercised through the heads of those departments, who are responsible for seeing that their subordinates are carrying out their duties as planned originally.

**In Its Own Special Department.** Administratively speaking, control is the great co-ordinative function. It sets everything in motion by issuing orders. Its particular task is to issue orders in such a way that, when all have been carried out, the result is exactly what was intended. It also observes failures, studies their reasons, and sets in motion the mechanism of instruction or training to prevent similar failures in the future.

It will be recognized that Control is the great organ for conducting manufacturing. Design determines forms, shapes, materials, qualities, and the special tools, if any, by which these desiderata are attained. Equipment provides the best known physical con-
ditions for both personnel and material. Control determines the acts of the personnel; it has to do with the stimuli that set people in motion; it deals with the influence of one person on another; it communicates, orders, explains, and teaches.*

**THE ORGANIC FUNCTION OF COMPARISON.**

Lastly we have Comparison. This is the last of the organic functions to be devoluted, as industry develops. It is, in an organic sense, of very recent growth. Every kind of plant where a number of men are employed must have some kind of Control (usually the simple devolution of authority downwards), but it need not have anything worthy of the nature of Comparison, save in so far as the check-book of its owner and his pile of unpaid bills represent that organic function. In fact, in the days of big profits the old-time manufacturer did actually compare the results of his undertakings month by month in just that simple way. In other words, in former days the organ of Comparison was rudimentary and quite undeveloped.

The aim of comparison is of an entirely

* The use of analysis in Control will be referred to in the chapter on Organizing the Function of Control.
different nature to that sought to be realized by the other functions. It is the organ by which we systematically accumulate Experience. It is therefore the function which makes use of existing Standards, and also compiles the data that enable us to revise these Standards from time to time.

The great instrument of Comparison is Measurement. One of the principal differences between the older practice of Management and the newer is, as Professor Dexter Kimball* has pointed out, the substitution of quantitative for qualitative methods wherever possible. Instead of ordering coals and pronouncing judgment on its quality after it has been burned, we specify calorific values and ascertain that they are present before accepting the consignment. Instead of putting materials into the cupola and expecting them to come out right, we make sure that they do come out right by analyzing the product and ascertaining that the correct proportions exist in it. We keep stores and materials under lock and key and weigh and measure out what is wanted for specific jobs. We analyze the elements of jobs, and find out how much labor should properly go into them

* Principles of Industrial Organization, p. 249.
before we contract with the operator to do the work.

All these proceedings involve Measurement, but measurement by itself is of little value, unless we have something with which to compare the quantity or value so measured. To measure without comparing is an idle task; it would be like the boys' amusement of writing down the numbers of automobiles as they pass him on the highway. Measurement, in short, is but the tool or instrument of Comparison.

But before we can compare anything we measure with another measurement, we must have the latter in our possession. In other words we must already be in possession of a STANDARD. The Organic Function of Comparison, therefore, is that which concerns itself with the setting up and comparison of standards. Such standards may not arise out of the experience gathered within the plant. They may be standards gathered from the experience of others in the first instance. Thus we may have a standard of power cost, of calorific fuel value, of water evaporation per pound of fuel,—these are general standards, common to all work of the kind. Then there is a class of arbi-
trary standards, such as a 54-hours week and a consequent comparison of how far employees comply with such standard, or how far machines are operating all the time or less than the time. Then there are standards special to the plant, such as time allowances on jobs, quantities of materials allowed to be held in stores, weights of castings, formulae for mixtures, output of specific machines, etc.

‘Writing some fourteen years ago in The Engineering Magazine, the present author said, ‘The object of the organization . . . should be to collect knowledge of what is going forward, not merely qualitatively but quantitatively; it should provide the means of regulating as well as the means of recording.’’ This was at the time when cost accounting was being developed, and the idea of standards had hardly received discussion, but since that date the quantitative idea has steadily grown, and is now recognized as the proper basis for all industrial operations.

Comparison, it has already been stated above, is to be likened to the receptive half of the nervous system of the body. It has its sub-organs of sense, its clocks, time recorders, weighing machines, scales, counting
machines, chemical and mechanical apparatus for testing, just as the nervous system has the five senses of sight, feeling, taste, hearing, and smell. Its office, then, is first to measure, then to record, and finally to compare. In practice, it is the counterpart of Control, since its function is to report the results of orders and instructions, and, by comparison with standards, ascertain whether these orders have successfully attained their end.

Comparison has two well-marked spheres of activity: the one dealing with the properties of materials, either in their raw state, or after they have been subject to Operation; and the other concerned with Time, Quantity, Number and Value. The former of these we term the technical sphere of Comparison, and the latter the accounting sphere. The technical side deals with chemical and physical standards. It analyzes the composition of material, such as fuel, alloys, chemicals, steels, etc., which have been purchased, and determines if they conform with standards. It also, in some cases, analyzes the results of Operation, and examines the composition of Product to see if it accords with the standards set up by Design. Fur-
ther it applies physical examination or "Inspection" both to purchased material and to product, and performs physical tests, as for hardness, elasticity, and so forth, when necessary. In all cases the results thus observed are compared with some expected result, or, in other words, with a Standard.

