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PRINCIPLES OF INDUSTRIAL AND MILITARY ORGANIZATION.

Lecture

by

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PRINCIPLES OF INDUSTRIAL AND MILITARY ORGANIZATION.

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- II. Types of Industrial Organization.
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WISDOM IS THE PRINCIPAL THING, THEREFORE GET WISDOM,
AND WITH ALL THE GETTING, GET UNDERSTANDING - PROVERBS.

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I. HISTORICAL Development of the Science of Industrial Engineering.

When the American Forces took possession of the City of Manila in 1898, they found in the Custom House a statue which had been shipped from Spain but which had not yet been set up. As a tribute to the Spanish discovery and development of the Philippines, the Commanding General of the American forces had the statue set up on the Luneta where it stands today. It represents Legaspi, the soldier, with his sword in his right hand and the colors of Spain in his left encircling the shoulders of Urdaneta, the priest, who holds a cross uplifted in his right hand. This statue typifies in a striking way the two oldest professions, viz., that of the priest and that of the soldier. The priest in primitive society was judge, teacher and physician, while the soldier was its protector. As war was the rule and not the exception in primitive society, military organization was the first cooperative effort of man. It was based primarily upon the principle of enforcement of authority and the fixing of responsibility.

The scientific method of approaching any problem is first to record data obtained by experience, second to formulate or deduce the law governing the particular phenomenon and third, to use this law to predict future phenomena. The Greeks were the first to adopt the scientific method of investigation, but with the advent of the Christian era, coupled with the degradation of the masses brought on by Roman imperialism, man began to apply faith, which was the basis of his religious life, to the domain of natural laws, which should have been the object of

scientific research. Twenty centuries, therefore, elapsed from the investigations of the Greeks until the renaissance in science was brought about through the influence of Francis Bacon (1561-1626) in England, Descartes (1596-1650) in France, and Galileo (1564-1642) in Italy. They challenged many of the preconceived theories, made doubt and not faith the foundation of the scientific revolution and ushered in a new Era.

As a result of this awakening of men's minds, the analytical method of reasoning took root. Alchemy gave way to chemistry and astrology to astronomy. Some examples of this renaissance (cited by Robinson) were

(a) English sailors, caught in the fogs of the North Sea, learned that by touching a needle with magnetic iron one end would always point to the North. This was the beginning of the compass which alone permitted Columbus to cross the Atlantic and permitted man to visualize the globe on which he lives.

(b) As early as the 13th century it was observed that lentil-shaped bits of glass would magnify objects. From this fact was developed the microscope, the telescope, the spectroscope and the camera which opened a new heaven and a new earth to man's vision;

(c) Gunpowder began to be used as a military explosive a few decades after the lens was discovered. This forced the invention of firearms and revolutionized society by making the peasant on foot the equal of the knight on horseback;

(d) Movable type and the printing press, invented about this time, originating merely as a scheme for saving the labor of copyists, coupled with the invention of paper, brought thought out of the cloister and made it possible for men to exchange ideas at a distance;

(e) Just a little later, a Scotshman, witnessing the action of steam in the family teakettle, revolved the idea of the steam engine which in less than two centuries has brought on an economic revolution and threatens again to make man a slave to his machines unless means are found to prevent it.

We are not, however, here concerned with the social and religious problems of our time, but rather with a new

science which has grown up to make this economic era still more efficient. This new science has developed within our own generation and while there is not as yet complete agreement as to its name, it is usually referred to in the curricula of our colleges as "Industrial Engineering". This new science deals with the problems of location of facilities, construction and arrangement of factory buildings, character of methods and processes, the organization of departments, the elimination of waste and the increase of efficiency in all phases of industrial management by the application of scientific methods.

In order to understand the language of this new science, it is necessary to define some of the terms used by it:

(a) Management initiates an enterprise, finances it, establishes the labor policies, provides the necessary equipment and personnel, organizes the enterprise so that all of its parts may function properly and directs and administers it after it is in operation.

(b) Organization is the mechanism of management. It is that function of management that actually sets up the enterprise, selects the equipment, plans the arrangement of the plant, selects the personnel and the departments and specifies the relations that shall exist between individuals and departments. It prescribes the relations that shall exist between departments as well as of individuals within each department. Organization and departmentization are not synonymous. A Department is simply an enlarged individual. An enterprise may be very well departmentized but poorly organized.

(c) Administration or direction is that function of management which actually executes or carries out the objects for which the enterprise is organized. It initiates the work to be performed, sees that the personnel is fitted to the work and trained to operate properly, and, in general, cares for the everyday routine necessary to insure that men, materials and equipment are functioning properly toward the desired end.

(d) System is the mechanism of administration by which the efforts of all men and departments are coordinated. It includes the written documents through which all orders and instructions are issued and all records of performance are obtained. It includes all reports of managers and may include committee and other coordinative influences. Since system is regulatory in its effect, it must always be applied with care, otherwise it may act as a deterrent to production, or as it is sometimes said, "there may be too much 'red tape'." (Kimball, p. 89).

"We organize to manage; we manage largely through system". (Daemer, p. 23).

As industry passed from the home to the factory, specialization and division of labor have been extended, and as special or scientific knowledge has become more and more necessary, the simple relations which existed between master and man, a few centuries ago, have been replaced by administrative, planning and constructive departmentization, the coordination of which has become a study in itself.

No two industries can be organized and operated in exactly the same way. Our primary interest is to ascertain what principles of organization have been evolved by scientific management which are applicable to the problems of the Army.

II. TYPES OF INDUSTRIAL ORGANIZATION.

Four kinds of industrial organization have been evolved. These are in chronological order of their development.

- First - Line or Military (Chart No. 1)
- Second - Line and Staff - Emerson (Chart No. 2)
- Third - Functional - Taylor (Chart No. 3)
- Fourth - Committee (Chart No. 4)

1. Line or Military (Chart No. 1)

As noted in the beginning of this lecture, military organization is the oldest form of cooperative effort known to man. The world was already old when Moses led the Jews out of their bondage in Egypt - one of the greatest military exploits in history. Requiring a powerful ally, he had married the daughter of Jethro, King of the Midianites. When Moses had safely insured the passage of the Red Sea, his father-in-law visited him at his headquarters. On the following day Jethro saw Moses sitting from morning until evening listening to the petty troubles of the Jews and he said to

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him, "The thing that thou doest is not good. Thou wilt surely wear away, both thou, and this people that is with thee; for this thing is too heavy for thee, thou art not able to perform it thyself alone." He advised him to select able men as leaders and give the Jews a military organization. Moses followed his advice, as it is recorded. "And Moses chose able men out of all Israel, and made them heads over the people, rulers of thousands, rulers of hundreds, rulers of fifties, and rulers of tens. And they judged the people at all seasons, the hard causes they brought unto Moses, but every small matter they judged themselves." (Exodus 18, 25-26). (See Chart No. 5). With the military and social organization thus formed on the advice of his father-in-law, the Jews under Moses and his successors fought their way back to the land of their fathers which they had looked upon as theirs since the days of Abraham.

The advantages of the military type of organization are

(a) An executive with deciding powers is provided at all points of an organization where action must be taken.

(b) The responsibility of every position is fully and carefully outlined.

(c) The duties of the various organization positions are made to conform satisfactorily with the ability of those shown to fill them after the best possible choice has been made of available men.

(d) No person is made subordinate to two or more others, if it can be avoided.

(e) The power to discipline men in any department is allowed to rest in the hands of the official who is held responsible for results.

(f) Wherever responsibility is placed, sufficient authority to carry out the work must follow.

(g) The duties of the members of the organization are distributed so that unequal loading is avoided.

(Perm State - p. 5)

The strictly military type of organization, however, has been found unworkable in the development of modern armies. In industry the disadvantages of strictly military or line organization have become particularly pronounced.

"The advantage of this form of organization, so far as discipline is concerned, is manifest. The duties and responsibilities of each man are clearly defined and no misunderstanding need arise as to each man's sphere of activity. It has, however, grave limitations and, because of these, pure military organization is no longer found in undertakings of any size or complexity. As plants have grown in magnitude this system tends invariably to load up a few men to the breaking point with a variety of duties, since the number of executives on any one level is limited. It tends also, therefore, to crude methods, since few men can do several things and do them well, particularly if these duties are decidedly different in character. Thus if the superintendent undertakes, as he formerly did, to be both administrator and chief designer he is not likely to be a great success in either capacity, as these duties call for characteristics not usually combined in one man. The instructions given to individual workmen regarding the prosecution of the work are necessarily meager, especially if the work is varied, hence reliance must be placed, to a large extent, in the knowledge and skill of the workman. And lastly, this form of organization tends to make the success of the undertaking depend, to a large extent, on the ability of a few strong men, the loss of any one of whom would be very severely felt. The military system has, therefore, seldom existed in a pure form even in military organizations, except where the number of men involved was small and the scope of the scientific basis of the undertaking narrow, as is sometimes the case in simple continuous processes." (Kimball, p. 95).

2. Line and Staff Organization (Chart No. 2)

An American engineer, Mr. Harrington Emerson, educated in both German and French schools, was in Europe during the Franco-Prussian war. He was profoundly impressed with the efficiency of the German war machine. He saw the King of Prussia with three members of a great planning staff, viz, Bismark, the Chancellor, planning for diplomacy; Von Moltke, the Chief of Staff, planning for the organization and training of the Army, and Von Roon, the Minister of War, planning for the mobilization and supply of the Army, transfer the hegemony of Europe from the French to the Germans.

The French planned to mobilize in nineteen days and required twenty-one. They were therefore eighty-six (86%) percent efficient. Von Moltke had planned to mobilize in eighteen days ~~which he~~ did, thereby demonstrating one hundred (100%) percent efficiency. Forty-five days after the declaration of war, Napoleon III, with all the prestige of his name, surrendered at Sedan and became a prisoner of war. Emerson lived to see the German methods copied by the Japanese, who in two wars in a single generation brought their country

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from feudalism to a rank among the so-called powers of the first class. His studies lead him to apply the principles of Staff Planning which had been so strongly exemplified by the Germans to the problems of industry. He believed that each factory should have a staff and he recommended three branches, as follows:

(a) An Order-of-Work Bureau to determine what work should be done next,

(b) A Routing Bureau to determine where it should be done;

(c) An Instruction-Standard Bureau to determine how it should be done.

In order that a Line and Staff organization shall work efficiently, Emerson laid down these principles.

"Line and Staff cannot be permitted to work uncontrolled. The line of authority is arrogant in its ignorance. The line of knowledge is arrogant with its authority. Every specialist in some branch of knowledge thinks his own panacea all important. The strong executive who can control, adjust and harmonize must rule over both line and staff." (Penn-State, p. 10).

It is seldom possible for a man trained in one language to interpret another with absolute accuracy. Emerson apparently conceived the erroneous idea that the success of the German General Staff was due to the fact that it was created for the purpose of furnishing expert advice. He apparently failed to understand that it was also an agency of command for the purpose of assisting in the exercise of authority. It will be noted in the quotation just given from Emerson that he speaks of the necessity for a strong executive to "harmonize" line and staff. Harmony, i.e., team work - may be produced for a time by good-fellowship but there comes a time in both industry and the Army when harmony must be secured by the exercise of authority alone. In the determination of when, how and to what extent exercise of authority is required to bring about team-work, lies the genius of leadership. It must be borne in mind, however, that there is much more cooperation among men in industrial plants than there is in the Army. This does not arise primarily from the fact that military men grow up under an autocratic system of control. They must be ready to fit into any command (whether line or staff) anywhere and at any time, regardless of whether they

are acquainted personally with other members thereof, or not. Each industry, on the other hand, differs from every other industry and its members, thru years of association, get to know the "personal equation" of all those about them. The Army must, therefore, rely primarily upon system and not upon individuality for its organization. Much better results can be obtained in a command where all are acquainted but, especially in time of war, the personnel of every command changes too rapidly to build up an organization dependent upon personal relationship alone.

(Note There is another type of organization sometimes referred to as the "departmental" type, but it is not sufficiently distinct to be given ordinarily a separate classification. It is based upon group specialization, in which a foreman and his gang, selected and trained for their special duties, have entire charge of certain subdivisions of various operations).

While the Line and Staff Organization is the one now generally accepted as correct by industrial plants, the staff has been given power not possessed by Emerson's original conception of it, but added by Taylor whose contribution we will now discuss.

3. Functional Organization (Chart No. 3).

Dr. Frederick W. Taylor, who rose from laborer in the Midvale Steel plant to Chief Engineer in six years perceived what he considered a weakness in the Line and Staff Organization as suggested by Emerson. This led him to offer his idea of Functional Control. "He saw that if a highly paid specialized staff were to give only 'advice' to the Line, a great deal of advice would be wasted. There are always stubborn leaders who will not listen to advice. Dr. Taylor, therefore, placed his staff specialists in contact with the line and gave them mandatory power in regard to their particular functions. For instance, he would place an inspector directly in contact with the man in the shop, but with the authority concerning the function of inspection which was even higher than the man's own foreman or "gang boss", as Taylor called him. Taylor took the job of an ordinary foreman, broke it down into eight separate jobs or functions and made each man in charge of a function a new kind of foreman. The man in charge of any particular function had charge of it throughout the factory. In other words, a man setting rates would do this all over the factory instead of each individual foreman dickering and setting rates for his own group of men. His functional foremen became staff specialists, but they had mandatory power

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instead of advisory power. In this way their advice was certain to be carried out." (Penn-State, p. 10). This may be understood better by reference to Chart No. 3. In this particular industry let us say it has been found that a superintendent of production does not possess sufficient specialized knowledge to deal with the engineering and chemical problems involved in production. Therefore an engineer and a chemist have been added to the Staff, each of whom is competent to give orders to the foreman as to matters under his charge. It will, therefore, be noted that each foreman has three bosses. Similarly each foreman under the Taylor system was made a specialist so that each of the workmen indicated on this Chart would have four bosses. This was one of the main weaknesses of the Taylor system which Mr. Henry L. Gantt, one of Taylor's assistants, saw and endeavored to correct by stopping functionalization with the "gang boss" or shop foreman, leaving each "gang boss" supreme over his workers. He felt that functionalization should cease at the point where the education and intelligence of the man in the factory would not permit him to carry out instructions from more than one source. The foreman being higher up in the scale could understand conditions and there was less conflict of authority. Not so, however, with the laborers who were confused if they received instructions from more than one source. Gantt's modification of the Taylor system combines the advantages of the "Military", "Line and Staff" and "Taylor" systems. Advocates of the system of pure functional control, however, claim that under it the eight functional foremen are not "bosses" but "teachers" to instruct the men how to produce more and earn more.

Dr. Taylor dies a discouraged man in 1915. He found himself opposed both by management and by labor. In his book "Shop Management" he states that the principal obstacles in the way of scientific management are

(a) "Soldiering" by the workers, this being due to (1) ignorance, (2) intentional, thru fear of reduction of piece rates or of over-production and the employees' working themselves out of a job".

(b) Ignorance of the management. (Diemer, p. 191).

The publishers of the American Magazine printed serially in its issues of March, April, May, 1911, a group of papers on the Principles of Scientific Management, by Frederick W. Taylor. As the result hundreds of letters came to the publisher of the magazine from all over the world mentioning obstacles and objections.

Dr. Taylor turned these letters over to Mr. Frank B. Gilbreth who answered them in a small and very interesting book written for the general public entitled "A Primer of Scientific Management". In general, the obstacles may be classified as:-

(a) Objections by the proprietorship.

- (1) It involves too high an overhead or manufacturing expense.
- (2) It disorganizes well-established relations.
- (3) Employees studying about the methods of scientific management will become discontented with actual conditions.

(b) Objections by employees.

- (1) It is humiliating to have a man stand over you with a stop-watch.
- (2) Working under standardized instructions throttles initiative.
- (3) The employer having found out the highest possible speed will cut the rate of pay.
- (4) Too many bosses.
- (5) Pay based on individual merit is contrary to the principle of collective bargaining. (Diemer, p. 193).