The accounting side of Comparison is concerned with figures rather than with properties. It does not investigate, it only records, groups, and compares figures. But here, again, it looks for agreement with certain expected figures, or in other words with standards. While the great field of accounting is the record and comparison of values, still it has other fields also. Certain efficiencies are measured in time, such as the attendance of employes, the utilized and idle time of machines, periods of maturing or seasoning in certain industries; and many more are correlated with time, such as the power demand, variations of pressure or vacuum, of heat, etc. Other efficiencies are measured by number or weight, such as the conformity to standards set by the firm for maxima and minima of stores and stocks, weight of fuel consumed per quantity of water evaporated, weights of the different
components of mixtures, in accordance with specifications of Design, and so forth.

Lastly Comparison is applied to values expressed in money. This is commonly known as Cost Accounting, but actually the accounting and the technical spheres of Comparison form a single function, and should be parts of a single whole—the aim of which is to standardize whatever can be economically standardized and to observe, record and compare all instances of non-conformity with such standards. If this is not recognized, then duplication of work and inaccuracy of record are sure to result. Instances need not be given of what is included in the field of cost accounting, save to recall that the main object should be Comparison of actual with expected result, or in other words with Standards.

In all these fields there will be instances constantly recurring of want of conformity to standard—that is, of inefficiencies or wastes. The observation, record and comparison of wastes is one of the most important services that can be rendered by this function. Even customary wastes can be standardized, and these standards either approached or exceeded. In a properly or-
ganized function of Comparison, all the avenues of waste, whether expressible in chemical or physical want of conformity with Standard, or in time, quantity, number or value, are systematically explored, so that nothing escapes attention.

Comparison may be with existing records or standards or it may be for the purpose of future comparison with further records to be made at some future day, but no record is of value unless we are either able, or expect to be able, to compare it with something similar. Even the compilation of a pay-roll, which does not seem to have any ulterior object save as a list of liabilities, is really a record of Comparison, being the firm's account of what the man has earned, as compared with his own notion of what is due to him. And every practical paymaster knows that, on pay-day, these two records do not always tally.

In examining an ailing business, the efficiency of the organ of Comparison is frequently found to be low. In fact, measurement is frequently confused with Comparison. Elaborate records are prepared, complicated cost systems installed, but the only thing that these should exist for, namely,
Comparison, is neglected. In this common fact lies a demonstration of the importance of basing all action on adequate theory. If, in installing a system of costs and records, the first question asked was, “With what Standard are these results to be compared?” it would often profoundly modify the form of the records and their complexity. For results can be compared broadly and in masses, and very important lessons deduced therefrom.

The value of detail only comes into play when we are able and willing to compare detailed results with detailed causes, and this demands a very high development of the function of control. If this development does not exist, then the detailed record is wasted.

It need hardly be pointed out that the aim of Comparison is entirely different to the aims of the other four functions. It occupies itself with quite different concerns from these.

Design makes use of the records provided by Comparison; so does Control; and Operation is frequently brought to book by their aid. But Comparison does not design anything, does not control anything, and
does not make anything; it is an organic function entirely separate and distinct.*

FINAL REMARKS ON ORGANIC FUNCTIONS.

We have now passed in review, briefly and generally, all the five organic functions into which manufacturing administration is naturally divisible. We have seen that, in the progress of industry, these functions become separated out, or devolved, one by one as the business expands. We have also seen that the last thing that remains, after all the others have been separated out and set on their own feet, is the function of control.

The five functions, though entirely distinct and representing wholly different kinds of aim, and therefore different qualities in which efficiency is to be attained, are nevertheless associated in different degree. Equipment is the base. In a modern plant, it is the first thing required. It embraces the very conditions of production, and therefore stands apart. Design and Operation on the other hand, may be considered a pair. They have always been in existence and have always been closely associated since the first.

* The use of analysis in Comparison will be referred to in the chapter on "Organizing the Function of Comparison".
cave man worked out the idea of an axe, and then proceeded to make it. Control and Comparison are also a pair. Together they form the brain and nervous system of a plant. Comparison is the receptive half, it observes, records, compares and transmits its observations to Control. Control is the central brain which receives information from Comparison, and from outside stimuli, such as customers' orders and directors' orders, and transforms its impressions into an act of will. It issues orders on its own account and transmits them to its subordinate local brains or ganglia, and so sets things going.

These analogies are not introduced for a merely fanciful purpose. They serve to picture the uses of the various functions. As has been remarked before, the division into organic functions is not fanciful or arbitrary either. It represents the division of human faculty in manufacturing, and it is believed by the author that the divisions here set down are truly fundamental and natural divisions. But, if this be true, it implies that organization to be successful must coincide, consciously or unconsciously, with just these natural lines of demarcation, and that where these natural divisions are departed from,
confusion and uncertainty in organization must result, in proportion as they are departed from.

We shall consider the concrete and practical organization of the organic functions later, but first must come the consideration of certain regulative principles, by which this organization must be guided in every instance. These will be dealt with in the next chapter. The scope of the organic function of Comparison may be thus tabulated and summarized:

**Table VI. Scope of the Organic Function of Comparison.**

- **Chemical Analysis.** Compares the composition of materials with purchase specifications (which are, of course, based on Standards) and with the Standards specified by Design as to use of formulae of mixture. Embraces all Comparison other than physical, i.e., all in which the constituent elements of bodies need to be compared with Standards.

- **Physical Analysis, or Inspection.** Compares the physical condition of materials which have been purchased or made, with the Standards specified by Purchase or Design, such as regards dimensions, color, pattern, surface finish, etc. Carries out physical tests for hardness, elasticity, elongation, tensile strength, etc. Passes on all physical properties not necessitating analysis.
**Time.** Records results of work of which the efficiency is measured in Time, and compares with Standards. Thus, attendance of employees, working and idle time of machines, time of operations in which result is dependent on duration, as in some industries, where product is matured, seasoned, etc.