Taylor was in advance of his time and in his enthusiasm probably failed to realize the length of time it takes to educate any group, however intelligent, to a new idea. The necessity for mass production during the World War vindicated the essential correctness of the principles advocated by him for the more efficient routing of work thru factories and how to increase production by both men and machines. American labor has now completely accepted the principle that to retain their present high standard of living, they must accept the adoption of those efficiency methods which increase production. With management and labor thus committed to the principles of specialization, American industry has entered a new and important phase since the World War. The new era however, lays special stress upon one principle which Taylor failed to emphasize sufficiently, viz., the fact that man is the essential thing in industry and that machines are his tools. In other words, he failed to lay sufficient emphasis on human psychology. At the same time it must be remembered that his theory of complete functional organization had to be modified by Gantt and failed completely when applied to the organization of our Ordnance Department during the World War, as will be explained later.

4. Committee Organization (Chart No. 4).

This form is never used by itself alone, but in combination with one of the other three types. It is merely an amplification of one of them. Committees are made up of workmen for the most part, although foremen and other representatives of the management are often represented. The first idea of committee organization was to look after safety conditions in factories. An era of Safety Appliance laws followed the introduction of these committees. From such committees others dealing with the health of employees quickly followed. Other committees found useful are. The Suggestions Committee, thru which prizes are offered to workmen for the most valuable suggestions for improvement in plants. The success of such a Committee depends upon whether the committee passes upon the suggestion and not the management. Each man thinks his own idea is wonderful and if the management turns him down, it may affect his loyalty, but he will feel differently if turned down by a committee of his fellow-workers. The Complaint Committee passes upon complaints regarding working conditions of the discharge of employees. An educational committee may pass upon the best means of instructing workers for their tasks. The list might be indefinitely extended. The idea of committee representation of workmen is a development of the democratization of industry. It is the American reply to socialism, communism and similar social evils, but the Committee system may be carried to an extreme. "Like dynamite, it is a dangerous thing with which to play. Whole factories have been organized under variations of this plan as industrial democracies. Some of these have been successful, but a great many more have failed. There is an old proverb about letting a camel put his head in the tent and the first thing you know he will be the whole way in and will have shoved you out." (Penn-State, p. 14).

Summarizing the question of organization, it must be understood that no two industries are organized along exactly the same lines, but that the most successful ones combine the best principles involved in the four typical kinds of organizations above described. The line or military organization being the oldest, simplest and strongest is the basis of all. Thru the influence of Emerson and others, a staff was added for the purpose of planning. Taylor saw that the staff suggested by Emerson did not have sufficient power of control to see that its plans were carried out, but he probably made the mistake of carrying functionalization too far. Gantt endeavored to correct this by limiting functional organization to

the higher executives. Finally the introduction of committees (mostly of workmen) marks a new phase in the democratization of industry. The line organization represents the extreme in autocratic control (not, however, to be confused with irresponsible or despotic authority) and hence is most suitable to military requirements. The committee form of organization represents the extreme in the democratization of industry. Where suitably modified (as in the "suggestion" system) it may become especially valuable. In 1916 the Eastman Company having 4,500 employees in their Rochester plants received 2,300 suggestions for improvement of which 1,000 were adopted.

III. PRESENT TENDENCIES.

(a) As to Types of Organization.

Our two greatest wars had important effects upon our industrial organization and development. The Civil War developed the system of interchangeability in manufacturing, making remote assemblages possible. The turret lathe was thus very largely responsible for the great industrial development of the last half of the Nineteenth Century. The World War gave a powerful impetus to quantity production while the acuteness of the labor situation brought management to adopt a more conciliatory attitude toward workmen. The result of the adoption by labor of the principle of quantity production, and by management of the principle of the "square deal" accounts very largely for the present industrial prosperity of the United States.

"The modern industrial tendency is toward increase in size of establishments, specialization by executives, standardization of specifications and types, extreme division of labor and the adoption of the principles of scientific management" - (Kimball). The last mentioned tendency is merely the application of analytical methods to increase the quantity and the quality of output, a result of bringing minds trained in the exact science of mathematics and engineering to bear on the problems of industry.

The present tendency is toward a "four-column" type of organization in which executives bear the relation to each other of the line-and-staff principle, combined with functionalization in the shops, either in the pure form advocated by Taylor (see below under "Planning") or the proposed modification by Gantt. Some advocate that the four Chief executives reporting to the General Manager should be the (1) Treasurer or Comptroller, (2) Works Manager, (3) Sales Manager and (4) Personnel Manager. (See Charts No. 6(a) and (b)). Others, laying less stress on personnel and more on finance, recommend that these

executives by the (1) Treasurer, (2) Works Manager, (3) Sales Manager, and (4) Comptroller (see Chart No. 7). It must be always born in mind, however, that charts of organization mean but little since they tend to lead to "water-tight" compartments and that many plants will not permit them to be used at all. For purposes of study, however, they are useful as showing the theoretical relationship between the various executives and departments. "Organization" as a science is new. There are hundred good administrators for one good organizer." (Hinc). "Principles applied by mediocre men are more powerful for good than the spasmodic floundering of unusually great men. The barn-yard rooster when chased from his dung-hill flutters strenuously but not efficiently. The eagle soaring for hours in the sunlight without flapping a wing is efficient but not strenuous". (Emerson).

(b) as to Planning:

Science is classified knowledge. As heretofore noted, the scientific method of approaching a problem is. (1st) to record data; (2nd) deduce laws; (3rd) predict future phenomena. Industry, in order to survive, must be able to interpret the future, and to plan its work so as to insure maximum production at a minimum cost. Planning, therefore, has come to be recognized as an important and necessary feature of management. "The General Manager must forecast future trade labor and market conditions from his knowledge and study of the statistics of the industry in question. He must shape the future policies of the business so as to make them coincide with the wishes of the directors. He must devise improved methods of management, assisted in this way by his principal subordinates." (Diemer, p. 93).

Comprehensive planning in an industrial plant involves;

- (1) Finances
- (2) Sales
- (3) Production
- (4) Labor
- (5) Plant

Chart No. 8 illustrates all the various phases of planning in an industrial organization. It is necessary to appreciate the importance of planning and especially to understand the difference between planning and operations. They really require two different types of mind. Some men are gifted with planning minds and prefer this type of work, others prefer to deal with the problems of operation and are more interested therein. The essential thing to remember,

however, is that no man can plan and operate at the same time. This is the greatest weakness of the Line or Military type of organization. Every man in the hierarchy of command is faced constantly with the necessity for operating, receiving orders from his immediate superior and transmitting them to his subordinates. If he permits administration to be completely engrossed with these operations, then he has no time to think ahead or to plan for the future and this must be accomplished for him by some staff officer especially picked for that purpose. The first line officer had no staff because he could do everything himself. This condition no longer exists in any military command larger than a company. As soon as a commander has to direct the work of officers instead of soldiers, duties become so complex that he must have one or more assistants to handle such problems as personnel, training, supply, etc. The larger the command the more complex become the various functions which must be handled by the staff. Chart No. 9 shows the method proposed by Taylor for separating the planning work in the office relating to any specified job from the operations in the shop. In the planning group he provided (1) an order-of-work man with power to decide what work should be done next and the routing of all work thru the shop, (2) an instruction card man who places detailed instructions on the card directing the workman how to do each job; (3) a time-and-cost man who computes the wages and bonuses earned by the workmen, thereby giving the cost department accurate data as to profits, and (4) a shop disciplinarian who alone has power to suspend or discharge employees. (He may also be given the right to hire them).

In the operating group he placed (1) the gang boss who assembles in advance the tools and materials required and sees that the workmen arrive on time, each one being notified in advance where his next work is to be done, (2) the speed boss (a term which was responsible for much of the opposition to Taylor's system - now superseded in some factories by the title "schedule boss") who sees that the operations are performed according to the instructions on the card, (3) repair boss who has charge of the maintenance of all machines in the shop and (4) the inspector who passes final judgment on the work, sees that there are no defects of material and then passes it on to the next operation or to the assembling or shipping room.

All of us are familiar with the evils from which the Army suffers as the result of a failure in the past to plan within the War Department. We thus have depots and arsenals located without regard to industry. We have housing conditions dictating the location of the Army in places where it should not be. We are handicapped for lack of funds because these things which should have been planned for years ago require expenditures from current appropriations.

"A superficial examination of planning methods frequently misleads proprietors, managers and superintendents accustomed to traditional methods into forming the opinion that planning means exceedingly high overhead expense. In actual practice, however, it has resulted in remarkable increased production with the same number of men and machines." (Dunbar, p. 109).

Probably the best example of planning in the United States is that followed by the subsidiary corporations of the American Telephone and Telegraph Company. The Engineering Department of every telephone corporation is always planning ten years in advance. The necessity for this is apparent. The average American expects to be able to build a house anywhere he wishes and immediately have a telephone installed in it. If telephone companies do not anticipate at least ten years in advance, not only the normal growth of a city, but especially the direction of that growth, it will not be able to install its trunk lines and central offices in time to keep in step with real estate developments. We are accustomed to seeing city streets dug up and repaved because somebody in the City Hall forgot something and did not plan in advance, but industrial organizations who must pay dividends have no taxpayers to fall back on to enable them to indulge in such luxuries.

Planning is the only way by which industry can pay dividends. In the Army it is conspicuous by its absence. To be efficient, the Army must plan (1) how to organize, (2) how to deputize and (3) how to supervise. Failure of any of these will result in disaster when confronted with the emergency of war.

IV. DEPARTMENTAL vs DIVISIONAL TYPES IN RAILROAD ORGANIZATION

Railroad organization is very similar to that of the Army. The primary reason for this is, that just as with an army, operations against an enemy in time of war is the sole criterion of efficiency, so with a railroad the sole criterion is whether trains, both passenger and freight, move as required. We may disregard the difficulties of building the railroad, both financial and engineering. We may disregard how it obtains its business and attends to its legal affairs, but the final test of efficiency is its capacity to move freight and passengers.

All organization, whether military or industrial, is colored with the national characteristics of the people involved. With Americans, strong executive control and great initiative are national characteristics. These

ideas have been carried into the organization of our railroads with the result that the tendency in most of them has been to adopt the divisional, or military, type of organization rather than the departmental, or functional, type. The character of our country requires long railroad lines, thereby separating men on the ground by great distances from men in the office. This has had much to do with evolving the present systems of railroad organization. The British railroads are operated very efficiently, handling a dense traffic over a relatively small area. They have accordingly adopted very generally the departmental type of organization. Habits of thought tend to become national. It is interesting to note that the British supply organization for their troops in France followed the departmental (functional) type of organization with which they were familiar at home, but with expeditionary forces, operating at great distances from the British Isles such as in Mesopotamia, the tendency was toward the divisional (line) organization which we used in the A.E.F. The echelons of command in the Army have exact parallels in railroad organization. Chart No. 10 shows the echelons of the Pennsylvania Railroad with their corresponding Army executives. It will be noted that they are practically identical from the president of each organization down to the track walker or the private in the ranks. It must be noted, of course, that railroad lines are fixed in their location. The parallelism therefore relates more to the territorial rather than to the tactical organization of the Army, yet it is applicable to both. Appendix "A" contains a description of the usual departments found in every railroad. It is extracted from an article by Mr. J.C. Clark in Mechanical Engineering, the official journal of the American Society of Mechanical Engineers, for May-November, 1926 (Volume 48, No. 11a). In order not to get confused with details, however, it will be sufficient for the present purpose if we confine our attention entirely to three individuals.

The ultimate test for any railroad organization comes when there is a wreck on the line and it becomes necessary to fix the responsibility therefor. Suppose, for example, a locomotive rounding a curve leaves the rails. Fixing responsibility for the accident demands upon the answer to three questions involving three separate departments. (1) Was the speed rounding the curve too great? If so, the Operating Department, or Divisional Superintendent, is primarily involved. (2) Was the accident due to defective mechanical equipment, as for instance a bad wheel? If so, the Mechanical Department is responsible. (3) Was it due to defective track? If so, the Maintenance of Way Department was responsible. If the Master Mechanic in charge of the shops and the Chief Engineer in charge of Maintenance of Way are staff officers and responsible solely to the Divisional Superintendent, then we have a divisional type of organization. If, on the other hand, the Master Mechanic

reports through his own technical channels to the Superintendent of Motive Power and the Chief Engineer reports thru his technical channels to the head of the Maintenance of Way Department, and they take orders only from their own technical chiefs, then the road is organized on the departmental system. As in all types of organization, there is a borderland where the Master Mechanic and the Chief Engineer are regarded as staff officers for the purpose of furnishing advice to the Divisional Superintendent. In such a case we have the familiar line and staff organization and in such a railroad organization the Master Mechanic and the Chief Engineer would be responsible to the Divisional Superintendent to see that trains move. While the divisional type of organization is the one most generally adopted by American railroads, the departmental system is used by a number of large systems, notably the New York Central. However, in many of those where the Departmental system is ostensibly used, a close inspection will disclose the fact that they really operate on the line and staff principle. Charts No. 11 and 12 show the essential difference in the two types of organization.

An interesting case of change from a departmental to a divisional type of organization and back again to the departmental, is offered by the Centralia Eastern Railroad (a fictitious name used for purpose of disguise). The syllabus of this case as reported in Harvard Business Reports, Volume 2, page 3, follows

"RAILROAD ORGANIZATION - Divisional Organization Substituted for Departmental.

Before 1916 a railroad handling dense freight and passenger traffic in a compact, densely populated, industrial territory, operated under the departmental plan. The three central departments were represented in each division by co-equal officials, a division superintendent was in charge of stations, yards, and trains, a division engineer was responsible for maintenance of way and structures, and a master mechanic was in charge of maintenance of equipment outside the general shops. In 1916 the railroad changed to the divisional plan of organization whereby in each division the superintendent was placed in full charge; the engineer and master mechanic became his subordinates. The decision was made in an attempt to conform to the policies of some other railroads, to develop the superintendents for higher positions, and to improve the divisional esprit de corps. The superintendents' lack of technical training and the pressure of their own work made the change unsuccessful".

"RAILROAD ORGANIZATION - Departmental Organization Reinstated,
With Modifications.

In 1921, a time of peculiarly difficult operating conditions, a railroad handling dense freight and passenger traffic in a compact, densely populated industrial territory, recognized that the divisional plan of organization adopted five years before was not successful. The former, Departmental plan whereby in each division the division superintendent, division engineer and master mechanic had co-equal authority and were controlled directly by three corresponding central departments, had persisted in fact despite the official placing of the division superintendents in full charge of their divisions. Because those superintendents had inadequate technical training and were heavily burdened by their original duties, and because the system was relatively compact, the railroads reverted to the departmental organization but with instructions to officials which would maintain the advantages of cooperation inherent in divisional organization."

When the departmental organization was restored, the chart showed a straight departmental type, yet the circular (order) placing it in effect implied a modification leaning toward continuing the spirit of the divisional plan. After discussing the purpose of the organization and how authority was expected to be enforced under it, the circular stated,

"General superintendents and superintendents are responsible to the public and to other jurisdictions for all matters relating to service, for trains of every character, and for the proper use and full protection of the company's property. Maintenance engineers and mechanical superintendents are staff officers of, and office with, general superintendents. Division engineers, master mechanics, division accountants, division storekeepers and captains of police are staff officers of, and office with, division superintendents. The responsibility of each to the general superintendents and to the superintendents as that of direct cooperation and supporting service".

It will thus be seen that what was restored was in reality a line and staff organization. The commentary of the faculty of the Harvard Graduate School of Business Administration on this case is as follows:

"COMMENTARY This case gives an excellent background for discussion of the relative merits of the divisional plan and the departmental plan of operating organization. The divisional plan is used more extensively than the departmental, especially on railroads having 3,000 or more miles of line. Notable among the exceptions is the New York Central Lines which adheres to the departmental idea. The Pennsylvania, Baltimore & Ohio, and Erie, companion trunk lines, operate under the divisional plan. In the case of smaller roads, the departmental type of organi-

"From the viewpoint of the chief executive, the greatest administrative problem under the departmental plan is to coordinate departmental activities so that each department will be conducted for the good of the whole rather than solely from the single departmental viewpoint. The departmental plan ordinarily insures a relatively high degree of skill in technical administration of maintenance work, but such work is not always harmonized effectively with operation. By operation is meant here the running of trains, the utilization of locomotive and cars, and the operation of the yards, terminals and stations.

"On the other hand, the chief administrative problem under the divisional plan is the coordination of operating divisions and districts, especially in maintenance policies. While under the departmental form there is danger of over-emphasizing the department and setting up watertight compartments which tend to lower operating efficiency, under the divisional plan there is danger of the possibility that the operating function - the actual production of transportation - may be unduly stressed to the detriment of physical maintenance.

"On the small road the chief executive ordinarily can control departments so as to develop the best in each by relative independence, and at the same time he can insure the desirable degree of coordination for the smooth working of the whole organization. This is more difficult in the case of a larger system. Here, under the divisional plan the function of maintenance is decentralized, as explained in the case, and the technical features are controlled by staff officers who set up standards and prescribe methods, and control the administrative features by inspection.

"The Centralia Eastern is a border-line case. In mileage it is not large - 2,400 miles of line - but its traffic is said to be "relatively very dense". The number of employees, (34,000) is more than that of the typical railroad of much greater mileage. Per mile of line the Centralia Eastern has 14 employees, the average for all railroads is less than 7. This case, therefore, should not be decided solely by the test of line mileage.

"In this case the Centralia Eastern, originally of the departmental type, had tried the divisional plan, found it to be less desirable than the departmental, and had reverted to the original form of organization. The chief interest and significance lie in the reasons which led to the change and subsequent abandonment of the divisional plan, and in the reasons which convinced the management

that the divisional plan, although preferred elsewhere on railroads of similar magnitude in transportation production, was unsuitable for the Centralia Eastern. Of almost equal interest is the unique attempt of the president to preserve the spirit of the divisional plan despite a return to departmental organization.

"The reasons for giving up the divisional plan are clearly stated: (1) the superintendents had not been trained under it and could not rise to their broadened opportunities; (2) traffic was so dense and operating burdens were so heavy that the superintendents could do no more than control the operation of trains, yards, terminals, and stations; and (3) the compactness of the system and the relatively short distances between the central offices and the division headquarters minimized the importance of local autonomy and insured a reasonable degree of freedom from departmentalization.

"Of the three reasons, that last given was of the greatest importance. The first was a temporary drawback. In time the superintendents could have been trained adequately. A part of the difficulty in this case may have been an undercurrent of opinion that the divisional plan would not be successful and would soon be abandoned. If this was the case, the superintendents were not likely to extend themselves at the risk of making enemies among their technical subordinates who might, in a short time, be their associates of equal official standing. All innovations require a period of time in which the officials and employees must adjust themselves to new conditions. If the inexperience of superintendents had been the sole disadvantage, it is not likely that the experiment would have been abandoned. As had been done elsewhere, the superintendents, in self-defense, would have become competent or would have been displaced by others who could have adapted themselves to the new order of things.

"Nor was the second reason controlling. It was probably true that the supervisory demands of transportation among the superintendents were so great as to preclude an adequate supervision over maintenance, yet that difficulty could have been met by the appointment of assistant superintendents. The divisional plan is admittedly more expensive, but the additional expense has been found to be fully justified by better supervision on other roads where that plan is working successfully. In this case the management evidently did not consider it wise to assume the expense of giving the superintendent more assistance, even though the new plan added substantially to his duties and responsibility.

"The third reason, apparently, was the major consideration. The ability to hold frequent meetings of division

superintendents without requiring them to absent themselves from their divisions more than a day at a time, insuring divisional coordination with minimum of effort or interference with operation. At these meetings, presumably, the general manager would have the mechanical manager and the engineer of maintenance or their representatives so that departmental walls could be broken down. Thus, without disturbing existing relations, one of the principal objectives of the divisional plan could be accomplished.

"We have no information as to the success of the unique feature of the restoration of the departmental form of organization. Its success probably depends upon the personality of the president and his persistence in driving into the minds of the maintenance and mechanical officials the thought that even though there is a departmental independence the division engineer or the master mechanic must consider himself as an officer on the staff of the division superintendent. Much will depend also upon the personality and tact of the division superintendent. In publishing a chart which indicated that these technical officers on the division were independent of the superintendent, and, at the same time, publishing a letter which instructed these officers to consider themselves on the staff of the superintendent, there was an apparent violation of the principles of organization, but an anomaly of the kind may be justified by peculiar conditions and may be successful when supported by the will of the commander-in-chief. February 1926. W.J.C."

While the departmental type of organization has been found effective for short compact railroad systems, lines extending over large areas of territory have most frequently used the divisional type. Perhaps the most important exception to this is the New York Central system. "The greatest company-worked railroad organization in the world in point of miles of line and diversity of conditions as well as that of the Union Pacific and Southern Pacific System built up by the late E. H. Harriman. Mr. Harriman placed 18,600 miles of rail lines and 35,600 miles of steamship lines under a single highly efficient administration which has been conspicuously successful in getting things done in an orderly and systematic fashion and in keeping a working record of the conditions of the property and of the business. Mr. Harriman himself was president of both roads and the leading spirit of both executive committees. Since his death the same positions have been ably filled by his associate Judge Robert S. Lovett." (Morris, pp 54-5).

It is interesting to observe that this vast system was operated under the direction of Mr. Julius Kruttschnitt, Director of Maintenance and Operation, located in Chicago, and by Mr. E.H. Harriman, the president, living in New York. The Union Pacific and Southern Pacific systems cover practically the whole of the central and southern part of the United States west of the Mississippi and the whole of the Pacific Coast. Such a vast system necessarily could only be operated by giving to Division Superintendents throughout the system the maximum possible authority. In order to do this, Mr. Kruttschnitt called to his assistance as Technical Advisor, Colonel Dhas. Delano Hine, who, between 1908 and 1911, installed on the Harriman lines what has become known as the unit system.

(Note Col. Hine graduated from West Point in 1891.

While serving in the Infantry at Ft. Thomas, Ky., he studied law at Cincinnati, was admitted to the bar and in 1895 resigned his commission to take up railroading. He began as a brakeman on the Cleveland, Cincinnati, Chicago & St. Louis Railroad. He became in turn, switchman, yardmaster, emergency conductor, chief clerk, trainmaster, assistant superintendent, right of way agent, general superintendent, receiver, general manager and vice president. He served in Cuba in 1898 and commanded the 165 Inf., 42nd Divn. in France, and was also on special duty in connection with the American railroad system in the A.E.F. He died in February 1927.)

The following is a typical order issued installing the unit system on one of the divisions of this line:

"OFFICE OF SUPERINTENDENT.

Circular No.....

..... 19,....

"Effective this date, this Division discontinues among its officials the use of the titles, Master Mechanic, Division Engineer, Trainmaster, Traveling Engineer and Chief Dispatcher.

"The following named officials are designated.

1. Mr. A.B..... Assistant Superintendent
2. Mr. D.C..... Assistant Superintendent
3. Mr. E.F..... Assistant Superintendent
4. Mr. G.H..... Assistant Superintendent
5. Mr. I.K..... Assistant Superintendent
6. Mr. L.M..... Assistant Superintendent

"They will be obeyed and respected accordingly.

"Each of the above named officials continues charged with the responsibilities heretofore devolving upon him, and in addition assumes such other duties as may from time to time be assigned.

"All of the above will be located in the same building with one consolidated office file in common with the Superintendent.

"All reports and communications on the Company's business, originating on this division, intended for the Superintendent or for any Assistant Superintendent, should be addressed simply "Assistant Superintendent" (telegrams "A.S"), no name being used unless the communication is intended to reach an official away from his headquarters, or to be personal rather than official, in which latter case it will be held unopened for the person addressed. It is intended that the Assistant Superintendent shall always be on duty in charge of the division headquarters offices during office hours. The designation of a particular Assistant Superintendent to handle specified classes of correspondence and telegrams is a matter concerning only this office. Each official transacts business in his own name, and no person should sign the name or initials of another. The principle to guide subordinate officials and employees is to be governed by the latest instructions issued and received.

"Train orders will be given over the initials of the Train Dispatcher on duty, as will messages originated by him.

"The modifications of pre-existing organization and method herein ordered have been carefully worked out to expedite the Company's business by the reduction and simplification of correspondence and records. It is expected and believed that officials and employees will insure a successful outcome by lending their usual intelligent cooperation and hearty support.

"Officials and other persons above and outside the jurisdiction of the division are requested to address official communications, intended for the Superintendent or any Assistant Superintendent, simply:

"Superintendent.....Division.....

.....
Approved: Superintendent

.....
General Manager"

It will be noted from the foregoing circular that Colonel Hine applied military principles to the organization of the Harriman lines. By doing away with the titles Master Mechanic, Division Engineer, etc., and designating the same men Assistant Superintendents, he raised them to the status of Assistant Chiefs of Staff empowered to issue orders within the division over their own signatures as Assistant Superintendents. Such orders were as binding on all concerned as if issued by the Division Superintendent personally. In order to effect complete coordination among the Assistant Superintendents, they were required to have offices adjacent to each other in the same building and to have a common filing system for all their correspondence. The adoption of the unit system of organization on the Harriman lines, amplifying the pre-existing divisional system, is a great tribute to the essential soundness of military principles of organization. It was the introduction for the first time into American railroading of the General Staff principle for control, a system which has been found indispensable to efficiency in the organization and command of modern armies. It is of interest that such a reform was introduced into American railroad practice by a man trained in military methods.

V. TYPES OF ORGANIZATION IN THE ARMY.

Industrial Engineering deals (as heretofore indicated) with intelligently directing the construction and arrangement of factory buildings, the character of methods and processes, the organization of departments, the elimination of wastes, and the increase of efficiency in all phases of industrial administration where data and experience are applicable. We are here concerned with principles of organization and not with factory processes.

Chart No. 13 shows the organization of The Quartermaster General's Office in April, 1917. In succession the Embarkation Service, the Cantonment Branch, the Construction and Repair Branch, the Transportation Division, the Finance Division and parts of the Supply Division were transferred, and what was finally left merged into the P. S. & TL Division of the General Staff. These are merely historical facts and are not repeated here for the purpose of reflecting in any way upon any individual whatever. We are concerned only in approaching a matter of vital concern regarding principles of organization in a spirit of scientific investigation. Our interest lies solely in determining what faults existed in pre-war organizations of the War Department. By referring again to Chart No. 13, it will be noted that the organization of the Quartermaster General's office was what is known as a "Military" or "Line" organization. This organization, as we have seen, is based upon the principle of authority, but has the disadvantage

of not giving the man at the top the benefit of a staff for planning and specialization. He is, therefore, figuratively speaking, riding on the axle all the time. What he needs are some springs, snubbers and balloon tires under him. Comparing the strictly Line Organization of the Jews under Moses (Chart No. 5) (selected merely to show how ancient this type of organization is), with the present line and staff organization of a division, Chart No. 15, we see the great development in types of organization as military units have become larger and more complex. When any organization, military or industrial, becomes so large as to be beyond the capacity of one mind to exercise personal direction over all its parts, when the Chief thereof must call to his aid staff specialists to assist. In this way the Germans developed the theory of a General Staff, viz., that it is composed of officers specially skilled in tactics and operations and thus capable of assisting the General in the exercise of command. The unfortunate mistranslation of the German word "generalstab" has been the cause of much confusion in this respect.

On the other hand, the functional type of organization adopted by the Ordnance Department during the World War affords a good illustration of the failure of that type to meet Army Requirements, Chart No. 14. When it was found that production was not coming through and the people were becoming impatient, industrial experts were called in who organized the Department along strictly functional lines. The Requirements Division prepared schedules of requirements by months projected far enough ahead to constitute a procurement and production program. The Engineering Division determined types, prepared drawings and specifications for the same. The Procurement Division prepared and executed all contracts entered into by the Department. The Production Division was a "follow-up" organization designed to assist contractors by every known means so as to accelerate delivery. The Inspection Division inspected and accepted all supplies procured by purchase or manufacture. When supplies were accepted, they were turned over to the Supply Division for storage and distribution to troops. Under this system, when the Chief of any branch of the office - say Machine Guns - was called upon by the Chief of Ordnance for information as to why machine guns were not reaching the troops, he might very properly make any of the following replies

- (a) The Requirements Division has not told us how many will be wanted.
- (b) The Engineering Division has not decided on the type.

(c) The Procurement Division has not placed contracts as yet.

(d) Production has not started because contractor is waiting for instruction cards as to how to machine certain parts.

(e) The Inspection Department will not accept what has been delivered to them.

This was an example of a strictly functional organization and it failed, just as the strictly line (military) organization of the Quartermaster General's office failed. Here we have two examples of failure in organization, one because it was too ancient and had not been modernized the other so modern that it had not before been subjected to the crucial test of war. (These two departments have been selected merely because the magnitude of their operations brought out clearly the defects in their respective organizations. Any other bureau confronted with an equally large task and with an organization similar to either of these would have found itself in the same difficulty). As in all such cases, the correct principle of organization appears to lie between these two extremes. It requires that planning and control be functionalized and operations be militarized, that one be a horizontal and the other a vertical organization. Properly combined, they give the maximum in efficiency by combining skill and specialization with authority in execution. If these principles are correct, the student should be able to supply them in the study of any Army organization. The following charts are appended merely for the purpose of illustrating a few:

Chart No.

- | | |
|---------|--|
| 15 | Organization of the G.S. of a Divn.
(C.S. & L. 1925) |
| 16 | Organization of the War Dept. (G.O. 41-'21) |
| 17 | Functionalization of Army Finance. |
| (a & b) | |
| 18 | Relations between Command & Technical
Supervision, A.E.F. (Dawes Report,
Vol. II). |
| 19 | Relation between War Dept. and a
General Depot. |

15

BIBLIOGRAPHY (Books marked * are especially recommended).

- Robinson..... The Mind in the Making.
- * Kimball..... Principles of Industrial Organization.
- * Diemer..... Factory Organization and Administration.
Industrial Organization and Management.
- * Hine..... Modern Organization.
- * Harvard Business Reports. Volume II.
- * Dept. of Ind. Eng., Penn State College. Organization Types and Principles - 1925. (Pamphlet).
- Gerstonberg... Principles of Business.
- * Morris..... Railroad Administration.
- Johnson & Van Metro..... Principles of Railroad Transportation.
- * Dawes..... Report of Military Board of Allied Supply. (G.P.O.).
- Alford..... Management's Handbook.
- Jones..... The Administration of Industrial Enterprises.
- Emerson..... Twelve Principles of Efficiency.
- Lansburgh..... Industrial Management.
- * Thompson..... Scientific Management (Vol. I)
Harvard Business Studies.
- Gilbreth..... Primer of Scientific Management.
- Hunt..... Scientific Management since Taylor.
- * Gowin..... Developing Executive Ability.
The Executive and His Control of Men.
- Knoweppel..... Graphic Production Control.

LIST OF APPENDICES & CHARTS

"Appendix A".. "Railroad Organization" - Extract from article by Mr. J.C. Clark in "Mechanical Engineering" (Mid-Nov. 1926); Vol. 48, No. 11a).

Chart No.

- 1 Military or Line Organization (Kimball)
- 2 Line and Staff Organization. Taylor Organization as Modified by Gantt. (Kimball).
- 3 Functional Organization as Proposed by Taylor (Kimball).
- 4 Chart illustrating Committee Control over Certain Activities together with Functional Control over Shop Routine (Diemer).
- 5 Military Organization of the Jews under Moses. (Ex. XIX).

Chart No.