**Quantity and Number.** Records fluctuations which are expressed in quantity or number, such as quantity of material in stock, consumption of tons of fuel in proportion to pounds of steam raised, number of employees present and absent, weight of components passing into a mixture, etc., and compares those figures with Standards.

**Value.** This is the sphere of Cost Accounting. Records the cost of labor, expense, and material, as and when incurred and used, and compares with Standards. Classifies the results of work as utilized capacity and waste. Groups Labor, Expense and Material so that the Cost of jobs is ascertained and compared with expected or standard cost of such jobs.

The Organic Function of Comparison is concerned with observing and recording the operations of all the other Functions, and comparing the results with standards. It is the organ which systematically accumulates Experience and records it in such a form as to be available for application. Its broad divisions are Technical and Accounting, the one dealing with properties of materials, the other with quantities, numbers and values.
Chapter V

The Regulative Principles of Administration, or Laws of Effort

We saw in the last two chapters that the five organic functions of administration are really the expression of five entirely different kinds of aim, two of these being in a sense primal, viz.—the desire to Design and the desire to Make; and three are in a sense auxiliary, viz.—the desire to provide suitable conditions by Equipment, the desire to Control, and the desire to Compare what has been done with what we set out to do. Yet we have also seen that, in the large modern plant, no one of these functions is now of less importance than another. The primal functions of Design and Operation cannot be worked on the large scale without highly developed Equipment, Comparison and Control.

Another way of describing the nature of the Organic Functions is to say that they represent varieties of Effort—Effort applied in five different ways to produce five differ-
ent kinds of result. As this is an important definition for our present purpose, it may be desirable to explain just what is meant by effort in this connection.

Effort may be mental or physical, but all effort which has visible results is a mixture of both. Mental effort must always have some kind of physical outcome, or it remains an unexpressed desire. To write a letter, or compose a speech, is a mental effort pure and simple, but it remains latent in the author's mind, until he translates it into physical effort of some kind, either by writing it down, or by dictating it to a stenographer, or by addressing an audience. Only thus can the mental effort be expressed and made to impinge on the consciousness of others and influence them to action.

It is not necessary therefore to divide Effort into mental and physical for practical purposes, since every mental effort requires physical means to express it, and every physical act on the other hand must have been prompted by a thought. It will be sufficient for our purpose to define Effort as any kind of human activity undertaken with a definite end in view. We have no need of any psychological subtleties in the matter; we
nay picture Effort very concisely as—"Man trying to do something".

The importance of this definition to our present discussion will be realized when we remember that our Organic Functions represent five different kinds of aim. It follows therefore that these functions in actual work represent "Man trying to do five different kinds of things"; or, more correctly—five groups of men, each group trying to do a different thing. Reverting to the use of the word Effort in this connection we can say that, in manufacturing, there are five different kinds of Effort involved, each kind being represented by a separate organic function.

We have therefore an industrial body—the manufacturing plant—with certain organic functions clearly marked, and each of these functions is a structure ready equipped to do some one special thing, by the aid of human effort. The next question arises whether this application of Effort is haphazard, or whether it is regulated by law. An analogy drawn from the human body may first be considered before we examine this question at length.

The human body has not only organs and a nervous system; it has also controlling
principles of action. In order that the normal functions shall go on, man must eat drink, breathe and sleep. Similarly, with our industrial body, it is not enough to have organs like Design, Equipment, Control, Comparison, and Operation, we must also exhibit these organs in action, alimened by the living stimulus of Effort.

Just as man must be careful about the food he eats and the air he breathes, so we must be careful about the exercise of Effort. The efficient exercise of Effort does not come by nature or at any rate does not come wholly by nature. It requires training. Just as man cannot distinguish a poisonous fish from an edible one until he eats it, so most of our progress in industry, as in other things, has been made by the process of trial and error. The advances which have been made, and of which we hold secure possession today, are but a small fraction of the failures and tragedies that have been long since forgotten. Innumerable inventions are constantly being made, not one per cent of which come to practical fruition. In fact, were it not for one thing, mankind could never have progressed at all, so many are the pitfalls and so difficult the path of success in every department of
human endeavor. Without this one thing he would be as the animal, confined in a round of instinctive habit, only to be modified in slight degree after ages of evolution.

The one thing that has saved man from this fate, this almost perpetual stagnation, is his faculty for accumulating and using the fruits of experience—and experience is but the record mentally assimilated of the efforts of ourselves or others in the past. It is by this faculty alone that progress is firm and assured. Thousands of years ago some cave man discovered that to bind a stone onto a stick gave him greater power to strike a blow, and mankind spread the record of this experience, and never lost the secret. We make hammers and axes in much the same way still.

The first and most important regulative principle of manufacturing, as of all other activity, is that

1) Experience must be systematically accumulated, standardized and applied

Experience is the knowledge of past attainment. It includes a knowledge of what has been done, and also how it has been done. It is inseparably associated with standards
of performance—that is, with the ideas of quantity and quality in relation to any particular method of doing something.

In practical matters, of course, this principle has a twofold application. It applies first to the building up and creation of the organic functions, and secondly to the daily routine of conducting business by means of those functions. In the former case we commonly apply experience gathered from outside, that of other manufacturers, of engineers, of accountants, of experts of various kinds—that is, we assemble existing standards—and we co-ordinate and perhaps supplement the experience thus available with that personally acquired by ourselves. The point is, briefly, that at the very beginning of our industrial life, we make use of, and in fact start from, the accumulated experience of the past as regards our particular industry.