- 6 a To Illustrate Present Tendency Toward Four Column Type of Organization (Diemer).
- 6 b To Illustrate how Line, Staff and Functional Authority are Utilized in Combination to Exercise Control in the Modern Factory (Diemer).
- 7 To Illustrate Four Basic Departments (Gerstenberg).
- 8 Planning Industrial Activities (Diemer).
- 9 Prepared by F.B. Gilbroth to illustrate separation of Planning & Operations under Functional Control (Diemer).
- 10 Echelons of Territorial Commands in the Army Compared with Corresponding Authority in the Pennsylvania R.R. Organization.
- 11 Typical R.R. Organization (Divisional) - Morris.
- 12 Typical R.R. Organization (Departmental) - Morris.
- 13 Line Organization of the Office of the Quartermaster General as of April 6, 1917 (Report, Q.M.G.O. '19).
- 14 Functional Organization of Ordnance Dept., 1918.
- 15 Functional Organization of General Staff, Inf. Div. (C.S. & L. - G.S.S. 1925).
- 16 Organization of War Dept., 1921 (G.O. 41, W.D. '21).
- 17 a To Illustrate Functionalization of Army Finance.
- 17 b To Illustrate Functionalization of Army Finance.
- 18 Relation between Command and Technical Supervision, A.E.F. (Dawes Report, Vol. II, Chap. 1).
- 19 Relation between War Dept. and a General Dept.

16.6

Extract from Article by Mr. J. C. Clark, in the
"Mechanical Engineering", (Mid-Nov. 1926; Vol. 48, No. 11a)

Functional Organization.

Board of Directors. The functional organization of a railroad usually begins within the board of directors. Most railroad boards of directors have permanent committees dealing with finance, operation, valuation, traffic, and other important matters. As a general rule, however, these committees do not have power to act, but in some cases they do. Regardless of whether the committee has authority to act or not, when a committee is charged with a certain duty it has a very important influence on the action of the board as a whole.

The board of directors usually holds the president responsible for conducting the business of the railroad within the limits set by the board. The president, in nearly all cases, is a member of the board of directors. Consequently his duties are both administrative and managerial.

Finance Department. The three major functions in the railroad organization are finance, traffic and operation. The finance or treasury department handles the money; the traffic department gets the business, and, subject to the authority of the Interstate Commerce Commission, fixes the tariffs; and the operating department moves the business. No attempt will be made here to describe the various functions except in a general way. It seems desirable, however, to get some idea of the various functions involved in order to show how the parts of the organization are coordinated.

Some railroads have a vice president in charge of finance. On these roads the finance department, in addition to handling the funds of the corporation, often has more or less work in connection with issuing stocks and bonds of the corporation. However, all railroad stock and bond issues have to be approved by the Interstate Commerce Commission, and very often these matters are handled by the finance committee of the board of directors with the bankers, and through the general counsel with the Interstate Commerce Commission.

The treasury receives money from agents and conductors, from other railroads, from investments, and some other minor sources. It pays this money out upon proper authorization to employees in the form of wages and salaries and claims, to other railroads to balance interline accounts,

to cities, counties, states, and the Federal Government in taxes, to patrons in settlements of claims, to manufacturers and dealers in railroad supplies, and to stockholders and bondholders for dividends and interest. It is quite apparent that the treasury department has a very wide range of contacts and their activities must be well organized if the best results are to be obtained. Take the matter of the handling and transmittal of money by agents and conductors. If the requirements of the treasury department are unreasonable or burdensome, it may cause serious complaint upon the part of these important groups of employees and result in lack of morale where morale should be maintained at the highest possible point. It is recognized, of course, that the treasury department must see to it that funds are handled and transmitted in a safe and proper manner, but in working out the method to be used consideration must be taken of the conditions surrounding the employee who must live up to the regulations. A great many illustrations could be given to show the importance of the careful coordination of the treasury department with the other departments. In a great majority of cases there is little or no friction on our American railroads in this respect, which speaks very highly for the finance and treasury departments.

Traffic Department. It is the function of the traffic department to develop traffic and also to fix tariffs with the approval of the Interstate Commerce Commission. There are two main ways in which traffic may be increased. The first is by soliciting competitive business, and the second is by developing industry in the territory served by the railroad. The freight or passenger agent soliciting competitive business is practically limited to one argument, which is service. The Interstate Commerce Commission has complete control over rates, and as they are fixed in most cases there is little advantage as between different roads in this respect. American railroads are coming to realize that service can be a very strong argument for securing competitive business. It is the operating department that actually moves the traffic, so that perhaps the main element of service can be provided only by that department. The traffic department, however, does give a very valuable service by keeping the shipper informed as to location of his shipment, and in other ways that do not directly affect the movement of traffic.

For the purpose of developing traffic in the territory served by a railroad there has been established in a good many cases a development bureau within the traffic department. This bureau endeavors to get new industries located on its line and to develop new markets for industries already on its line. It also cooperates with various schools and colleges to develop better methods in farming and in marketing farm produce.

We cannot enter into any discussion of freight rates here, although it is a very important part of the work of the traffic department. The head of the traffic department is usually a vice president; the next in line are a freight-traffic manager and a passenger-traffic manager. Under these officers are general and district freight and passenger agents, and in most cases traveling freight and passenger agents. There is nothing complicated or unusual about this organization and as a rule it functions very smoothly.

Operating Department. This department is the one that looms the largest in the railroad business. The man at the head of the operating department is a vice president or, in some cases, a general manager who reports directly to the president. This officer has charge of the maintenance of the physical property as well as of its operation. He will therefore have under him one or more general superintendents, a general mechanical superintendent, and a general maintenance-of-way superintendent or engineer. Reporting to the general superintendent will be two or more division superintendents. It is at this point that two types of organization appear. In the so-called divisional organization the division superintendent will have charge of maintenance of way and of structures, maintenance of equipment, and the operation of the division. In the so-called functional organization the division superintendent has no direct authority over maintenance of way, structures, or equipment, the master mechanic and the division engineer reporting to the mechanical superintendent and the engineer maintenance of way, respectively.

We shall consider first the divisional organization. The strong point of this type of organization is the fact that the division superintendent has direct control of both the maintenance of the property and operation on his division within the limits set by higher administrative authority. Under this plan the division superintendent is in close touch with all of the activities and can more easily secure complete coordination and cooperation between his departments.

Under the functional organization where the division master mechanic reports to the mechanical superintendent and the division engineer reports to the engineer maintenance of way, it is more difficult to get this coordination and cooperation. The tendency is for each department to consider itself as almost a separate business. On the other hand, under the functional organization it is possible to develop a higher degree of efficiency within

each department and in many cases there is a very high degree of cooperation between the departments. There are very successful railroad organizations under both types of organization.

There are numerous other functions in a railroad organization that have not been mentioned. It would require a good-sized book to go into details regarding the duties and form of organization of all of these departments. We shall name some of them, however, and give a brief outline of the organization.

Accounting Department. One of the most important functions is that of accounting, and some of the railroads have a vice-president in charge of this work. Under the general auditor there is usually an auditor of disbursements, an auditor of revenues, an auditor of passenger accounts, an auditor of freight accounts, and an auditor of miscellaneous accounts, with an officer at the head of each sub-division with an appropriate title. It is the auditing department that is usually in charge of the work of making most of the reports to the Interstate Commerce Commission. It may be interesting to note that the Interstate Commerce Commission, in its order of July 1, 1914, specified a very definite procedure for all railroad accounting and established approximately 700 different accounts in order to insure uniform accounting on all railroads. These accounts are designed to secure the most minute information for the Interstate Commerce Commission. There are several volumes available giving complete information on railroad accounting. The author mentions this because he believes most railroad officers outside of the accounting division should be better informed regarding the accounting requirements of the Interstate Commerce Commission. It has a very definite bearing on the organization of the accounting department and the relationship between the accounting department and all other departments.

Legal Department. This department has a very important function in railroad organization. A large railroad system will operate in 12 or 14 different states. Every state has its own laws to be observed, and in addition to this there are numerous Federal laws to be lived up to. It would be an impossible task for the legal department on any railroad to familiarize every employee with the various state and national laws so it becomes necessary for the legal department to carefully scrutinize all rules for the government of employees to see that they conform with all existing laws, and in this way employees who might violate laws in the performance of their duties are controlled. In addition to this phase of the legal department

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work, they also have to defend their railroad against all kinds of damage suits and other legal actions. The claims departments of most railroads are under the legal department. There is a general claims agent who handles personal injury claims, stock claims, and, in fact, every character of claims except freight claims, which are handled in a separate department by a freight claim agent.

Another very important function which usually comes within the jurisdiction of the legal department is that of handling matters of taxation. The tax agent on a railroad has rather an important job as taxes are one of the large items of expense. It is complicated by the fact that railroad property extends in narrow strips thru all of the cities, counties and states in its territory, which means that every local taxing political unit is levying taxes against the railroad. The result is that the railroad is compelled to protect itself by a careful examination of all taxes levied. Closely allied with the tax question is the handling of real estate. Railroads necessarily hold a considerable amount of such property. In some cases the real estate and ~~taxation~~ taxation departments are one. In other cases the real estate is handled under a separate department.

Valuation Department. There is another function on the railroad that has assumed great importance within the last 15 years. This is the question of valuation. In 1914 Congress passed a law requiring the Interstate Commerce Commission to place a valuation on all railroad property required for transportation as the basis for fixing reasonable freight and passenger tariffs. The Interstate Commerce Commission organized parties usually under the supervision of engineers who made a complete inventory of all railroad property in the United States. This work at the present time is incomplete, although the Commission has fixed a tentative valuation in most cases. There is a wide difference of opinion as to what principles should be adopted in determining valuation for rate-making purposes. In order to handle questions affecting valuation in the best way possible a great many railroads have established a valuation department, often under the immediate supervision of a vice-president.

Medical Department. This department performs an important function on the railroad. Due to the fact that the swift movement of trains is hazardous it is very important that all employees having anything whatever to do with train movement should be physically qualified to perform their duties. Physical examinations were established on practically all railroads twenty-five or more years ago. In

addition to the initial physical examination, employees in train and engine service are required to pass periodic examinations, especially for eyesight and hearing. The medical department also must hold itself in readiness to give medical and surgical attention in case of accidents. Claims usually grow out of accidents. Therefore the medical department must cooperate with the claims department by furnishing exact information as to the extent and nature of injuries to persons. The medical department on a railroad is usually organized under the general manager, but in some cases it is organized directly under the claims department, and in other cases under the relief department.

Methods of Organization.

There are other functions too numerous to mention or describe here. Outside of the main functions that have been described there is considerable variation in the method of organization. For example, the safety department, on some railroads this department is organized under the general manager, elsewhere it may be organized within the claims department, or within the insurance department, so there is a wide difference in this respect. The main point to be made here is that an organization is essentially human and it must be built up with the full realization that every job within it is to be filled by a human being who is subject to all of the instincts, passions and prejudices inherent in human nature.

In planning or developing an organization for a railroad, it seems essential to make what might be called "vertical and horizontal divisions". The work to be done usually divides itself more or less naturally into functions, and these functions would be the vertical divisions. As the business of the corporation grows it is the tendency for functions to grow in number and in importance. On some of our large railroads there are twelve or more vice presidents, each in charge of a separate function, while on the smaller roads there may be only two or three vice presidents, each having charge of several functions. For this reason there is usually a better opportunity for managers on the smaller roads to secure a wider range of knowledge and consequently a better understanding of relationship between the various functions. On the other hand, a large enterprise makes it absolutely essential that the highest-trained experts be placed in charge of the various functions if the best results are to be obtained, and in the larger companies this is usually done, with the result, however, that it is more difficult properly to coordinate the work of the various functions and to secure proper cooperation between the heads of the departments. The tendency is quite natural for each department head to emphasize the importance of his own function, and in some cases the various functions are looked upon as almost a

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separate business. Each department head should be held strictly accountable for the operation of his particular function or department. At the same time he should be made to realize that he is only a part of the great enterprise and that in many situations it is essential for some of the departments to subordinate their interests to others. The author has in mind certain cases where the accounting and legal departments have been able to emphasize the importance of their functions to the point where unreasonable restrictions and requirements were enforced on other departments.

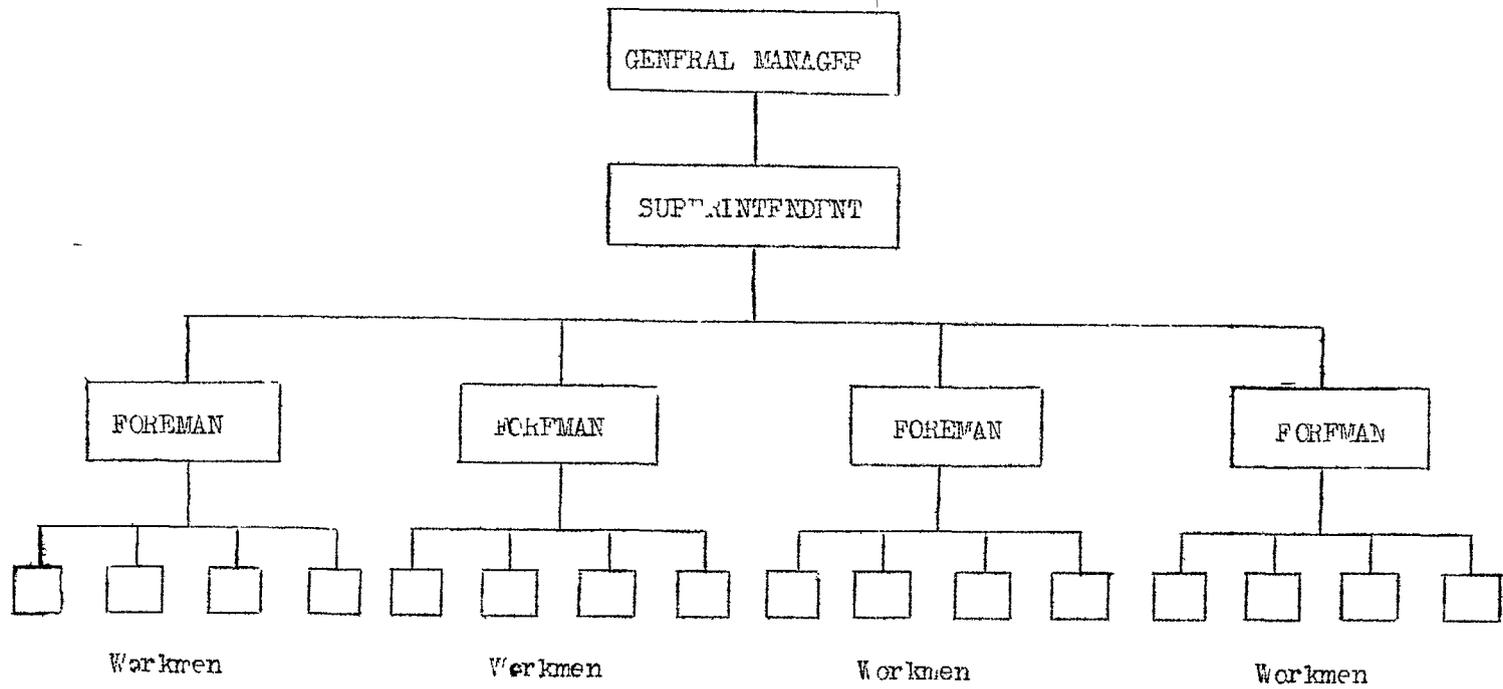
The horizontal division of the organization indicates how much authority any one official should exercise and how much can be delegated to subordinates; how much detail can be loaded on to any given position and still leave the holder of the position sufficient time for supervision and other matters. It is obvious that no two men are equally capable of handling detail and supervision. It follows that changes in personnel, which are constantly occurring, very often require changes in the organization set-up. It is quite evident that a human organization, in order to be effective must be elastic. It is also quite evident that changes in organization made necessary by changing personnel or changing conditions, should be given very careful consideration. The duties of a position of importance should be ~~fairly well~~ defined and there should be a very clear understanding of the limits of authority and responsibility. It is not essential, and in the author's opinion not desirable, to have all these duties and responsibilities expressed in writing, but it is desirable and essential that every officer should have a very clear understanding with his superior in this respect.

The author recently talked with a responsible railroad official who stated that he had never discussed with his superior the duties and responsibilities of his own position and, in fact, had not given much consideration to the matter himself except as various matters which came to his attention forced it upon him. This officer made the statement that after two years in his present position he had no clear understanding of his duties and responsibilities, and that he could assume responsibilities that seemed to be entirely out of his department, and in some cases he had done this because he felt that the good of the service required it.

In many cases officers in responsible positions are not allowed to appoint their subordinates without inter-

ference from their superior officers. The proper consideration of appointments in any organization is most important. If the head of a minor department is to be held responsible for the operation of that department, he must be given a pretty wide authority in the matter of appointments. If some one higher up in an organization makes appointments that the official responsible for the department does not approve, he can say with a good deal of reason that he is not responsible for results because he was not permitted to make the appointments which he considered best.

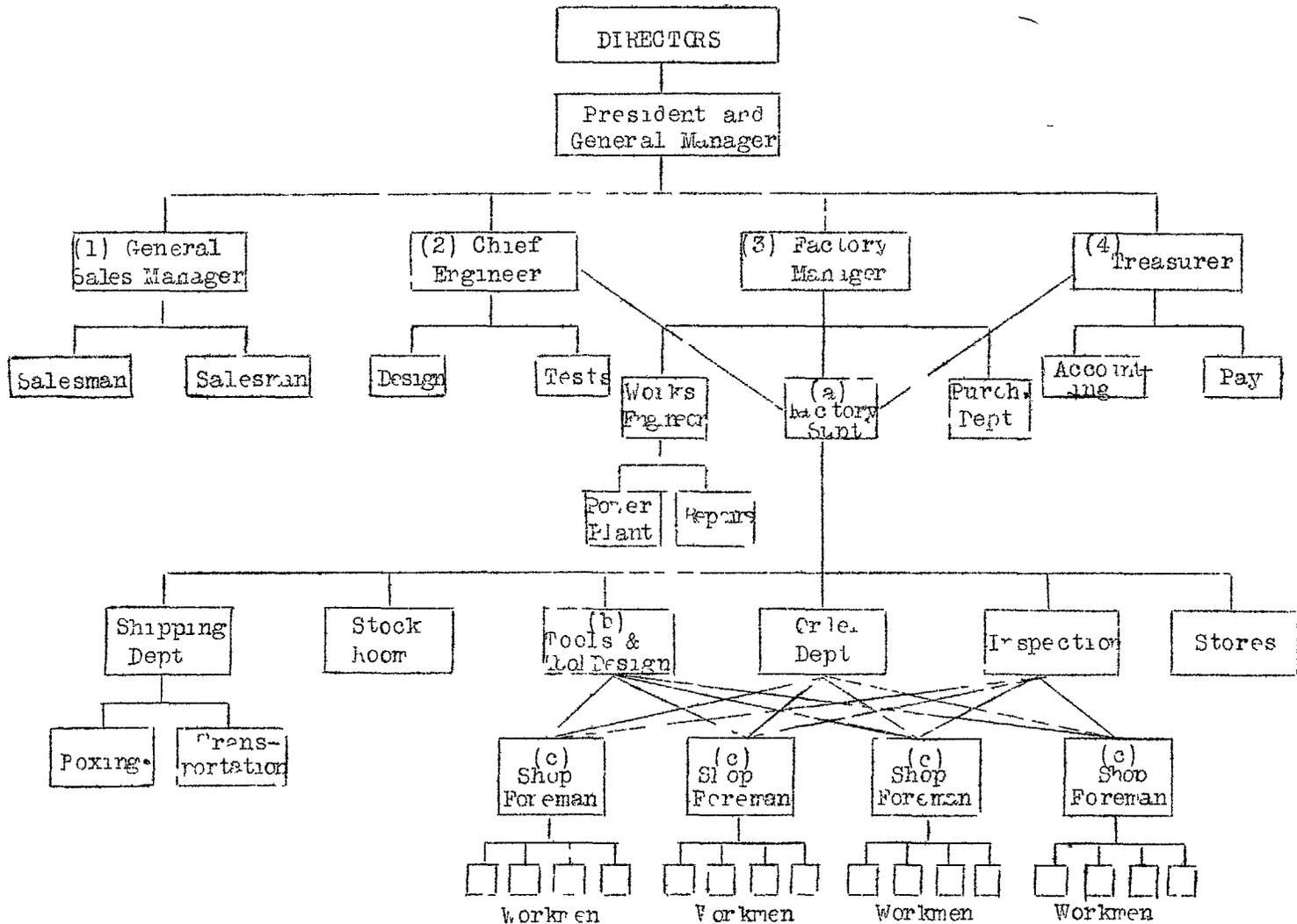
(Appendix "A" - 36)



MILITARY OR LINE ORGANIZATION (KIMBALL)

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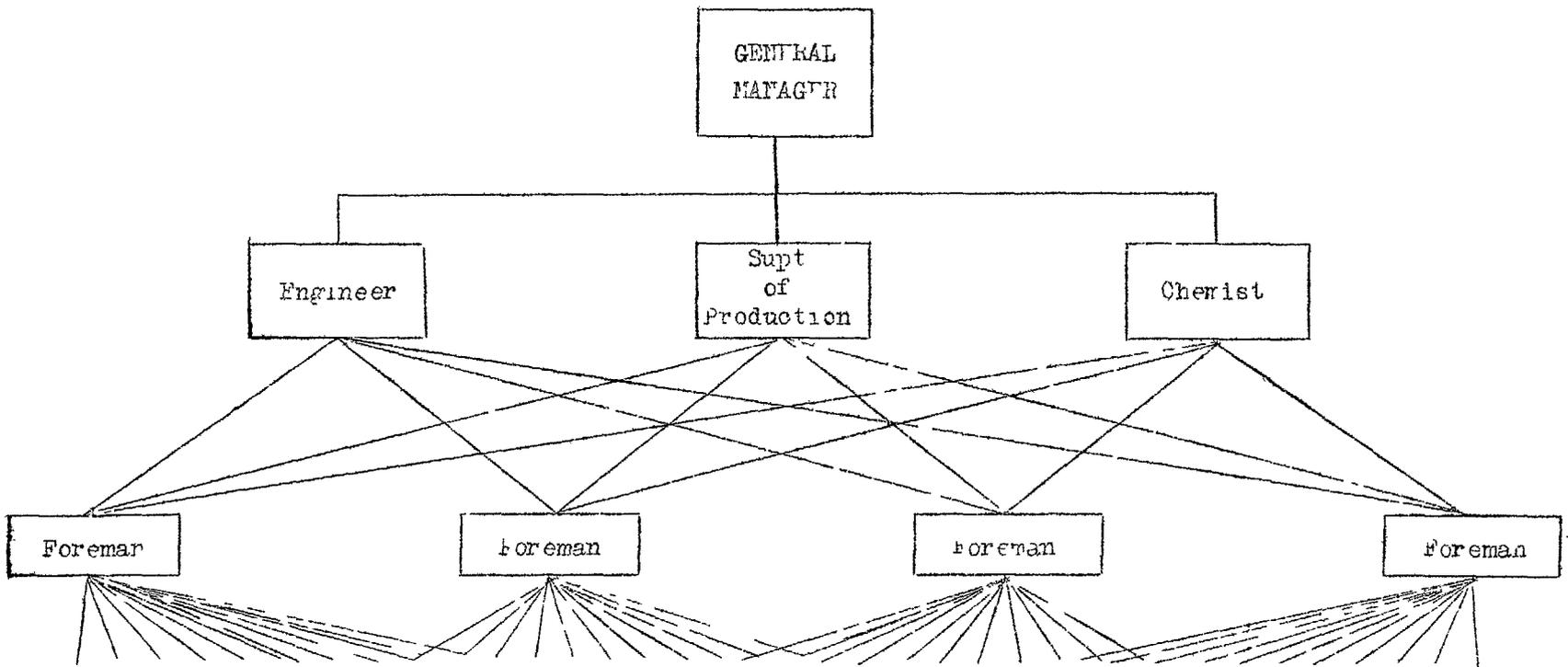


(1) (2) (3) & (4) Committee on General Policies
 (a) (b) & (c) Committee on Manufacturing Methods.

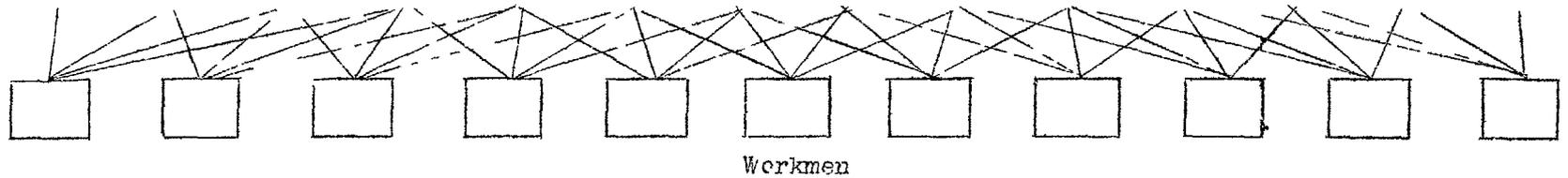
LINE AND STAFF ORGANIZATION
 TAYLOR ORGANIZATION AS MODIFIED BY GANTT (KIMBALL)

Oct 10 1911

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EACH FOREMAN SPECIALIST GIVES
 INSTRUCTIONS TO ALL WORKMEN
 SEE CHART IV



FUNCTIONAL ORGANIZATION
 AS PROPOSED BY TAYLOR. (KIMBALL)

CHART IV

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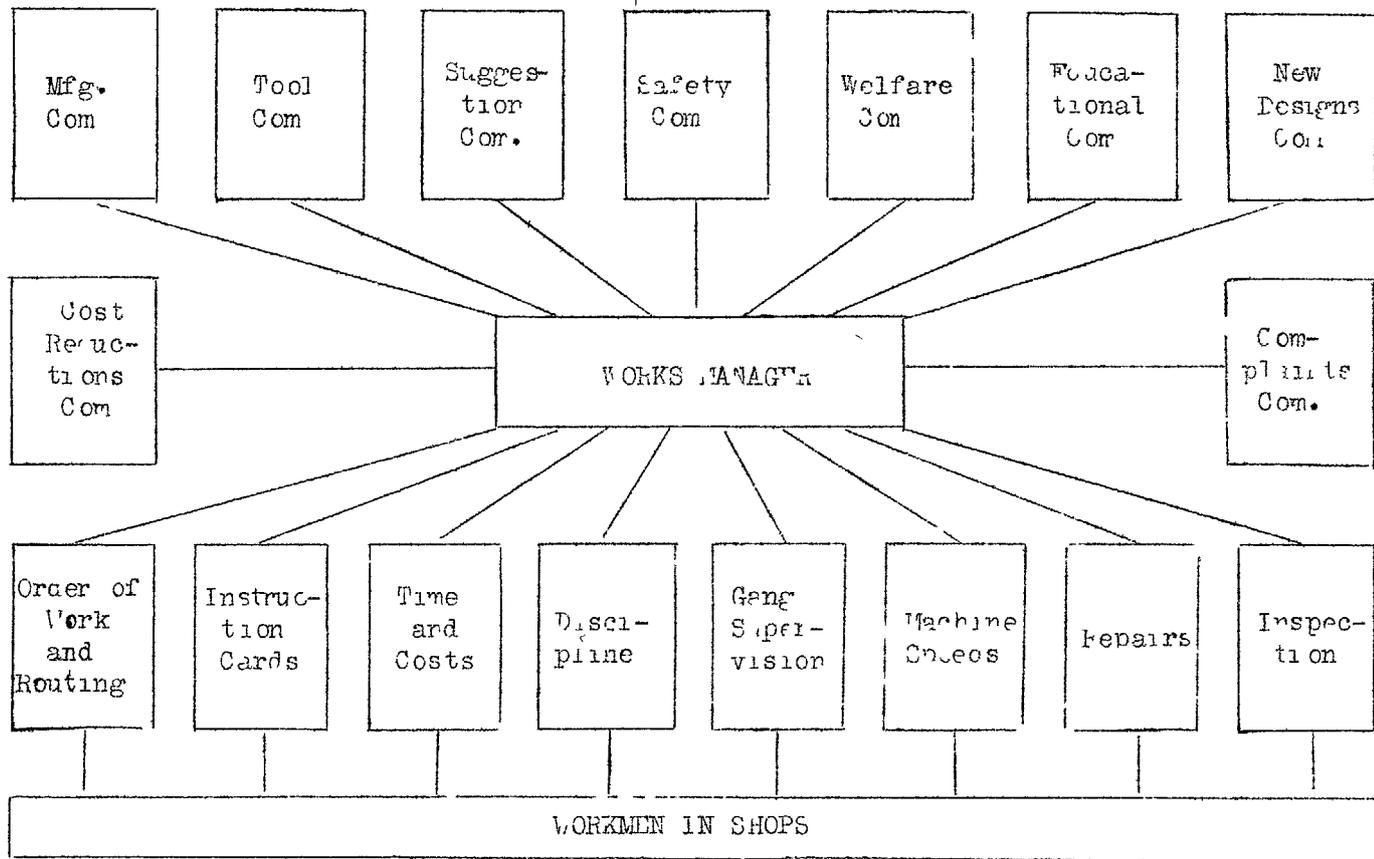
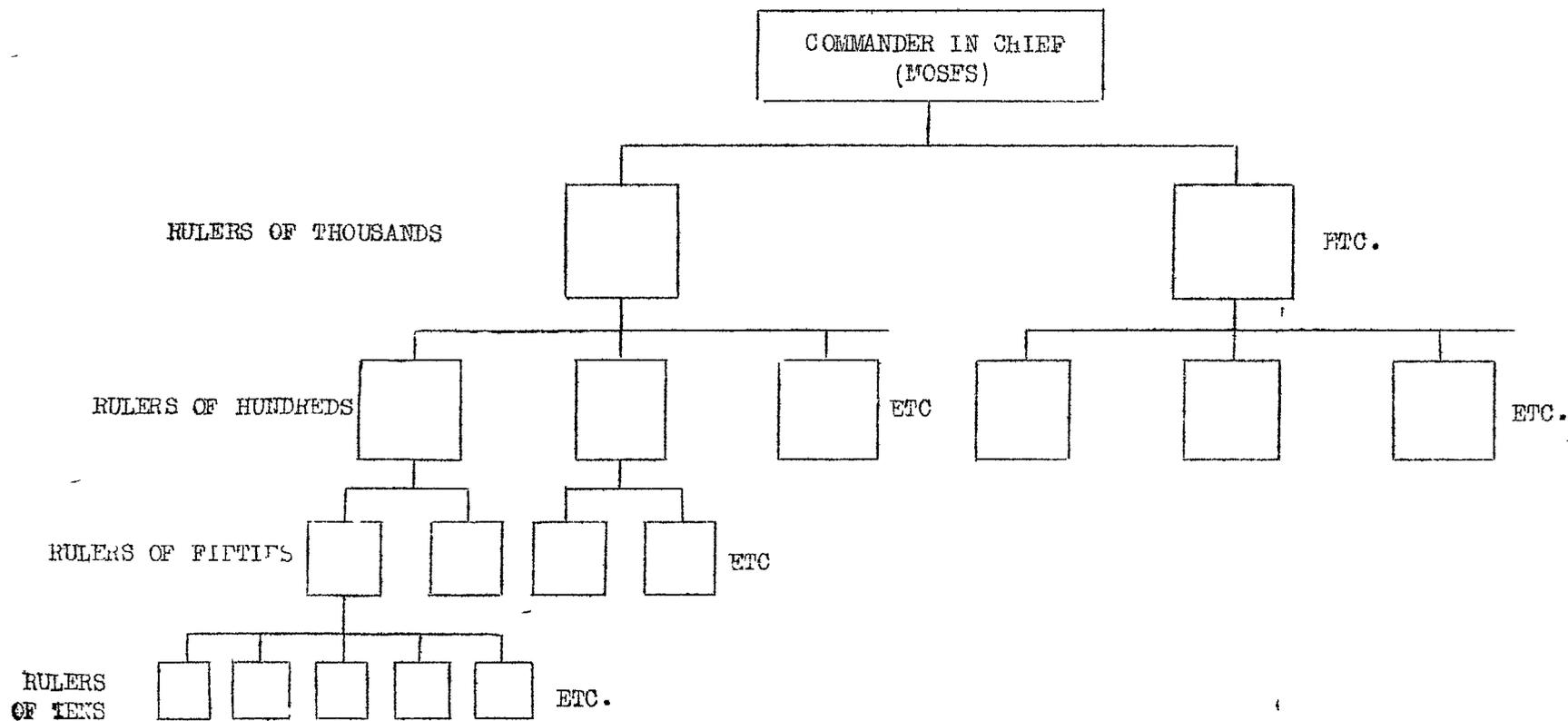