Having started the plant, we proceed, or should proceed, to accumulate and to apply experience gathered on the ground. This experience may not modify our practice, either because we have discovered nothing new, or because we have neglected to observe that the principle calls for application as well as for
accumulation. Further, if we are wise, we keep our attention on what others are doing. We hear or read of their new experiences, collate them with our own knowledge, and possibly extend them further. That is, we revise our standards from time to time. But if we do not do this, if we neglect to accumulate experience beyond the original stock* with which we commenced business, and put it to use, then it is very certain that we shall stagnate, and very probable that we shall come to grief.

The principle that experience must be systematically accumulated and applied means first that we must observe existing standards, and secondly that we must constantly seek to improve them. It is the principle of systematic observation, of assimilation of knowledge, of study of causes and results. To a large extent it is the motive force behind all progress. Standards are the milestones which mark this progress, and as was explained in the last chapter, the organic function of Comparison is that in which experience is gathered and compared with standards. Hence it is the function over the doors of which the motto "Experience must be systematically accumulated and ap-
plied'' should be always in evidence as a guide to action.

When we speak of the use of accumulated experience we mean its translation into effort of some kind. Otherwise experience remains a merely mental abstraction, without any practical influence. If we know that a certain fish with blue fins is poisonous, this (though a useful piece of knowledge under certain circumstances) remains practically inoperative until such a fish actually is offered to us. We have then to go a step further and apply the experience, and we can only do this by an action of the will dictating a movement to the bodily organs, or in other words by an effort. We either disregard experience, stretch out our hands and take the fish, or we allow experience to dominate our effort and we push it away.

This brings us to the second regulative principle of administrative action, namely:

(2) Effort Must Be Economically Regulated

In industrial matters the regulation of Effort is not by any means so simple an affair as the acceptance or rejection above cited. Industrial Effort is very complex, and tends to become more so. It is necessary for us,
therefore, to analyze further the regulation of Effort as we find it in practical affairs, especially remembering that we are here dealing not with the effort of a single man, who can do only one thing at a time, but with the combined and simultaneous efforts of a collection of men all working to a common end.

It will readily be seen that this question of regulation of Effort becomes no mere academic discussion under these circumstances, but a matter of great practical importance.

Under modern industrial conditions the regulation of Effort is a matter of such complexity that its laws must be closely studied, and the methods of regulation analyzed. The first sub-section that naturally presents itself is that of Division of Effort. Contemplating a modern factory, the first thing that strikes us is that each one of perhaps hundreds or thousands of men is engaged on a different kind of work. Without this variety of occupations industry would be impossible. To make a typewriter would probable occupy the most skilful mechanic the better part of a life-time, if he had nothing to copy from, and no modern tools to assist him. The first
sub-principle of the law that Effort must be regulated, is then, that

(2a) Effort Must Be Divided

It is comparatively easy to divide Effort—to assign definite pieces of work, or definite duties to this man or that, whether these pieces of work and these duties are mental or physical or mixtures of both. But only very simple and obvious tasks could be carried to a successful conclusion if that were all we did. The moment we divide Effort we divide responsibility. More than that, we divide control. If one man is making two parts to fit one another he is all the time looking ahead to the moment when he will have to bring them together as a single piece of work. But if the two pieces are made by different men, this control vanishes. The two pieces will only fit if we supplement Division of Effort by another sub-principle, namely, Co-ordination of Effort.

Whenever, therefore, we divide Effort, we must keep in mind this second sub-principle:

(2b) Effort Must Be Co-ordinated.

Co-ordination is the converse, or it might almost be said the antidote or remedy for
Division. For division of Effort is, after all, a necessity forced upon us, rather than a principle specially admirable in itself. There are, in fact, some kinds of Effort that it is impossible to divide, and the higher the faculties concerned, the more difficult it is to divide effort satisfactorily. In the authorship of a book, for example, the possibility of satisfactory division of effort is very small. Collaboration between two men for such a purpose is exceedingly rare, and the result is still more rarely of the first class. Few great books have had more than a single brain concerned in their production.

In industry, however, division of labor is a necessity, and as we have seen, this division is applied to Effort of all kinds in the modern plant. It is necessary therefore to give due prominence to the corrective principle, that of Co-ordination, if the end which we set out to attain is to be realized exactly.

The sub-principle Co-ordination of Effort might be described tersely as the doctrine of "gap and overlap". We have to make certain that our division of Effort does really cover the whole field, and secondly that Effort is not duplicated unnecessarily. In practice, the existence of "gap and overlap" may
frequently be found, and the form they take will be discussed later.

It is not sufficient to divide a piece of work among several men, and to provide means (by drawings, working plans, or detailed instructions, or by the nature of the machines employed) whereby co-ordination of the separate efforts is secured. We must also seek a certain standard of efficiency in these operations. One of the great differences between the newer ideas of what proper management consists in and the older ideas, lies in recognizing that a farther step is necessary. We must see that the work is carried out by the most direct path, that the methods employed by the various persons are the most advantageous methods known to us, that they are supplied with all the appliances and auxiliary aids to good and swift work that experience has developed up to now and that everyone is kept fully employed. In other words, a further sub-principle of the law that Effort must be regulated is brought into operation, namely, the Conservation (or Saving) of Effort. This may in some cases act as a limit to the division of Effort, because division may be carried so far that it becomes economically wasteful.
It is not sufficient to do the things required so that the end sought is attained, for it may be attained at too great a cost. It is therefore necessary to keep a sharp lookout on the various stages of the work in the light of the sub-principle that