CHART ILLUSTRATING COMBINED CONTROL OVER CERTAIN ACTIVITIES TOGETHER WITH FUNCTIONAL CONTROL OVER SHOP ROUTINE (DIEMER)

Chart No. 4

173



MILITARY ORGANIZATION OF THE JEWS UNDER MOSES (EX. XIX)

PRESIDENT
OR
GENERAL MANAGER

TRIASURER OR
CONTROLLER

Financial Budgets
and Schedules
Accounts
statistics
Master Cost Ac-
counts
Payrolls
Credits and Col-
lections
Office Management
Legal, including
patents, trade
marks, copyrights

WORKS MANAGER

Industrial Engi-
neering
Technical Engi-
neering & Research
Plant Equipment
and Processes
Motion and Time
Studies
Preparing In-
structions
Purchasing
Traffic
Production Con-
trol
Stores
Cost Data and
Cost Service
other than Ac-
counting.
Planning
Routing
Preparation
Scheduling
Inspection
Superintendence
and Supervision
of shops
System and Pro-
cedures

SALES MANAGER

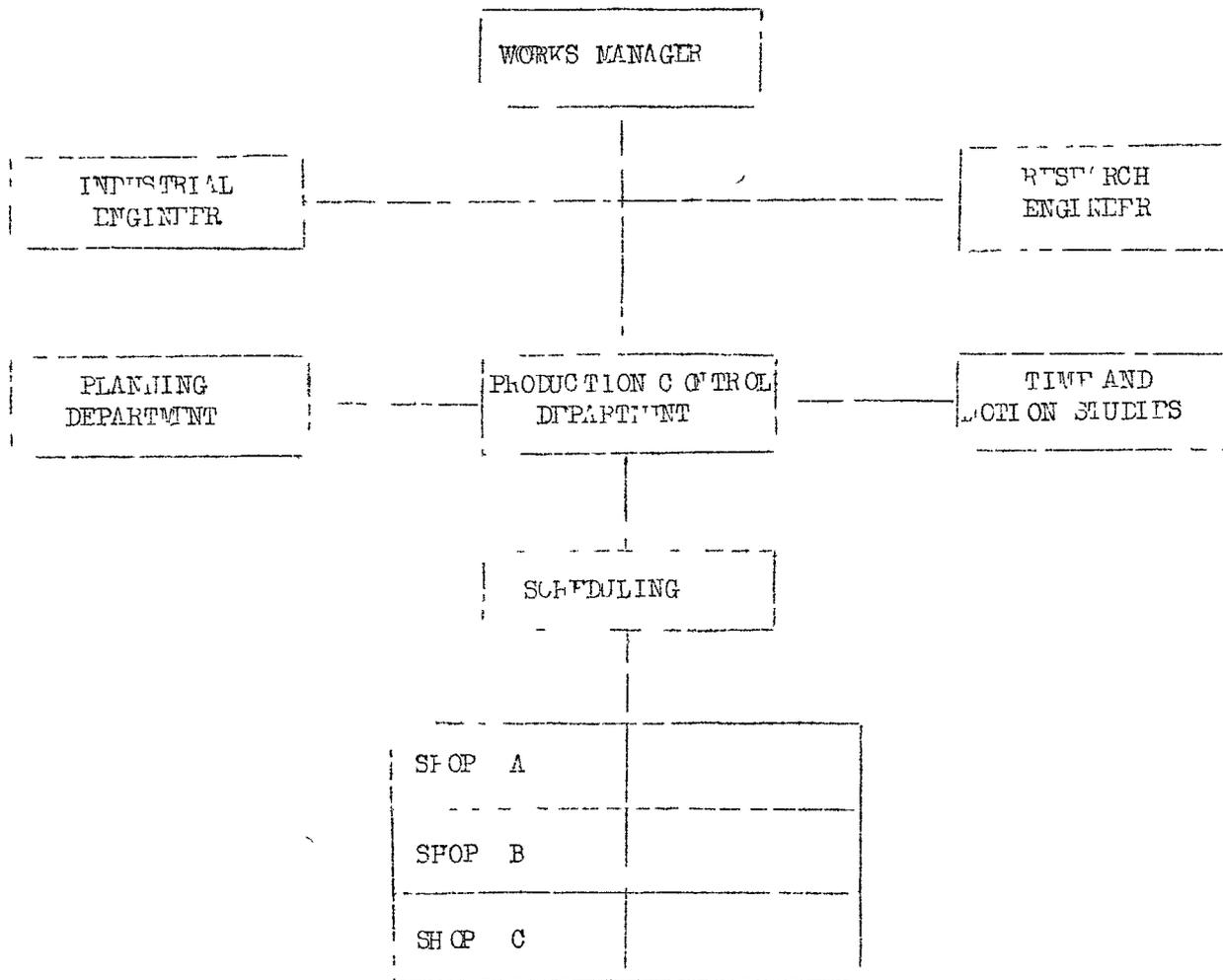
Sales Research
Market Analysis
Sales Promotion
Advertising
Training Sales-
men
Directing Sales
Force
Warehousing

PERSONNEL MANAGER

Employment
Transfers
Promotions
Training Courses
for Shop, Office,
Foremen and Ex-
ecutives
Employee Service
Activities
Health
Safety
Cafeteria
Recreation
Employee Paper
Wages
Profit-sharing
Employee represen-
tation
Benefit Assoc-
iation

TO ILLUSTRATE PRESENT TENDENCY TOWARD FOUR COLUMN TYPE OF ORGANIZATION (DIEMER)
Chart No. 6 a

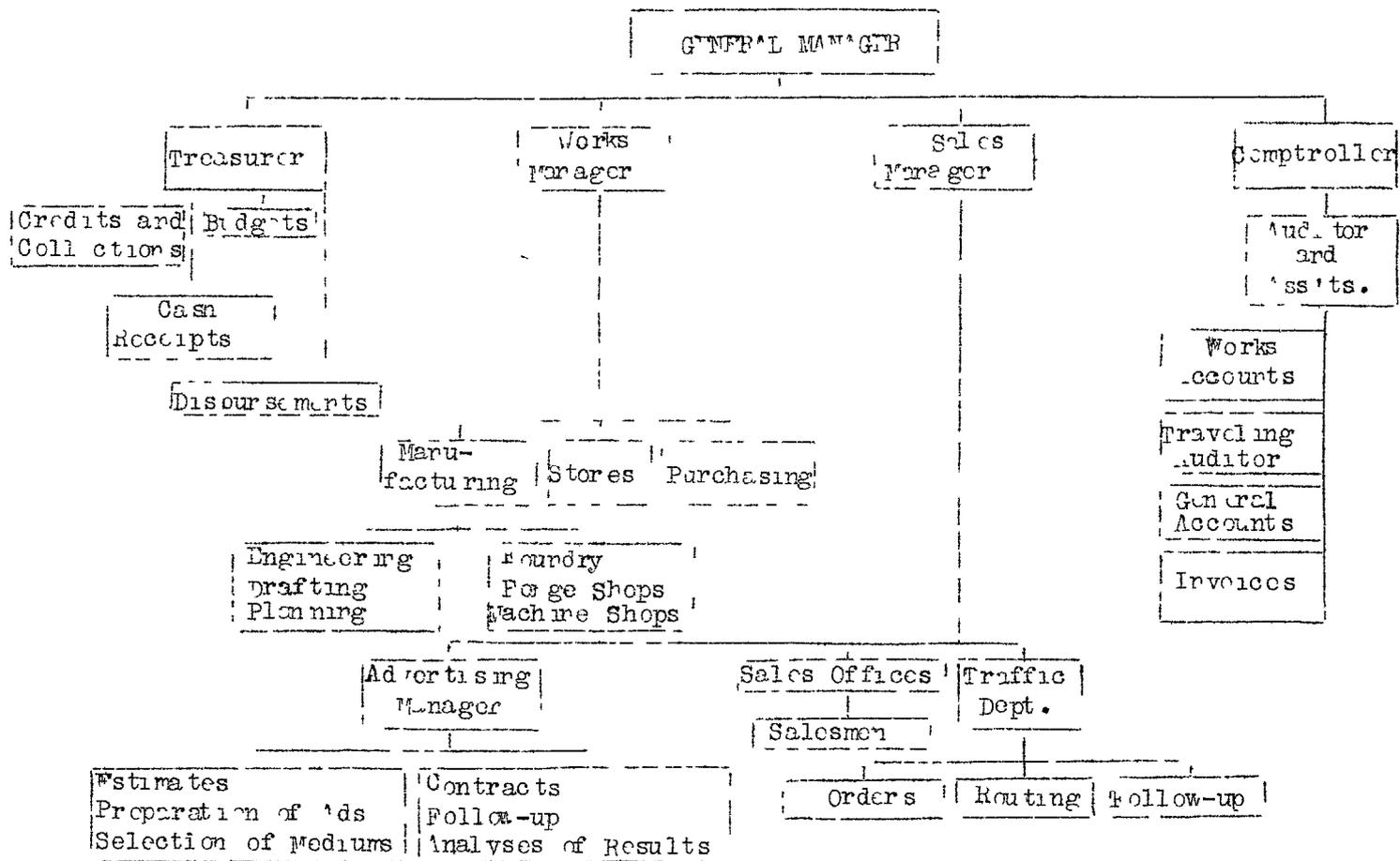
175



To illustrate how line, staff and functional authority are utilized in combination to exercise control in the modern factory. (Dumont)

Chart No. 6 b

176



TO ILLUSTRATE FOUR BASIC DEPARTMENTS (Gerstenberg)

Chart No. 7

177

I. Treasurer or Comptroller

As to finances (a) What money is coming in and when? (b) What money is going out and when?
(c) What money must be borrowed or raised and how?

II. Sales Manager

As to sales (a) What to sell? (b) How much to sell? (c) How to sell it?

III. Works Manager

As to production

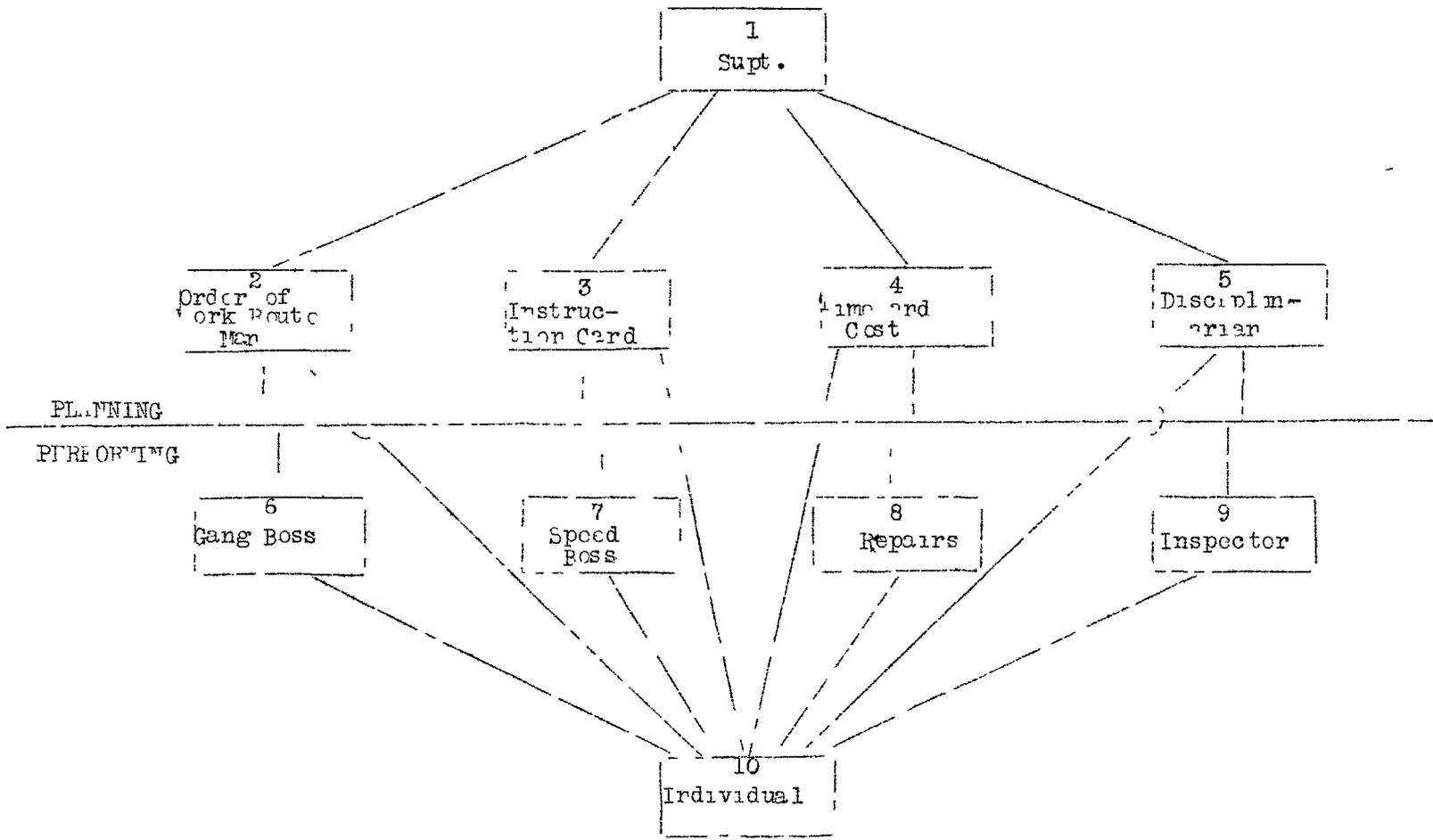
1. Production Manager What work is to be done?
Secures data as to definite and probable future work. (a) From Sales Dept.
(b) From Designing Dept. (c) From Manufacturing Committee (d) From Order
Dept. (e) From Stores Dept.
2. Stores Manager What materials are required?
Secures data as to materials needed. (a) From Bill of Material Dept
As to what is on hand and what has to be bought or made (a) From Stores Dept.
As to out and orders (a) From Purchasing Department.
3. Route Manager Where is work to be done?
Secures data as to what is to be made (a) From Production Dept.
As to where to do the work (a) From Routing Dept
4. Time Study and Instruction Manager How is work to be done?
Secures data as to detailed methods and time (a) from Time Study Dept.
As to accuracy (a) From Inspection Dept
5. Order of Work Manager. How long will work take and when shall it be done?
Secures data as to when work is wanted (a) From Sales and Order Depts.
As to how long work usually takes (a) From Cost Dept.
As to work ahead at each machine, bench, or other production center
(a) From Order of Work Dept

IV. Employment Manager or Superintendent

As to employment (a) What kind of men and how many to employ (b) What kind of men and how many
to drop (c) Whom to promote. (d) What welfare, social safety, and educational
activities to conduct

V. Plant Manager

As to facilities (a) Where shall plant be located? (b) How shall it be laid out? (c) What
equipment will be required? (d) How will it be maintained?