(2c) Effort Must Be Conserved (or Saved)

We have now arrived at the stage where our regulation of Effort is nearly complete. We have distributed our work amongst a number of persons; we have taken precautions that the work of each will dovetail accurately when the various tasks are completed; and we have observed that each man has the necessary skill, the proper tools, and the requisite auxiliary aids to perform his task in the most efficient manner and the shortest time. It only remains that some recognition of his skilled assistance be made, or in other words, that he be paid for his labor. This brings us to the final sub-principle of the Regulation of Effort, viz.—that

(2d) Effort Must Be Remunerated

The relation of this sub-principle to the organic functions is one that must not be misunderstood. It has not to do with the
nature of the incentive to be applied, because that is obviously a part of the third principle, presently to be discussed, viz., "the promotion of personal effectiveness". It does not embrace the application of bonus or premium systems. Its particular field is the study, in each organic function, of what particular type of Effort should be selected for encouragement and reward. It will be obvious, for example, that incentive as applied to the men in the shop, might be wholly unsuitable for the draftsmen, or the clerks, for the reason that their particular type of activity would not respond to the same kind of incentive. The remuneration of Effort, therefore, is that principle which leads us to the analysis of the different kinds of aims met with in the different organic functions, and enables us to determine how and where to apply incentive, so as to promote the efficiency of the particular function.

We have now recognized two great regulative principles, (1) that experience must be accumulated and applied, and (2) that Effort must be regulated in four ways, namely, by dividing, co-ordinating, conserving and remunerating it.

These two principles, it will be obvious,
are closely related, since the way in which we regulate Effort depends upon the degree of our Experience, and the extent to which we practically utilize such experience. But as both Experience and Effort are human attributes (for we cannot speak of the experience of a machine or of its making an effort) there would seem to be indicated a third principle, qualifying in some way our attitude towards the human factor in production, and bringing the latter into sharper focus. Such a principle would obviously deal in some way with the one thing interesting to us in an industrial sense, namely, the perfectionibility of the human factor for our purposes.

Such a principle can be formulated, and can be expressed in the following terms, viz.

(3) Personal Effectiveness Must Be Promoted

This is, of course, equivalent to saying that the quality and quantity of effort put forth by the individual are controllable; that they depend upon conditions; and that these conditions can be studied and adjusted so as to extract the best results. This principle embraces among other things the study of incentive. In each organic function the ap
plication of the principle of the Remunera-
tion of Effort will have shown what particu-
lar directions of Effort should be encour-
aged. It then becomes the task of this third
principle to effect that encouragement. But
this is really a much wider matter than a
mere question of incentives, or systems of
payment. The modern science of manage-
ment recognizes that the human factor is one
of the most subtle of the problems with which
manufacturers have to deal, and that meth-
ods of incentive to labor are only one part
of it.

Personal Effectiveness has, in the first
place, a physical basis. The human organ-
ism cannot work effectively save between
certain limits of heat and cold. It is af-
fected by humidity, purity of atmosphere,
quality of light, presence or absence of noise,
and the necessity of eating and drinking at
certain intervals. It cannot work, as a ma-
chine can, for indefinite periods. On the con-
trary periodic rest is essential to it, and this
rest has an important relation to the quality
and quantity of work performed.

It has also a psychological basis. Men
differ from each other in temperament, mem-
ory, forcefulness or will, persistence, con-
scientiousness and a hundred other things. Some are fitted to command and some to obey. Some wish to "get on" and others are perfectly content to remain in a groove. Some have high mental gifts and others high moral gifts. Some, on the other hand, have slow, stolid natures, fitted for little else than simple physical effort.

The field of the third principle will now be clear. It concerns the study of the personnel of the industrial plant in their capacity as human beings, and with a view to their improvement as workers. It covers the consideration of the conditions external to them, by which they are necessarily influenced; and it covers the study of their inner qualities, by which study we avoid putting the round pegs in the square holes. Further it embraces the study of incentive, by which we direct the energies of each individual into the precise path of most advantage to the organization.

The principle of the Promotion of Personal Effectiveness is the youngest of all the principles of administration. It is as yet only in its infancy, and its possibilities are far from being fully understood. In former days it had only one branch, viz.:—the use
of the goad. This was superseded by the simple principle of dangling the carrot before the donkey's nose. Neither of these primitive methods will work today. The direction in which the application of this principle is tending in modern plants is that of making the individual comfortable in the first place,—that is, removing all avoidable bad conditions from his neighborhood; secondly, determining what qualifications are desirable for each task or duty, and selecting candidates who possess those qualifications in superior degree; thirdly, providing appropriate incentive so adjusted as to reward the exercise, as a matter of habit, of just those special qualifications.

Beyond the consideration of the individual it comprises consideration of the mass. Esprit de corps must be fostered. It is the orchestration of Effort that is our aim, and therefore the mutual relations of men must be carefully studied and adjusted. Each man must be, in a practical degree, persona grata to the men with whom he comes in contact. Team work rests on a basis of mutual respect, or at least mutual tolerance. Discordant notes must therefore be eliminated. All these matters have as yet received little at-
tention. Systematic study of the Promotion of Personal Effectiveness is the great work of future years.

CONCLUSION.

We have now enumerated and briefly examined what may be fairly considered as the main guiding or regulative principles of all varieties of manufacturing administration. They may be tabulated as follows:

The exercise of Effort in manufacturing industry is subject to three regulative principles or laws summarized in the table on page 111.

These are universal principles, common to all forms of manufacturing industry, and are as true in a textile mill as in a machine shop or a shoe factory. They are probably, indeed, of universal application in every case where associated groups of men are organized for any definite work. In other words, if experience proves that they have been correctly stated, they may be regarded as true laws of effort.

Properly applied they will be found to be important aids to practical administration, inasmuch as they point out what to look for, what precautions must be taken, what dan-
geres should be avoided, and what advantages may be realized, in organizing or managing a plant.

**TABLE VII. THE LAWS OF EFFORT.**

1. Experience must be systematically accumulated, standardized and applied.
2. Effort must be economically regulated:—
   2a. It must be Divided.
   2b. It must be Co-ordinated.
   2c. It must be Conserved.
   2d. It must be Remunerated.
3. Personal effectiveness must be promoted:—
   3a. Good physical conditions and environment must be maintained.
   3b. The vocation, task, or duty should be analyzed to determine the special human faculty concerned.
   3c. Tests should be applied to determine in what degree candidates possess special faculty.
   3d. Habit should be formed on standardized bases, old or new.
   3e. *Esprit de corps* must be fostered.
   3f. Incentive must be proportioned to effort expected.
A NEW organization,” says a recent writer,* “is new in a limited sense only. It uses men of experience. It uses existing machines and implements. It follows existing methods of conducting business and in the general management of its affairs.” No more succinct description of the field of the first law of Effort, viz., that Experience must be systematically accumulated, standardized and applied, could be given.

In beginning any enterprise, the first thing to be done is to ensure that the start is made at the highest level of attainment yet known. We must not equip ourselves with an out-of-date plant, with inexperienced officials, with imperfect materials or with ancient and discarded methods. To do so would be, in all probability, to fail after a brief career of struggle against odds. But to avoid all this

* Human Factor in Works Management, by James Harness, p. 46.
it is necessary to become closely in touch with what others have done before in the same line of effort. We must adopt the best current standards. Having ascertained these, having accumulated this experience, we must next reproduce it in action or, in other words, apply it. In proportion as we are successful in this task, our chances of success will be increased.

Similarly, in conducting our business from day to day, we shall have two kinds of experience to accumulate and apply. One kind will refer to what others outside our own undertaking are doing, the other kind will refer to changes and happenings within our own plant. These streams of experience will need to be collated, and the lessons they teach transmuted into revised standards and new practice when necessary. We shall find that in each of the five organic functions we must be on the outlook for a different kind of experience to accumulate and apply.

What does this mean, expressed in practical language? It means that as regards the five organic functions we must provide a separate series of standards, and that these must not be merely set up when we commence operations, but must be continually brought
up to date and improved, by the results of the experience of others and of ourselves being incorporated with them. Thus we shall require standards as to design, as to operation, and as to equipment, control, and comparison. Very little consideration is necessary to realize that the highest and best standards are necessary in all these functional activities, and that these standards are wholly independent of each other. High standards of comparison may exist alongside lax standards of control, in which case the lessons taught by exact comparison will probably be wasted, for they will never be translated into new effort. In other words experience will be systematically accumulated, but it will not be applied.

Similarly high standards of operation, extremely skilful workmen, fine machines, efficient processing, may exist alongside lax standards of design. In such case the efficiency of operation is not impaired, but the total efficiency of the plant as a whole is impaired. High efficiency of design can only be brought about by careful observation of the laws of effort as applied to the function of design, and so with each of the other functions.
(a) Standards in Regard to Design

At the outset the division of Design into design for technical use and design for manufacture must be observed. Although we are considering the latter alone in this inquiry, it may be mentioned that the first law of Effort applies to design for technical use also. For example, in placing a new machine or product on the market, the performance of existing machines or the qualities of existing product with which we have to compete, create Standard which we must at least equal and if possible surpass. Similarly it is obviously necessary to be on the alert as to all improvements made by our rivals, and to study out improvements of our own if we do not wish to find ourselves some day in an unfavorable condition for survival. This is to say that we must, as regards the design for technical use of our product, systematically accumulate and apply all the experience possible, so that the product does not become inferior and get passed in the race.

In regard to design for manufacture, which is the sphere of the organic function of Design as treated here, it is also necessary systematically to accumulate experience
and set up and apply standards. The standards which we apply here will, in fact, exert a most powerful influence on the fortunes of the plant, because as pointed out in a former chapter, Design sets in motion a long chain of Effort, and if it does not do so efficiently, no degree of high efficiency further along the line will ever be able to compensate for the original errors of method introduced.

What are the directions in which design for manufacture should accumulate and apply experience? As this aspect of Design is an internal matter, the Experience to be sought is a thorough knowledge of the operation units—the machine processes, trades and skills represented in the shops—of the transport facilities, in the case of large size product, of the various machine accessories necessary to production under certain conditions. As design for manufacture consists in so arranging the units of product that they correspond exactly to the facilities for manufacture present in the plant, it is obvious that too much cannot be known about such facilities by the Designer. Then there is the further question of what parts should be made and what purchased, what parts are kept in stock and what parts must be made
specially. All these questions will be discussed later, but the point now to be emphasized is that they should all be systematically gone over, and a standard practice set up, which practice should become the working tradition of the office. The more standards of this kind that are established, provided they are wise and well thought out standards, the smoother will be the work of design, and the fewer will be the errors, omissions, and unnecessary work caused by unsystematic and unstandardized practice.