Prepared by L. B. Gilbreth to illustrate separation of planning & operations under functional control. (Diemer)

Chart No. 9

177

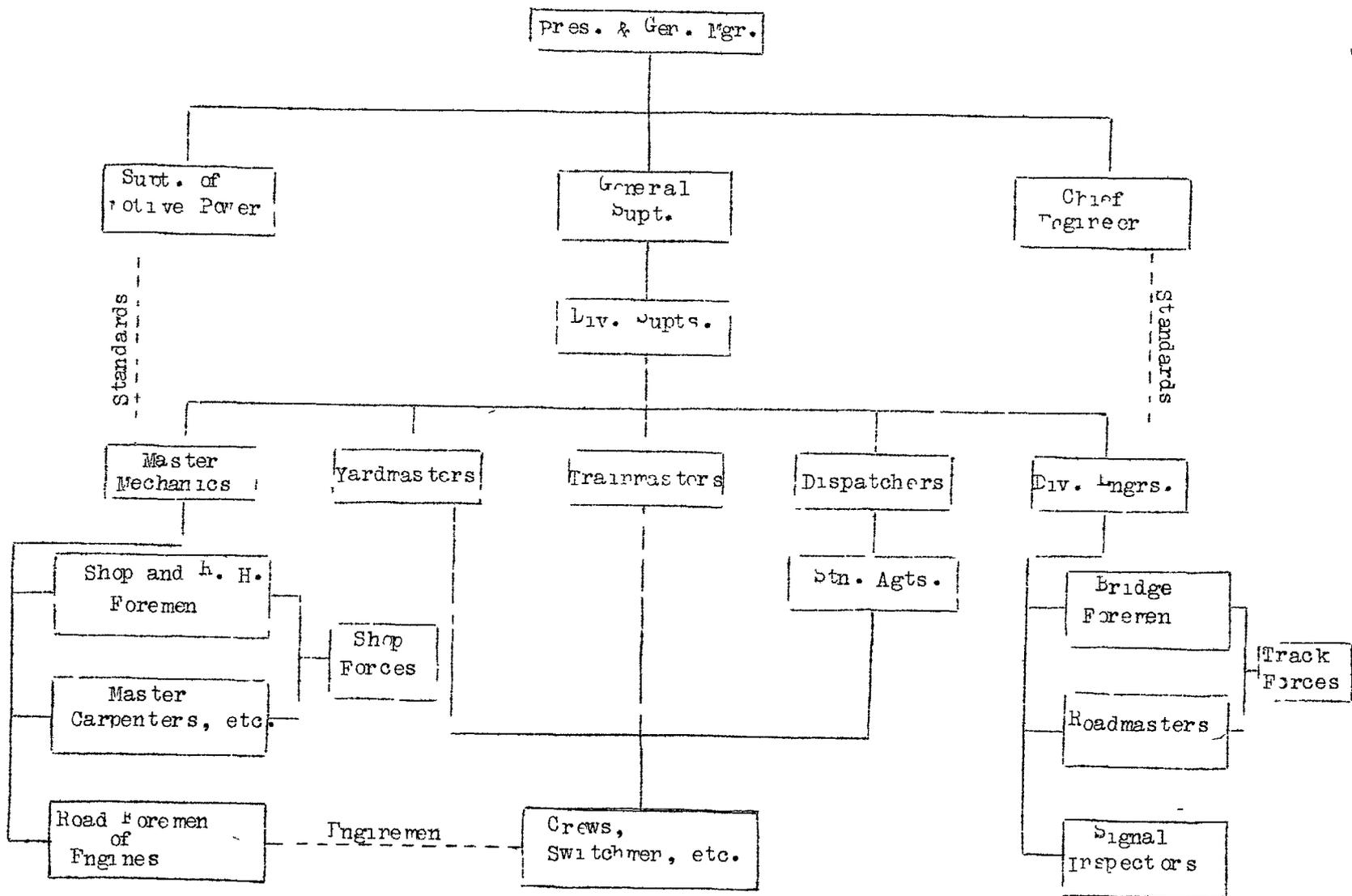
ARMYPENNS. R R

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- | | |
|-------------------------------|--|
| 1. Secretary of War | 1. President |
| 2. Chief of Staff | 2. Vice President |
| (a) Asst. Chiefs of Staff | (a) Vice Presidents in Charge of Operation, Traffic, Finance, Purchases, etc |
| (b) Bureau Chiefs | (b) Chf Tpn.-Chf. Motive Power - Chf. Engr., Personnel, etc. |
| 3. Corps Area Commdrs. | 3. Regional Vice-President |
| (a) Chief of Staff | (a) General Manager |
| (b) Asst. Chiefs of Staff | (b) Assts. to General Manager |
| (c) Tech. Adm. & Supply Staff | (c) Gen. Supts. of Tpn. - Motive Power - Chf. Engr. |
| 4. Division Commdr | 4. General Supt |
| (a) Division Staff | (a) Supts. Mot. Pow. - Engr. Floating Equip. - Gen. Accounts |
| 5. Unit Commdrs. (Posts) | 5. Divn Supts |
| (a) Tech. Adm & Supply Staff. | (a) Asst. Supts. - Div Engrs. - Master Techs. - Trnmstrs. - Div Accnts. |
| 6. Troops | 6. Trainmen - Shopmen - Yardmen - Str. Agts, etc. |

Echelons of Territorial Commands in the Army compared with Corresponding Authority in the Pennsylvania R.R. Organization.

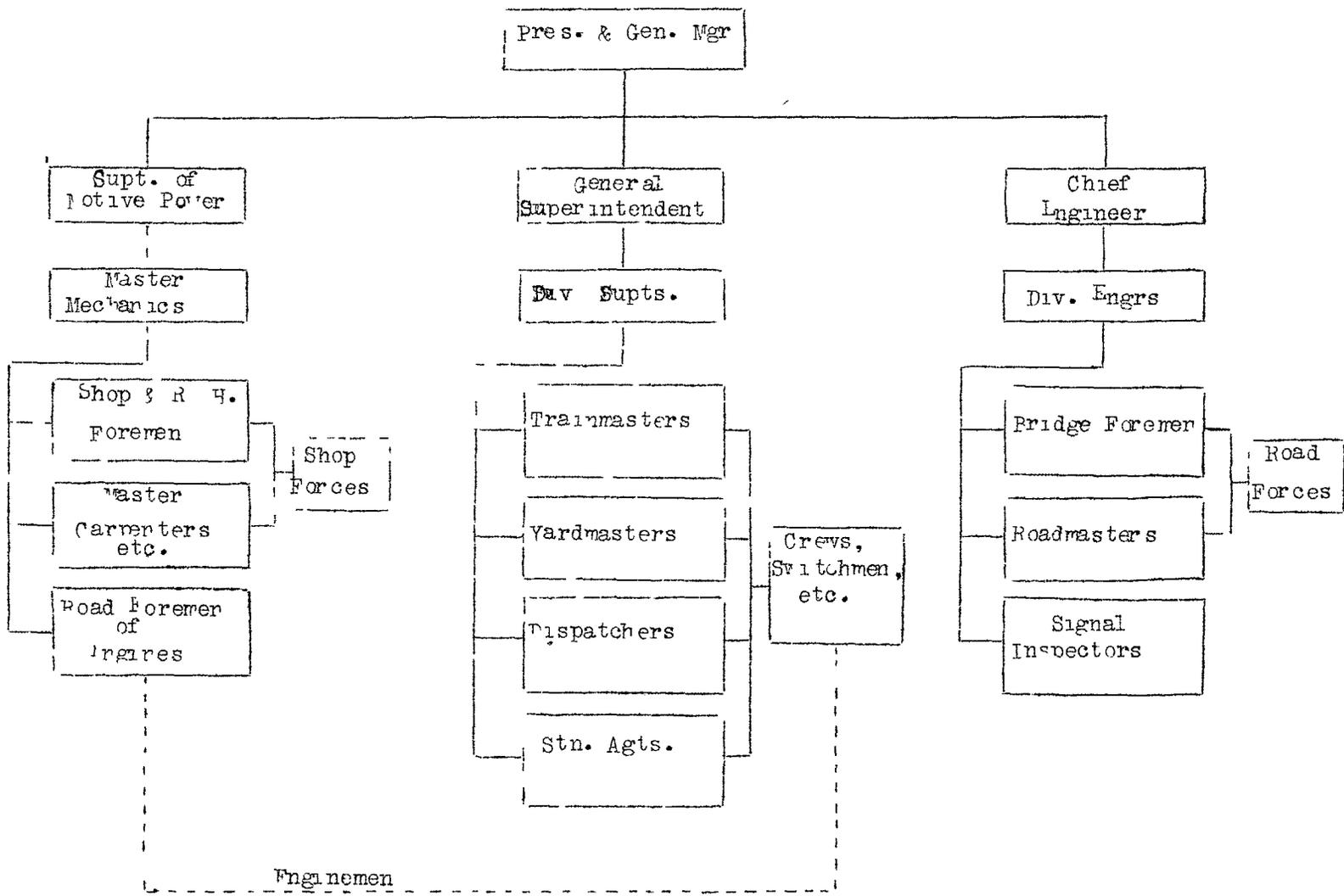
Chart No 10.



Typical R. R. Organization (Divisional) - Morris

Chart No. 11

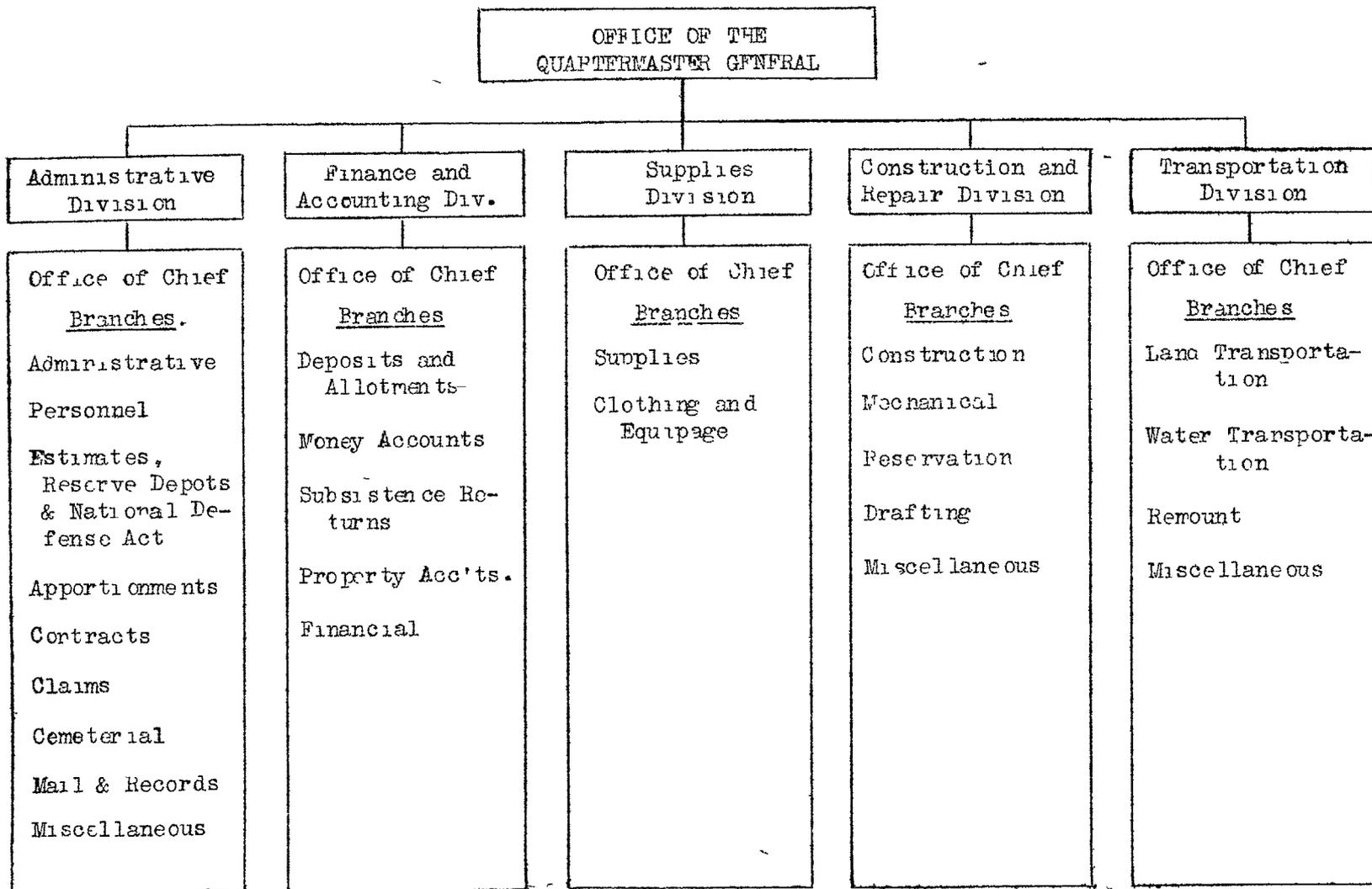
181



Typical R. R. Organization (Departmental) - Morris

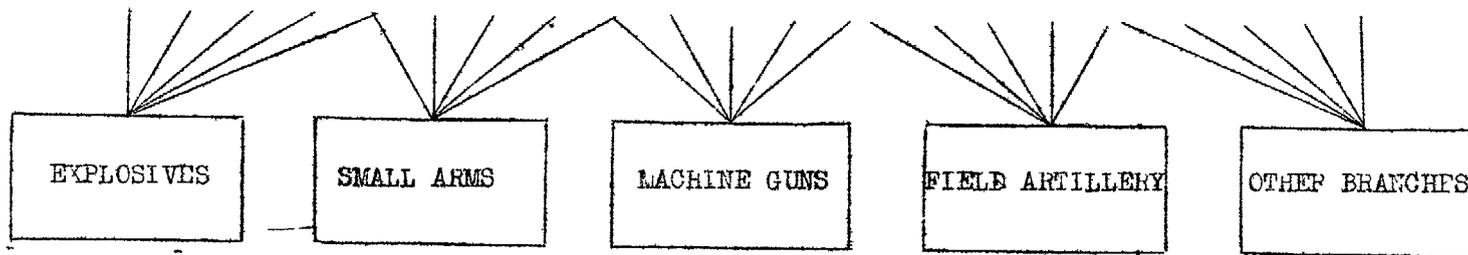
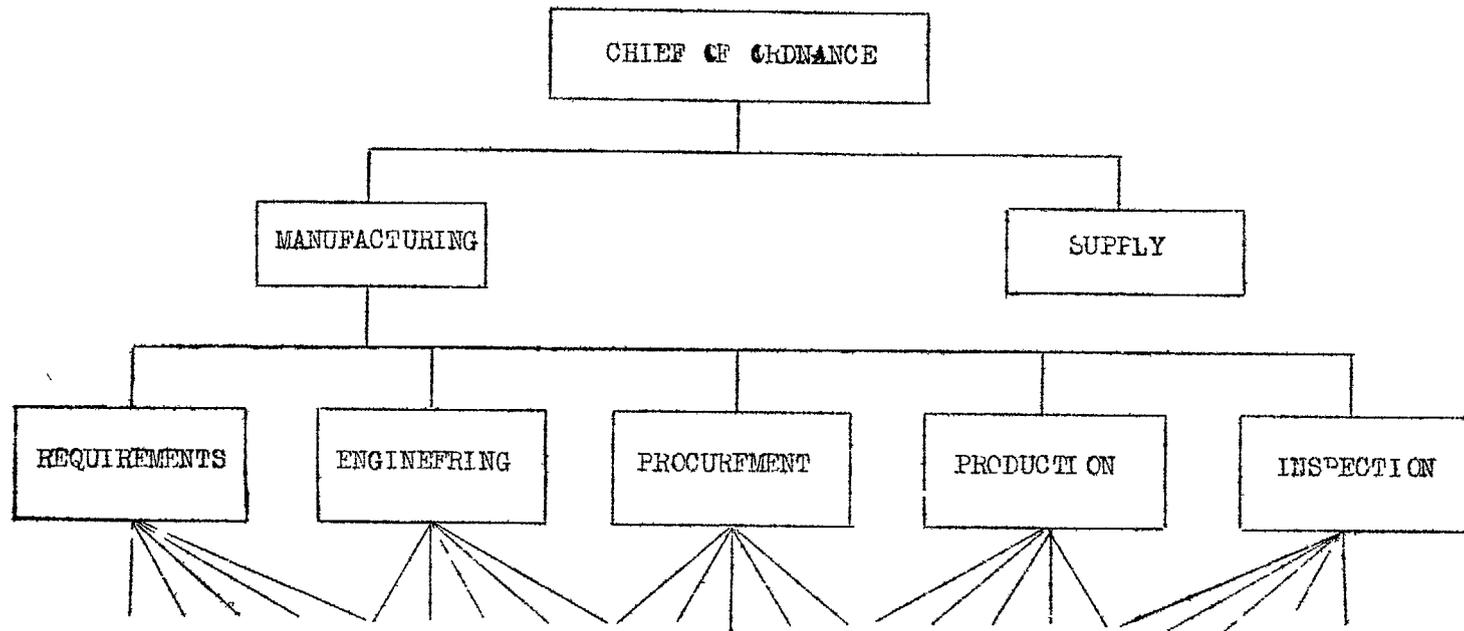
Chart No. 12