(b) In Regard to Equipment

Both in the installation, and in the administration and maintenance of Equipment a large field exists for the systematic accumulation, standardization and application of Experience. In erecting a plant a knowledge of the standards already recognized and established is essential if our plant is to be one of the highest possible efficiency. We must find out the most advanced practice in each department of Equipment, collate it with our own experience or that of a competent expert, and make our plans accordingly. Plants now building, for example, embody very different ideas as to day lighting, arti-
ficial lighting, power generation and transmission, and as to transporting and storage arrangements, from those erected ten or twelve years ago. The dark, dismal and dirty shops of the past are being superseded by light, bright and airy shops. A forest of belting, with its inconvenient brushwood of counter-shafts and pulleys, is no longer the salient feature observable when entering a modern shop. In some industries the confusion caused by a crowd of help carrying things about has been banished by silent smooth-working conveying appliances. And many other instances will occur to everyone.

What does this change imply? It is simply that much thought, much systematic study has been given to all these matters. Experience has been accumulated with regard to each, with the result that new standards have arisen and have become accepted. In erecting a new plant we must obviously search out and apply these standards, or our plant is likely to be inferior in some respect.

In the administrative aspect of Equipment, similar conditions apply. The generation of power, for example, is a matter which fairly bristles with standards, and while it is the sphere of the organic function of Com-
parison to make observation of the data regarding the daily working of the power plant, the utility of this observation will depend entirely on how far we make use of it to compare with standards.

The less definite matter of maintenance and repair has no such general standards as, for example, pounds of fuel per pound of steam in the case of the power plant. But even here, we have a natural standard—freedom from breakdown—which can be set up, and departures from it systematically noted and studied. Or the other hand the maintenance of heating temperature has, of course, an exact standard, viz.:—the degree of heat specified as measured by the thermometer. Similarly all the various physical conditions which it is the business of Equipment to maintain can be brought under this law. As regards all of them, experience can be systematically accumulated, standards set up, and these standards revised from time to time in the light of new experience.

(c) In Regard to Control

The use and application of the accumulated experience of the past with regard to systems of control is not so easy. Most plants start
on a small scale; and as we have seen, Control tends in small plants to be simple and rudimentary. There is but little definite and scientifically based experience in the past to adopt. Systems of control have up to the present been arbitrary combinations, growths rather than structures, strictly adaptable only to the particular business in which they were developed.* We could get ideas from observing existing systems of control but we could not get definite working rules for guidance. Nor is it possible to get much help from the various theoretical systems put forward of late years. These are for the most part arbitrary combinations also, having a limited area of application, and adapted to few industries. They have been in some cases very important contributions to the subject of administration, but after all they are specific combinations and not universal principles.

In any case a small plant just starting cannot have a highly developed organ of control, just as a baby does not have as large a head as a full-grown man. But while the

*It will be remembered that as industry progresses, the other organic functions are definitely devolved and given shape, but Control remains to the last and is the last to be systematized.
child's head grows larger automatically, a system of control is just as likely to grow wrong as to grow right. One of the most important services which the reduction of management to a correct classification of functions and regulative principles can offer is the demonstration of the "why and wherefore" of each department of organization. Then, and only then, will the beginnings of Control be established on such a basis that they can be developed harmoniously as the business increases in size, and a source of disturbance thereby eliminated.

All this means that standardized practice in regard to Control is as yet not very definite. What standards exist are negative rather than positive. "No man can serve two masters" is one of these, or in other words, we must avoid the clashing of authority, and must establish clear lines of subordination throughout the plant. The idea, taken from military organization, of "line and staff" is to some extent a standard of Control, but only large plants can develop such a system. In applying it, a danger exists of confusing executive with advisory functions, that is, of giving executive power to the latter, which is a dangerous practice.
But while definite standards in the installation of control systems are as yet somewhat scarce, when we come to the administrative aspect of Control, the law that experience must be systematically accumulated, standardized and applied has a definite sphere. Few systems of control work perfectly, but they can be gradually improved if every instance of a hitch is recorded and studied, its cause ascertained, and new standard practice set up of a kind to eliminate the defect. While a "self-perpetuating system" is a myth and contrary to common-sense, nevertheless a considerable amount of self-adjustment to changing conditions can be made, if the application of this first law of Effort is kept in mind.

(d) In Regard to Comparison

The organic function of Comparison is more fortunate than that of Control, inasmuch as its methods have reached a higher degree of standardization, and a more settled condition of practice.

The different Standards in the technical sphere of Comparison, both chemical and physical, are necessarily definite and exact, and our search for experience will rather be
in regard to methods of ascertaining them than otherwise. In the accounting sphere the methods available for adoption, though lacking the extreme precision of technical methods, are nevertheless highly developed and well-known. Methods of recording time, quantity, number and value are many, and in many cases bound up with the use of special appliances of a labor-saving character, but they are in all cases definite, and only require study to enable the right method to be selected as a standard.

But while the methods of Comparison are fairly well standardized, the objects of this function are by no means so generally agreed upon. What should be recorded and why it should be recorded appear at present to be matters of personal taste, though of course it should not be so. We shall return to this subject later, and all that is germane to our present subject is to point out that while experience as to methods is available in plenty, it is generally lacking in regard to the objects to be attained by recording and comparing data. Every plant can however set itself systematically to accumulate experience about its own needs in this respect, and so set up and apply its own standards.
(e) In Regard to Operation

Finally we come to the organic function of Operation. Here we may or may not be able to draw copiously on the experience of the past, when settling the methods to be followed in a new plant. In some industries the fundamental principles of Operation are already determined, particularly those industries in which the processes are largely scientific, such as chemical manufacture, steel making, paper making, sugar manufacture and so forth. But in other cases only empirical practice exists, unilluminated by any thought of working principles. In machine work, for instance, the classical researches of Mr. Fred W. Taylor showed how far the apparently simple operation of cutting metal is really affected by quite a large number of factors, each of which must be understood and allowed for if the highest efficiency is to be realized.

Operation, as has been pointed out in a former chapter, is the function in which the greatest differences exist between one industry and another. It is only by chance that the operative methods of one industry can be applied to another industry. All the other functions must obviously have common prin-
principles, because in all industries their aims or ends are precisely similar, but the technical operation of making steel rails has probably not one single point in common with the making of silk neckties. The end in view—namely, rails—is entirely different in every respect from the other end in view—namely, neckties. It is the dissimilarity of aim, and not merely the nature of the materials, that makes it impossible to suppose that common ground can be found to exist in industries so wholly dissimilar as those suggested in the example above.

Nevertheless this does not prevent the first law of Effort from applying to Operation in the fullest degree. If we wish to make neckties, we must first accumulate all the experience we can gather on the various operations concerned. So with any other product. Only our task will be much greater in one case than another. To master thoroughly all that is known about the operation involved in the making of dynamos is a bigger task than it is to master all that is known about the manufacture of steel tanks. But the principle is the same in both cases; namely, to accumulate all the experience possible, to standardize it, and apply it.
(f) Application of Experience in Running a Plant

Thus far we have considered mainly the use of experience in organizing or setting up the various functions when starting a plant. But the principle applies with equal force in running a plant, although not so obviously, since everyone would scot the idea of not starting a plant on the best known lines, while afterwards there is a tendency to consider that experience has little more to teach us. While therefore the application of the first law of Effort in regard to new plants is merely a platitude or a truism, which many people will not think worth setting down on paper, its application to plants in operation is a different matter. In every one of the separate fields of Effort represented by the organic functions, progress is possible, both on our own part and on the part of other plants. The technical side of any industry is not alone progressive; progress is constantly being made in the organization of all the functions—in methods of Design, in arrangement of Equipment, in means of Control, in processes of Comparison, as well as in the technics of Operation. Standards on all of these are constantly being improved
and therefore constantly being superseded
by new and higher ones.

WHERE THEORY TOUCHES PRACTICE

TABLE VIII. APPLICATION OF THE FIRST LAW OF
EFFORT

The Law:—Experience must be systematically
accumulated, standardized and applied.

In Design. Application of the Law to the function
of Design implies that all similar products
should be scrutinized and their advantages and
defects analyzed. Their performance or value, com-
mercially, forms a standard which we must at least
equal. In Design for manufacture experience as to
the character of the operation units, and as to what
parts are purchasable, which are stocked, etc., must
be assimilated by the designer. This information is
embodied in standards of designing practice, which
should become traditional in that office.

In Equipment. In installing Equipment, the
experience of others, or of oneself, in the past must
be drawn on so that the most perfect types of appli-
cance are selected. They must also be arranged in
the most efficient way. The best known practice of
the day is thus a standard which we set up and
follow, and must later supplement and improve if
possible. In administration of Equipment, various
standards of performance for such equipment exist,
and must be applied regularly and, if possible, sur-
passed.

In Control. Experience should be drawn on
when settling the plan of Control, but true standards
of Control are very scarce. Moreover, Control needs
to expand, and is therefore more difficult to stand-
ardize than the other functions. Each plant can, however, accumulate experience in controlling methods for itself, and thus accomplish a measure of self-adjustment. Owing, however, to the difficult nature of the task, the professional adviser will probably always find his largest opportunity in this field.

In Comparison. Comparison employs technical and accounting methods in the selection of which experience must be drawn on. Each of these methods then becomes a standard for that kind of work. The selection of objects for Comparison—that is, what must be compared—is a matter very far from standardization at present. Each plant can accumulate experience for itself on this point.

In Operation. The existing processes of Operation in the given industry should be scrutinized and the best methods selected at starting. Technical progress in some industries is rapid. The law of accumulation of experience is therefore very important in this function. Operation standards are subject to constant improvement, and must therefore be the subject of continual observation and study.

Ceaseless vigilance is the price of progress as it is of liberty. The first law of Effort—that Experience must be systematically accumulated, standardized and applied—is merely the expression of this truth in another and more complete form, since the actual use of experience is the important thing. But the foregoing arguments will have been presented to little purpose if it is not obvious
that what we have to do is not merely and
generally to accumulate Experience, but that
this experience must be of five different and
independent kinds, gathered from different
fields, and indeed gathered and applied by
different persons for the most part; namely,
experience as to Design, as to Equipment, as
to methods of Control, as to ways of Com-
parison, and as to technical Operation.

This, perhaps, is the first striking applica-
tion of the organic basis of Administration—
the recognition that our organic functions
are not merely nominal, but that they
embody five different kinds of experience,
which must be both gathered and applied in-
dependently. Here we descend from the ab-
stract to the practical in a breath, we observe
that our functions correspond to something
real, something in the nature of things, which
like all natural facts is worthy of attention.
Applying the first law of Effort to these func-
tions in turn, we see that though it applies to
all, it produces different results in each. In
each it creates a new store of knowledge,
new materials for progress; but these stores
and these materials are of quite different
nature in each function, and have their appli-
cation in quite different fields.