187



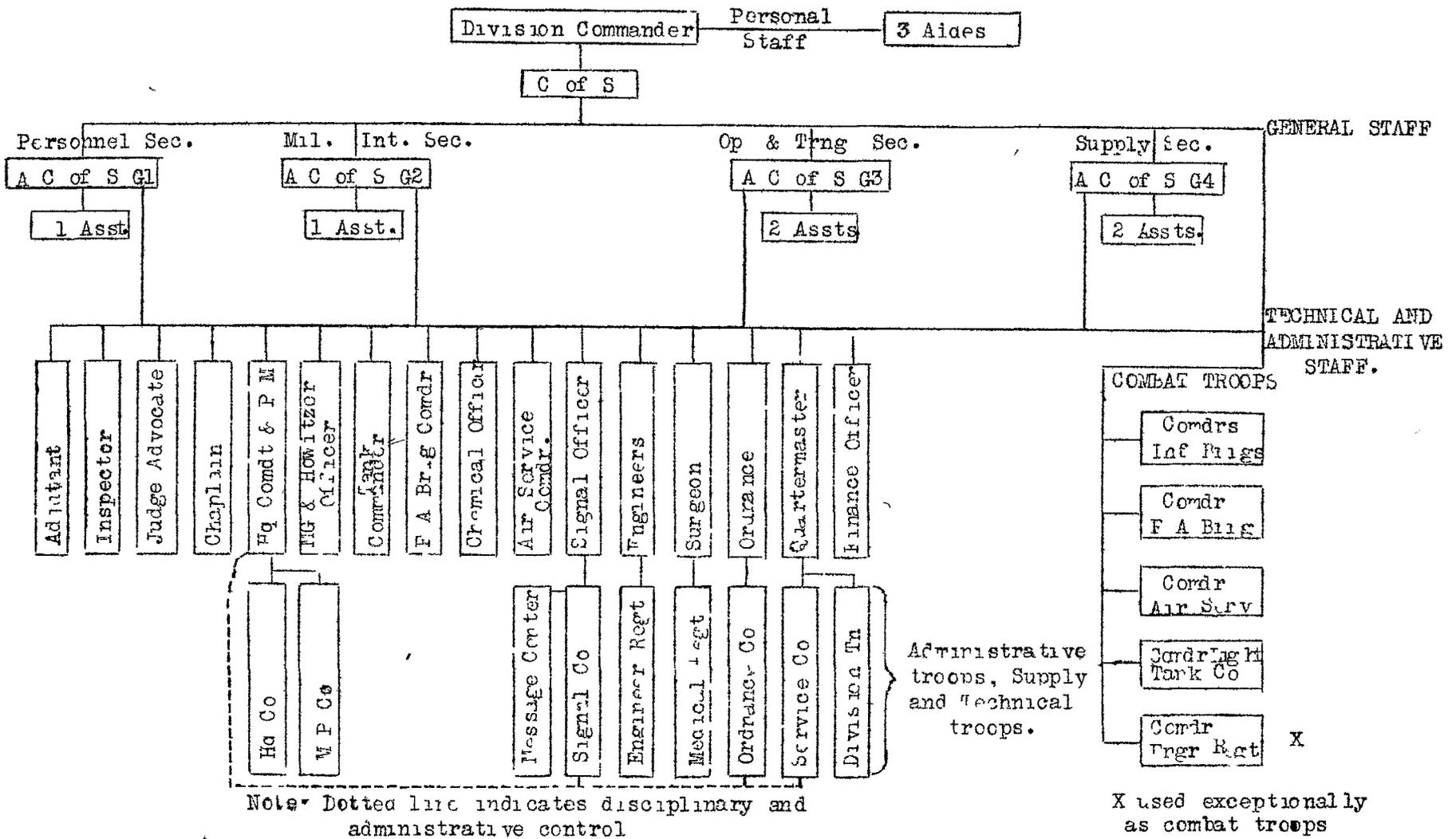
LINE ORGANIZATION OF THE OFFICE OF THE QUARTERMASTER GENERAL
 AS OF APRIL 6, 1917
 (REPORT Q.M.G.O. 1919.)

13



FUNCTIONAL ORGANIZATION OF ORDNANCE DEPARTMENT 1918.

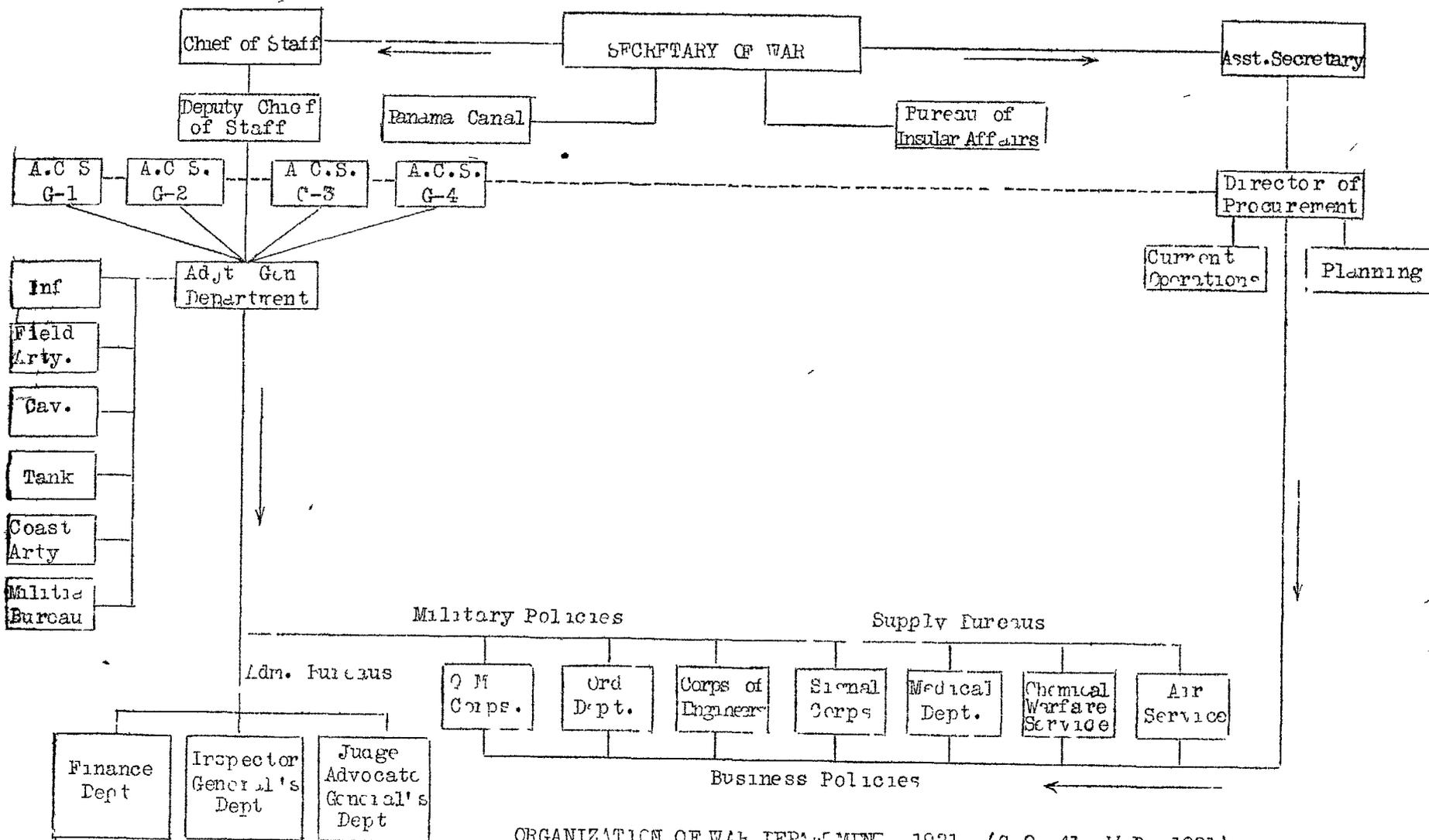
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FUNCTIONAL ORGANIZATION OF GENERAL STAFF, INFANTRY DIVISION
(C.S. & L. - G.S.S. 1925)

Chart No. 15

1925



ORGANIZATION OF WAR DEPARTMENT 1921 (G O 41, W D 1921)

- (a) Functional (Taylor) for Military Policies;
 (b) Line and Staff (Emerson) for Business Policies.

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GENERAL ORDERS)

War Department,
Washington, June 1, 1926.

NO. 10)

EXTRACT

* * *

Purpose Number	Purpose
34. REPAIRS AND ALTERATIONS, WATER AND SEWERS	
3405	Water and sewers, water and sewerage systems.
3410	Water and sewers, water and sewerage system, U.S. Military Academy
3411	Water and sewer systems (N.G. only)
3415	Not listed specifically
35. REPAIRS AND ALTERATIONS, BRIDGES and WHARVES.	
3505	Bridges.
3506	Bridges (N.G. only)
3510	Wharves.
36. REPAIRS AND ALTERATIONS, WALLS, FENCES, ETC.	
3605	Fences, trellises, ornamental and commemorative structures, walls, etc.
3610	Fences, trellises, ornamental and commemorative structures, walls, etc at U.S. Military Academy
3611	Fences, walls, picket line, etc (N.G. only)
3615	Flagstuffs, gun monuments, tablets, etc. (commemorative).
3620	Not listed specifically
37. REPAIRS AND ALTERATIONS, NONSTRUCTURAL.	
3705	Electric wiring and fixtures in structures, transmission, distribution and street-lighting systems.
3706	Electric-light systems, including pole lines, wiring and fixtures, (N.G. only)
3710	Gas distribution systems and appliances, including piping in buildings
3715	Landing and take-off runways
3717	Radio systems
3718	Telephone and telegraph systems (N.G. only)
3719	Telephone, telegraph, and cable systems
3720	Not listed specifically.
38. REPAIR AND ALTERATIONS, MILITARY DEFENSE STRUCTURES	
3805	Fortifications.
3810	Torpedo structures.
3815	Not listed specifically.
39 and 53 REPAIRS AND ALTERATIONS, EQUIPMENT	
3900	Telephone and telegraph equipment (N.G. only)
3901	Air Service, not listed specifically (N.G. only).
3902	Airplanes, (N.G. only).
3903	Antiaircraft artillery and 155-mm guns (N.G. only).

* * * * *

To illustrate functionalization of
Army, Finance.

CHART NO 17a.

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FINANCE CIRCULAR)

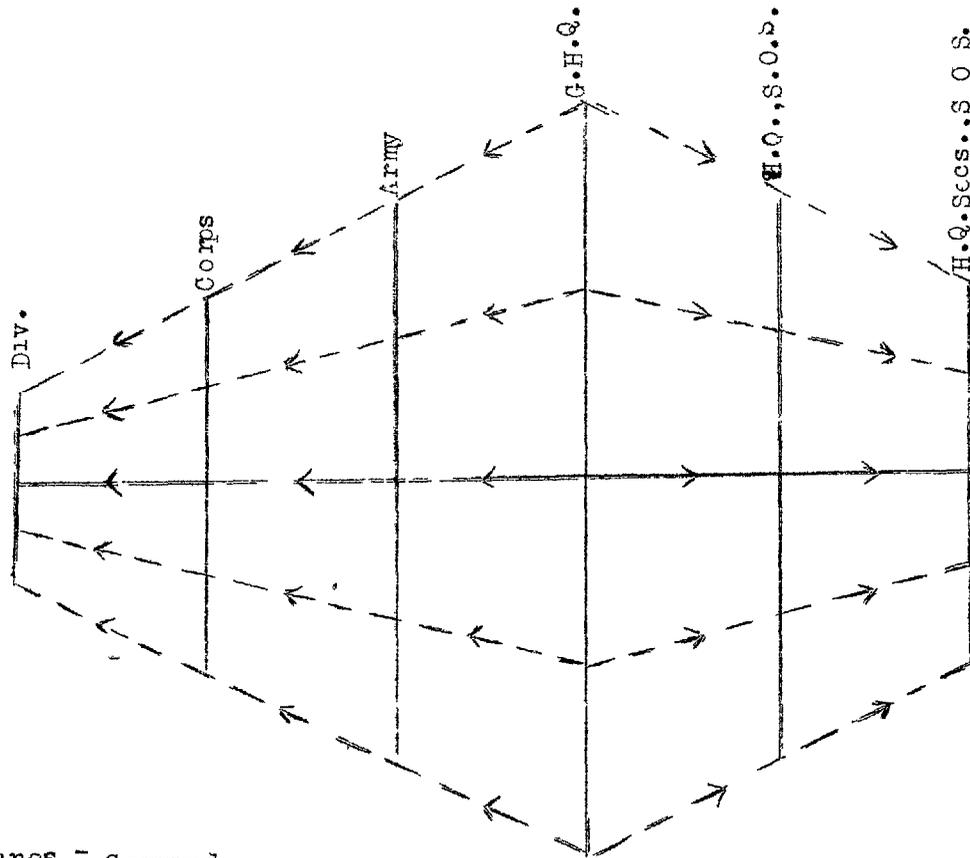
NO. 7)

WAR DEPARTMENT,
Office Chief of Finance,
Washington, May 15, 1926.

CODE NUMBER	TITLE OF APPROPRIATION	ABBREVIATION	YEAR	PURPOSE NUMBER, APPLICABLE to (see code published in General Orders No. 10, 1926).
	EXTRACT			
	* *	* *	* *	
3700	Rent of buildings, Quarter-master Corps	R. B. , 0 .0	1927	3107, 3155, 3129, 3145
3740	Repairing roads to National cemeteries.	R. R. to N. C.	1927	1595, 1717, 1740, 3325 (Remaining purpose numbers omitted)
3775	Repairs, Arlington Memorial Amphitheater and chapel	R., A. . A & C.	1927	115, 3205, 3325, 3405 (Remaining purpose numbers omitted)
3760	Repairs of arsenals	R of A.	1927	425, 1295, 1338, 1387 (Remaining purpose numbers omitted)
3800	Replacing Army Transportation.	R. A. T do	1926-27 1927-28	205, 1025, 1225, 1227 (Remaining purpose numbers omitted)
3810	Replacing clothing and equipment	R C. & E	1926-27 1927-28	804, 806, 819, 821, 825 (Remaining purpose numbers omitted)
3820	Replacing Medical Supplies	R. M. S. do	1926-27 1927-28	600, 603, 1025, 1229 (Remaining purpose numbers omitted)
3830	Replacing Ordnance and Ordnance stores	R. O. & O. S.	1926-27 1927-28	1215, 1240, 1247, 1358 (Remaining purpose numbers omitted)

To illustrate functionalization of Army Finance

CHART NO. 17b.



_____ Solid Lines = Command

- - - - - Broken Lines = Technical Supervision
and Inspection

Relation between Command and Technical Supervision, A. L. F.
(Dawes Report, Vol. II, Chap 1.)

Chart No. 18

189

Secretary
of
War

Asst Secretary
of War

Chief of Staff

Director
of
Procurement

G-1 G-2 G-3 G-4 WPD

A. G.

QMG

Chief
Ord

Other
Supply
Corps

WAR DEPARTMENT

GENERAL DEPOT

C. O.

Qm Section	Ord. Section	Remaining Sections
---------------	-----------------	-----------------------

Relation between War Dept. and
a General Depot.

Chart No. 19

1892